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AN EXPLORATION

OF THE

TAZIN AND TALTSON RIVERS NORTH WEST TERRITORIES

BY

CHARLES CAMSELL

GEOLOGICAL SURVEY

DEPARTMENT OF MINES

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CHAPTER I.

INTRODUCTION.

GENERAL STATEMENT.

This report contains an account of an exploration carried out during the summer of 1914 in the hitherto unexplored region lying between Lake Athabaska and Great Slave lake and east of Slave river. The expedition was undertaken with the object of obtaining as much information as possible on the geography, topography, geology, and natural history of a region that had previously been visited by only one man who had left any written record of his journey. That man was Samuel Hearne, an officer of the Hudson's Bay Company, who crossed the region in company with a band of Chipewyan Indians in the winter of 1771-72 as he was returning to Fort Churchill from his voyage of exploration to the Coppermine river.

The exploration carried out by the writer consisted of a single canoe traverse across the region from south to north leaving Lake Athabaska at a point a few miles west of the mouth of Charlot river and entering Great Slave lake at the mouth of the Taltson river about 40 miles east of the mouth of Slave river. Parts of the route are travelled by the Indians that live and hunt in the region, but the whole route is apparently not known to any single individual, and there are certain parts of it that have never been travelled by any one of the present generation. As a result, it was found impossible to get any native to accompany the expedition in the capacity of guide and the route was followed with the aid only of a rough sketch drawn by an Indian, in which there were many blanks.

Though a period of five and a half months elapsed from the time the party left Ottawa on May 5 until its return on October18

only about 2 months of this time was actually employed in geographical and geological investigation of the field, the remainder of the time having been taken up in travel to the point of starting on Lake Athabaska, and from the point of completion of field work on Great Slave lake.

Our course to the point on the north shore of Lake Athabaska where exploration actually began followed the usual boat route from Athabaska, at the end of the railway line, down the Athabaska river to its mouth and thence northeast for about 100 miles on Lake Athabaska. The return journey from Resolution, on Great Slave lake, was made by way of Slave river to Lake Athabaska and thence by the Athabaska river to the point of starting at Athabaska.

ACKNOWLEDGMENTS.

The successful completion of the exploration through a somewhat difficult region was due in great measure to the hearty co-operation of all the members of the party and especially of A. J. C. Nettell. Much assistance also was given us by residents of the district at Chipewyan, Resolution, and Fort Smith, especially by Mr. Colin Fraser, officers of the Hudson's Bay Company, and members of the Royal North West Mounted Police. Mr. R. H. Campbell, Director of the Forestry Branch of the Department of the Interior, was good enough to place at our disposal the Fire Patrol boats on the Slave and Athabaska rivers, and by their use we were saved much time and hard work in ascending these rivers on the return journey.

ORGANIZATION.

The party consisted of eight men in three canoes. The writer was entrusted with the general charge of the expedition, with Francis Harper as naturalist and A. J. C. Nettell as geological and topographical assistant. The other members were S. L. McMillan, J. Nolan, J. Soulier, G. Greensky, and Baptiste Forcie, canoemen.

The results of Mr. Harper's work on the natural history of the region traversed are embodied in a separate report.

METHODS OF SURVEY.

The survey was begun on Lake Athabaska where the canoe route leaves the lake, and was tied to an accurate survey of the lake made by A. G. Haultain of the Geological Survey who in turn connected his survey with the boundary line between Alberta and Saskatchewan, which has recently been run out to Lake Athabaska. Bearings were taken by compass. All portages were paced, and distances on the lakes and rivers were measured with a Massey floating boat log. Observations for latitude were taken almost daily and sextant observations for compass variation at frequent intervals. The heights of hills and the falls in the rivers were measured by aneroid.

Because of the peculiar nature of the rivers and owing to the fact that the course of the traverse was in general northward the methods of survey employed were found to give fairly satisfactory results. The survey was completed at Resolution, the position of which has been fairly well fixed by the observations of W. Ogilvie and others.

LOCATION AND AREA.

The unexplored portion of northern Canada, exclusive of the islands of the Arctic, is embraced in a number of blocks of territory marked off from each other by the travelled routes of explorers. The largest of these blocks has an area of about 75,000 square miles and the total number of those over 5,000 square miles in extent is about twenty-five. The aggregate area of all the unexplored blocks is over 850,000 square miles or about one-fourth of the total area of continental Canada.

One of the largest of these unexplored blocks is that across which our traverse was made. It covers an area of about 53,000 square miles and extends in a north and south direction from Athabaska lake to Great Slave lake and Hanbury river, and in an east and west direction from Slave river to the Thelon and Dubawnt rivers. It embraces the whole of the basin of the Taltson river and the headwaters of the Thelon river. It includes the extreme northwest corner of the province of

Saskatchewan and the northeast corner of the province of Alberta, but the greater portion of it is in the North West Territories, beyond latitude 60 degrees north.

ROUTES OF TRAVEL.

From Edmonton, which is a convenient starting point for expeditions into that northern country, the region may be reached by either of two routes. One follows the course of the Athabaska river for 430 miles, to Lake Athabaska, and the other lies over the new Edmonton, Dunvegan, and British Columbia railway to Peace River Crossing and thence follows the Peace river to Athabaska lake.

The only means of entering this unexplored block of territory in the summer and of travelling through it, is by canoe, and there are several Indian canoe routes leading into it from points on Athabaska lake, Slave river, and Great Slave lake. Most of these routes lead to a point on the edge of the Barren lands near the headwaters of the Taltson river, which has been a rendezvous for many years for the Indians of Fort Smith, Fond du Lac, and Resolution, during the autumn hunting season.

The route followed by our expedition in the summer of 1914, leaves the north shore of Athabaska lake in a bay a few miles west of the mouth of Charlot river. From there a series of five short portages, with a total length of 3 miles, leads from one lake to another, across the height of land, to Tazin lake. From Tazin lake, the route is down Tazin river, through Thainka, Hill Island, and a number of other lakes, to the Taltson river and thence down that stream to Great Slave lake.

From the north side of Tazin lake a canoe route through a series of lakes and connecting rivers and portages leads to the above-mentioned rendezvous on the Barren lands and to the headwaters of the Thelon river. Another canoe route to the same point, from Fond du Lac, on Lake Athabaska, leaves that lake by way of Grease river, following a series of small lakes and streams northward. These routes are still unexplored.

The Indians known as Caribou Eaters when travelling eastward from Smith Landing on Slave river to the Barren

lands usually follow one of three canoe routes. The southern of these routes touches our route by way of Tazin and Taltson rivers at Hill Island lake and leaves that lake again on the east side by way of Thoa river. The middle route reaches Tazin river by Klo creek, and after following the course of Tazin river for a few miles up stream leaves it by a portage at the lower end of Soulier lake. From there it strikes northward to Thekulthili river into the large lake of that name and thence to the Taltson river. The northern route reaches Taltson river 3 miles below the mouth of Tazin river and thence follows the course of Taltson river up to its head. These routes also are still unexplored.

The Resolution Indians in travelling through this region follow the Taltson river from its mouth up to Deskenatlata lake; from there they turn off the main river up one or the other of two streams which enter the east side of that lake. An alternative route carries them farther up Taltson river through Tsu lake, 2 miles beyond which they leave the main river on the northeast side by way of Konth river. All of these routes rejoin the Taltson river above the mouth of Tazin river and follow that stream to its head.

On account of the great number of lakes and watercourses and the broken, rocky character of the region, summer travel through it other than by canoe is impossible. Consequently, there are no summer land trails except short portage trails connecting the lakes or navigable portions of the rivers with each other.

Winter trails are numerous; but they can only be followed by those who are familiar with them. These trails are used by the Indians in travelling to and from their hunting or trapping grounds and by the voyageurs of the traders, who visit the Indian encampments occasionally in winter for the purpose of obtaining meat or trading furs.

HISTORY.

The block of territory through which the Tazin and Taltson rivers flow and which forms the subject of this report is probably the most accessible of all the larger blocks of territory that remain unexplored in northern Canada. It has, however, remained

unexplored and unvisited except by Samuel Hearne in the early part of the year 1772 and by a few of the voyageurs of the Hudson's Bay Company and other fur traders who enter the region during the winter months on occasional visits to the Indian camps for meat or furs. That this block has remained unexplored so long might seem extraordinary on observing that the western edge of the block abuts against a part of the main highway of the whole Mackenzie basin, namely the Slave river, a highway which has been travelled constantly winter and summer for about 120 years. It is, however, not so strange when we realize that the block of territory itself has no known natural resources of sufficient importance to attract people to the region, nor does it lie on any easy or direct route to any particular place of importance beyond it.

For these reasons as well as for the reason that it is not an easy country to travel through either in winter or summer, it has remained virtually unexplored and our general knowledge of it up to the summer of 1914 has been limited to the information contained in Samuel Hearne's book entitled "A Journey from Prince of Wales Fort in Hudson's Bay to the Northern Ocean," published in 1795. Besides this the writer had some additional information obtained on the occasions of former visits to Athabaska and Great Slave lakes, in the course of conversation with Indians who inhabit the region.

Hearne's book, a new edition of which has lately been published by the Champlain Society under the editorship of Mr. J. B. Tyrrell, contains the account of his journey from old Fort Prince of Wales, now Churchill, on Hudson bay, to the Coppermine river and return, in the years 1769 to 1772. The object of Hearne's expedition was to explore the interior of northern Canada west of Hudson bay and to determine the source from which the natives of that region obtained their supplies of native copper. For reasons over which he had no control Hearne's two first attempts failed, but in his third effort he succeeded after an exceedingly arduous journey in reaching the mouth of the Coppermine river in July, 1771.

Returning southward from the Coppermine river late in the year 1771, Hearne reached the north shore of Great Slave

lake, then known as Athapuscow, on December 24. He crossed the lake, probably by the same route used to-day by the Indians, namely through the Simpson islands and Les Iles de Large east of the entrance to the north arm of the lake. It is probable that he reached the south shore somewhere in the neighbourhood of the mouth of Taltson river, or to the west of it, for if he had been farther to the east he would not have described this shore as "a fine level country in which there was not a hill to be seen or a stone to be found." The shore east of the Taltson river is rough and very rocky, while that to the west forms part of the ancient delta of Slave river and is consequently level and well wooded.

Hearne's course southward from Great Slave lake is very hard to follow from his description and map, and there are many evident inaccuracies both in his statements regarding the course he followed and in his description of the natural features. For example, instead of his course being southwest from Great Slave lake it must have been, in general, due south. And again, there is no place on the river, above the point where it begins to spread out to the delta, where it is "about two miles wide." It is likely, however, that he first touched Slave river somewhere in the neighbourhood of Point Ennuyoux and followed it at least as far as Pointe Brulé, for it is at the latter point that, as he says, the river "begins to tend due south." If, however, he is correct in his estimate of the height of the banks he must have been not far below the present position of Fort Smith when he turned off to the eastward.

From the time he left Slave river until he reached Hill Island lake it is again difficult to follow his course, partly on account of our own lack of knowledge of the country between those two points and partly on account of the lack of detail in his description of this part of the route. He, however, speaks of following for several days a small river which "empties itself into lake Clowey and has communication with Great Slave lake." This stream is almost certainly Hanging Ice or Tethul river which, though it does not empty into Lake Clowey, has communication with Great Slave lake by way of Taltson river, while Taltson river itself is believed to be the stream which drains Lake Clowey.

Hearne's Wholdyeah-chuck'd Whoie or Large Pike lake, which he described as being 7 miles wide where he crossed it, has not been identified, but may be one of the lakes on the Indian canoe route between Smith Landing and Hill Island lake.

Bedodid lake, which he reached the day after crossing Large Pike lake and which he describes as a narrow lake upwards of 40 miles long, is probably a lake which the Indians now call Bedareh lake and which lies southwest of Hill Island lake on the regular canoe route between Smith Landing and Hill Island lake.

Hill Island lake is the only point where we can definitely place Hearne's route, for the lake still retains the name that it had in 1772 when Hearne crossed it, and it is identified by a prominent cone-shaped island standing alone about half way down the lake (Plate I).

Hill Island lake is the point at which Hearne's traverse crosses our route northward down Tazin river. From there his course was eastward, through a region not since traversed by any explorer, until he arrived at Wholdiah lake on Dubawnt river, a stream surveyed in 1893 by J. B. Tyrrell.

Hearne's map of this portion of his route is far from correct, but the inaccuracy is due to the loss of his quadrant at Point lake and the stopping of his watch at Great Slave lake. He apparently had no other instruments for obtaining his direction or measuring his distances.

Until recently there was no other geographical information available concerning this region and the general maps of Canada nearly all either copied Hearne's map or left the region blank. The most recent maps of Canada show some changes and additions, especially in the region between Hill Island lake and Fort Smith, which were made by H. V. Radford, the explorer recently killed by Eskimo near Bathurst inlet. Radford spent the winter of 1909-10 at Smith Landing, and submitted a map of the country to the east of that point to the Chief Geographer of Canada, which was incorporated in the map of Canada; but whether he visited the region in person or merely obtained his information of the geography from Indians, it has been impossible to ascertain.

It is interesting to note that Richard King who accompanied Captain Back on his voyage of exploration to Backs river in 1833, 1834, and 1835, planned a second trip to Backs river by way of the Tazin and Taltson rivers. In his book entitled "A Narrative of a Journey to the Shores of the Arctic Ocean," Vol. II, page 289, he publishes an Indian sketch and a short description of the route obtained from one of his guides. This route was the same as our own route as far as the junction of the Tazin and Taltson rivers, but from there he proposed following the Taltson river to its head, portaging over the height of land to the Thelon river and following that stream down to a point where it begins to turn east. Here a portage would be made by way of Baillie river to Backs river.

King's proposed trip was never carried out, but it is interesting as showing that there is a canoe route through this region to the Thelon river that has been known to the Indians and used by them as far back as 80 years ago.

Although a route across this region by way of the Tazin and Taltson rivers has been known for many years, we were the first party to traverse it. J. B. Tyrrell,[1] while surveying the north shore of Athabaska lake in 1893, met a party of Indians near the mouth of Charlot river who had just come over the portages from Tazin lake, and he states that it is possible to follow this route through to Great Slave lake. Tyrrell's statement induced us to enter the region by this route, for at the time the expedition was planned no other route was known to us.

[1]Report on the country between Athabasca Lake and Churchill River by J. B. Tyrrell and D. B. Dowling, Geol. Surv., Can., Vol. VIII, Part D.

CHAPTER II.

SUMMARY AND CONCLUSIONS.

PHYSICAL FEATURES OF THE REGION.

The chief results of the expedition into the region north of Athabaska lake were the carrying of a survey across an unexplored block of territory 53,000 square miles in extent; the exploration of two streams previously unexplored, the Tazin and Taltson rivers, for a distance of about 290 miles; the exploration of a number of lakes, ranging from 15 to 30 miles in length, along the course of these rivers; and the location of a number of belts of the older, pre-Cambrian, stratified rocks, in which minerals of economic importance may occur.

The Taltson river drains practically the whole of the country between Athabaska and Great Slave lakes, east of Slave river to the 108th meridian. Its main tributary is the Tazin, which drains the region immediately north of Athabaska lake, while the Taltson river itself carries the water from the region between the east end of Great Slave lake and latitude 61 degrees, its headwaters interlocking with those of the Thelon river.

Neither the Tazin nor the Taltson can be considered navigable for large boats, except in short stretches, and steamers could only ascend the Taltson river from Great Slave lake for a distance of 23 miles, to the first falls. Falls and strong rapids occur at frequent intervals and in our descent of the two rivers it was necessary to make about forty portages, the longest one mile in length, and to run dozens of rapids.

The basin of the Taltson river lies entirely within the Laurentian Plateau region, and its physical features of land and water are characteristic of the great region that comprises the northeastern part of the continent of North America. It is a country, when viewed on a large scale, of moderate relief and rounded outline, but in detail it is rugged, broken, and rocky.

It abounds in lakes, and its streams flow in ill-defined and irregular valleys, rarely more than 100 feet deep.

The highest elevations in the region are on the immediate shores of Athabaska lake where the hills rise somewhat abruptly to a maximum height of about 700 feet above the lake or about 1,400 feet above the sea. From there, the surface slopes gradually and regularly, northwest, to Great Slave lake. In consequence of this general character of the region the height of land between Athabaska and Great Slave lakes lies about 3 miles north of Athabaska lake and the average slope of the upper level of the plateau from there to the mouth of Taltson river at Great Slave lake is about 5 feet to the mile and presents no decided break at any point.

The Taltson river flows northward to Great Slave lake following the slope of the land surface; but, like most rivers in the Laurentian Plateau region, it has no well defined valley nor has it an evenly graded profile. It is characterized rather by a succession of level stretches and short, sharp falls. Here and there, for considerable distances, its valley is well defined and regular; but, more generally, it flows from one expansion to another through narrow, gorge-like openings at which there are as a rule direct falls or strong rapids. For the greater part of its course it flows through a rocky country, on which there is little or no soil; consequently, there are few gravel beaches and the river itself is clear and carries no sediment. Within 30 miles of Great Slave lake, however, it enters an alluvial plain which has been built up in the past by Slave river and is a part of the ancient delta of that stream. Here, the river cuts a shallow valley in the old delta deposits, exposing sections of sands and silts.

The country abounds in lakes, all of them remarkable for the clearness of their water and the beauty of their surroundings. The largest of these are: Tazin lake, 29 miles long and 8 miles wide, Hill Island lake, about 24 miles long and 2 miles wide, Tsu lake, 17 miles long, and Thekulthili lake, a lake which we did not thoroughly explore, but which is at least 25 miles long. They are all rock basins, with irregular shore-lines and few beaches.

Over the greater part of the region the bed-rock has no covering of soil nor loose material. Here and there sand-plains or patches of boulder clay occur; and, towards the mouth of the river, the bed-rock is covered by sediments from Slave river. On account of the lack of soil there are no possibilities for agriculture even if the climate were more temperate. The forest trees are small and stunted and no commercial timber, other than pulpwood, occurs anywhere in the whole region. The principal trees are spruce, Banksian pine, poplar, birch, and tamarack.

The lakes and streams abound in fish, including whitefish, pike, suckers, and lake trout. Game, however, is scarce except in the winter season when caribou come into the region in great numbers from the Barren lands. Besides these, there are a few moose and black bears. All the fur-bearing animals common to the Mackenzie River region are found here.

The country is inhabited by Indians known as Caribou Eaters, a branch of the Chipewyan stock, who trade at Fort Smith. A few other Indians, also, from Chipewyan, Resolution, and Fond du Lac hunt over parts of it.

The commercial possibilities of the region are small, and it is not likely to support any population except, possibly, such as might be engaged in mining pursuits. Agriculture is out of the question and unless economic minerals are found in it, it will always remain unsettled. So much of this block of territory remains to be explored that it is impossible to say, yet, what it may contain in the way of minerals. Quartz veins were noted in the Tazin rocks in several places, notably at Hill Island lake, a region which it might be worth while to prospect. These veins may possibly prove in places to be gold-bearing.

GEOLOGY.

All the solid rocks of the region are of Pre-Cambrian age. The oldest rocks encountered are a series of schists, quartzites, conglomerate, narrow beds of limestone and argillite, and some volcanic rocks, all classed together under the name Tazin series. They occur in several isolated bands which trend northwest

to north and are entirely surrounded by granite or gneiss. These bands are merely remnants of a once more widespread series of rocks which were reduced in area by the intrusion of the granites and by erosion. They are economically the most important rocks met with since they are cut by a number of quartz veins which may contain some of the precious metals. These bands of Tazin rocks are the areas to which prospectors should devote their attention in prospecting in the region.

The Tazin rocks are everywhere intruded by granites and gneisses of a great, composite batholith, which covers 86 per cent of the country along the route of our traverse. Granites and gneisses of different ages are here grouped together, but some of the massive varieties are clearly younger than the gneissic. The trend of the gneiss is mainly north and south, conforming to the trend of the rocks in the Cordilleran region rather than of those in eastern Canada.

A small remnant of conglomerate of the Athabaska sandstone formation rests on the decomposed surface of the granite at the northeast end of Tazin lake. From its physical and chemical characters this formation is probably a land deposit and is correlated with the Keweenawan.

Over the surface of the solid rocks is spread thin and scattered deposits of Glacial and post-Glacial drift material. The drift is nowhere abundant, except at the mouth of Taltson river where this stream enters the old delta plain of Slave river.

One of the most marked features of the region is the evidence of the intensity of the glaciation with the resulting freshness and unweathered character of the rock surface. The rocks are everywhere rounded, grooved, and striated and, even in the beds of streams where erosion and obliteration of glacial markings would be expected to be most rapid, striæ still remain. In general, the region is characterized by glacial erosion and removal of material rather than by glacial deposition. Deposits such as boulder clay, moraines, drumlins, sand-plains, while present, are not as widespread as in the region farther south and west, and, consequently, the streams have little sediment to carry.

The average direction of movement of the ice, as shown by striæ, was about S.62°W. with variations to one side or the other of this direction due to local irregularities of the surface. There is also some evidence of a later and more feeble glaciation, the striæ of which show a more northerly trend.

CHAPTER III.

GENERAL CHARACTER OF THE DISTRICT.

TOPOGRAPHY.

The basin of the Taltson river covers almost the whole region between Lake Athabaska and Great Slave lake from the Slave river on the west to longitude 108 degrees on the east. Its watershed lies within a short distance of Lake Athabaska and, on the line of our traverse, is only 3 miles back from the shore of the lake. Since no streams of large size enter the east side of Slave river, the Taltson River watershed must come within a short distance of that stream. On the Great Slave Lake side the same condition holds and, from information obtained from the Indians, it was learned that at the east end of Great Slave lake the main branch of Taltson river is barely a day's travel distant. On the east, the headwaters of both the Tazin and Taltson rivers interlock, in a lake country, with the headwaters of the Thelon river which drains northeastward to Hudson bay. The basin of the Taltson, then, is probably about 19,000 square miles in area, though this cannot be determined definitely until more of the region is explored.

The basin of the Taltson river lies entirely within the great Laurentian Plateau region, or as it has often been called, the Canadian Shield, and its physical features of land and water are characteristic of the great region that comprises the northeastern part of the continent of America. When viewed broadly the topography is that of a broad plain sloping gradually to the west and northwest. In detail, however, it is very irregular, broken, and rocky, with an uneven, hummocky, or mammillated surface, which is very difficult to travel over. It is a country also of numerous, rock-bound lakes, which occupy all the lower levels, and of streams flowing in ill-defined and irregular valleys. The intervening areas are rocky, sparsely timbered

hills, which rarely rise more than 200 feet above the lakes or rivers and are, as a rule, less than 100 feet high (Plate II).

To the extreme northwest of the basin, the rocky, Laurentian Plateau country gives place to a level drift-covered region which is part of the old flood-plain of Slave river. The Taltson river first touches this region below Tethul river and finally enters it at Pierrot creek about 23 miles from its mouth, continuing in it down to Great Slave lake. In this region the rocky, hummocky surface of the Laurentian Plateau has been covered by the sand and silt carried down by the Slave river since Glacial times. A level plain has in this way been built up and is being gradually extended into Great Slave lake. From this plain only a few of the higher knobs of the old Laurentian surface now project. The Taltson river itself has done nothing to build up the plain since it flows through a region in which there is little loose surface material and, consequently, carries no sediment. Its action in this region is confined to the excavation for itself of a channel through the Slave River deposits.

The highest elevations in the region travelled over are on the immediate shores of Athabaska lake, where rocky hills of granite gneiss rise to a maximum height of about 700 feet above the lake. From these hills the surface slopes gradually northwestward to Great Slave lake, the elevation of which is given on the most recent maps as 520 feet above the sea. The grade of this slope, which is the slope of the upper surface of the plateau, is about 5 feet to the mile in a northwesterly direction and that without any decided break at any one point.

In consequence of this general slope of the region the height of land between Lake Athabaska and the Taltson river, on the route of our traverse, lies about 3 miles north of Athabaska lake and is about 460 feet above that lake. The ascent from Lake Athabaska to the height of land is gradual with a rise of 250 feet to the first lake and an additional rise of 200 feet to the summit of the portage between the third lake and Thluicho lake. From the summit there is a short descent of about 50 feet to Thluicho lake which has its outlet northward to Tazin river and thence to the Taltson.

On the most recent maps of Canada the elevation of Lake Athabaska is given as 690 feet above sea-level, and that of Great Slave lake as 520 feet, a difference of 170 feet. Carefully calculated aneroid observations along the route of our traverse seem to show that the difference in level between these two lakes is much greater, and has been reckoned by us at 290 feet. Judging by the fall in Slave river which connects these two lakes, the larger figure is more correct, for Slave river has a length of over 300 miles and its current is fairly uniform throughout, except for the rapids between Smith Landing and Fort Smith where there is a measured fall of 125 feet in 16 miles.

The calculated fall in the Tazin and Taltson rivers between Thluicho lake at the height of land and Great Slave lake is 700 feet and the distance about 310 miles. This gives a grade to the Tazin and Taltson rivers of about 2.3 feet to the mile.

The Tazin and Taltson rivers follow the slope of the surface of the plateau and drain to Great Slave lake; but, like most rivers in the Laurentian Plateau region, they have no well defined valleys nor have they evenly graded profiles. They are characterized rather by a succession of level stretches of river or lakes separated from each other by falls or strong rapids. Here and there, for considerable distances, their valleys are well defined and regular (Plate III); but, more generally, they flow from one lake expansion to another through narrow gorge-like openings at which there are, as a rule, direct falls or strong rapids that cannot be navigated in a canoe.

In some portions of their courses the rivers occupy pre-Glacial valleys, the course of which has been determined by the structure of the underlying rocks. For example, the Tazin river for long stretches follows the foliation of the gneiss or its channel has been excavated along the contact of the gneiss with the older stratified rocks. In many cases, however, the valleys are mere connecting links between the lakes, and their courses are dependent on chance irregularities on the rock floor.

These characteristics of the rivers show a lack of organization to the whole system of drainage of the Taltson river, a lack for which continental glaciation is responsible. Since the Glacial period the streams have done little to develop a more

mature system of drainage and have not cut nor deepened their channels in the solid rocks. This is proved by the glacial striæ which are found in the stream bed in some cases under the running water at the edge of rapids.

Glacial and post-Glacial unconsolidated materials have, however, been cut into and removed by the stream and in the lower part of the Taltson river a well graded profile has been developed where the stream flows through the old flood-plain of Slave river.

The whole course of the Tazin river and the greater part of the course of the Taltson river are in a rocky country with little or no soil and very little other loose surface material. These rivers, consequently, are clear and carry very little sediment. Whatever they pick up in passing through deposits of glacial material, they soon deposit again in the lakes which are perfect sedimentation basins.

As is generally the case throughout all the Laurentian Plateau region, lakes are numerous, and they are almost invariably shallow, rock basins, with smooth, rocky shores and but few beaches of sand, gravel, or boulders(Plate IV). The positions, shapes, and alignment of these lakes have been determined not so much by glacial erosion as by the character and disposition of the rocks in which they lie. For example, lakes have been formed more readily in rocks of schistose or gneissic character than in granites, because such rocks are more susceptible to the action of decomposing and eroding agencies, than are the more massive, granitoid rocks. And, again, lake basins excavated in schists or gneisses are aligned and shaped more in conformity with the strike of the schistosity or foliation of the schists or gneisses than with the direction of ice movement. Glacial erosion has, however, contributed in some degree to the formation of lakes; for, after decomposition had affected the surface of the rocks along lines conforming with the strike of foliation or schistosity to depths varying with their character and structure, glacial ice removed this decomposed portion down to the unaltered rock, giving the surface the irregular hummocky character that it now has. The more deeply eroded areas were, after the retreat of the ice sheet, filled with water to form the lakes.

The more important of the lakes discovered and surveyed were: Tazin lake, 29 miles long and 8 miles in greatest width; Hill Island lake, 24 miles long and 2 miles wide; Tsu lake, 17 miles long and of very irregular outline; and Thekulthili lake, not thoroughly explored but which is probably at least 25 miles long. All of these lakes are remarkable for the clearness of their water and the beauty of their surroundings.

The combination of numerous lakes, acting as reservoirs, with waterfalls in the streams, makes the whole Taltson River system an excellent one for the development of water powers.

CLIMATE.

No information is available with regard to the climate of the region traversed except that obtained during the months of July and August from our own observations. During these two months the prevailing conditions were bright, warm days and cool nights. Storms of wind or rain were infrequent and the rainfall was so light as to interfere very little with the progress of the work.

The maximum temperature recorded at noon was 86 degrees F. on July 25. Frost was not noted until September.

The four factors which influence the climatic conditions in this region are: (1) the warm winds from the west; (2) the presence of the two large bodies of water on either side, namely, Athabaska lake on the south and Great Slave lake on the north; (3) the cool winds coming over the Barren lands from Hudson bay on the east; and (4) the absence of soil or other loose material on the bed-rock over a great part of the region.

Ice remains in Athabaska lake until the middle of June and in Great Slave lake somewhat later, and no doubt has the effect of retarding the advance of the spring, particularly in the country bordering these lakes. The proximity of the Barren lands on the east and of Hudson bay has a similar effect, so that spring is much later in this region than in the same latitude farther west, towards the foot of the Rocky mountains. These two factors so counteract the effects of the warm winds from the

Pacific as to produce, also, a somewhat lower average temperature throughout the year than that which prevails in the same latitude farther to the west.

Judging by information obtained from the natives, the precipitation of rain and snow is very much the same as it is at Chipewyan where the average rainfall for the year is about 15 inches and the snowfall 4 feet.

The following table of temperatures and precipitation for a period of 10 years is compiled from the records of the Government Meteorological station at Chipewyan. By reducing the temperatures given in this table slightly one can get an approximation to the conditions which prevail in the region dealt with in this report.

Mean Values of Temperatures and Precipitation at Chipewyan.

Period 10 years	Temperature degrees Fahr.					Average Precipitation		
	Means			Extremes		Rain inches	Snow inches	Total inches
	Maximum	Minimum	Mean	Highest	Lowest			
January	-1.3°	-19.9°	-10.6°	38°	-55°		10.7	1.07
February	0.9	-18.5	- 8.8	42	-50	T	6.8	0.68
March	15.5	- 5.1	5.2	46	-49	T	5.7	0.57
April	39.3	18.5	28.9	69	-32	0.90	4.8	1.38
May	54.8	33.8	44.3	83	-14	1.50	1.9	1.69
June	64.8	43.4	54.1	88	16	2.80	0.5	2.85
July	70.9	50.3	60.6	93	23	2.30		2.30
August	67.6	46.1	56.9	85	23	3.30		3.30
September	53.2	34.8	44.0	78	10	2.30	1.7	2.47
October	42.3	26.2	34.3	63	0	1.50	3.3	1.83
November	20.5	5.9	13.2	51	-31	0.40	8.9	1.29
December	6.4	-11.3	- 2.4	42	-54		7.7	0.77
						15.00	52.0	20.21

From this table it appears that the winter temperatures are not too low to permit of people living in the region with some degree of comfort. The chief drawbacks to travel and residence in the region are the myriads of mosquitoes in the

summer months. These pests are in such numbers in the months of June and July, and in the early part of August, that some protection from them is absolutely necessary when travelling either through the woods or on the lakes and streams.

AGRICULTURAL POSSIBILITIES.

So far as it has been possible to ascertain from a single traverse across the region and from information obtained from natives, the basin of the Taltson river offers little opportunity for agriculture. The greater part of the basin has been subjected to intense glacial erosion by which the surface has been worn down to the live rock and denuded of its loose material which has been carried westward to the valley of Slave river, and beyond. Little unconsolidated surface material was left on the disappearance of the ice sheet and practically no soil has been formed since (Plate V).

The country in general is rocky, with only here and there a glacial sand-plain or small, detached areas of boulder clay. Within 30 miles of Great Slave lake, however, the Taltson river enters the old flood-plain of Slave river where the country is level and underlain by silt or fine sand deposited by the river. In this portion of the Taltson River basin vegetables could no doubt be grown successfully, but neither here nor in any other part of the basin do the natives make any attempt to cultivate the soil.

FAUNA.

These subjects are dealt with in detail by Francis Harper, naturalist to the expedition, in a report made separately to the Geological Survey. It is sufficient, therefore, to mention the principal mammals that are found in the region.

Moose are not abundant except in the level country near the mouth of the Taltson river. Barren Ground caribou frequent the eastern part of the region in great numbers at certain seasons in the late autumn and winter, but are rarely found there in the

summer months. Black bears are found throughout the whole region, but not in great numbers.

When Samuel Hearne visited the region in 1772, great herds of wood bison roamed over the level country about the mouths of the Taltson and Slave rivers, but their range apparently never extended eastward into the rocky country. They have long since disappeared from the country east of Slave river and only a remnant of their former numbers is now found on the west side of that stream.

An occasional woodland caribou, it is said, is shot by the Indians in the western portion of the Taltson River basin; but, like the wood bison, the range of this animal does not extend far eastward into the rocky country. Wolves frequent the region at all times of the year and at certain seasons in considerable abundance, especially during the annual migrations of the Barren Ground caribou.

Nearly all the common fur-bearing animals are trapped in the region, but it cannot be said that any of them are abundant; they include the red, cross, and black fox and the otter, beaver, lynx, wolverine, marten, mink, muskrat, and ermine.

The lakes and streams of the region abound in fish, but the variety is not great. Nearly all the larger lakes contain lake trout and whitefish. Pike, suckers, and loche are found nearly everywhere in the rivers. The inconnu and grayling are caught in the lower part of the Taltson river below the last falls, but do not ascend to the upper parts of the stream.

INHABITANTS.

The only inhabitants of the region are Indians, whose numbers are not great. They belong to two tribes of the Athabaskan linguistic group, namely, the Chipewyans and the Dogribs. The latter occupy the region about the mouth of Taltson river and the shores of Great Slave lake, and trade at Resolution; the former occupy the central and upper portions of the Taltson River basin and the shores of Athabaska lake and trade at Fort Smith, Chipewyan, and Fond du Lac.

The Dogribs are said to number about 1,100 in all; but only about 100 of these claim the Taltson River region as their hunting ground. This region was formerly occupied by the Yellow Knives or Copper Indians, but they appear to have been either dispossessed or absorbed by the Dogribs within comparatively recent times. Evidences of the former occupation of the region by the Yellow Knives is preserved in the name of the river, Taltson. In Richard King's map, published in 1835, the Taltson river is called the Copper Indian river, suggesting that it flowed through a region inhabited by the Copper Indians or Yellow Knives. The name "Taltson" is a variation of "Tatsan" which means "scum of water" and is a figurative expression for "copper." The Indian name of the Yellow Knife Indians is Tatsanottine.

The Chipewyans who inhabit this region belong mainly to the branch called Etheneldeli or Caribou Eaters whose total numbers are said to be about 450.

Both the Chipewyans and the Dogribs live a roving life, moving from place to place throughout the year, according to the migrations of the game. They have no permanent dwellings and make no attempt to cultivate the soil. They obtain a precarious living by hunting and fishing, and supply themselves with clothing, guns, ammunition, and other necessaries by the sale of their furs. Both tribes have made treaties with the government and visit the trading posts usually in June or July for the purpose of receiving the government's annual grant of money. After this they return to their hunting grounds and towards the end of the summer most of them congregate on the borders of the Barren lands to hunt caribou. During the winter they visit the trading posts again only at Christmas or Easter to take part in the celebrations of the church at those seasons. They have all become Christians and belong to the Roman Catholic faith.

CHAPTER IV.

GENERAL GEOLOGY.

GENERAL STATEMENT.

Because of the intensity of the glaciation and the thoroughness with which the region has been denuded of its former covering of soil and decomposed rock by the movement of the ice sheet across it, the solid rocks are exceptionally well exposed and it was easy, even at the rapid rate at which we travelled, to study the characters and relationships of the rocks. Rock outcrops are abundant, but there is not a great variety of rock formations. For mile after mile of the traverse between Lake Athabaska and Great Slave lake the route lies over a great composite batholith made up, probably, of two distinct types of granite, one gneissoid, and the other massive. Remnants of an older series of stratified rocks, dominantly sedimentary, known as the Tazin series, that was engulfed in the batholith, occur as elongated bands in a few localities, but these bands are so small relative to the batholith that the impression is conveyed that the granitic batholith lies not far beneath them. Though these bands of Tazin rocks are not of very great consequence areally, they constitute the only formation of any economic importance and any mineral deposits that may in the future attract attention to the region will probably be found in them. The only other solid rock formation is a small area of red sandstone and conglomerate at the east end of Tazin lake. This is younger than the granitic batholith and rests on it. It has been doubtfully correlated with the Athabaska sandstone formation on the south shore of Lake Athabaska, which is probably Keweenawan.

All of these formations are of Pre-Cambrian age, but while it may be safe to correlate the rocks of the batholith with the Laurentian of the eastern part of Canada, it is difficult to make any correlation of the rocks of the Tazin series.

Loose, unconsolidated material on the surface of the solid rocks is nowhere abundant, except at the mouth of Taltson river. There are two classes of this surface material, the older being glacial deposits in the form of sand-plains, moraines, and boulder clay, and the younger post-Glacial stream deposits and lake beaches.

Table of Formations.

Recent	River deposits, lake beaches.
Pleistocene	Glacial deposits (sand-plains, moraines, and boulder clay).
	Unconformity—
Pre-Cambrian	Athabaska sandstone (sandstone and conglomerate).
	Unconformity—
	Granite and gneiss.
	Intrusive contact—
	Tazin series (mica, chlorite and quartz schists, slates and limestone).

TAZIN SERIES.

Distribution.

Rocks of the Tazin series occur along the route of our traverse between Lake Athabaska and Great Slave lake in seven distinct areas, of which the two southernmost are very probably continuous with each other. These areas are as follows:

Thluicho Lake area.
Thainka Lake area.
Long Reach area.
Hill Island Lake area.
Thekulthili Lake area.
Kozo Lake area.
Tsu Lake area.

Thluicho Lake Area.

The Tazin rocks of the Thluicho Lake area are exposed on Lake Athabaska, where they outcrop along the shore for several miles southwest of the first portage, and extend from there in a northwesterly direction to Thluicho and Tsalwor lakes. The known length of this band of rocks is at least 10 miles and it is very likely that it is continuous with the

band on Thainka lake. If it is continuous in this way the length of the band is about 28 miles.

The northeastern border of the band runs through the middle of Thluicho lake and thence through the middle of Tsalwor lake. The western border was not seen, so that it is impossible to say what is the width of the band. Its rocks, however, are exposed on the shores of Lake Athabaska southwestward to a point beyond Cypress river, so that, there, it has a width of several miles. It presumably decreases in width towards the northwest.

The rocks of the Thluicho Lake area, as exposed on the portages between Lake Athabaska and Thluicho lake, consist of light and dark coloured quartzites, quartzose sericite schists, and some thin bands of limestone. The rocks of this area, as exposed along the shore of Athabaska lake west of the portage, are described by J. B. Tyrrell [1] as "dark brown, thinly foliated, ferruginous chlorite schists, associated with a band of coarse green conglomerate with well rounded pebbles and a scanty chloritic matrix." They are all much altered both by regional and contact metamorphism and have been considerablydisturbed. The dip on these portages is towards the southwest and varies from 15 degrees to vertical. The strike also varies, but is, in general, northwesterly, conforming to the major axis of the whole band.

Small, irregular veins of quartz were noted in these rocks on the second portage, where they are also traversed by dykes of pegmatitic granite, offshoots apparently from the granitic batholith that lies on the northeastern border of the band.

At the southeast end of Thluicho lake the quartzites and schists are intruded by a coarse-grained granite, an occurrence which establishes conclusively the relation between the rocks of the Tazin series and the granites and gneisses.

Thainka Lake Area.

The Thainka Lake area is probably the northwestward extension of the Thluicho Lake area. Tazin river cuts diagonally

[1] Geol. Surv., Canada, Vol. VIII, 1895, p. 17D.

across this band of rocks for 4½ miles below Teseljiri falls; and Thainka lake cuts across the same band farther west, near the northern end of the lake. The band strikes northwest and appears to decrease in width in that direction, for, at the north end of Thainka lake it is only 1½ miles wide.

The rocks of this band consist of dark green porphyries, volcanic tuffs, and green schists, standing in vertical attitude and striking north-northwest. The porphyries contain phenocrysts of plagioclase and orthoclase feldspar in a fine-grained, greenish groundmass, composed largely of chlorite. The tuffs are acid tuffs containing much acid feldspar, some quartz, and a lot of fine-grained indeterminate material. They show a marked flow structure or lamination, in which the material of the groundmass flows around the feldspar crystals.

The tuffs and porphyries have been very much disturbed and sheared and in certain localities have developed a schistose structure. They are intruded both at Teseljiri falls and at the narrows of Thainka lake by dykes of granite emanating no doubt from the great batholith.

Long Reach Area.

The Long Reach area of Tazin rocks extends along nearly the whole length of the Long Reach, or for about 10 miles. The area is apparently very narrow and occupies only the west side of Tazin river. The other side of the river is occupied by granite gneiss which is intrusive into the Tazin rocks.

The rocks consist of dark quartzites and dark glistening sericite schists. The quartzites contain fragments of feldspar and quartz cemented together largely by calcite. The schists also are quartzose and appear to be a sheared schistose form of the quartzite. They stand vertically and strike almost north and south, conforming to the trend of the river.

They are cut by sills of aplitic granite which are in places so numerous as to give a banded appearance to the rock.

Hill Island Lake Area.

This is one of the largest areas of Tazin rocks, and probably the most important from an economic point of view encountered

in the whole traverse. The Tazin rocks of this area were examined along the west shore of Hill Island lake from the entrance of Tazin river to Natael bay near the north end of the lake. They are known to occupy the east side of the lake at the south end and, judging merely by the character of the country, they probably occupy the east shore almost to the north end of the lake. The belt of rocks, is therefore, at least 18 miles in length and of an unknown width.

The rocks consist of dark bluish limestones, interbedded with calcareous clay rocks which have been altered to slates and sometimes phyllites. Occasionally there are narrow bands of ferruginous mica schist. The banding of this rock is very distinct, the bands varying in width from one inch up to 2 feet. Apophyses of granite and bedded veins of quartz in the rocks increase the banded appearance.

The attitude of these rocks along the shores of the lake is vertical and the strike varies from N. 25° W. to almost true north. There are minor folds and contortions; but, in general, the trend of the beds conforms to the long axis of Hill Island lake.

In certain places, such as at the entrance of Tazin river, and on the west shore opposite the mouth of Thoa river, there are a number of veins and lenses of quartz. The veins are usually parallel to the planes of bedding, though one set cuts the bedding at an angle of 40 degrees. They are usually small and short. Some, however, were noted that are up to 18 inches in width and extend for about 500 feet. The quartz is white, bluish, or rose coloured, and contains in places some pyrite and limonite.

This area of rocks is the most promising one in the whole region traversed in which to prospect for economic minerals, and it is quite possible that careful prospecting may prove that some of the quartz veins are gold-bearing.

Thekulthili Lake Area.

The extent and distribution of the rocks of Thekulthili Lake area are not definitely known, because they were only

encountered and examined at one locality, namely, on the north shore of Thekulthili lake, for about a mile along the shore. This locality is 2 miles northwest of the outlet of the lake, where the shore-line projects out into the lake between two deep bays.

The rock at this locality is a squeezed and almost schistose conglomerate, containing flattened and elongated pebbles of quartz, granite, and volcanic rocks in a greenish matrix, made up of grains of quartz, feldspar, and some calcite and crystals of pyrite. The rock shows crushing and squeezing and an apparent flow structure of the matrix about the pebbles. The strike of the rock is N. 55° W. and the dip is about 45 degrees to the northeast.

Small quartz veins, showing a little mineralization by pyrite, traverse the rock both as bedded and cross veins.

The relations of the conglomerate to the granites and gneisses was not determined definitely; but, from its attitude and metamorphism, it is probably earlier than most of the granites. From the fact that it contains granite pebbles it is evident, however, that some of the granites are older than the conglomerate.

Kozo Lake Area.

The Kozo Lake area of Tazin rocks is a narrow band extending along Taltson river from Kozo lake to Napie falls. The band at Kozo lake is a little more than a mile wide and the known length is about 6 miles. It is elongated in a direction N. 10° W. and the Taltson river, which here flows in a southeasterly direction, first cuts diagonally across the band and then follows its western contact with the gneiss.

Because of the narrowness of the band and the intrusive relation to it of the gneisses on either side, the rocks are considerably altered from their original mineralogical composition. They consist of mica and garnetiferous schists interbedded with each other in narrow bands from 2 inches to 1 foot wide. The beds stand in a vertical attitude and strike in general

about north and south, though they frequently show considerable contortion.

They are traversed by many small veinlets of white or bluish quartz and are cut by apophyses of granite. They are intruded on either side by granite gneiss with a very indefinite line of contact; and the gneiss along the contact assumes a banded appearance owing to the inclusion of bands of the Tazin rocks.

Tsu Lake Area.

The Tsu Lake area of Tazin rocks, as exposed on Tsu lake, is small and so disconnected and highly metamorphosed by the intrusion of the granite gneiss that it is now difficult to say what the original characters of the rocks were.

This area of rocks occupies the shore of Tsu lake near the entrance of Taltson river and the islands nearby. It is bordered by granite gneiss on the east and west; and it is difficult to draw a sharp line of contact between the two series of rocks because of the widespread injection of dykes of granite gneiss into the Tazin rocks, and the extreme metamorphism of the latter. It is probable that the band is a mile or more wide at Tsu lake, and expands to the north, for a great many boulders of a grey quartzite and conglomerate are found in the glacial drift on the islands near the entrance of the river.

The trend of the band is north and south.

The rocks are of sedimentary origin, but are now mainly paragneisses. They contain narrow lenses of iron formation, bands of garnetiferous or micaceous rocks and pyroxenite, and are penetrated everywhere by sills of granite; they show bedding and dip at high angles to the east; they are also highly contorted and twisted, though their prevailing trend is north and south.

Iron ore is sufficiently abundant in this area to affect the compass appreciably, so that the declination varies several degrees in different parts of the lake.

Structural Relations.

The various patches of Tazin rocks throughout the region between Lake Athabaska and Great Slave lake are merely the remnants of one or perhaps several series of rocks that probably once extended over the whole region. Widespread intrusion and absorption of these rocks by the great granitic batholith reduced their areal extension considerably and cut them up into a number of detached blocks, while deep decomposition and intense glacial erosion further reduced the area of these remnants and removed some of them altogether, leaving only isolated patches scattered here and there on the surface of the great batholith.

All these areas of rocks show evidence of profound orogenic disturbance and intense contact metamorphism, so much so that their structure has been disturbed and their composition so changed as to make it difficult at times to tell what the character and composition of the beds originally were.

Contact metamorphism is, naturally, most profound on the borders of the various areas, where the rocks have been altered to schists and even to paragneisses, by the intrusion of the granite. In the interior of some of the larger areas there has been little chemical change in the beds and their original character remains almost unchanged.

The structure of most of the areas is synclinal and the trend varies from northwest to north, indicating that the compressive forces which produced the synclinal structure in these areas, acted at right angles to the trend. The prevailing trend of the foliation of the gneiss is northwest to north as well, and it is interesting to note that this direction is at right angles to the prevailing trend of the Pre-Cambrian rocks in eastern Canada and conforms more closely to the trend of the structure in the Rocky mountains.

While the strike of individual beds in these areas conforms in general to the trend of the areas themselves, there is much local variation of strike and contortion in the bends. Faults, too, are common; but the throw is usually small, suggesting that the beds were under considerable load during their disturbance.

The attitude of the beds is more generally vertical than inclined. Dips as low as 40 degrees were noted in the Thainka Lake area, but these low angles are rare. In such cases the inclination of the beds is away from the nearest contact line with the granite.

There is no doubt as to the relations of the Tazin series to the other formations of the region because the rocks are so well exposed that these relations are easily determined.

Every area of Tazin rocks is intruded by the granites and gneisses of the batholith. Not only do we find many apophyses of the granite cutting the Tazin rocks but there are many inclusions of Tazin rocks in the batholith. At the same time the contact metamorphism effected by the granites and gneisses in the Tazin rocks leaves no doubt as to the relative ages of the two series.

The granites and gneisses are certainly the younger, and as the Athabaska sandstone rests on the eroded surface of the batholith, that series is much younger still.

However, though the conglomerate of the Thekulthili Lake area is intruded by the granite, it also contains pebbles of granite and it is evident that the granite body from which these pebbles were derived is older than the Tazin series. Some of that older granite may still exist in the region if it has not all been assimilated or destroyed by the later batholithic intrusion, but there is no evidence that any of it was encountered in the course of our traverse.

Age and Correlation.

It is difficult to assign any definite age to the Tazin series or to correlate the series with any group of rocks whose age has been definitely fixed in the time scale. Tyrrell has referred the rocks of the Thluicho Lake area to the Huronian, both on the grounds of lithological resemblance to Huronian rocks in eastern Canada, and on the relation of this area of rocks to the granites and gneisses which are classed as Laurentian. If we accept this correlation for the Thluicho area we should carry it farther, to cover the Tazin rocks of the other areas herein

described, because it seems apparent from lithological similarities and structure, that all the areas are of somewhat the same age. It is, however, considered inadvisable to use the term Huronian for these rocks because of the danger of attempting correlations over such great distances, and for this reason the new name, Tazin series, was adopted.

If any attempt at correlation with the rocks of eastern Canada is made, it would seem best to correlate the Tazin series with the Sudbury and Timiskaming series of northern Ontario, or the Pontiac series of northwestern Quebec, both because of the similarity of lithology and structure and of the relations to the great granitic batholith.

At present, however, all we can say is that the Tazin series is Pre-Cambrian; it is the oldest known series in the region and is certainly intruded by the granites and gneisses.

GRANITES AND GNEISSES.

Distribution.

With the exception of the seven small areas of Tazin rocks, the whole route between Lake Athabaska and Great Slave lake is underlain by granites and gneisses. These rocks occupy about 86 per cent of the region immediately adjacent to the line of the traverse, and it is very likely that they cover by far the greater part of the whole Taltson River basin, because most of the glacial boulders scattered over the surface of the region are of these rocks.

Lithological Characters.

While there are some differences in mineral composition and structure in the various rocks classed under this head, it seems likely that they are all parts of one great composite batholith; not, perhaps, all intruded at one single period but rather in a succession of intrusions without any great interval between.

The batholith is made up of a variety of rocks, ranging in composition from a granite to a quartz diorite. The prevailing type is a hornblende granite or its gneissic equivalent. Biotite granite is much less common and diorite still less so.

The hornblende granite is a massive rock with a reddish colour containing pink orthoclase, plagioclase, quartz, and green hornblende. In thin section the rock shows evidence of having been crushed and of having undergone considerable stress, for the feldspars are crushed and broken and have a wavy extinction. The quartz also is crushed but has later intergrown. The hornblende is in greenish shreds. Some biotite is occasionally present. A foliated structure is developed in this rock in many places, particularly along its contacts with the rocks of the Tazin series, and in these cases it becomes a gneiss. In some varieties of the hornblende granite a porphyritic structure is well developed and the pink feldspars increase in size to one inch or more in diameter.

The biotite granite is also both massive and gneissoid. A common type of this rock consists of orthoclase feldspar, much microcline, a little plagioclase, quartz, and a variable proportion of black biotite. It generally appears fresher than the hornblende granite and does not exhibit the effect of stress to such an extent. The biotite granite also shows a porphyritic structure in places.

A peculiar type of very acid granite occurs about the junction of the Tazin and Taltson rivers. In structure it is massive with well developed planes of jointing. It consists of pale pink feldspar and bluish opalescent quartz graphically intergrown, and a small quantity of black hornblende and biotite. It is traversed by many small quartz stringers and the whole rock shows evident silicification. It has also suffered considerable stress.

At the first rapids below Methleka lake is a small body of gabbro intrusive into biotite granite gneiss, the areal extent of which is unknown. It is a dark massive rock consisting of plagioclase, pyroxene, shreds of hornblende, much iron ore, and some quartz. The rock is, therefore, a quartz gabbro similar to that at the east end of Lake Athabaska.

Structural Relations.

The granites and gneisses as a whole are intrusive into the rocks of the Tazin series. The contacts, however, are never sharp, but are marked by a wide zone in which, on the one hand, there are numerous dykes of the granite in the Tazin rocks and, on the other hand, abundant included blocks of Tazin rocks in the granites and gneisses. The granites and gneisses have also altered the Tazin rocks by contact metamorphism and silicification.

Quartz veins are very abundant in the Tazin rocks in certain of these contacts and it is there that we should expect to find mineral deposits of economic importance.

While it might have been considered advisable to separate the rocks classed under this head into two divisions according to structure, the one division containing the massive granitoid rocks, and the other the gneisses, it was not found possible to do so because the massive granitoid rocks become gneissic on their contacts with the Tazin rocks. Gneissic structure is not, however, confined to the contacts, for such a structure can be seen at many places where there are no older rocks in the neighbourhood.

The trend of the foliation of the gneiss varies from northwest to north, coinciding with the trend of the various areas of Tazin rocks. The prevailing trend is almost true north and determines in many cases the direction of the river courses. There are wide, local variations from this general direction, but these variations can generally be accounted for by a contact with the rocks of the Tazin series. In general the trend of the foliation of the gneisses is a Cordilleran one rather than one conforming with the trend of Pre-Cambrian rocks in eastern Canada.

Age and Correlation.

No attempt is here made to correlate the granites and gneisses with any rocks of similar composition in other Pre-Cambrian areas of Canada, though the natural correlation would be with the Laurentian.

It is quite clear that all the granites and gneisses of this region are not of exactly the same age, for dykes of one kind of granite are found cutting gneisses and granites of a different kind. Included blocks of gneiss were also noted in the massive granite, indicating that one was at least somewhat older than the other. But, with the exception of the gabbro, there is no proof of such a great difference in age as to warrant the mapping of them as two distinctly different igneous bodies. Rather, it appears as if most if not all of the granites and gneisses are parts of one great batholithic intrusion, which, because of some disturbances or other causes, had successive periods of activity at which molten material was injected into parts of the batholith that had already partly or wholly crystallized.

Since the granites and gneisses form the basement on which the conglomerate of the Athabaska sandstone formation was laid down they are certainly older than that formation, and their relative age, therefore, must be placed between the deposition of the Tazin series and the laying down of the Athabaksa sandstone.

ATHABASKA SANDSTONE.

Distribution.

A small area of rocks that are doubtfully referred to this formation, are exposed at the northeast end of Tazin lake. The area is exposed along the shore for nearly a mile, where it forms low cliffs which strike eastward into the interior.

Similar rocks are exposed on some islands about 2 miles southwest of that point. These outcrops are isolated from the main body by an intervening area of granite gneiss, but they were no doubt at one time continuous with it, the connecting beds having been removed by erosion.

Another area of this formation probably occurs about the eastern end of Thekulthili lake, for the western shores of the lake are strewn with many blocks of a reddish sandstone. The rocks were not found in place in this area, however.

Tyrrell[1] describes an outcrop of Athabaska sandstone on an island in Athabaska lake off the mouth of Charlot river, near

[1]Geol. Surv., Canada, Vol. VIII, 1895, p. 59D.

the point where our route left the shore of the lake. This outcrop consists of "grey or reddish, coarse grained Athabaska sandstone, occasionally containing a few rounded quartzite pebbles."

General Character and Structure.

The exposures at the northeast end of Tazin lake are in a bluff about 100 feet high consisting mainly of conglomerate. The beds are massive but are occasionally separated by thin layers of red shaly sandstone. The conglomerate contains both angular and rounded pebbles, cemented together with a coarse to fine, dark, reddish sand. The pebbles are mainly of the red granite which underlies the conglomerate, but there are also many pebbles of white quartz.

The beds lie in an almost horizontal attitude and the deposit appears to be in the form of a shallow syncline resting on the granite. The thickness of the beds is here about 100 feet. The structure is massive and in weathering the rock breaks along two sets of joint planes into huge blocks.

Origin and Age.

The angular character of the pebbles of the conglomerate suggests that they have not travelled far from their original source and this, with the oxidized nature of the underlying granite and of the matrix of the conglomerate, would lead to the conclusion that the conglomerate is a land deposit laid down on the eroded and decomposed surface of the granite.

The question of the age of the Athabaska sandstone on Athabaska lake has been discussed by Tyrrell in the report previously cited, and in a report on "The Basins of the Nelson and Churchill Rivers." W. McInnes collects and summarizes the evidence on the age of the various areas of Athabaska sandstone. These authors agree in correlating the various areas with the Keweenawan of Lake Superior, "the correlation being based mainly on lithological similarity, but being also in accord with their stratigraphical position so far as it has been determined."[1] No fossils have as yet been found in any of the areas of Athabaska sandstone.

[1]Geol. Surv., Canada, Memoir No. 30, p. 57.

PLEISTOCENE.

Distribution and Character of the Deposits.

The surface of the whole region traversed, shows abundant evidence of glaciation by the Keewatin glacier, a vast ice sheet which moved across it in a general southwesterly direction. On the whole, however, this evidence is far more that of erosion than that of deposition, and it appears abundantly clear that a great deal more material was taken off the surface of the region by glacial action than was afterwards deposited by the same agency. The proportion of bare rock surface is now very large compared to that covered by unconsolidated surface material, at least that is the impression that one gets in comparing the region with the country to the south and west.

There is no continuous mantle of glacial deposits over the surface of the region, the drift occurring only in isolated patches here and there. The country in the neighbourhood of Athabaska lake is particularly bare, but there seems to be a perceptible increase in the amount of glacial material to the west, towards the valley of Slave river. This is to be expected, as the nearer an area lies to the centre of glaciation the smaller in amount should be the glacial deposits upon it, while on an area farther out towards the edge of the continental ice sheet the action of deposition would have been stronger than that of erosion and loose surface material should have accumulated to a much greater extent.

Some of the most important areas of glacial deposition along the course of Tazin and Taltson rivers are: the north shore of Thluicho lake over to Tazin lake; the valley of Tazin river from the outlet of Tazin lake to Thainka lake; the upper and lower ends of the Long Reach; the south end of Hill Island lake; the north end of Soulier lake; the north end of Yatsore lake; the south shore of Thekulthili lake; the region about the junction of Tazin and Taltson rivers; Taltson River valley below the Twin gorges, and below Tethul river.

There are a great many other areas of greater or less extent in which glacial material has accumulated and such areas are

usually depressions in the rock surface, indentations in the shores of lakes, or stream valleys. Here, one can usually find a thin covering of boulder clay or patches of sand or gravel.

The glacial deposits are chiefly in the form of boulder clay, sand-plains, moraines, and erratics.

Boulder clay is not abundant on the Tazin river nor on the upper part of the Taltson, but below the Twin gorges on Taltson river, patches of it occur here and there on the river banks, and the rock hollows in the country back from the river usually have a floor of boulder clay. Low cliffs of this material occur on the shores of Tsu lake.

Sand-plains occur at Thainka lake, at the south end of Hill Island lake, and in a few other places; and at Thainka lake, low cliffs of sand have been formed by wave-cutting and sand-spits have been built out by the material so cut away.

Moraines are fairly common and usually consist of irregular groups of drift hills from 20 to 100 feet in height.

Glacial erratics of all sizes occur everywhere, some of them perched in the most insecure places on the slopes of hills, from which only a very slight effort would be required to dislodge them. Some of these erratics are of enormous size. The one shown in the accompanying illustration (Plate VI) is 22 feet long, 9 feet high, and about 10 feet through.

Glacial Striation.

All exposed rock surfaces throughout the region have been severely glaciated and have the characteristic forms of roches moutonnées elongated in the direction of ice movement. The rock prominences have been rounded and all protuberances have been removed from them; but, in detail, their surfaces are still rough, partly because the granites and gneisses do not polish to a smooth surface and partly because the eroding agents of the glacier were coarse and contained little fine polishing material. Striæ are, therefore, not as abundant as one might expect in a region so severly glaciated. Frequently one sees coarse grooves and deep gouges in the rock. Sometimes striations may be seen running up slopes as steep as 60 degrees.

The direction of ice movement as determined by striæ ranges from S. 54° W. to true west, and if we compare this with the list of striæ given by Tyrrell[1] for the region southeast of Athabaska lake, we find that the general movement of the ice sheet is here much more westerly. This evidence appears to support the idea of a central gathering ground for a great ice sheet on the east side of Hudson bay from which the ice moved along the radii of an arc extending from south to west and possibly even northwest.

There is little evidence in the region traversed that more than one general ice sheet flowed over the country. Only at the north end of Hill Island lake were two distinct sets of striæ found crossing each other. One of these sets strikes S. 75° W. and the other, consisting of fainter and younger lines, strikes N. 65° W. In most cases the divergences in direction of striations are small and may be due to deflection of the ice sheet by local, topographical features.

The following is a partial list of glacial striæ observed along the route of the traverse:—

Locality.	*True bearing.*
Tazin lake, southeast end of large island	S. 54° W.
" river, south end of Long Reach	S. 54° W.
Hill Island lake, south end	S. 70° W.
" " " west shore opposite Hill Island	S. 67° W.
" " " " " " " "	S. 70° W.
Hill Island lake, north end	S. 75° W.
" " " " "	West
" " " " " (younger set)	N. 65° W.
Tazin river, first portage below Hill Island lake	S. 70° W.
Soulier lake, north end	S. 62° W.
Yatsore lake, " "	S. 60° W.
Thekulthili river	S. 55° W.
" lake, south shore	S. 65° W.
Tazin river, Kolethe rapids	S. 66° W.
Kozo lake	S. 81° W.
Methleka lake	S. 59° W.
Taltson river, Nende rapid	S. 61° W.
Tsu lake, north end	S. 65° W.
" " east side	S. 62° W.
Mouth of Tethul river	S. 58° W.
Taltson river, 8 miles below Tethul river	S. 60° W.
" " 15 " " " "	S. 62° W.
" " Oracha falls	S. 57° W.
" " 5 miles below Pierrot creek	S. 60° W.
Great Slave lake, mouth of Taltson river	S. 60° W.

[1]Geol. Surv., Canada, Vol. VIII, 1895, p. 21D.

RECENT.

The two types of recent deposits encountered in the region are lake beaches and river deposits, the former being of little consequence, but the latter covering a considerable area about the mouth of Taltson river.

The shores of the lakes throughout the region are for the most part rocky and devoid of large accumulations of loose material from which beaches can be formed. The sand-plains, however, at Thainka lake, at Hill Island lake, and at one or two other places, have been wave-cut and modern beaches have been formed. Sand-spits have also been formed on these lakes by combined wind and water action and now project into the lakes, some of them as far as one-third of a mile (Plate VII).

Where beds of boulder clay have been cut into by wave action on the shores of lakes, the clay has been removed and the boulders left to form the beaches. In certain cases, notably on Tsu lake, the boulders have been symmetrically arranged on the shores along the water level.

Neither the Tazin nor the Taltson rivers carry much sediment, and the little that they pick up is deposited again within short distances in the lakes and other stretches of dead water along their courses. They are consequently not building up river deposits except at the delta of the Taltson.

For the last 23 miles of its course, however, the Taltson river flows through a flat alluvial plain, into which it has cut a shallow valley, exposing sections of the material of which the plain is built. This alluvial plain is apparently the old delta plain of Slave river and the sands and silts of which it is built have been deposited there by that stream during a period subsequent to the Glacial period. Taltson river from Oracha falls to its mouth, marks, approximately, the eastern border of the alluvial plain, which extends westward from there across Slave river to the valley of Little Buffalo river.

The region about Deskenatlata lake is another alluvial plain built up probably in the same way by material from Slave river.

CHAPTER V.

ECONOMIC GEOLOGY.

Within the last few years a little desultory prospecting has been carried on along the northern shores of Athabaska lake by three or four individuals, particularly in the neighbourhood of Charlot river and at the extreme eastern end of the lake; but, as yet, no prospector has visited the region described in this report.

Reports have been circulated of free gold having been found on Lake Athabaska in quartz veins traversing rocks corresponding in lithological character to those of the Tazin series. Small amounts of iron ore have also been noted in these rocks. Some nickel is known to occur in the bodies of gabbro that cut the granites and older sediments, but the amount of work done on these deposits has not been sufficient to prove or disprove their importance as ores of those metals. There are evidences, however, that the region bordering Lake Athabaska on the north is a mineralized region which may eventually prove to contain some of the precious metals in quantities rich enough to work even in a district so remote from easy means of transportation.

The important rocks from an economic point of view are those belonging to the Tazin series, and, judging from experience gained in areas of similar rocks elsewhere in Canada, and particularly in Ontario, the belts of Tazin rocks in this region should afford promising fields in which to search for the valuable minerals, especially gold.

As described in the preceding chapter, there are seven areas of Tazin rocks; but some of them are not likely to be of much importance because of their small size. Other areas, namely, the Thluicho and Thainka Lakes area, Hill Island Lake area, and the Thekulthili Lake area are larger and there is reasonable probability that deposits that may be found in them may have persistence and continuity in length and depth.

The three larger areas are all traversed by quartz veins which are probably genetically related to the granitic batholith which intrudes the Tazin series. These veins are both cross and bedded veins, the one series running parallel to the bedding planes, and the other series cutting them at an angle of about 45 degrees.

So far as our observations went the Hill Island Lake area is the most important of the three, and in places contains a great many quartz veins. At a locality on the west shore, about halfway down the lake, the country has been fire swept and the timber and moss burnt off leaving the surface of the rocks exposed. The Tazin rocks are here silicified and cut by many veins of quartz and granite dykes. The majority of the veins are narrow and short, but some could be traced for about 500 feet and have in places a width of 18 inches. The quartz is white, bluish, or rose coloured and is slightly mineralized with pyrite and limonite. This appears to be one of the most favourable localities in which to prospect for gold ores.

Some very large veins and bunches of quartz occur in the granite, but in all cases they were seen to contain a barren white quartz which appeared to be quite devoid of any sulphides.

Small, unimportant lenses of iron ore occur in the rocks of the Tazin series at Tsu lake and at the north end of the Long Reach, and the behaviour of the compass was so erratic at the former place as to suggest the possible presence of larger bodies of iron ore in the vicinity. No other evidence, however, was obtained of this mineral occurring in important quantities.

CHAPTER VI.

DESCRIPTION OF ROUTE FROM LAKE ATHABASKA TO GREAT SLAVE LAKE.

LAKE ATHABASKA TO TAZIN LAKE.

The canoe route from Lake Athabaska to Great Slave lake by way of the Tazin and Taltson rivers leaves Lake Athabaska at the bottom of the large bay situated on the north side of the lake about halfway between Chipewyan and Fond du Lac. This is the most northerly point of the shore-line of Lake Athabaska. The route leaves the lake by a portage at a point a few yards east of Overflowing creek, the outlet of which is in a deep bay having a very narrow entrance. Overflowing creek lies 3 miles west in a direct line from the mouth of Charlot river or about $4\frac{1}{2}$ miles from it by water.

The shore of the lake in this vicinity is rocky and somewhat rugged, particularly about the mouth of Charlot river, where the hills rise to a maximum height of about 700 feet above the lake level. To the west, the country drops away gradually to a slightly lower level though preserving the same general character of rounded rocky hills arranged in no definite alignment.

The rocks on the shore immediately at the portage belong to the Tazin series and are bedded, dark and light coloured schists and quartzites, while at the entrance to the bay and on the islands which lie just outside the bay the rocks are coarse, reddish sandstone and conglomerate which Tyrrell[1] has identified as belonging to the Athabaska Sandstone formation.

The magnetic variation of the compass on the lake shore is 34 degrees 30 minutes east.

The portage from Lake Athabaska to the first lake on the canoe route is 1,900 paces in length and rises 250 feet in that distance. The trail is good and shows evidence of having been used a

[1]Tyrrell, J. B., "Report on the country between Athabasca lake and Churchill river": Geol. Surv., Can., Vol. VII, 1895, p. 59D.

great deal by the natives. It follows the eastern side of the valley of Overflowing creek through a forest of spruce, poplar, birch, and Banksian pine. Old beaches of Lake Athabaska, indicating a higher level to that lake in former times, are crossed on the trail and some of these have been cut into by Overflowing creek to form benches. These old beaches have been noted by F. J. Alcock at a few points along the north shore of the lake up to elevations as high as 200 feet above the present level of the lake.

The rocks on the portage consist of dark and light coloured quartzites which have been somewhat sheared. The beds show considerable disturbance and dip at various angles.

The portage ends at a lake about a mile long which is known to the Indians as "Ebertheltuntue" or "the belly of an animal lake." The lake drains southward to Athabaska lake by way of Overflowing creek. Its shore is steep and rocky and it is set in a group of irregular rocky hills which rise to a height of about 400 feet above it.

From a bay at the northwest corner of this lake a portage 1,530 paces long leads to a second lake or pond, about a quarter of a mile long. The portage trail follows the western side of a creek which joins the two lakes, and lies on dark and light coloured quartzites and schists similar to those on the first portage. The rocks strike, in general, almost north and south, are usually highly inclined, and are cut by small dykes of pegmatite and irregular stringers of quartz.

The second lake, which is called by the Indians "Ootuetue" or "leech lake," is connected with a third lake at the north end by a portage 270 paces long. This lake is 15 feet lower in elevation than the second lake and apparently has no outlet. It is about a third of a mile long and is completely surrounded by high rocky hills. The rock exposed on the lake shore, by the portage, is a coarse-grained, biotite granite, containing pink feldspar, quartz, biotite, and some iron sulphide. The relations of this rock to the schists and quartzites of the first and second portages were not observed at this point, but it appears clear from the evidence obtained at Thluicho lake that the granite is younger than the schists and quartzites and intrudes them.

The third lake is crossed in a northwesterly direction to a point near the northern corner, whence a fourth portage leads across a high rocky ridge to Thluicho lake. This portage forms the height of land between Lake Athabaska and the waters draining northward to Great Slave lake. The portage is 1,320 paces long. Its highest point, 460 feet above Athabaska lake, is also the highest point on the whole route between Lake Athabaska and Great Slave lake. From the summit of the portage there is a descent of 50 feet to Thluicho lake which is, therefore, 410 feet higher than Lake Athabaska.

The portage is over schists and quartzites of the Tazin series, which are intruded by a body of granite which lies to the northeast of the trail.

The magnetic variation at the south end of Thluicho lake is 31 degrees east.

Thluicho is the Chipewyan Indian name for whitefish, which are, presumably, caught in the lake.

Thluicho lake is an irregular body of water deeply indented by bays and having a length from southeast to northwest of about 4 miles. The east shore is occupied by granite, while the west side is underlaid by the stratified rocks of the Tazin series. The shores are, in the main, rocky, except at the northern end of the lake where a low bouldery point, evidently of glacial material, projects into the lake (Plate VIII).

Beyond this point is a shallow, sandy bay, from which an old and now abandoned portage trail leads across to Tazin lake, about a mile distant. This was at one time the regular route to Tazin lake but has now been abandoned for an easier but more circuitous route, by way of Tsalwor lake, to the west.

Thluicho lake empties into Tsalwor lake by a small stream about 8 feet wide, flowing out of a bay on the northwest side of the lake. The stream is not navigable for canoes because of a fall in it with a drop of 10 feet. A portage, 65 paces in length, is consequently made on the north side of the stream, into a narrow arm of Tsalwor lake. This arm is about 300 yards deep and is almost separated from the main body of Tsalwor lake by a narrow ridge of sand, through which there is a gap about 5 feet wide, overhung by willows, and kept open by the strength of the current.

North of the portage is a rounded hill of pink, fine-grained granite belonging to the post-Tazin group of eruptives. The southwestern slope of the hill is plentifully strewn with large boulders, some of them of a reddish sandstone, carried there by glacial action from the red sandstone area at the northeast corner of Tazin lake, more than 20 miles away.

The canoe route over Tsalwor lake follows the eastern shore around two long, projecting points, into a deep bay at the northeastern corner, a distance of about 6 miles, where the outlet is found to flow northeastward into Tazin lake. The western shore of the lake was not explored, but from the top of a high hill it was seen to be indented by three deep bays each several miles in length. The two bays lying farthest south are elongated in the direction of glaciation across the strike of the rocks and are probably the result of glacial scouring. The most northerly bay runs in a northwesterly direction and is frequently used by the Indians as an alternative canoe route to Tazin river, a route which reaches the Tazin river at Thainka lake.

Tsalwor lake lies along the contact between the schists and quartzites of the Tazin series which occupy the islands and the southwest shore, and the post-Tazin granites and gneisses which form the northeast shore. The foliation of the gneiss has a strike N. 20° W., conforming approximately to the strike of the contact of the two rock series.

The shores of the lake are generally rocky and the projecting points are all of that character, while occasionally in the bays there are beaches of sand or gravel. Inland, the surface of the ground slopes upward to rounded hills 200 to 300 feet above the level of the lake. Here and there the slopes are broken by cliffs of solid rock and by irregular depressions. The hills on the east shore have been burnt and are now covered by a small scrubby growth of forest. These patches of burnt country are found in all cases to mark the courses of the regular Indian canoe routes.

Tsalwor lake empties by a small stream into Tazin lake, from a narrow bay in the northeast corner of the lake. The stream is too shallow and too rapid for canoe navigation and, in consequence, a portage 620 paces in length is made on the north side of the

stream. The difference in level between the two lakes is 20 feet.

TAZIN LAKE.

Tazin lake is a large body of clear water, elongated in an east and west direction, having a length of about 29 miles and a maximum width of 8 miles. Its shore-line encloses an area of 207 square miles, but a large island, about 19 square miles in extent, and a number of smaller ones reduce the surface area of the water of the lake to about 180 square miles.

The lake is known to the white people of Lake Athabaska as Black lake, but as there is another Black lake at the east end of Athabaska lake, the Chipewyan name Tazin, which means black, has been adopted for the lake as well as for the river which flows out of it. The name was no doubt given to the lake on account of the colour of the water which, though clear, is very dark.

Whitefish and lake trout are plentiful in the lake and fish of the last named species were caught that weighed as much as 20 pounds. The fish are well flavoured and firm, owing, perhaps, to the coldness of the water, the surface temperature of which on July 6 was 54 degrees Fahrenheit.

The lake is a rock basin and, judging by the number of islands that jut out here and there through the water, it is not of very great depth. The shores are steep and rocky, running back to hills, usually about 300 feet high. Gravel and sand beaches are rare and are found only in a few places, notably at the northeast end of the lake and along the south shore, east of the portage from Tsalwor lake.

A number of streams enter the lake, mainly from the north and east. About the middle of the north shore and opposite the northeast end of the large island that lies in the middle of the lake, a small stream enters from the north, up which the Indians have a regular canoe route to the Barren lands. Another stream, known as Enatesse or Cree river, enters at the extreme northeast corner. In the large bay at the southeast end, a third stream is said to enter, which drains the country as far eastward as longitude 108 degrees. On the south side, the only stream known to enter the lake is the stream which flows from Tsalwor lake.

Some abandoned houses, formerly occupied by an Indian named Charlot, stand on a level sand-plain, fronted by a broad, sandy beach, at the northeast end of the lake.

Coarse-grained, pink granite is the prevailing type of rock all around the north, west, and south shores. This granite is generally massive and jointed, but in places is foliated. Rarely, dark bands occur in it, giving it a gneissic structure. In places, it is traversed by veinlets of white or bluish quartz.

A band of coarse, reddish conglomerate, which has been doubtfully correlated with the Athabaska sandstone formation of the south shore of Lake Athabaska, occupies the extreme northeastern corner of the lake. It outcrops as a steep bluff near the mouth of Cree river and forms some of the islands off the point which separates the two large bays at the east end of the lake. It contains many rounded and some angular boulders and pebbles, mainly of coarse reddish granite, cemented together by red sandstone. The sandstone also occurs in separate layers. The conglomerate is an arkose, probably a land formation, which has been laid down on the surface of the granite in a synclinal basin. Its attitude is almost horizontal.

All the rock exposures around the lake shore show heavily glaciated surfaces, with striæ running about S. 50° W. On points or islands which lie across the strike of glacial movement, striæ were sometimes noted running up a rock surface against a slope of 60 degrees.

The only unconsolidated material on the rock surface around the lake is glacial and this is not abundant. Glacial sand-plains occur at the northeast end of the lake and, in places, along the south shore, near the portage to Tsalwor lake. Some of the small islands near the latter point are glacial moraines.

The portage into Tazin lake from Tsalwor lake ends in a bay on the south shore of Tazin lake. The route from there to the outlet of the lake, after rounding a point to the north, follows the southwest shore of the lake for about 11 miles, and from the south side of a deep bay at the western end of the lake Tazin river flows out of the lake by a broad channel bordered by high rocky hills.

TAZIN RIVER FROM TAZIN LAKE TO THAINKA LAKE.

Tazin river where it leaves Tazin lake is about 200 yards wide, with a scarcely perceptible current, and its course, for about 6 miles, is almost west. Half a mile from the lake, the stream contracts to about 40 yards and the water becomes swift and broken. No portage is necessary to avoid the rough water, until, after passing a couple of small expansions, the stream again contracts between two of these expansions and forms a fairly strong rapid. A portage is frequently made at this point on the south side of the river, but as the water was high at the time of our passage we were able to run our canoes through without difficulty.

For the next 4½ miles the river widens and flows with a gentle current through a broad valley floored with sand and gravel of glacial origin. The banks of the river are made up of these loose, unconsolidated deposits and here and there rocky knobs of gneiss rise through them. This portion of the valley is preglacial and is floored with glacial material, which, judging from the irregularity with which it is spread, was probably laid down as a terminal moraine. Glacial erratics are also scattered sparingly on the rocky knobs, sometimes in the most unstable and insecure positions. Banksian pine is the principal tree along the river banks and where it has been burnt off, as has been the case over large areas, a second growth of the same trees has sprung up.

The temperature of the water of the river on July 9 was 45 degrees Fahrenheit.

The volume of water flowing in the river was estimated to be about 2,000 cubic feet per second.

Several large lake trout and pike were caught in the river and it is probable that whitefish could be obtained also.

Five and a half miles below Tazin lake the river takes a sharp bend to the south and skirts a lake about a mile long which lies to the north and west of the bend and, in about one-third of a mile, falls over a ledge of gneiss, where a portage of a few yards has to be made on the left hand side.

The river continues in a southerly direction for about a mile through several small lake-like expansions below which it turns sharply to the west, passing out of the rolling gravelly region into a rough rocky country.

After doubling back on itself in the form of a letter S the valley contracts between rocky walls of gneiss, the current increases in strength, and the river plunges over a fall, the roar of which can be heard for a long distance.

From a small cove on the north side of the river, within a few feet of the head of the falls, a very indistinct and rough portage trail ascends the bank through a narrow valley. The portage is about 200 yards in length and the descent to the river at the farther end is very steep and rocky.

Teseljiri, as this fall is called by the Indians, has a drop of about 30 feet and a width across its crest of about 100 feet (Plate IX). Below, is a narrow, rocky gorge, half a mile long.

The fall marks the contact between a coarse-grained, pink granite gneiss and a dark green, fine-grained, porphyritic rock, showing phenocrysts of pink feldspar and belonging to the Tazin series. The gneiss is intrusive into the porphyritic rock and sends off many dykes into it. Both are much sheared and the strike of the shearing is about N. 80° W., parallel to the contact, which strikes diagonally across the river.

Below the portage, the valley widens slightly and its sides become more sloping, a result probably of the change from a gneiss bed-rock to one more susceptible to erosion. A strong bouldery rapid follows, which can be run by canoes with half loads. This is succeeded in a quarter of a mile by another rapid around which a portage of 260 paces is made on the north side of the river.

The portage is good and shows considerable use by the Indians. The rapid is a long straight chute with a fall of about 20 feet in 200 yards.

The rock at this portage is a dark green porphyry, similar to that at Teseljiri falls. In places it has been so squeezed as to become schistose, but the flattened pink feldspars can still be distinguished. The rock strikes N. 70° W. and dips at an angle of 40 degrees to the south. In places this angle increases

and the beds are contorted. Rocks of similar character outcrop on the shores of the river down to Thainka lake, nearly 1½ miles below the portage.

Somewhere in this stretch of river, below Teseljiri falls, the regular Indian canoe route which branched off westward from our own course at Tsalwor lake joins Tazin river; for many old camps and other signs of the passage of Indians are seen along the shores. The exact point at which this route joins Tazin river was not found.

THAINKA LAKE.

The name "Thainka" is a Chipewyan word meaning "sandy narrows" and was suggested as a suitable name for the lake by the occurrence of a prominent sand-spit which almost divides the lake in two near the northern end.

The lake is narrow and shaped like the letter L. Its length is 8 miles and its average width is less than half a mile. The upper arm is 3½ miles long and lies in an east and west direction. The lower arm turns sharply to the north and extends in that direction for about 4½ miles.

The shores of the lake are made up mainly of sand and have been cut into in many places by wave action to form low cliffs. At several points sand-spits project into the lake, formed, without doubt, by the combined action of wind and water (Plate X). On both sides of the lake sand-plains extend back inland for nearly a mile and through these knobs of rock project here and there. The most prominent of these knobs is situated on the east side of the lake and rises to a height of 200 feet above the plain. The sands, where exposed in the low cliffs of the lake shore, show rough stratification and the whole region about the lake is probably a glacial outwash plain.

Porphyritic, green, quartzose schists outcrop on the river near the point where Tazin river flows into the lake, but there are no more outcrops on the shore of the lake until the bend is reached, where the rock is granite gneiss. Evidently in this distance one passes across the contact between the rocks of the Tazin series and the post-Tazin gneisses. The surface of the

gneiss is strewn with boulders of an iron-stained quartzose rock which has many small quartz stringers ramifying through it. The boulders probably come from a bluff of similar rock situated about a mile to the east, apparently near the contact of the Tazin rocks with the gneiss.

No exposures of solid rocks are then encountered on the north arm of the lake until the narrows are reached, where a steep bluff rises abruptly from the water's edge to a height of 100 feet. The bluff is composed of green porphyritic schist, lying almost flat, and cut by a dyke of fine-grained, acid granite.

Opposite the bluff and half a mile back from the lake shore, a rounded, sugar loaf hill rises 200 feet above the plain. The hill is composed of the same green porphyritic schists striking N. 15° W. and dipping vertically.

The green schists form a band about $1\frac{1}{2}$ miles wide in the gneiss and are intruded by it. The lake cuts diagonally across the schists in its western course and again in its northern course, the northern end of the lake being in gneiss.

Observations for latitude and compass declination were made at the narrows of the lake on July 12. The latitude at this point was found to be 59° 51′ 41″, and the compass variation 33° 30′ east.

TAZIN RIVER FROM THAINKA LAKE TO HILL ISLAND LAKE.

The distance from Thainka lake to Hill Island lake is about 37 miles and the river in this distance follows a northerly direction running in straight reaches many miles in length.

Tazin river leaves Thainka lake by a strong, shallow rapid, with a drop of about 8 feet in a distance of 100 yards. A well defined portage trail follows the east bank, but at most stages of the water canoes may be run through the rapid with a full load without any difficulty.

Pink granite gneiss striking N. 20° E. and cut by small quartz veins, is exposed in the river banks both above and below the rapid.

Below the rapid, the character of the valley changes, the banks become rocky and the shore-lines irregular and indented with bays.

Two miles below the rapid, the stream turns sharply to the east and, passing through a narrow rocky gap known as "Tesseni," enters a long straight reach which extends for several miles in a direction slightly east of north, parallel to the strike of the gneiss. In this reach the river is narrow and bordered by rocky banks of gneiss. Here and there are irregular morainal deposits of sand and gravel. A slight current is perceptible in the river, especially at constrictions.

At the end of the first long reach, about 8 miles below Thainka lake, the river makes a right-angle bend to the west, across the strike of the gneiss, and passes into a band of siliceous and micaceous schists and quartzites. Turning again to the north it runs in almost a direct line for 12½ miles and has a much broader, open valley. This broad, open stretch is more like a lake than a river and is known to the Indians as the "Long Reach." For almost the whole of its length it is bordered on the east by gneiss and on the west by a band of schists and quartzites, the river having been excavated along the contact. The band of schists is not wide and near the north end of the Long Reach pinches out in the gneiss. The schists strike N. 10° E. and dip at high angles to the west.

The country on both sides of the Long Reach is rolling and consists of a succession of rounded, wooded hills, rising to an average height of 150 feet above the river. Much of the country has been burnt and is now covered with a young second growth, mainly of Banksian pine.

Near the northern end of the Long Reach and on the west side of the river, is a bold, isolated hill, 200 feet high, forming a good land mark for several miles around. The hill is composed of white pegmatitic granite containing white feldspar, quartz, and biotite, with bunches and veins of white and bluish quartz.

The river below the hill is wide, with marshy shores and low sandy banks. Below this, the river turns sharply to the left and some hard, banded gneiss forms a short rapid with a fall of 5 feet. A portage is made at this point and canoes are run empty through the rapid. The gneiss here contains some lenses of magnetite which deflect the compass needle nearly 20 degrees out of its normal bearing.

Below the rapid Tatse lake, half a mile wide, extends for 2 miles to the south and the river flows from its northern end, around a low sandy point. From this lake the river again trends northward, in conformity with the strike of the gneiss. The valley is wide and flaring and the forest growth has recently been burnt. Outcrops of rock are frequent, though the shores of the river are in many places marshy and the banks sandy.

At the next contraction of the river, there is a fairly strong rapid which may be run with loaded canoes, though there is a good portage trail around it on the west bank.

Below the rapid the river again gradually widens and the hills on either side recede farther back, especially on the west where they eventually form a wide curve, encircling a shallow marshy lake. A narrow fringe of trees separates the river from the marshy lake.

From this lake a canoe route is said to lead westward through a series of lakes to Slave river at Smith Landing. This report was not verified, but it is very likely true since traces of Indian travel are much more numerous on the river below this point than above it.

Below the marshy lake the hills again approach the river closely and the valley seems almost to close altogether. At the foot of this stretch the river takes a turn to the eastward and, bending around the hills to the right, passes through a constriction at which there is a small rapid and enters Hill Island lake.

Granite gneiss is the prevailing type of rock between the Long Reach and Hill Island lake and, though the shores of the river are often marshy or sandy, outcrops are frequent. The strike of the foliation of the gneiss is usually parallel to the trend of the river and has been the controlling factor in determining the course of the river. Frequently the gneiss contains micaceous bands, which were probably originally portions of the Tazin series of rocks that have been engulfed in the gneiss and almost completely assimilated by it. Some small, barren quartz veins also occur in the gneiss.

HILL ISLAND LAKE.

Hill Island lake is a narrow body of water, 24 miles in length and about 2 miles in average width. It gets its name, Hill Island, which is a translation of the Chipewyan name Nusheth, from a cone-shaped island about halfway down the lake, which, though small, is a prominent feature when looking down the lake from the point where Tazin river enters it. Samuel Hearne was the only previous explorer to visit it. He passed through it in 1772 as he was travelling eastward towards Hudson bay on his return from the Coppermine river. This is the only point on the whole of our traverse between Athabaska and Great Slave lake that we are certain had previously been visited by any one but natives of the country.

Tazin river enters the lake at a point about 4½ miles from the southern end and leaves it again at the extreme northern end. The lake has, however, a second outlet which flows from a long narrow bay running westerly from a point about 3 miles above the northern end of the lake. This second outlet was not explored, but its water probably rejoins Tazin river about 34 miles below.

The southern end of Hill Island lake is very irregular in outline and has several sandy spits projecting into it. It is almost separated from the main body of the lake by two points of land which project from either side. This end of the lake was not explored beyond the narrows.

The main body of the lake is fairly regular in outline and has few islands. The western shore is neither as steep nor as high as the eastern and several sandy spits break its regularity. At the northern end of the lake there are several small rocky islands, some of them barely appearing above the water, and on the west side there is a long narrow bay known as Natael bay that runs in to the westward for over 5 miles. A few Indian houses are situated on the east side about halfway down the lake.

The northern end of the lake, like the southern end, is almost separated from the main body of the lake by a large island, beyond which the lake extends for 1½ miles to the outlet.

No streams enter the lake from the west side and, on the east side, the only stream that is known is Thoa river, which enters a bay north of the Indian houses. It is likely, however, that there are other streams of which we have at present no knowledge. Thoa river is said to be used by the Indians as a canoe route eastward to the Barren lands.

The country on either side of the lake slopes up regularly to the level of the plateau which is about 150 feet above the lake. It is wooded mainly with spruce and Banksian pine, which on the west shore has been largely burnt off (Plate XI).

Hill Island lake lies in a belt of sedimentary rocks of the Tazin series and is elongated in conformity with the strike of those rocks. The valley of the lake lies transverse to the direction of glaciation and its origin, therefore, is not due to glacial scouring but, in all probability, antedates the Glacial period.

The rocks of the lake, as far north as the entrance to the Natael arm, consist of thin bands of dark bluish limestone, interbedded with clay rocks which have been altered to slates and phyllites. Some of the bands are of ferruginous mica schists. The banding is very distinct and the bands vary from a fraction of an inch up to 2 feet in width. They stand in vertical attitudes and strike on the average about north and south. There are many minor folds and contortions and the beds are frequently faulted.

These rocks show considerable metamorphism and disturbance and are traversed by small dykes and sills of granite. They also contain many small veins of quartz, most of which are parallel to the bedding but some cut the beds at an angle of about 40 degrees. The veins are generally neither strong nor continuous but some were traced for distances of 500 feet. The quartz is white, bluish, or rose coloured and carries some pyrite and limonite.

These sedimentary rocks are intruded by the granite gneiss. The actual contact was examined at the point where the river enters the lake and again at the northern end of the lake.

On Natael arm and on that part of the lake north of the

mouth of that bay the rock is a coarse-grained granite gneiss, which, near the contact with the sedimentary rocks, holds many inclusions of the latter rocks. Near the bottom of Natael arm the gneiss is traversed by large veins of white quartz which, however, seem to be barren of any sulphide minerals. The strike of the gneiss is variable and is to some extent governed by the strike of the contact with the sedimentary rocks.

All the solid rock surfaces on the shores of the lake have been smoothed, rounded, and striated by glacial action. The principal direction of ice movement, as shown by striæ, is about S. 80° W., but there are local variations to one side or the other of this direction up to 10 degrees, resulting from local irregularities of the surface. At the north end of the lake there is evidence of a second set of striæ, younger than the first, which strikes N. 65° W.

Unconsolidated deposits of sand are common at the southern end of the lake and these have been formed by combined wind and water action into a series of sand-spits that project into the lake from the western shore.

Beds of peat resting on sand have also been cut into by wave action and exposed on the west shore north of the entrance of Tazin river. Sections of these show about 8 feet of peat.

We reached Hill Island lake on the evening of July 14 and camped in a bay about a mile beyond the entrance of Tazin river. A great many old Indian summer and winter camps were seen about the entrance of the river and, probably on account of the fishing, this place seems to be a favourite camping ground for the Indians.

On the following day, after spending the morning in examining the rocks on both sides of the lake, we continued down the west shore, but because of a strong head wind, which made landing difficult except in sheltered spots, we were only able to reach a point opposite the mouth of Thoa river, where we camped on July 15.

The country back of our camp at this point had been recently fire swept and the rocks were absolutely bare of any vegetation. They consist of banded schists, limestones, and slates and are traversed by a great number of quartz veins. There is only

slight evidence of mineralization in the veins examined, but careful prospecting in this locality might reveal others carrying gold.

Continuing down the lake on the following day, much time was lost in exploring for the outlet of the lake in the Natael arm which extends inland to the west for several miles and is full of islands. A stream was found flowing from the bottom of this bay, but it was too small to be the main stream, and we returned to the main body of the lake to find the outlet at its extreme northern end.

Sextant observations at the entrance to the Natael arm on July 16 gave a latitude of 60° 35′ 27″ and a compass variation of 36 degrees east.

The elevation of Hill Island lake was calculated by aneroid as 300 feet above Lake Athabaska and 590 feet above Great Slave lake.

TAZIN RIVER FROM HILL ISLAND LAKE TO SOULIER LAKE.

From Hill Island lake, Tazin river flows in a direction slightly north of west as far as Soulier lake, a distance of about 11 miles. At the outlet of the lake the river is about 500 feet wide, but it immediately expands again to a small lake. In fact from Hill Island lake down to and far beyond Soulier lake the river is a succession of lakes joined by constricted river-like portions in which there are generally rapids or falls.

North of the outlet of Hill Island lake is a gravelly plain, noticeable because of the infrequency with which these plains occur throughout the region. The plain has an uneven, hummocky surface and is, no doubt, a glacial moraine. Poplar and birch are interspersed with spruce and pine over the plain and the growth is more luxuriant than the forest growth throughout the country generally. Some Indian graves are situated on the bank overlooking the narrows.

Beyond the narrows at the outlet, the river expands to a lake, deeply indented with bays and having a number of islands at its northern end. It narrows again, however, in a little over a mile and turns northwestward for half a mile to a rapid. The

rapid has a fall of 20 feet in two drops, and a portage of 290 paces is made on the west side over a broken, rocky piece of country.

The rock at the portage is a rather coarse-grained pinkish granite gneiss containing some dark hornblendic bands. It shows a tendency to porphyritic structure and contains pink feldspar, quartz, and dark greenish hornblende with a distinct foliation. Occasionally the basic mineral is segregated in larger bands up to one inch in thickness. The strike of the rock is not well defined, but there is some twisting and curving of the foliation.

A short distance below the rapid, the river again expands to a lake, across which the canoe route follows the northern and eastern shore to a second rapid. In this, there is a drop of 5 feet, to avoid which a portage of 140 paces is made over a rocky point on the east side.

The succeeding lake expansion is $1\frac{1}{2}$ miles long, and at the end of this the river is split into three channels by two rocky islands. Rapids occur in each of the three channels and a portage of 55 paces is made over the southernmost island. From there to Soulier lake the river passes through two expansions joined by river-like channels without rapids.

Soulier lake is nearly 3 miles long and three-quarters of a mile wide. From its northwestern end a canoe route leads northward to Thekulthili lake and thence to the Barren lands at the head of Taltson river. The canoe routes from Chipewyan on Athabaska lake and from Smith Landing on Slave river converge at Soulier lake, and the Indians from both these places follow the route northward to hunt deer in the autumn.

An observation at the northwest end of Soulier lake on July 18, gave a latitude of 60° 41′ 29″.

The country generally between Hill Island lake and Soulier lake is very rocky and rugged, though the hills on either side of the river rarely exceed 100 feet in height. The country rock is a coarse-grained hornblende granite gneiss without any well defined strike of foliation. This bed-rock forms a very different topography from that which obtains on Hill Island lake where the country rocks are schists, limestones, and slates. The shores of the lakes are not regular in outline, but are deeply

indented by bays and it is consequently difficult to find the outlet when traversing a lake without a guide.

There is very little soil covering the rocks and the only loose material on the surface is the patches of sand or gravel found here and there at intervals. Much of the country on the south and west sides of the river has been burnt within the last four years.

THEKULTHILI RIVER AND LAKE.

The distance from Soulier lake to Thekulthili lake is about 20 miles and two days were spent in making a side trip there for the purpose of exploration and in trying to find some Indians from whom information of the country and canoe routes might be obtained. Although Indians had been camped on Thekulthili lake a few days before we reached there, we were disappointed in finding that they had moved to other hunting grounds and it was useless to seek them further.

The route to Thekulthili lake leaves the northwestern end of Soulier lake by a portage the beginning of which is marked by some old Indian camps and a number of fish drying stages. The portage is 200 paces in length and leads over to a lake about $2\frac{1}{2}$ miles long draining southwestward to Tazin river. From the extreme northwestern end of this lake a portage of 220 paces was made to Yatsore lake which proved to be on the Thekulthili watershed. Both portages are good and are much used.

Some time was lost in exploring the north shore of Yatsore lake for the route, which was finally found to turn off at the westward around a point about a mile from the portage. We turned again to the north and ran up behind a large island; here the lake contracts gradually until it has the appearance and dimension of a river and a slight current becomes perceptible.

This proved to be Thekulthili river which was afterwards found to flow out from the southwestern end of Yatsore lake. Whether Thekulthili river eventually flows into Tazin river or into Taltson river could not be learned even from the Indians who travel over this route.

Above Yatsore lake Thekulthili river flows in an almost direct course from the north expanding in several places to lakes. Its shores are rocky but rarely more than 100 feet high and little current is perceptible in it except at the contractions.

After passing a right-angle bend to the east, the valley resumes its northward course, and within half a mile of Thekulthili lake, we passed a rapid by a short portage on the west side of the river. The river at the outlet of the lake is divided into two narrow channels each flowing over the solid gneiss which has been smoothed and flattened by glacial action. Thekulthili river gets its name, which is of Chipewyan origin, from the fact that it flows out over flat rocks.

Thekulthili lake was explored only by a traverse, made across from the outlet where the lake is about 2 miles wide. The lake, however, is said to be at least 25 miles long, the greater part of it lying to the east of the outlet. It lies in an approximately east and west direction and is surrounded by low hills about 100 feet in height. Its shores are rocky and at the western end it contains a number of islands.

The lake lies on the route of the Fort Smith Indians to the Barren lands and is a favourite stopping place for them, as it is said to afford good fishing. An Indian house stands on the south shore about a mile east of the outlet.

The rocks along the route between Tazin river and Thekulthili lake consist mainly of gneisses striking in general parallel to the course of the river. These appear to be cut in places by bodies of a massive fine-grained granite which weathers to a reddish colour.

On the west shore of Yatsore lake the gneiss is in contact with highly metamorphosed green schists, which are contorted and twisted into sharp folds and are traversed by many small veins of barren white quartz. The gneiss is probably intrusive into the schists.

Gneisses also occupy the south shore of Thekulthili lake, but on the north shore, opposite the outlet, is an area of green squeezed conglomerate somewhat schistose and striking N. 55° W. and dipping at an angle of 40 degrees to the northeast. It carries veins of quartz a few inches in width, which are slightly

mineralized with iron sulphides. No contact showing the relation of the schist to the gneiss was seen, but the schist is undoubtedly older than and cut by the gneiss. The area is possibly worth prospecting for gold-bearing quartz veins.

Glacial striæ on Thekulthili lake strike S. 65° W. and all the rock surfaces are smoothed and rounded. Glacial material is not very abundant except in certain localities, notably the south shore of the lake, west of the outlet, where there are morainal deposits of boulders, gravel, and sand, heaped up in irregular hills. Among the materials of these morainal deposits are boulders of a red sandstone, suggesting that an area of those rocks occurs in the country to the northeast, possibly on the shores of Thekulthili lake. Glacial material is abundant also in the country north of the north end of Yatsore lake.

TAZIN RIVER FROM SOULIER LAKE TO TALTSON RIVER..

Tazin river flows out of Soulier lake in a southwesterly direction past a low gravel point on which are some Indian graves. One mile below this the stream turns south around a long narrow point and two courses appear, one to the southeast down a long narrow arm, and the other to the southwest into another arm. We followed the southwest arm which proved to be the course of the river, but it is quite possible that the other arm is the regular Indian route, for as we continued on our course we soon found that there were very few signs of Indian travel and the portages were overgrown and indistinct. The other route probably rejoins the Tazin river near Nolan falls about 21 miles below.

About a mile below the point where we turned off the Indian route the stream contracts and turns sharply to the right. Two short rapids follow in quick succession and the stream again expands into a small lake of very irregular outline. At the end of this is another short rapid easily navigable and the stream divides around an island nearly a mile long.

Three-quarters of a mile below the large island, the stream contracts to a width of 40 feet and rushes in a rapid through low rocky banks. Some care is necessary in navigating this to

avoid being thrown against the rock wall by whirlpools near the lower end of the rapid.

After two more expansions the river divides into three channels and the roar of strong rapids on the eastern channels can be heard. From the right hand side of the middle channel a portage of 150 paces is made to avoid a rapid which has a fall of 10 feet.

Immediately below this is a rapid nearly half a mile long to which the name Kolethe, meaning "burnt woods" in Chipewyan, has been given.

The total fall in Kolethe rapids is 25 feet, but it was found possible to run the canoes through the rapids after removing the loads. The portage follows the right hand bank and runs through country from which the timber has recently been burnt.

The western branch of the river is the smallest of the three and runs away through a channel about $4\frac{1}{2}$ miles long before it rejoins the main stream. The island it encircles is $3\frac{1}{2}$ miles in length with hills on it rising 150 feet above the level of the river.

The country bordering the river between Soulier lake and Kolethe rapids is similar to that previously passed through. The rocks are mainly granite gneiss, with bodies of coarse, pink granite intrusive into it. In places, the gneiss has inclusions or bands of more basic rock, but these are relatively small. The strike of the gneiss varies from N. 35° W. to N. 10° W.

Half a mile below Kolethe rapids the river divides about a small island where there is a short rapid, the portage being made over the island itself.

For the next 9 miles the river continues in a southerly direction and is wide and without noticeable current except in one or two narrow portions. It is unusually free from islands and its course is consequently not difficult to follow. The bordering country is somewhat higher and more rugged and the rounded hills of gneiss have an average elevation of about 150 feet above the river. The gneiss strikes in general about N. 20° E. and is in places distinctly banded with layers of mica schist. Local variations of the strike are common and in places the lines of foliation are bent and contorted. Immediately above the rapid which follows this stretch of river

is a body of quartz-mica diorite which from its fresh and massive appearance is probably intrusive into the gneiss.

In the succeeding 3 miles, the stream is interrupted by a series of strong rapids and falls, and three portages have to be made to avoid them. The outline of the river is very irregular and its shore-line is indented by a number of bays. This broken shore-line, together with the numerous islands, makes the route difficult to find and follow.

The first of these three portages is 400 paces long and runs over a ridge of gneiss about 60 feet high on the right hand side of the river. The river has here a total drop of 11 feet in two short rapids. The second rapid has a fall of 15 feet in a horizontal distance of less than 100 feet and the portage runs across the point on the right hand side. The river turns eastward from this point and passes from one expansion through a contracted portion and into a second expansion. At the southeast end of the second expansion there is a rapid known as Nolan falls.

At Nolan falls, the stream is divided into two channels by a rocky island at the head of the falls and the river drops 20 feet in a distance of about 150 feet. We portaged on the right hand side down a steep rocky slope, but as there was no sign of a trail it is possible that the regular Indian portage is on the other bank.

In the whole distance from Nolan falls almost to Soulier lake there were no recent signs of Indian travel and, although this route appears to have been used years ago, it has apparently been abandoned for a more easterly one which joins Tazin river, possibly in the lake below Nolan falls.

Below Nolan falls, the stream enters a lake and turns southwest and then almost west. In the last reach the river turns to the south behind some islands, but as we were following the northern shore we missed the river and continued westward more than 2 miles farther to the bottom of a deep bay. Here, we found a small stream flowing out of the bay down some rapids, but as there was no evidence that this was the proper route and the stream was too small to be the main stream, we returned and soon found the proper channel.

Dykes of a reddish, porphyritic granite with phenocrysts of black hornblende cut the gneiss at several points below Nolan

falls. The granite is massive and fresh-looking and has not been subjected to the disturbances that have affected the gneiss. Enormous glacial boulders of this granite were noted near the tops of some of the hills, perched in the most insecure positions and apparently only requiring a slight push to dislodge them.

The river flows nearly due south for the next 7 miles, to a point just above Klo creek, where it turns sharply to the northwest. In this distance, the valley is narrow and the current is strong, breaking here and there into short rapids, all easily navigable. The banks are steep and rocky and consist of pink granite gneiss which strikes N. 10° E. parallel to the course of the valley.

At Klo creek, the Tazin river enters at right angles a broad marshy valley which trends north and south. Klo creek occupies this valley and is used by the Indians as a canoe route between Tazin river and Smith Landing.

Between Klo creek and the junction of Taltson river, Tazin river is rarely followed by the Indians. There are on this portion of the river two difficult portages which at the time of our passage showed no signs of recent use and were so overgrown with willows and small trees that they had to be cleared before it was possible to carry canoes and loads over.

Nettell fall is a mile below Klo creek and is the largest and most beautiful fall on the Tazin river. The total drop is about 50 feet, which is made in a series of steps. The falls are caused by a dyke of massive red granite which strikes across the river and is intrusive into the granite gneiss (Plate XII).

A portage of 540 paces was made on the right hand side to avoid the falls.

For the next 6 miles, the river flows in a series of right-angled bends which in one direction are parallel to the foliation of the gneiss and in the other at right angles to it. Shortly below the last bend a small stream enters from the north and from there down to Taltson river the course of the river is almost a straight line. The valley is fairly wide, but in places becomes narrow and gorge-like. At the first of these constrictions, where the width is about 90 feet, a short but strong rapid occurs which

can be run with light canoes after portaging the load over an indistinct trail on the south bank.

A broad expanded portion of the river follows, but in about 2½ miles it again contracts to a narrow rock-walled gorge not more than 40 feet wide in its narrowest part. Through this the water rushes with such force that no boat could possibly live in it. The rapids are called by the Indians Tthikethe rapids which means "water flowing between rock walls" (Plate XIII).

The portage around the rapids is made on the northeast side of the river and is 1,300 paces along. The trail, which was very indistinct, follows the top of the bank and passes over a ridge 120 feet high composed largely of gravel. The ascent from either side is steep but regular.

Tthikethe gorge is apparently a preglacial gorge which during the Glacial period was filled with sand, gravel, and boulders. All this material has since been eroded away from the bed of the stream, and it seems likely that some post-Glacial deepening of the bed-rock has taken place as well, as there is a rock bench about 20 feet above the water on the north side representing the old river bed.

The rock of Tthikethe gorge is a peculiar, acid granite, consisting of pale pink feldspar, bluish opalescent quartz, and thin fibres of green chloritic material. It is traversed by many small veinlets of quartz and the whole rock shows evident silicification. It has a platy structure with the principal line of fracture striking parallel to the trend of the gorge and dipping 45 degrees to the north. In consequence of this structure the north wall of the gorge at the bottom overhangs slightly, while the other wall has a slope conforming to the dip of the planes of fracture.

A quarter of a mile below the end of the portage Tazin river passes through a narrow gap with a small rocky island on the left and joins the Taltson river which flows from the northeast.

Sextant observations at the junction of the Tazin and Taltson rivers gave a latitude for this point of 60° 26′ 2″ and a compass variation of 41 degrees east.

A rough measurement of the discharge of Tazin river at its mouth, taken on July 30, was found to give a volume of 5,100 cubic feet per second.

TALTSON RIVER FROM TAZIN RIVER TO TSU LAKE.

Taltson river is said to rise in lakes lying on the borders of the Barren lands, south of the extreme eastern end of Great Slave lake. It flows from there in a west and southwest direction through a series of lakes and connecting stretches of river. Its course above the junction with Tazin river has never been explored so that it is difficult to say what is the total length of the river. From Tazin river to Great Slave lake it is about 140 miles in length so that it would be reasonable to suppose that the total length from headwaters to Great Slave lake is at least 300 miles.

Comparative measurements of its discharge with that of the Tazin river were made to determine which was the larger stream. The Tazin was calculated to have a volume of 5,100 cubic feet per second, while the Taltson above its junction with the Tazin carried 5,340 cubic feet per second. The Taltson is, therefore, the larger stream.

We reached the Taltson river on July 29 and camped on a beautiful, sandy, wooded flat opposite the mouth of Tazin river. We found on the flat signs of recent Indian travel and it was afterwards learned that the third canoe route between Smith Landing and the head of Taltson river reaches the Taltson about 3 miles below its junction with the Tazin and follows the Taltson upstream and thence crosses to Thekulthili lake.

Taltson river was not explored beyond Natalkai falls which are about $1\frac{1}{2}$ miles above the mouth of Tazin river. At Natalkai falls the river falls over a lip of granite into a narrow gorge which is scarcely 40 feet wide. The falls have a drop of 15 feet and are passed by a short portage trail following the southeast side of the river. This trail is well beaten and shows much usage, indicating that this is one of the main routes used by the Caribou Eaters band of Indians.

The rocks on Taltson river about the mouth of Tazin river are the same silicified granites described as occurring at the last portage on Tazin river. The surface is covered to a considerable extent with a mantle of loose glacial material irregularly spread and frequently heaped up in rounded morainal hills. The

locality, therefore, marks the position of a temporary halt in the retreat of the glacial ice sheet from the region.

From the confluence of the Tazin river, the Taltson turns westward and follows the same valley occupied farther east by the Tazin river. After passing through a small lake the river contracts to a rocky narrows, where the same siliceous granite forms the walls. The granite is in places porphyritic, with phenocrysts of pink feldspar often one inch long. This rock occupies both sides of the river for about 6 miles, where, at another constriction, it is seen to be intrusive into gneisses and schists of sedimentary origin.

Glacial striæ on the rocks near the contact have a direction S. 86° W., and indicate that the ice movement had a more northerly trend in that region than in the region about the shores of Athabaska lake. Also glacial drift is more abundant. Accumulations of sand and gravel flank the western slopes of hills in many places and it is noticeable that where the river flows across the course of glacial movement glacial debris has accumulated on the eastern banks of the river while the western banks are bare. The areas underlain by glacial material are easily recognized from a distance by the kinds of trees growing on them, pine and black spruce growing usually on the rocky surfaces, and birch, poplar, white spruce, and pine on the sandy and gravelly surfaces.

The river enters Kozo lake at the southeast end and leaves it about half a mile farther west. The lake is about 2 miles long and extends in a westerly direction. Its shores have recently been swept by fire. Immediately on leaving Kozo lake, the river forms a rapid which, however, is easily navigable. The rocks at the rapid are garnet and mica schists with a strike N. 30° E. The river follows the strike of the rocks and, after flowing for a short distance between low walls of rock, breaks into a second rapid where a portage is made on the west side.

No trail was found at this portage and from here down to Tsu lake there are few indications of Indian travel. The portages all had to be cut and cleared and it was evident that though there had been some travel over this portion of the river

years ago, the route has been abandoned possibly for some chain of lakes to the northeastward.

The trend of the river from Kozo lake to Napie falls is southward passing in the first 2 miles diagonally across the belt of schists and then following the contact of the schists with the granite gneiss.

At Napie falls (Plate XIV) the river makes a spectacular leap of 20 feet over a rock lip into a narrow gorge walled by gneiss on one side and schists on the other and, after turning a sharp bend to the west, cascades over another fall with a drop of 12 feet.

In descending the river at these falls we made two short but difficult portages both on the right hand bank of the stream. There is a longer but easier portage of about half a mile leading across the bend of the river past both falls.

From the bend at Napie falls, the river follows a northwesterly course for about 8 miles through a fairly wide valley, flanked by rocky wooded hills about 100 feet high. The stream, after passing through two expansions, enters a narrow, rocky defile with vertical cliffs of granite on the northeast side and more gentle slopes on the other side. The shape of the valley here is rather characteristic and is the result of the movement of the continental ice sheet across it, plucking and forming a steep cliff on the northeastern side and planing down the other side to a more gentle slope.

Below this defile the stream enters and passes diagonally across Methleka lake, which is about 3 miles or more in length and is elongated in an almost northwest-southeast direction parallel to direction of foliation of the gneiss.

A mile below Methleka lake the river turns sharply through a narrow gap to the west and breaks into a series of rapids which occupy nearly a mile of the river. The total fall in these rapids is only about 15 feet and some of them no doubt are navigable in canoes, but instead of following the main channel it is better to follow an almost abandoned channel of the river on the south side, making three short portages from one small lake to another.

Below these rapids the river is split into several channels by islands and in about 1½ miles drops sharply over a ledge of massive jointed granite gneiss with a fall of 20 feet. A small branch of the river cuts a narrow canyon across the bend on the north side and through this gap a portage of 160 paces is made to avoid the fall. The Chipewyan name Naili is proposed for this fall, a name suggestive of its abruptness (Plate XV).

From the basin below Naili falls the river flows southward down a well-defined valley bordered by short stretches of gravel banks and beaches. It is then deflected through an acute angle to the right by a change in the strike of the rocks and, after breaking into a short riffle, turns again to the southwest.

At the end of the last reach the river divides into several channels about a number of islands. We followed the extreme right hand channel, running a rapid on this with almost a full load in the canoes.

About half a mile below the point where the various channels unite, the river enters one of the wildest and most dangerous portions of its whole course. At what we have called the Twin gorges, the stream divides into two channels, each with high vertical sides cut into the solid gneiss. Each of the channels is a mere cleft in the rock, very narrow, and having a total fall from one end to the other of 90 feet (Plate XVI).

From a small cove at the head of the gorges on the right hand side of the river, an old disused portage trail, 1,100 paces in length, runs through the woods some distance back from the brink of the gorge. At its lower end it makes a very steep and difficult descent to the river below the gorge.

Swift and broken water continues below the portage, finally breaking again over falls and rapids with a total drop of 30 feet. The portage around the last falls and rapids leaves a narrow inlet on the right hand side and runs for 550 paces through a dry and gently sloping valley and strikes the river below all dangerous water.

Below these rapids the character of the river course changes and from an irregular, crooked, and broken stream it becomes straight, regular in outline, and more river-like in appearance. For the next 17 miles or as far as Konth river, its course is almost

straight in a direction N. 35° W. Rocky bluffs are still frequently seen but there is more glacial material covering the surface. The banks are more sloping and the water's edge is fringed with marshy grass and willows. Grassy bays and inlets run in here and there from the main channel. A slight current, too, is always perceptible. The bordering country is more level and not so rocky and patches of boulder clay are more frequently noted on it.

This part of the valley, which is about 125 feet deep, was cut, undoubtedly, in preglacial times.

Wherever the solid rock is exposed it is either a pink granite gneiss containing pink feldspar, quartz, and green hornblende, the strike averaging about N. 15° W., or a coarse-grained, massive granite that appears to be later than, and intrusive into the gneiss. Aplite dykes appear in the gneiss near the contact of the granite as well as some quartz veins, the latter apparently barren of any metallic minerals except a little iron oxide.

Two strong rapids interrupt the navigation of the stream in the stretch extending to Konth river. At the first, called Natla rapids, a stretch of rapid, broken water with a total drop of 15 feet necessitates the making of a portage 570 paces in length on the northeast side of the river. At the other, known as Nende or Long rapids, a portage of 1,900 paces is made on the northeast side to avoid rapids that have a total fall of 45 feet.

The river at Nende rapids is narrow and cut into the gneiss to a depth of 150 feet below the surface of the plateau. The gneiss strikes N. 15° W. or parallel to the river and contains small included bands of basic, highly metamorphosed rock, probably parts of the older Tazin series that have not been completely absorbed by the gneiss. All the surfaces are smoothed and rounded by glacial action and striæ have a bearing, S. 65° W.

A short distance below the portage the stream enters a narrow lake about 2 miles long, at the northern end of which Konth river enters.

Konth river is said to be used by the Indians as a canoe route eastward to the upper part of the Taltson river; and by following it they avoid all the rough and dangerous water on the Taltson river between that point and the Tazin river.

Taltson river leaves the above-mentioned lake by a short rapid too full of rocks and whirlpools to navigate and in consequence a short portage of 40 paces has to be made across a rocky point on the right hand side of the rapid. A mile and a half below this the river enters Tsu lake where recent Indian camps indicate that this is a regularly travelled route.

TSU LAKE.

We reached Tsu lake on August 6 and two days were spent in exploring the shores of the lake, but on account of the many deep bays and islands this was not done at all thoroughly.

From observations taken at a small island about a mile northwest of the river, the latitude of that point was found to be 60° 40′ 44″, and the elevation of the lake, worked out by aneroid, was calculated to be 190 feet below Lake Athabaska and 100 feet above Great Slave lake.

Tsu is the local Indian word for pine and the name Tsu lake was no doubt suggested by the forest of Banksian pine growing on the shores of the lake.

Tsu lake is a very irregular body of water with many islands and several long arms running far to the north and south. Two of these arms cut into the south shore, one of them extending for nearly 8 miles from the middle of the lake. Another arm extends for 7 miles into the north. The extreme length of the lake is 17 miles and the greatest width of the central part about 4 miles.

The lake is a rock basin, with a number of rocky islands, and rocky shores rising steeply to heights of 100 to 150 feet above the water level. The major arms are elongated, not in the direction of glaciation but across it, parallel to the strike of foliation in the gneiss. The shores are usually steep and rocky with, here and there, beaches of sand and gravel. Loose glacial material covers many of the southwest slopes of both the

islands and the shores, that is the slopes facing in the direction of the ice movement.

Judging by the number of old camp sites on the shores of the lake, the Indians frequently visit it, presumably for the purpose of fishing, for the lake is said to abound in whitefish averaging about $1\frac{1}{2}$ pounds in weight.

From a bay at the extreme north end of the lake a trail leads to a chain of small lakes which probably connect with Deskenatlata lake. The route, however, appears to be more frequently used for winter than for summer travel.

Tsu lake has been excavated along a contact between the gneiss and a remnant of the Tazin series of rocks. This remnant may have extended, at a time previous to the Glacial period, over the greater part of the lake basin; but it is now confined to a narrow, highly metamorphosed and disrupted band on the east side of the lake.

The rocks at the entrance to the lake are banded red and black paragneisses containing iron ore, and belonging to the Tazin series. Similar rocks occur on some of the adjacent islands. These rocks are apparently sediments which by the intrusion of the granite have been transformed to gneisses. They contain narrow lenses of specular iron ore, bands of garnetiferous and micaceous rock, and pyroxenite, and are penetrated everywhere by sills and dykes of pink granite. They show bedding and dip to the east at high angles, and are also highly contorted and disturbed. On the west side of the lake these rocks occur in detached lenses and as fragments in the gneiss.

This belt of altered sediments appears to thin out to the south, but to the north it probably expands to a much greater width and is not so metamorphosed. The numerous boulders of grey quartzite and conglomerate found in glacial drift probably originated in an area of these rocks to the east. The iron ore in these rocks is responsible for the erratic behaviour of the compass at certain places on the lake.

The west shore of the lake from end to end is formed of acid hornblende granite gneiss which has a fairly persistent strike, N. 10° W. It is difficult to draw a sharp line of contact between the two series of rocks because of the widespread

injection of the granite gneiss into the sediments. This is particularly true of the western contact of the sediments. The eastern contact may be drawn about half a mile up the river from Tsu lake.

Though glacial erosion has been intense in this region, there is also much more evidence of glacial deposition than there is in the country farther east. Boulder clay is common and is found in most of the depressions. Sand or gravel beaches, too, are frequently seen. The general effect of the passage of the glacier has been to reduce irregularities of the surface and to give more gentle slopes to the hills. Perched boulders are numerous. Plate VI shows one such boulder 22 feet long by 9 feet high, resting insecurely on smaller boulders, on the slope of a hill.

Through Tsu lake the route to the outlet follows the northern side of some large islands to the point which separates the two large southern arms of the lake. From there, the outlet of the river lies southwest, about 3 miles, across the lake.

TALTSON RIVER FROM TSU LAKE TO TETHUL RIVER.

The distance from Tsu lake to Tethul river is a little over 11 miles and the river for this distance keeps a fairly direct course, S. 65° W.

At the outlet of the lake there is an easily navigated rapid and from there the river continues in a northwesterly direction to Shethko falls, about 1½ miles below. There, it falls over a rock ledge through a gap 50 feet wide and drops about 8 feet. Below is a rocky gorge and the river divides about an island, with a fall of about 5 feet.

A portage of 350 paces, made over a rise of 50 feet on the left hand side of the river, avoids both falls. The portage presented evidence of comparatively recent use by the Indians.

The rock at Shethko falls is granite gneiss, slightly foliated and very coarse-grained. At the lip of the fall the rock is glaciated, with striæ showing under the running water. The preservation of striæ at such a spot illustrates the small power of erosion of the stream. The small eroding action of the stream is due no doubt to the purity of the water and to the

absence of sediment resulting from the sedimentation that takes place in Tsu lake.

For the next 8 miles the river is fairly wide, its course is direct, and there are no obstructions to navigation. In this distance the surface of the plateau slopes westward more rapidly than the river, so that while at Shethko falls the surface of the plateau is 100 feet above the river, at the end of the reach it is only about 20 feet above the river, that is to say the slope of the plateau is about 8 feet to the mile westward.

About 2 miles down this reach from Shethko falls the stream contracts and flows with a slightly increased current between high walls of granite. Dangerous whirlpools—of which however, we saw no sign—are said by the Indians to occur at this contraction, which require, according to the natives, complete silence on the part of those passing through, otherwise there is danger of being engulfed in the waters and being drowned. We passed through in ignorance of the supposed danger we were incurring and it is hard to imagine that any danger ever exists.

A small stream enters from the northwest about 3 miles above Tethul river, and $1\frac{1}{2}$ miles below that is a rapid which, however, does not necessitate a portage.

Below the rapid the river is divided by low, rocky islands into several channels, each with a strong rapid or fall. Our course followed the middle channel where, at a steep chute, a portage of 100 yards was made over the bare rock on the right hand side of the stream. At this point the stream falls 20 feet into a large basin which also receives another branch of Taltson river. Tethul river debouches into the southern end of the same basin by a strong shallow rapid. The other branches of Taltson river enter about a mile below.

Tethul, or Hanging Ice river is said to rise a short distance northeast of Smith Landing and to flow almost parallel with Slave river to its junction with the Taltson. It is said to be occasionally used by the Indians as a canoe route from Taltson river to Slave river.

The prevailing type of rock between Tsu lake and Tethul river is a red granite containing red and white feldspar, quartz, and green hornblende. It is massive and shows no foliation and

is the younger granite which penetrates the gneiss over the greater part of the region. This granite extends from 2 miles below Shethko falls down to the rapids at Tethul river where it is in contact with a somewhat contorted gneiss.

TALTSON RIVER FROM TETHUL RIVER TO PIERROT CREEK.

At Tethul river the character of Taltson river and of the adjacent country changes radically. Above this point the river is more or less like a chain of lakes connected by short stretches of swift or broken water. The valley is in many places ill defined, the shore-lines irregular, and the grade of the stream very uneven, and there are long stretches of dead water, separated from each other by rapids or falls. From Tethul river down, however, the valley is well defined, the stream of a fairly uniform width and regular in its shore-lines, and there is generally a very perceptible current. Rapids still occur here and there, making portages necessary.

In this lower part of the valley, also, the country adjacent to the river becomes more level; there are fewer outcrops of the solid rocks, and a larger proportion of the country is covered with soil and unconsolidated surface material. This is due partly to glacial deposition of material and partly to the Taltson river entering a region that received material deposited either in an ancient arm of Great Slave lake or in times of flood by the Slave river at a period directly following the retreat of the continental ice sheet. Into this surface material Taltson river occasionally cuts and exposes sections of sand and silt.

The change in the geological conditions of the country is reflected in the forest growth, for whereas Banksian pine and spruce were the principal trees above Tethul river, there are now besides these trees, poplar, birch, and willows.

From Tethul river down to the head of the large island where the stream divides to flow into Deskenatlata lake, is a distance of 11 miles and the general course of the stream is almost north. In this distance the stream has an average width of about 600 feet, its banks of mud or sand are about 8 feet high, and the shores are often fringed with grass. There are

only occasional isolated outcrops of granite gneiss striking parallel to the course of the river. Deserted Indian camps on the banks of the stream indicate that the natives frequent this part of the river for the purpose of fishing.

At the head of the large island the stream divides, the eastern branch, which is the main stream, flowing northeast to Deskenatlata lake and from there westward to join the eastern branch about 9 miles below.

The eastern branch was not explored, for the shorter and regular route down the river is by way of the western branch. Deskenatlata lake, however, is said to be a narrow lake about 20 miles long receiving the waters of a couple of streams which are used by the Indians as canoe routes to the east.

Our route lay down the western branch of the river, which is a small sluggish stream with low banks but a fairly direct course. Granite gneiss outcrops on this branch in three or four places only.

Eight miles down this branch is a short rapid where a portage of 40 paces has to be made over a low point of rock to avoid a fall of 3 feet. The rock here is a coarse-grained porphyritic granite with glacial striæ running S. 61° W. At this portage a sextant observation on the sun gave a latitude of 60° 47′ 51″ and a compass variation of 38° 30′ east.

A mile below the portage one of the branches of the eastern channel enters from the east and 2 miles farther on a second branch enters. The Indian canoe route is here said to follow the second branch of the eastern channel, but not knowing this we continued down the western channel which we soon found was interrupted by a series of rapids.

The first of these rapids is easily navigable, but the second has a greater fall and a portage of about 100 paces had to be made on the southwest side. The third rapid is longer and shallow, but after picking out a course through it we were able to get through safely without making any portage.

Immediately below the third rapid the third branch of the eastern channel enters and the river regains its normal width and character with a uniform current of about $1\frac{1}{2}$ miles per hour. The banks continue low and the surrounding country

is scarcely more than 20 feet above the river. Outcrops of rock are rare and they are mainly of the coarse-grained, massive granite which here and there contains inclusions of the older granite gneiss.

Three-quarters of a mile below Frog island, a small insignificant islet, the river again divides into two branches, the right branch continuing northward and the left branch turning to the southwest. The two branches unite some miles below after encompassing an island about 7 miles in length and possibly a couple of miles in width.

The left branch of the river is about 11 miles in length and it makes a wide turn to the west. It has an average width of 500 feet and flows at a rate of $1\frac{1}{2}$ miles per hour through a low, level, and partly marshy country, wooded with poplar, spruce, willow, birch, and tamarack. There are no outcrops of solid rock except at a small island near the head of the large island and at the rapid near the junction of the two branches. These outcrops are of coarse-grained, reddish granite, which at the rapid is associated with and transitional into a grey granite.

The rapid presents no difficulties to navigation by canoe.

A broad expansion with marshy shores succeeds the rapid and at the lower end the stream is divided by a number of rocky islands of granite, through which the water flows with a slightly increased current until it finally plunges over the smoothly glaciated granite in a series of steep chutes with a fall of about 15 feet. The chutes are known to the Indians as Oracha or Pelican chutes. They are impossible to navigate and in consequence it is necessary to make a portage of 100 paces on the south side of the river (Plate XVII).

At Oracha chutes on August 13, we met Indians for the first time since leaving Chipewyan on Lake Athabaska and they were so surprised at seeing us that it was with difficulty they were persuaded to approach. We obtained a great deal of information from them relative to the names of many of the places we had passed and about the various routes of travel throughout the region.

The river falls into an oval basin at Oracha chutes and from there flows a little east of north for a mile. Passing around a

long island it turns westward and falls again in a series of steps with a total drop of 10 feet. From the right hand side near the head of the falls, a portage trail of 200 paces runs through the woods to a back channel of the river.

The river is there split into a number of channels by rocky islands of coarse-grained, reddish granite. The granite is frequently porphyritic and holds phenocrysts of feldspar up to $1\frac{1}{2}$ inches long.

The canoe route continues down the right hand channel and in three-quarters of a mile another portage of 100 paces is necessary to avoid a small fall of about 3 feet.

This is the last portage on the river; below it the river is navigable by steamboats from Great Slave lake, a distance of 23 miles. About a mile below the last portage Pierrot creek enters from the west, and on the north side of this is a group of Indian houses occupied by Pierre Pierrot and some of his relatives, all of whom trade at Resolution. Here we found an encampment of Indians of eight families living entirely by hunting and fishing, and while there is no doubt that they could grow vegetables successfully in the clearing about their houses they make no attempt to do so.

We reached Pierrot creek on August 13 and were delayed there a day by rain and bad weather.

TALTSON RIVER FROM PIERROT CREEK TO GREAT SLAVE LAKE.

The distance from Pierrot creek to the mouth of Taltson river is about 23 miles and the river flows almost due north in a fairly direct course.

Pierrot creek marks the boundary to an entirely different type of country from that through which the river flows above that point. From there down to Great Slave lake the river flows through a level country in which there are very few outcrops of the solid rocks. Sections exposed on the banks of the river show fine, interstratified sands and silts without any coarse material associated with them. This material appears to have been deposited by Slave river as a delta deposit on the shores of Great Slave lake at a time when that lake stood at a

slightly higher level than it does to-day. Deposition of material over this region from that source has now ceased and the Taltson river is engaged in cutting a channel for itself in it and carrying the material down to the mouth of the river where it is very slowly building a delta of its own.

It is probable that this old delta of Slave river did not extend much farther eastward than Taltson river; for, in that direction, one soon passes out of the level country into a rough, rocky region where the solid rocks are exposed at the surface.

A short distance below Pierrot creek, where the river is all confined to one channel, the stream has a width of 360 feet and an average rate of flow of a little more than one mile per hour. The greatest depth, in a cross section of the river, is 35 feet and the average depth for the whole width of the river is 23 feet.

A rough measurement of the volume of the river at this point, taken on August 14, gave a discharge of about 11,000 cubic feet per second. This figure, as well as those given in a previous page for the discharge at the junction of the Tazin and Taltson rivers, is probably more correct than those given in the Summary Report (1914) on this region which does not allow for a one-fifth reduction for surface flow.

About 2 miles below Pierrot creek, the stream divides, a small channel known as Snuff channel branching off to the east. This channel does not rejoin the main stream but flows directly into Great Slave lake a short distance east of the main outlet.

The banks of the river which, at Pierrot creek, are about 20 feet high, become gradually lower towards the mouth. They are wooded with spruce and poplar in the upper reaches and with willows and alders lower down. The shores are fringed with grass and at the mouth there is a large marsh through which the river flows by several channels.

The current is not strong but here and there it is of sufficient strength to cut into the banks and expose sections of the sands and silts of which the surrounding country is made up.

Rock outcrops are rare. A few occur on the banks of the stream, and most of the islands have outcrops at their upper ends. The rock, wherever exposed, is a coarse-grained, reddish

granite, sometimes porphyritic, carrying pink and white feldspars, quartz, greenish hornblende, and some biotite.

A mile and a half from its mouth the stream again divides into two branches and, farther on, each of these sends off several other branches to form a marshy delta.

Snuff channel and the branch of the stream that we followed empty into a deep bay which is almost cut off from the main body of Great Slave lake by a chain of islands lying 1½ miles off shore (Plate XVIII). The western side of this bay is low and marshy, but the eastern side is higher, very rocky, and composed of a coarse-grained reddish granite with a rudely foliated structure.

The rocks on the islands lying off the mouth of the river consist of banded gneisses, presumably paragneisses, cut by dykes of the coarse reddish granite of the mainland. These paragneisses are highly metamorphosed and form the southwestern extremity of a band of sedimentary rocks that extend northeastward along the lake shore for several miles. In that direction the band is traversed by a number of bedded quartz veins, the largest noted being about 2 feet wide. The quartz contains some iron oxide, but the veins do not appear to be of much importance economically.

We reached Great Slave lake on the evening of August 15, having taken a month and a half in the traverse from Lake Athabaska. We camped for three days on the northeast end of an island that lies 2 miles north of the mouth of the river, and during this time sextant observations were taken for latitude and compass variation. A mean of two observations at this point gave a latitude of 61° 26′ 28″, while the variation of the compass proved to be 43 degrees east.

GREAT SLAVE LAKE FROM TALTSON RIVER TO RESOLUTION.

The distance from the mouth of Taltson river to Resolution is about 50 miles and the canoe route follows the shore of Great Slave lake past Stone island and into one of the eastern channels of the delta of Slave river. Ascending this

channel the route crosses the main channel and descends one of the western channels known as Mission channel past the Roman Catholic Mission sawmill, and thence into a deep bay behind the point on which Resolution stands. Crossing this bay the canoe route passes through the channel separating Mission island from the mainland and from there Resolution can be seen on a point about 1½ miles to the east.

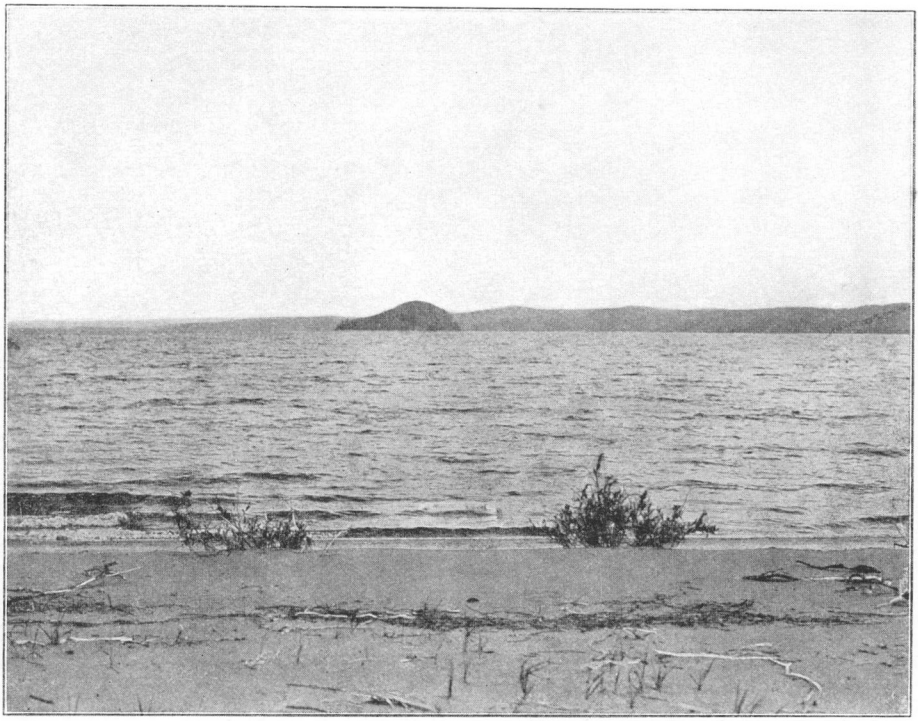
The shore of Great Slave lake between Taltson river and the mouth of Slave river is low and flat and lined with a great quantity of driftwood brought down by Slave river. The shores are muddy and in places sandy and the solid rocks outcrop only at Rocky point and Stone island. At the former place a low range of hills composed of red granite gneiss runs down to the lake shore, while at Stone island and on the adjacent shore the rock is a conglomerate containing pebbles of quartz, jasper, schist, and granite, tightly cemented in a fine-grained, greenish sand matrix. The rock breaks across the pebbles and is cut by small dykes of granite. Glacial striæ on its surface strike S. 57° W. The compass variation is here 37 degrees east.

A number of log houses at Stone island are occupied by Indians and a fur trader, and the Roman Catholic Mission makes a fishery here in the autumn for whitefish and inconnu.

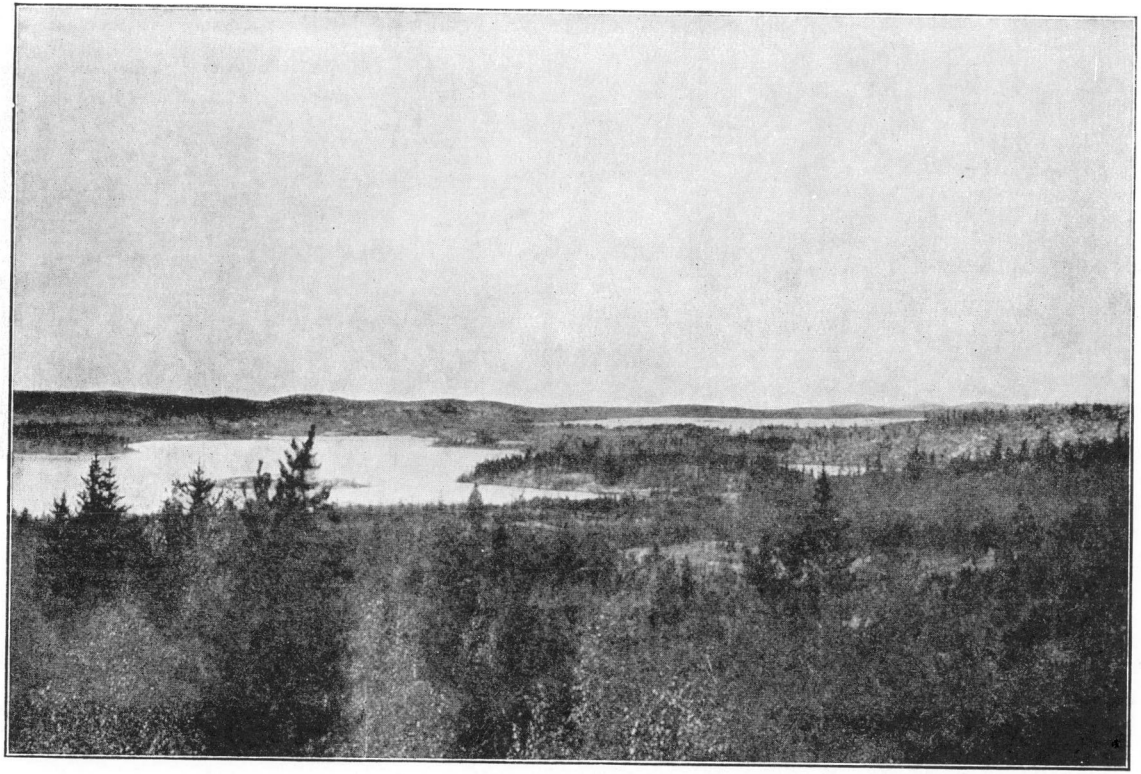
West of Stone island the modern delta of Slave river is rapidly being built out into the lake by the sediment carried down by the river. The river spreads out into a great number of channels across a width in a straight line of about 11 miles from the mouth of the easternmost channel to the mouth of the extreme western channel.

We reached Resolution on August 21, and after spending ten days in the examination of certain lead-zinc deposits west of Resolution and collecting a number of fossils from the Devonian limestones exposed on the shores of the lake near that point, the return journey to Edmonton by way of Slave and Athabaska rivers was begun on September 1. Athabaska was reached on October 10, and Ottawa October 18.

PLATE I.

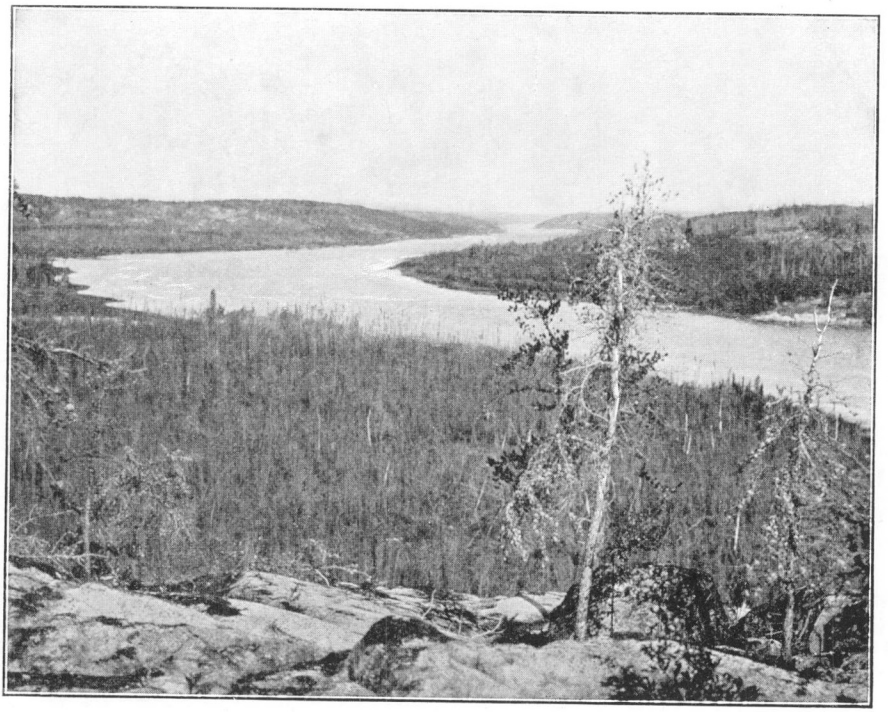


Hill Island lake, near the point where Samuel Hearne is supposed to have crossed in the winter of 1772 on his return journey to Hudson bay after his expedition to Coppermine river. (Page 8.)



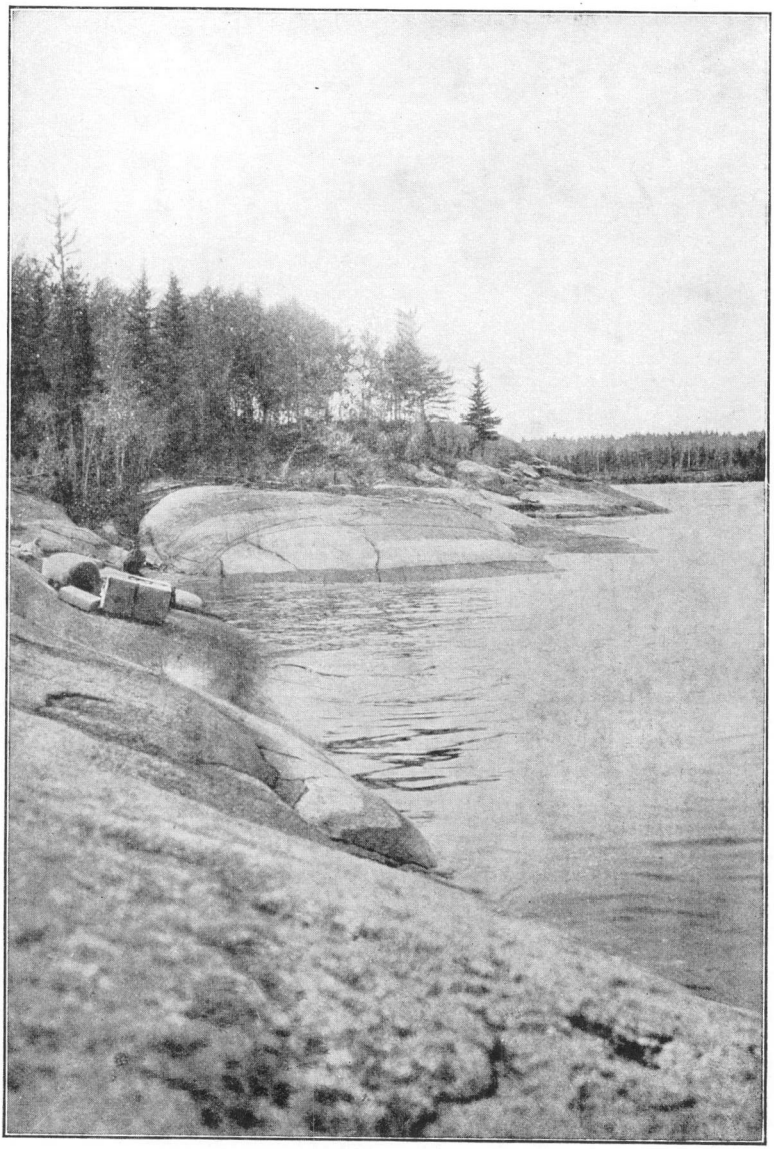
A typical view of the country drained by the Tazin and Taltson rivers. (Page 16.)

PLATE III.



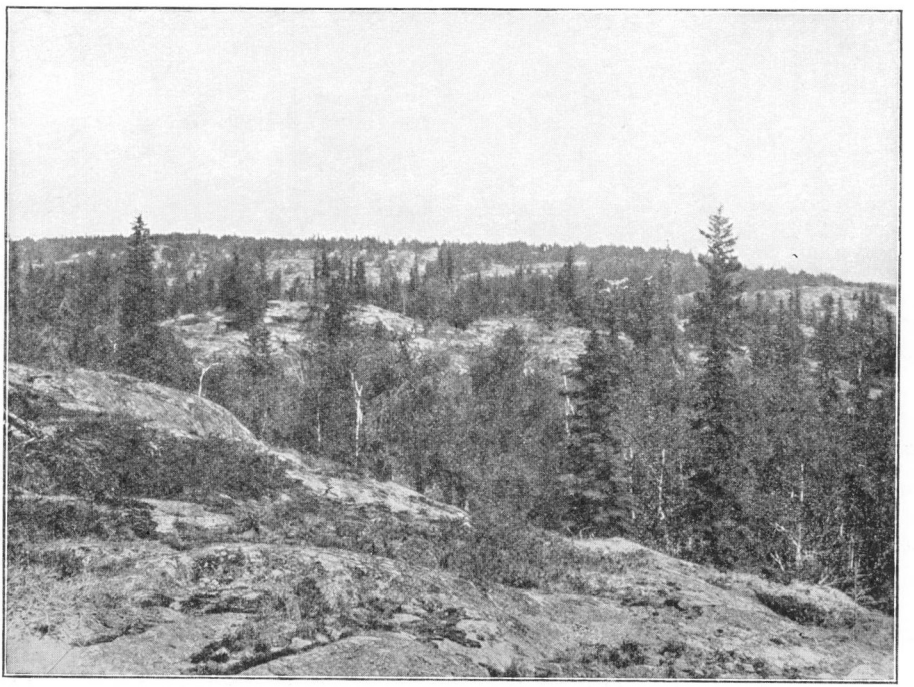
Taltson river between the Twin gorges and Natla rapids, a portion of the river where the valley is regular and well defined. (Page 17.)

PLATE IV.



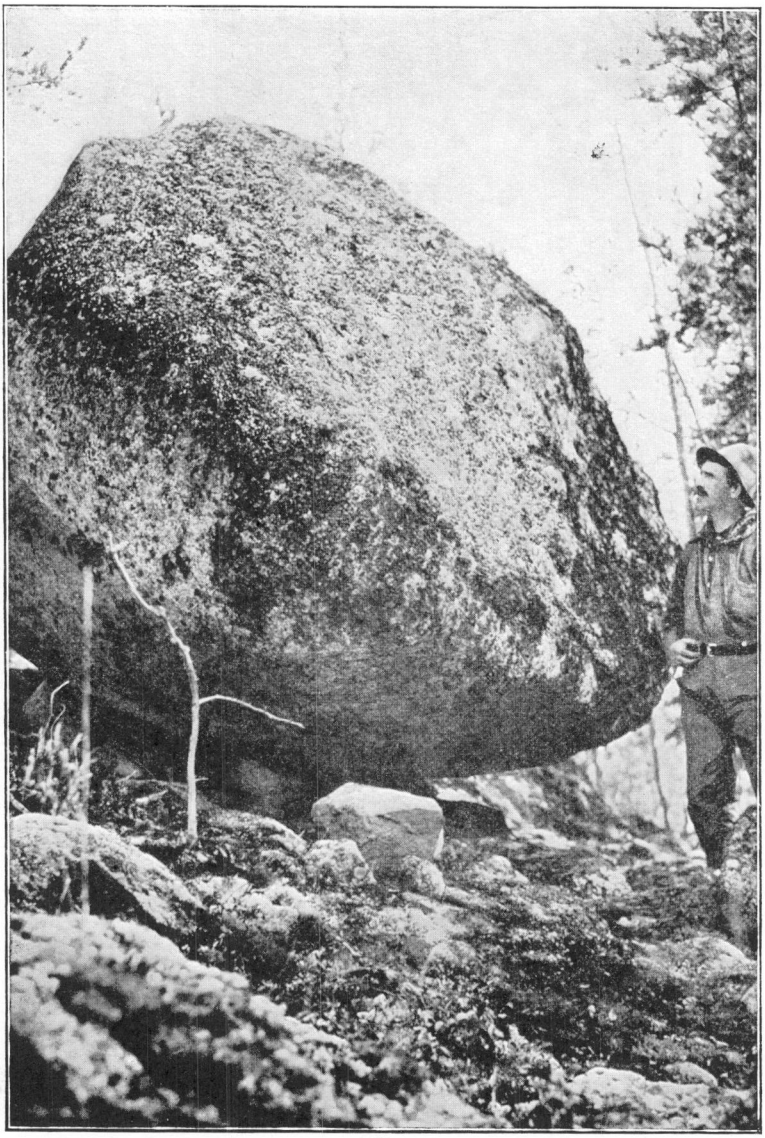
Typical shore-line of the lakes of Taltson River basin showing rocky, glaciated shores with no beaches. (Page 18.)

PLATE V.



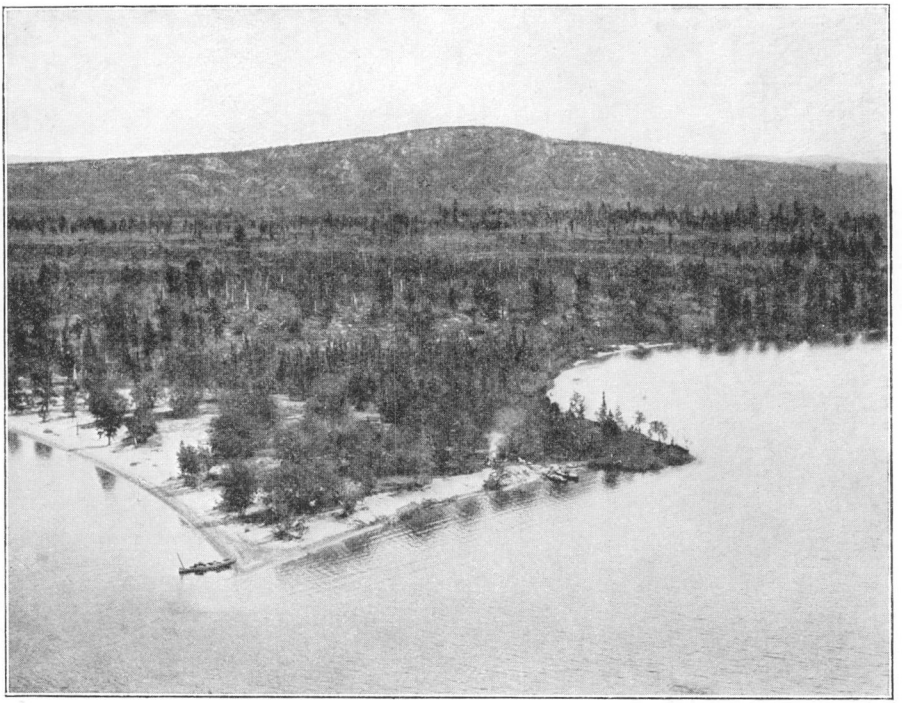
View showing the rocky, sparsely timbered character of the surface of the region and illustrating the general absence of soil. (Page 21.)

PLATE VI.



A glacial erratic 22 feet long by 9 feet high by 10 feet wide, insecurely perched on some smaller boulders on the slope of a hill at Tsu lake. (Page 39.)

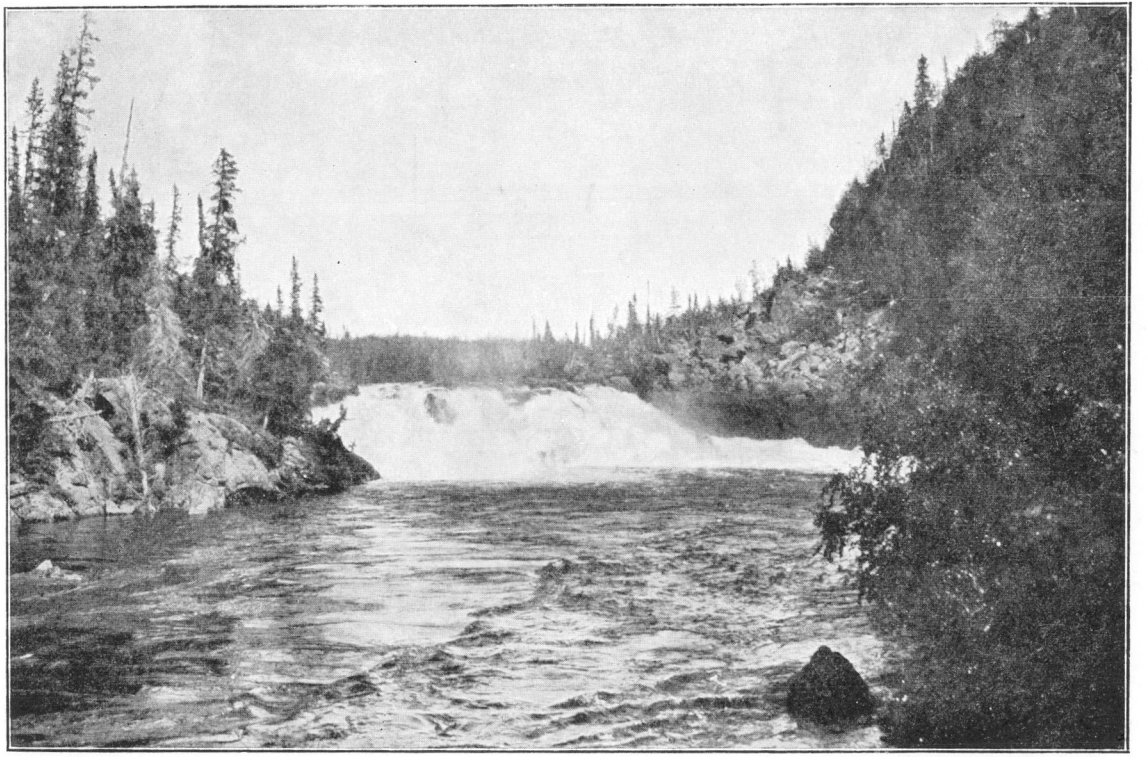
PLATE VII.



Sand-spit on Thainka lake with a glacial sand-plain in the background from which the material was derived to build the spit. (Page 41.)

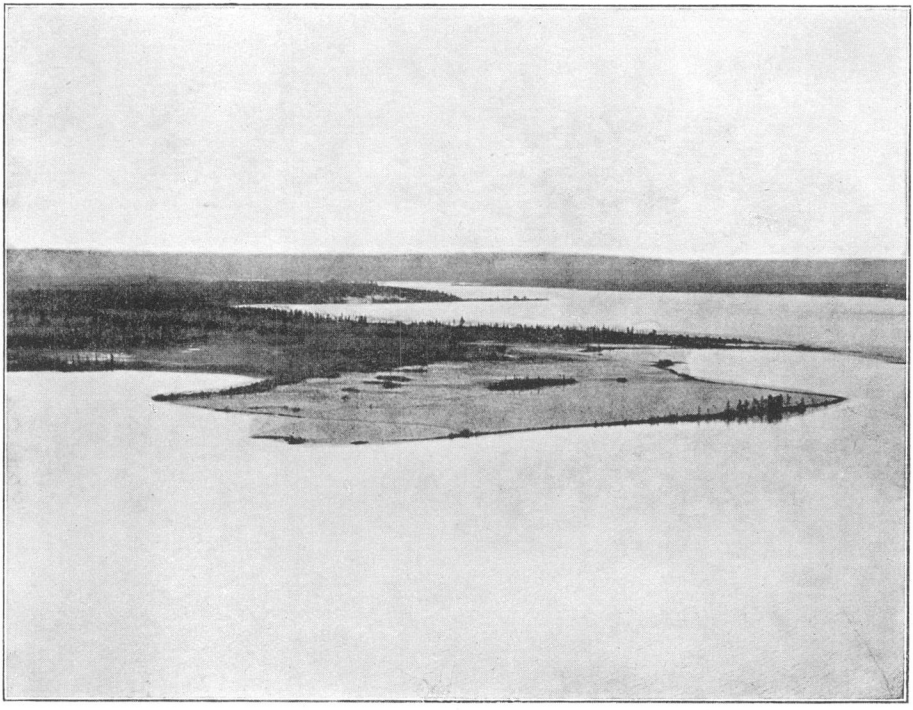
PLATE VIII.

Thluicho lake, looking north from the portage at the south end. (Page 46.)



Teseljiri falls on Tazin river. (Page 51.)

PLATE X.

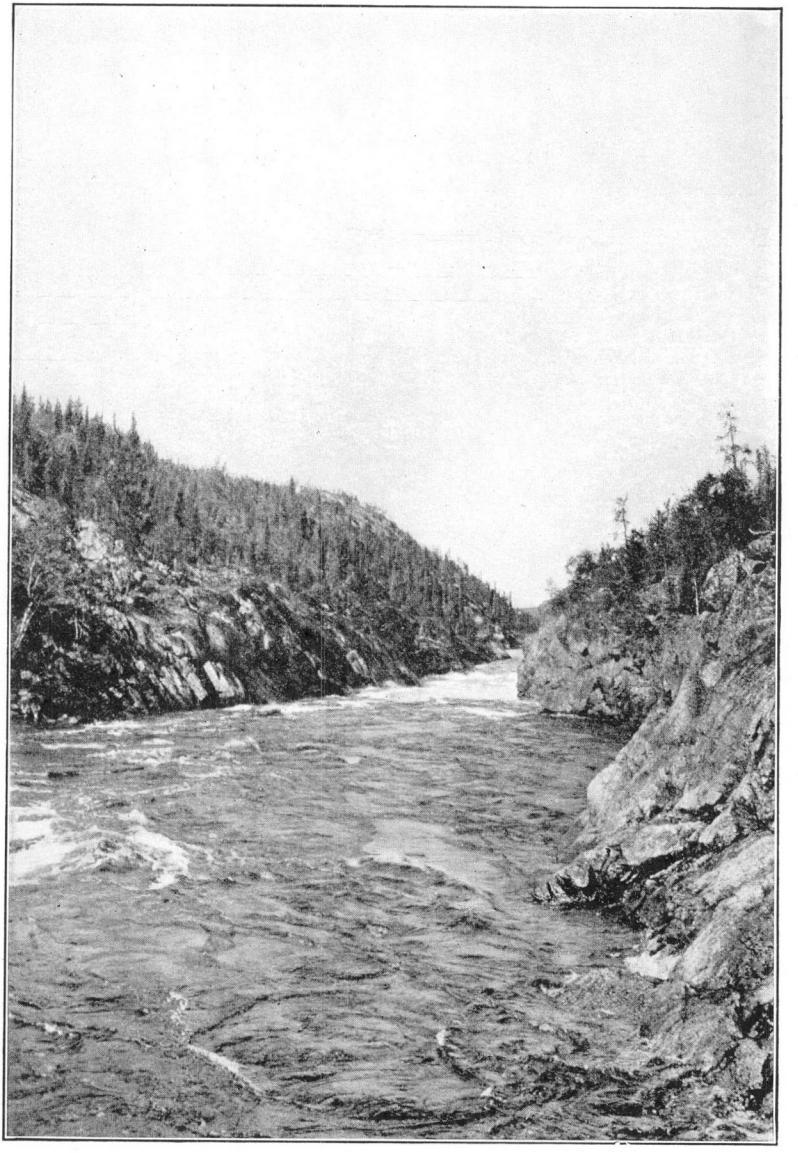


Thainka lake, showing the outline of a sand-spit in process of formation by wind and water action. (Page 52.)

General view of the plateau at the northern end of Hill Island lake. (Page 57.)

Nettell falls on Tazin river. (Page 66.)

PLATE XIII.

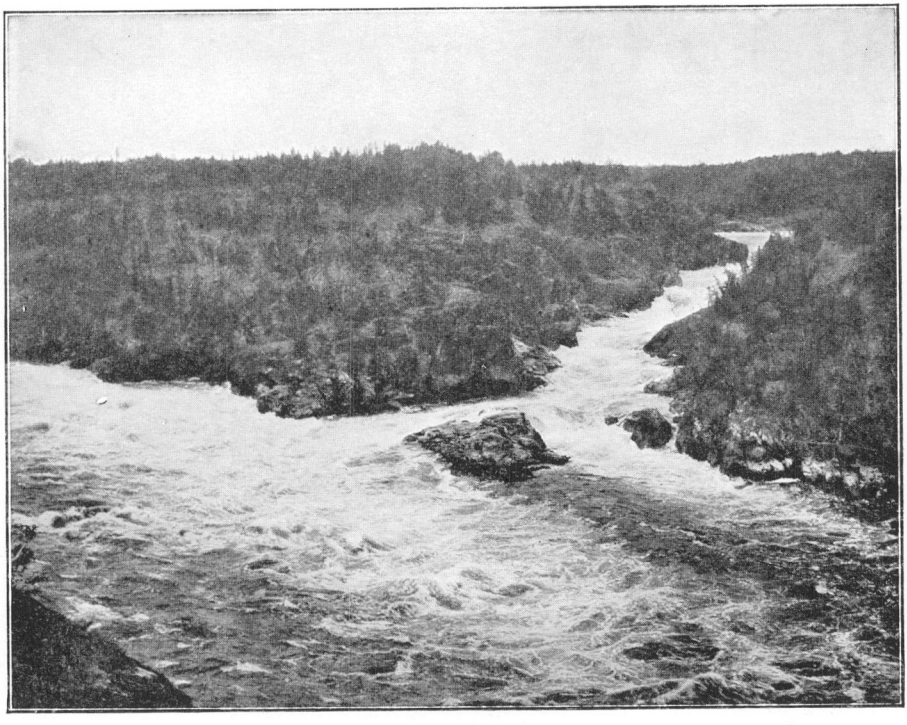


Looking down Tthikethe gorge, one of the constrictions of Tazin river. (Page 67.)

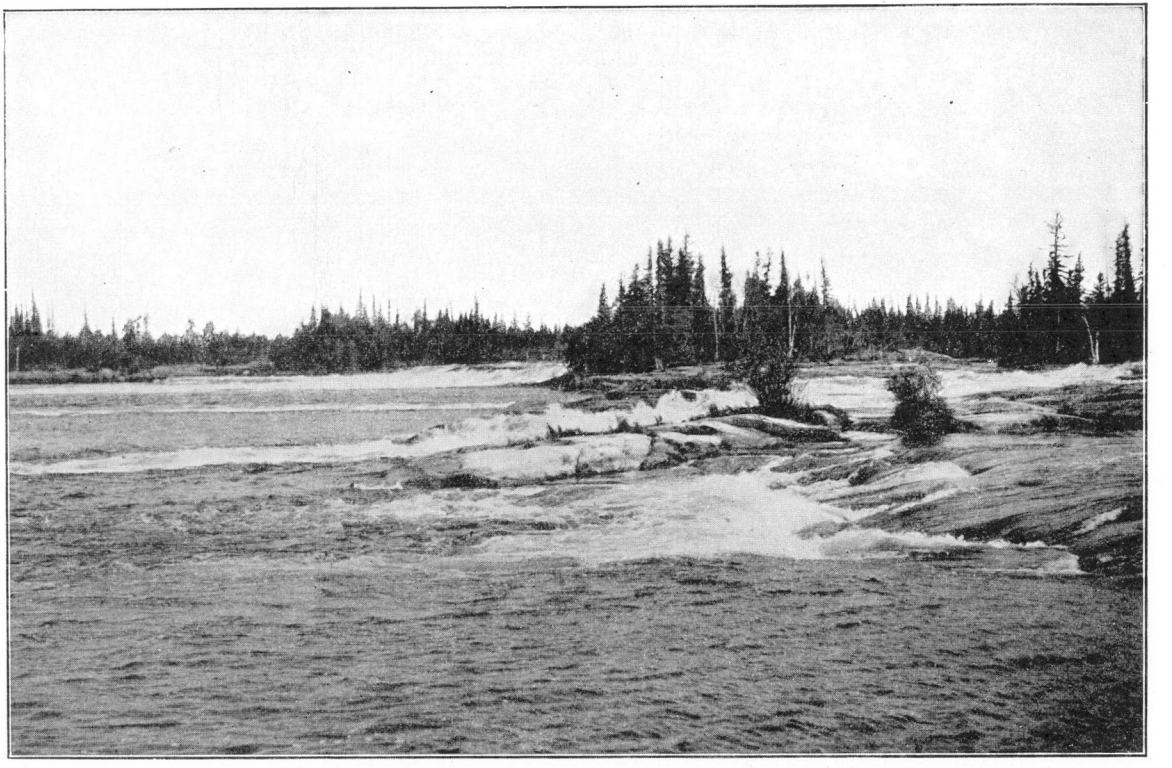
Napie falls on Taltson river. (Page 70.)

Naili falls on Taltson river. (Page 71.)

PLATE XVI.

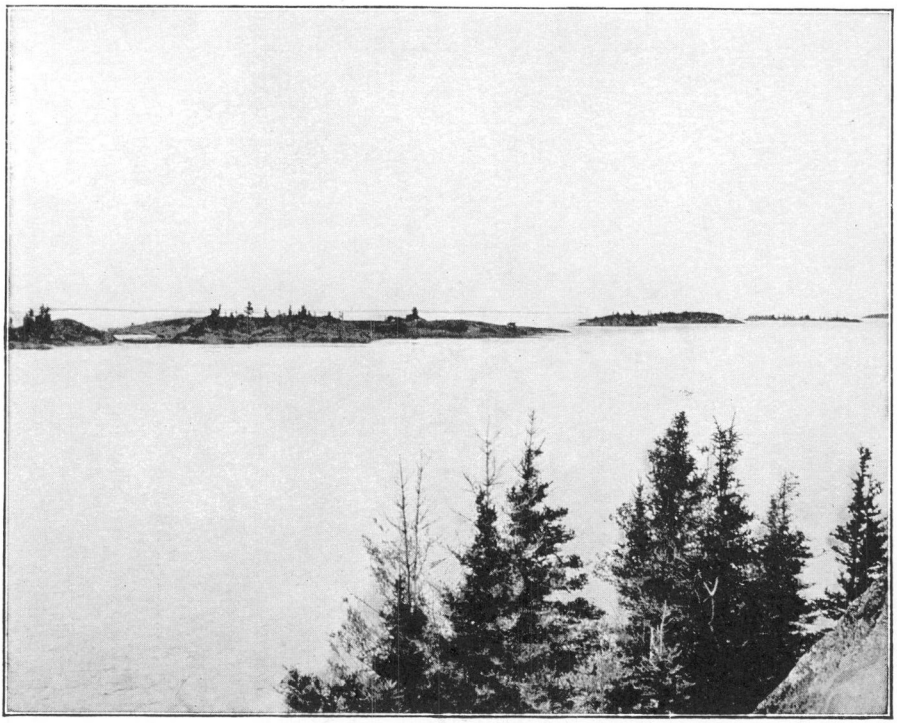


The Twin Gorges, Taltson river. (Page 71.)



Oracha chutes on Taltson river. (Page 79.)

PLATE XVIII.



Chain of small rocky islands on Great Slave lake at the mouth of Taltson river. (Page 82.)

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PUBLICATIONS OF THE GEOLOGICAL SURVEY.

The Geological Survey was established in 1842 and "Reports of Progress" were issued, generally in annual volumes, from that date to 1885, the first report being that for the year 1843 published in 1845. Beginning with the year 1885, "Annual Reports" (new series) were published in volumes until 1905, the last being Vol. XVI, 1904. Many of the individual reports and maps published before 1905 were issued separately and from 1905 to the present, all have been published as separates and no annual volume has been issued. Since 1910, the reports have been issued as Memoirs and Museum Bulletins, each subdivided into series, thus:—

Memoir 41, *Geological Series 38.*
Memoir 54, *Biological Series 2.*
Museum Bulletin 5, *Geological Series 21.*
Museum Bulletin 6, *Anthropological Series 3.*

In addition to the publications specified above, a Summary Report is issued annually; and miscellaneous publications of various kinds including Reports of Explorations, Guide Books, etc., have been issued from time to time.

Publications Issued 1910-1915 Inclusive.

MEMOIRS.

MEMOIR 1. *Geological Series 1.* Geology of the Nipigon basin, Ontario, 1910—by Alfred W. G. Wilson.

MEMOIR 2. *Geological Series 2.* Geology and ore deposits of Hedley mining district, British Columbia, 1910—by Charles Camsell.

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MEMOIR 24. *Geological Series 16.* Preliminary report on the clay and shale deposits of the western provinces, 1912—by Heinrich Ries and Joseph Keele.

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MEMOIR 82. *Geological Series 68.* Rainy River district, Ontario. Surficial geology and soils, 1915—by W. A. Johnston.

MUSEUM BULLETINS.

The Museum Bulletins, published by the Geological Survey, are numbered consecutively and are given a series number in addition, thus: Geological Series No. 1, 2, 3, etc.; Biological Series No. 1, 2, 3, etc.; Anthropological Series No. 1, 2, 3, etc.

In the case of Bulletins 1 and 2, which contain articles on various subjects, each article has been assigned a separate series number.

The first Bulletin was entitled *Victoria Memorial Museum Bulletin;* subsequent issues have been called *Museum Bulletins.*

MUS. BULL. 1. *Geological Series 1.* The Trenton crinoid, Ottawacrinus, (*Issued 1913*). W. R. Billings—by F. A. Bather.

Geological Series 2. Note on Merocrinus, Walcott—by F. A. Bather.

Geological Series 3. The occurrence of Helodont teeth at Roche-Miette and vicinity, Alberta—by L. M. Lambe.

Geological Series 4. Notes on Cyclocystoides—by P. E. Raymond.

Geological Series 5. Notes on some new and old Trilobites in the Victoria Memorial Museum—by P. E. Raymond.

Geological Series 6. Description of some new Asaphidæ—by P. E. Raymond.

Geological Series 7. Two new species of Tetradium—by P. E. Raymond.

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Geological Series 10. A new genus of dicotyledonous plant from the Tertiary of Kettle river, British Columbia—by W. J. Wilson.

Geological Series 11. A new species of Lepidostrobus—by W. J. Wilson.

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UNCLASSIFIED.

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A reconnaissance across the Mackenize mountains on the Pelly, Ross, and Gravel rivers, Yukon and North West Territories, 1910—by Joseph Keele.

Summary Report for the calendar year 1909, issued 1910.

Report on a traverse through the southern part of the North West Territories, from Lac Seul to Cat lake, in 1902, issued 1911—by Alfred W. G. Wilson.

Report on a part of the North West Territories drained by the Winisk and Upper Attawapiskat rivers, 1911—by W. McInnes.

Report on the geology of an area adjoining the east side of Lake Timiskaming, 1911—by Morley E. Wilson.

Summary Report for the calendar year 1910, issued 1911.

Summary Report for the calendar year 1911, issued 1912.

Guide Book No. 1. Excursions in eastern Quebec and the Maritime Provinces, parts 1 and 2, 1913.

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Guide Book No. 9. Toronto to Victoria and return via Canadian Pacific, Grand Trunk Pacific, and National Transcontinental railways, 1913.

Guide Book No. 10. Excursions in northern British Columbia and Yukon Territory and along the north Pacific coast, 1913.

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Prospector's Handbook No. 1. Notes on radium-bearing minerals, 1914—by Wyatt Malcolm.

The archæological collection from the southern interior of British Columbia,1914—by Harlan I. Smith.

Summary Report for the calendar year 1913, issued 1915.

Summary Report for the calendar year 1914, issued 1915.