GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA
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REPORT

ON AN EXPLORATION IN THE

YUKON DISTRICT, N.W.T.,

AND

ADJACENT NORTHERN PORTION OF

BRITISH COLUMBIA.

1887.

BY

GEORGE M. DAWSON, D.S., F.G.S.

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Introductory.

Yukon Expedition.

The Yukon expedition, to which the present report relates, was undertaken for the purpose of gaining information on the vast and hitherto almost unknown tract of country which forms the extreme north-westerly portion of the North-west Territory. This tract is bounded to the south by the northern line of the Province of British Columbia (Lat. 60°), to the west by the eastern line of the United-States territory of Alaska, to the east by the Rocky Mountain Ranges and 136th meridian, and to the north by the Arctic Ocean. The region thus generally defined is referred to as the Yukon district, this name being rendered appropriate from the fact that the greater part of its area lies within the drainage-basin of the river of that name.

Yukon district.

Area of Yukon district.

The Yukon district, as above defined, has a total area of approximately 192,000 square miles, of which, according to the most recent information, 150,768 square miles is included in the watershed of the Yukon. The superficial extent of the district may perhaps best be realized when it is stated that it is nearly equal to that of France, greater than the United Kingdom by 71,100 square miles, ten times the area of the province of Nova Scotia, or nearly three times that of the New England States. It is unnecessary to add that the present report must be considered merely as a first contribution to our knowledge of this wide country.

Purpose of the Expedition.

The immediate necessity for the exploratory and surveying work undertaken by the expedition, arose from the fact that somewhat important developments of placer gold-mining had of late been attracting a yearly increasing number of miners and prospectors into a portion of the district in question; and the work decided on, included the preliminary determination of the point at which the Yukon or Pelly River crosses the 141st meridian, which here constitutes the boundary between the North-west Territory and Alaska.

Organization.

The writer was placed in general charge of the expedition, with Mr. R. G. McConnell, B.A., and Mr. J. McEvoy, B.Ap.Sc., also of the Geological Survey, as assistants, while Mr. W. Ogilvie, D.L.S., was intrusted with the conduct of instrumental measurement and the astronomical work in connection with the determination of the position of the 141st meridian.

Work by Mr. Ogilvie.

In consequence of information gained from persons having some knowledge of the region to be traversed, it was decided that Mr. Ogilvie should carry out an instrumentally measured traverse of the route from the head of Lynn Canal to the Lewes and along the line of the river to the 141st meridian, where he was to make arrangements for wintering, and in the spring and summer of 1888 continue his surveys north-eastward to the Mackenzie River and up that river to connect with previously surveyed lines on Athabasca Lake.

Work by the writer.

Having ascertained that there was a fair probability of his being able to carry a line of survey and exploration from the Cassiar district in northern British Columbia, by way of the Upper Liard and across the height of land to the Yukon basin, the writer decided on attempting that route, which, though known to be difficult, appeared to offer, in conjunction with Mr. Ogilvie's work, the best opportunity of adding to our knowledge of the country as a whole.

Work by Mr. McConnell

Mr. McConnell was entrusted, in the first instance, with the instrumental measurement of the Stikine River, from the point to which surveys had previously been carried, as far as the head of navigation, and subsequently, with the exploration of the lower portion of the Liard River; the original intention being that he should return after reaching the Mackenzie, in the autumn of 1887, by the ordinary trade route up that river. Before we finally separated from Mr. McConnell,

Change of plan.

at the confluence of the Dease and Liard, however, so many unexpected delays had occurred, that it was considered advisable to instruct Mr. McConnell to endeavour to make arrangements for passing the winter of 1887-88 on the Mackenzie, and subsequently to descend the Mackenzie, cross the northern extremity of the Rocky Mountains to the Porcupine River, and by following that river and ascending the Lewes, to return to the Pacific Coast at Lynn Canal. This arrangement further

provided for the examination of a great additional region of which the geological structure was altogether unknown. Mr. McConnell has since successfully completed the arduous journey thus outlined. Reports. preliminary report of his work, as far as the mouth of the Liard, [redacted] given in conjunction with that of the writer, in Part III, Annual Report of the Department of the Interior, 1887. A progress report of Mr. Ogilvie's work forms a portion of Part II of the same volume.

The present report relates exclusively to the exploration by the writer in 1887, with the following exceptions:—(1.) Mr. McConnell's traverse and geological observations on a portion of the Stikine are included in the description of that river and are incorporated on the accompanying map. (2.) The Lewes River, as laid down on the map, (with the exception of the mountain features in its vicinity and some additions to the outlines of the lakes), is from the survey of Mr. W. Ogilvie. The results of Mr. McConnell's work, carried out after his separation from us at the mouth of the Dease, will form the subject of a separate report of the Geological Survey, and Mr. Ogilvie will also prepare an independent report of his survey on his return. The present report.

In order to present within a reasonable compass the results of the portion of the work of the expedition here reported on, the daily record of progress, which the unknown character of the country traversed might otherwise appear to warrant, has been discarded, and but slight allusion is made to the modes of travel adopted and the numerous vicissitudes encountered during our journey. This, while resulting in the loss of interest which a connected narrative might possess, has distinct advantages in other respects. On account of the extent of the region treated of, the descriptive portion of the report has been divided into separate chapters, each treating of a distinct portion of our route and constituting practically a separate short report. In the pages immediately following this introduction, some general notes on the region as a whole, are given. Arrangement of matter.

Summary of Proceedings.

The following summary of our proceedings in connection with the expedition is substantially the same as that given in my preliminary report before alluded to.— Journey to Stikine.

We left Ottawa on the 22nd of April, 1887, travelling by the Canadian Pacific Railway to Victoria, but, in consequence of irregularity in the sailing dates of the Alaskan mail steamers, were unable to reach Wrangell, at the mouth of the Stikine River, where our work may have said to have begun, till the 18th of May. Here Mr. McConnell stayed behind, for the purpose of getting Indians and canoes to enable him to make a micrometer survey of the Stikine from the end of the

line measured by Mr. J. Hunter in 1877, to Telegraph Creek, while I proceeded up the river by the first steamer of the season to Telegraph Creek, the head of navigation. From this place, goods are carried by pack animals to Dease Lake, the centre of the Cassiar mining district; and here again a delay of several days occurred, as the animals had not been brought in from their range or shod for the season's work at the date of our arrival. Finally, on June 5th, we reached the head of Dease Lake, and found the greater part of the lake still covered with ice. It was not till the 9th that we were able to reach the point on the shore near Laketon at which two men, previously sent on in advance with an Indian packer, were sawing lumber for boats. Seven days were here busily employed in this work and in constructing three boats for the purposes of the expedition. On the evening of the 16th, a strong wind having broken up the remaining barrier of ice, we reached Laketon with our boats, Mr. McConnell, with a crew of five Coast Indians intended for my work on the Upper Liard, having meanwhile joined us. On the 18th, having completed our supplies and outfit at Laketon, we left that place, and on the 23rd reached the "Lower Post" at the confluence of the Dease and Liard Rivers. Here Mr. McConnell, with one boat and two men, separated from us for the purpose of surveying and geologically examining the Lower Liard.

Journey to Dease Lake.

Building boats.

Departure from Dease Lake.

Personnel of parties.

On leaving the confluence of the Dease and Liard, my own party included, besides myself, Mr. McEvoy, Messrs. L. Lewis and D. Johnson, engaged at Victoria, two Tshimsian and three Stikine (Thlinkit) Indians, all good boatmen. Two local Indians hired as guides, and to help in portaging, deserted a day or two after engaging, and from the "Lower Post" to near the confluence of the Pelly and Lewes, for an interval of more than six weeks, we met neither whites nor Indians.

Journey to Frances Lake.

The ascent of the Liard and Frances rivers to Frances Lake proved unexpectedly difficult and tedious, the rivers being swift throughout and three bad cañons having to be passed through. Frances Lake was reached on the 8th of July, and after spending a few days in examining and mapping the lake, making the observations necessary to fix its position, and in the endeavour to find some Indian trail by which we might travel across to the Pelly, we began the work of portaging on the 17th.

Journey overland to Pelly River.

As we had been unable to discover any route now in use by the Indians, and no trace whatever remained of the trail employed by the Hudson Bay Company in former years; and further, as no local Indians could be found to act as guides or to assist in carrying our stuff, it was evident that the crossing of this portage (which had been estimated by Mr. Campbell at about 70 miles in length) would be a difficult matter,

and that we might indeed find it impossible to carry over a sufficient supply of provisions for work on the Pelly. We therefore, constructed a strong log *cáche* on the shore of Frances Lake, and left there, to be taken to Dease Lake by the Indians when they returned, everything we could possibly dispense with. Had we been unable to effect the portage, there was in our *cáche* a sufficient supply of provisions to enable the whole party to return to the "Lower Post." After a very toilsome journey, we were, however, so fortunate as to reach the bank of the Upper Pelly on the 29th of July, with still nearly a month's provisions for four persons, our instruments and a small camping outfit, a canvas cover from which a canoe might be constructed, and the tools and nails for building a wooden boat, should that prove to be necessary. Our Indians, who had for a long time been very uneasy because of their distance from the coast and the unknown character of the country into which they had been taken, were here paid off, and to their great delight allowed to turn back.

Descent of the Upper Pelly.

As a dangerous rapid was reported to exist on the upper part of the Pelly, it was decided to construct a canvas canoe in preference to building a boat, which it might prove impossible to portage past the rapid. Having completed the canoe, we descended the Pelly, making a portage of half a mile past Hoole Rapid or Cañon, and arrived at the confluence of the Lewes branch with the Upper Pelly on the 11th of August. We had now reached the line of route which is used by the miners, and expected to find, at the mouth of the Lewes, a prearranged memorandum from Mr. Ogilvie, from whom we had separated in May. As we could not find any such notice, and as Mr. Ogilvie had not been seen on the lower river by a party of miners whom we met here on their way up the Lewes, we were forced to conclude that he had not yet reached this point. The same party informed us that there had been few miners during the summer on the Stewart River, where most of the work had been carried on in 1886, but that in consequence of the discovery of "coarse" gold on Forty-mile Creek, over 200 miles further down the river, most of the men had gone there. We were also told that Harper's trading post, where I had hoped to be able to get an additional supply of provisions should we fail to connect with Mr. Ogilvie, had been moved from the mouth of the Stewart to Forty-mile Creek. From the place where we now were we still had a journey of nearly 400 miles to the coast, with the swift waters of the Lewes to contend against for the greater part of the distance. If therefore it should have become necessary to go down stream 200 miles to Forty-mile Creek for provisions, so much would have been added to our up-stream journey that it would become doubtful whether we should be able to afford time for geological work on

Proceedings at Mouth of Lewes

Building our fifth boat.

the Lewes, and yet reach the coast before the smaller lakes near the mountains were frozen over. I therefore decided to set about the building of another boat, suitable for the ascent of the Lewes, and on the second day after we had begun work, Mr Ogilvie very opportunely appeared. After having completed our boat and obtained Mr. Ogilvie's preliminary report and map-sheets, together with the necessary provisions, we began the ascent of the Lewes, from the head-waters of which we crossed the mountains by the Chilkoot Pass and reached the coast at the head of Lynn Canal on the 20th September.

Reach Lynn Canal.

Reported Indian troubles

In addition to the physical obstacles to be encountered on the long route above outlined, some anxiety was caused by reported Indian troubles on the Yukon. We heard a most circumstantial account of these from a couple of miners who followed us in to Dease Lake, the report being that the hostile Indians had retreated up the Pelly. As it was impossible either to confirm or refute these reports without practically abandoning the scheme of work, it was determined to proceed according to the original arrangement. On reaching the mouth of the Lewes we ascertained that the story was entirely false, but it had none the less kept us in a state of watchfulness during a great part of the summer.

Main Geographical Results.

Geographical data obtained.

The main geographical results of the Yukon expedition, in so far as those are covered by the present report, are best shown by the accompanying maps, which may be compared with previous maps of the same region. Mr. Ogilvie's instrumentally measured line from the head of Lynn Canal to the intersection of the Yukon or Pelly by the 141st meridian, will form a sufficiently accurate base for further surveys. In addition to this we now have an instrumental survey of the Stikine from its mouth to the head of navigation (Telegraph Creek), which is connected with Dease Lake by a carefully paced traverse. This is continued by a detailed running- or track-survey following the lines of the Dease, Upper Liard and Pelly rivers, and connecting with Mr. Ogilvie's line at the mouth of the Lewes, the total distance from the mouth of the Stikine to this point, by the route travelled being about 944 miles. Adding to this the distance from the mouth of the Lewes back to the coast at the head of Lynn Canal (377 miles), the entire distance travelled by us during the exploration amounts to 1322 miles. This, taken in connection with the coast-line between the Stikine and Lynn Canal, circumscribes an area of about 63,200 square miles, the interior of which is still, but for the accounts of a few prospectors and reports of Indians, a *terra incognita*. The same description,

Length of route traversed.

with little qualification, applies to the whole surrounding region outside the surveyed circuit, but much general information concerning the country has been obtained, which will facilitate further explorations.

Along the routes thus travelled numerous points have been carefully fixed in latitude by sextant observations, and a sufficient number of chronometer longitudes have been obtained by which to lay the whole down within small limits of error. Special attention was paid to the sketching and fixing of mountain topography in sight from the line of travel, and the approximate altitudes of a number of the more prominent peaks was ascertained. Positions fixed.

No reference is made here to the further work carried out by Messrs. Ogilvie and McConnell in 1888, which will, as above stated, be separately reported on.

Orography and General Features.

The region traversed by the routes just mentioned, including the extreme northern part of British Columbia and the southern part of the Yukon district (as previously defined), is drained by three great river systems, its waters reaching the Pacific by the Stikine, the Mackenzie, (and eventually the Arctic Ocean,) by the Liard, and Behring Sea, by the Yukon. The south-eastern part of the region is divided between the two first named rivers, whose tributary streams interlock, the Stikine making its way completely through the Coast Ranges in a south-westerly direction, while the Liard, on a north easterly bearing, cuts across the Rocky Mountains to the Mackenzie valley. The watershed separating these rivers near Dease Lake has a height of 2730 feet, and both streams may be generally characterized as very rapid. Drainage system.

To the north-westward, branches of the Stikine and Liard again interlock with the head-waters of several tributaries of the Yukon, which here unwater the entire great area enclosed on one side by the Coast Ranges, on the other by the Rocky Mountains. As the general direction of this line of watershed is transverse to that of the main orographic ridges of the country, it will probably be found, when traced in detail, to be very sinuous. The actual watershed, between the Liard and Pelly, on our line of route, was found to have an elevation of 3150 feet, but it is, no doubt, much lower in the central portion of the region between the Rocky Mountains and Coast Ranges. Watershed.

To the north of the Stikine, at least one other river, the Taku, cuts like it completely across the Coast Ranges, but its basin is comparatively restricted and little is yet known of it.

It will be noticed, that while the several branches of the Yukon con- Courses of Rivers.

form in a general way to the main orographic axes, the Stikine and Liard appear to be to a large degree independent of these, and to flow counter to the direction of three mountain ranges.

Relief of the region.

The region as a whole, being a portion of the Cordillera belt of the west coast, is naturally mountainous in general character, but it comprises as well important areas of merely hilly or gently rolling country, besides many wide, flat-bottomed river-valleys. It is, moreover, more mountainous and higher in its south-eastern part—that drained by the Stikine and Liard,—and subsides gradually, and apparently uniformly, to the north-westward; the mountains at the same time becoming more isolated and being separated by broader tracts of low land. The general base-level, or height of the main valleys, within the Coast Ranges, thus declines from about 2500 feet, to nearly 1500 feet at the confluence of the Lewes and Pelly rivers, and the average base-level of the entire region may be stated as being a little over 2000 feet.

Trend of ranges.

Disregarding minor irregularities, it is found that the trend of the main mountain ridges and ranges shows throughout the entire region here described a general parallelism to the outline of the coast. In the south-eastern and more rugged tract, the bearing of such ranges as are well defined is north-west by south-east, while beyond a line which may be drawn between the head of Lynn Canal and Frances Lake the trend gradually changes to west-north-west.

The Coast Ranges.

The Coast Ranges, with an aggregate average width of about eighty miles, the whole of which is closely set with high, rounded or rugged mountains, constitutes the most important orographic uplift in the entire region, and here reproduces geographically and geologically the features characteristic of it in the more southern portion of British Columbia. Beyond the vicinity of Lynn Canal, this mountain axis runs behind the St. Elias Alps, ceasing to be the continental border, and may be said to be entirely unknown, as any indications of mountains which have appeared on this part of the map are purely conjectural. Notwithstanding the great width of the Coast Ranges, it is not known that any of their constituent mountains attain very notable altitudes, but it is probable that a great number of the peaks exceed a height of 8000 feet. These ranges are composed of very numerous mountain ridges, which are not always uniform in direction, and, so far as has been observed, there is no single culminating or dominant range which can be traced for any considerable distance.

Rocky Mountain Ranges.

The mountain axis next in importance to that of the Coast Ranges, is that which forms the water-parting between the Upper Liard and Yukon, on one side, and the feeders of the main Mackenzie River on the other. This represents the north-western continuation of the Rocky Mountains proper. Its eastern ridges were touched on during

the present exploration in the vicinity of Frances Lake and the head waters of the Pelly River, and are there designated on the map as the Tootsho Range. This forms, so far as has been ascertained, the culminating range of a number of more or less exactly parallel ridges, and summits in it attain heights of from 7000 to 9000 feet. It has, however, been traced to a comparatively limited distance only, and it appears probable that a very complicated mountain system remains to be worked out in this portion of the region.

A third notable mountain axis, which I have designated on the map as the Cassiar Range, is cut through by the Dease River in its upper course, and further to the north-westward appears to form the line of water-parting between the tributaries of the Upper Liard and those of the branches of the Yukon. Peaks near the Dease, in this range, exceed 7000 feet, but it is probable that none much exceed 8000 feet, and that the range in a general way becomes lower to the north-westward. Cassiar Range.

In the north-western and less elevated moiety of the region, the mountain ranges and ridges are in general lower and become discontinuous and irregular, or while retaining a general parallelism, assume an overlapping or echelon-like arrangement.

In each of these mountain chains above described granitic rocks appear in greater or less force, as more fully noted on succeeding pages. In the intervening and subordinate mountain systems of the south-east, granitic axes are not found and do not exist as prominent features. Granitic rocks.

Scarcely anything is known of the character of the country drained by the Macmillan, Stewart and White rivers, but it is probable that the basins of the two first-named streams closely resemble that of the Upper Pelly, which is described in following pages. Miners who have ascended the Stewart for a hundred miles or more, report the existence of a continuous range of mountains of considerable height, which runs parallel to the river on the north, from a point about fifty miles from its mouth onward. The absence of tributaries of any size along the south-west side of the Lewes below the Tahk-heena, with the general appearance of the country in that direction, so far as it has been overlooked, seems to show that the basin of the upper portion of the White River must be comparatively low, and situated as it is within the St. Elias Alps, this country must possess most remarkable features, both geographically and from a climatic point of view, and well deserves exploration. It would further appear to be nearly certain that the sources of the Tanana River are to be looked for in this district, well to the east of the 141st meridian. Orography of neighbouring regions.

The topographical features of the entire region here described have been considerably modified by the events of the glacial period, and the Effects of the glacial period.

changes produced at that time have more particularly affected the drainage-basins and the courses of the various streams. The valleys and lower tracts of country are now more or less completely filled or covered by extensive deposits of boulder-clay, gravel, sand and silt laid down during that period. To these deposits are due the flat floors of the larger valleys, and also to a great extent the appearance which the more irregular mountain regions present of being partly submerged in level or rolling plains. Many changes in direction of flow in river-valleys have doubtless also been produced during this period, though most of these yet remain to be worked out. The general result has been to produce systems of "inconsequent" drainage wherever the natural slopes of the country are easy and the limiting ranges irregular. Most of the rivers at the present day have done little more than cut out new channels in the glacial *débris*, touching only here and there upon the subjacent rocky floor.

Sources of the Yukon and Nomenclature.

Confused nomenclature.

Such particulars as have been ascertained relative to the various rivers examined in the course of the exploration, are given in a subsequent part of this report. As, however, some confusion has arisen in respect to the nomenclature of the Yukon and its tributaries, and erroneous statements have been made as to the "source" of the river, it may be appropriate here briefly to note the facts in the case in so far as I have been able to ascertain them. Further details of the early exploration of the river are given on page 136 B.

First exploration of Yukon.

The estuary of the Yukon appears to have been first explored by the Russian, Glasunoff, in 1835 to 1838, and the river was then named by the Russians the Kwikhpak, which name, according to Mr. W. H. Dall, is in reality that of one of the channels by which it issues to the sea. The lower part of the river, however, continued to be known under this name for a number of years, and it is so called on the (Russian) map of Lieut. Zagoskin, made from reconnoisance surveys which, in 1842-43, he carried up as far as Nowikakat. The mouth of the river is shown on Arrowsmith's map of 1850, but is there nameless.

Origin of the name.

The name Yukon was first applied in 1846 by Mr. J. Bell, of the Hudson Bay Company, who reached the main river by descending the Porcupine, and called it by what he understood to be its Indian appellation. The head-waters of one of the main tributaries of the Yukon had previously been attained by Mr. R. Campbell (also an officer of the Hudson Bay Company) in 1840, and in 1850 he descended the river as far as the mouth of the Porcupine, naming the whole river thus traversed the Pelly, and naming also the Lewes, White and Stewart rivers, as well

as numerous smaller tributaries. Campbell's nomenclature and his sketch of the river appear on Arrowsmith's map published in April, 1854, and Campbell practically established by his journey the identity of his Pelly River with the Kwikhpak of the Russians. The connection between the two is given by a sketch (shown in broken lines) on the map just cited, on which also the mouth of the Tanana River (under the name Mountain-men River) is shown, and other details represented with reasonable accuracy. The sketch of the river below the mouth of the Porcupine appears to have been due to the Hudson Bay Company's traders, who, before Campbell had communicated his geographical information in London (in 1853), had already met the Russian traders at the mouth of the Tanana. Much later, in 1863, I. S. Lukeen, of the Russian Trading Company, ascended the river to the Hudson Bay post, Fort Yukon, at the mouth of the Porcupine.*

Connection of Yukon and Kwikhpak.

The name Yukon does not appear at all on Arrowsmith's map of 1854, that of the Pelly standing for the whole length of the river explored by Campbell, but since that date the term Yukon has gradually become applied to the main river. The next map in order of publication in which original data are employed is, I believe, that accompanying Mr. Whymper's paper of 1868, in the Journal of the Royal Geographical Society,† which is also reproduced in his book, Travels in Alaska and on the Yukon (1869). His general map gives the name Pelly for the whole river above the mouth of the Porcupine, "Kwich-Pak or Yukon," for the lower part. In his large-scale map, on the same sheet, the river above the Porcupine is named the Yukon or Pelly. Whymper refers to the river as the "Yukon (or Pelly) as it has long been called on our maps."‡ In the United States Coast Survey map dated 1869§ the main river between the Porcupine and Lewes is definitely named the Yukon; but in the map accompanying Raymond's official report (1871) this name is again confined to the river below the Porcupine, and the statement is made in the report (p. 21) that from Lake Labarge to Fort Yukon the river is called the Lewes.

Usage on subsequent maps

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* By a singular oversight, Mr. W. H. Dall states in the first part of his work, Alaska and its Resources 1870 (p. 4), that "the identity of the Yukon [Pelly] River with the so-called Kwikhpak of the Russians" remained to be established when the explorations of the Telegraph Survey commenced on the river in 1865, while giving the credit of this achievement to Lukeen on a subsequent page (p. 277). Raymond repeats this error in his Report of a Reconnoissance of the Yukon River (1871). Mr. Dall's work above cited constitutes a veritable mine of information on the subjects of which it treats, and is frequently referred to in the sequel. Where, therefore, as in the above case, criticisms are offered, it is in no spirit of detraction.

† Vol. xxxviii.

‡ *Op. cit.*, p. 223.

§ In United States Coast Survey Report for 1867 the same nomenclature is adopted, as it is also in the map accompanying Mr. Dall's Alaska (1870), in the Ethnological map of Alaska by the same author (1875), and in most later maps. These, however, do not embody any original data for this region.

Further confusion of nomenclature.

Much later, Lieut. Schwatka, in the maps accompanying the official report of his explorations of 1883 and in other maps elsewhere published, in defiance of the fact that the name of the Lewes had a published priority of thirty years, erased it completely, extending the name Yukon so as to include under that designation the Lewes River. This extension of the name Yukon appears to be justified by Lieut. Schwatka on the ground that the Lewes is the larger branch at its confluence with the Upper Pelly. As elsewhere stated, this is no doubt true, but from what is now known of the Upper Pelly, that river is almost certainly the longer, its sources are furthest removed from the mouth of the Yukon and its course is more directly in continuation of its main direction than is the case with the Lewes. Granting, however, that the Lewes excelled in all these particulars, it would still, I believe, be unjustifiable to alter an old established name for the sole purpose of giving to a river a single name from its mouth to its source. In any case it is incorrect to state that the Yukon (Lewes) rises in Lake Lindeman, or streams flowing into it, as is done by Schwatka, for by far the greater part of the water of the river enters by the Taku arm of Tagish Lake.

With respect to the substitution of the name Yukon for that of Pelly on the portion of the river between the Porcupine and Lewes, it is simply a question of well established priority *versus* use It is possibly a matter of small importance which shall be employed in future, but no valid excuse can be offered for the attempt to substitute any new name for that either of the Lewes or Pelly above the site of old Fort Selkirk.

True sources of the Yukon.

From the point of view of the physical geographer, and apart from the question of nomenclature, the position of the furthest source of the great Yukon River is, however, an interesting subject of enquiry; though it may yet be some years before we are in possession of sufficient information to settle this question definitely. It may be confidently assumed that this point is to be found by following up either the Pelly or the Lewes from their confluence at the site of old Fort Selkirk. As already stated, the Lewes there carries the greater volume of water, but draining as it does a considerable length of the humid Coast Ranges, which bear throughout the year great reserves of snow and numerous glaciers, it does not compare on terms of equality with the Upper Pelly, which unwaters a region relatively dry. Whether reckoned by size or distance from its mouth, the source of the Lewes must be placed at the head waters of the Hotilinqu River,* explored by Byrnes, of the Telegraph Survey, in approximate latitude 59° 10',

* The Tes-lin-too occupies the main orographic valley above its confluence with the Lewes, but is smaller than the Lewes, and besides doubles back on its course, as is shown on the map.

longitude 132° 40′. In regard to the Pelly, it is not yet absolutely certain that the Pelly proper rises further from the common point at Fort Selkirk than its great branches, the Macmillan and the Ross rivers, but it is highly probable that it will be found to do so.

Comparison of tributaries.

With the above facts premised, we may compare the respective distances of assumed or probable sources of the Yukon as below, the distances being in each case measured in a straight line from the common point at Fort Selkirk:—

Fort Selkirk to summit of Chilkoot Pass, source according to Schwatka (position fixed).....		224	miles.
" "	to head of Hotalinqu River of Telegraph Survey (position approximate).....	294	"
" "	to "Pelly Banks" (position fixed).....	213	"
" "	to head of Pelly Lakes (above "Pelly Banks," according to Campbell's sketch).....	276	"

The upper lake on the Pelly must be fed by a considerable stream or streams, the addition of the length of which, if known, would add considerably to the last of the above distances.

Size of the river.

I must confess to having been somewhat disappointed in the size of the Pelly or Yukon where we saw it below the confluence of the Lewes. The river is there, when undivided by islands, about 1700 feet only in width, with a maximum depth scarcely exceeding ten feet when at a stage which may be considered as its approximate mean. It appeared to me to be about equal in size and velocity to the Peace River at Dunvegan and Mr. Ogilvie, who is also familiar with the Peace, concurred in this estimate. Below this place the river, of course, receives a number of important tributaries, but at any fairly comparable point on the two rivers I believe that the Mackenzie must far exceed the Yukon in volume. Numerical data on this point are unfortunately still almost entirely wanting, but the comparison of the drainage-areas of the two rivers, according to the latest available information, strongly bears out the statement just made, that of the Yukon being 330,912 square miles as against 677,400 square miles in the case of the Mackenzie.* In other words, the drainage area of the Mackenzie is more than double that of the Yukon, while nothing is known to show that the mean annual precipitation over the two areas, as a whole, differs very greatly. Exaggerated statements which have been made, to the effect that the Yukon discharges a volume of water approaching that of the Mississippi, appear to carry their own refutation in the fact that the basin of the latter river has an area of no less than 1,226,000 square miles.

Comparison with Mackenzie River.

* Of the area drained by the Yukon, about 150,768 square miles are in Canadian, 180,144 square miles in United-States Territory.

Discharge of rivers.

Some attempt was made by us to gage the flow of several of the rivers in the Yukon basin, as more fully stated further on. The discharge of the several rivers above the site of the old Fort Selkirk may be roughly summarized as follows. The figures given in heavy type are derived from measurements more or less approximate, the others are based merely on comparisons made by eye and without any attempt to cross-section the streams. The scheme may, however, serve to give a general idea of relative dimensions. All the figures represent cubic feet per second and refer to the latter part of the summer, when the rivers may be assumed to be at their mean height. In common with all the streams of the interior region these are highest in the early summer and lowest toward the end of the winter.

Pelly River, at "Pelly Banks"	**4,898**
Ross River, at mouth	4,898
Macmillan River, at mouth	9,796*
Tes-lin-too, at mouth	**11,436**
Lewis River, above confluence with last	**18,664**
Big Salmon	**2,726**
Total thus accounted for	52,418
Pelly or Yukon at site of Fort Selkirk	**66,955**
Difference from above total, not accounted for	14,537

Upper Pelly and Lewes compared.

By adding two-thirds of the water thus not accounted for to the Pelly and one-third to the Lewes, to represent the flow of numerous smaller tributaries not enumerated, the discharge of these two rivers above Fort Selkirk will stand thus :—

Lewis	37,672
Pelly	29,283
Total as above	66,955 †

* The discharge of the Ross is taken as equal to that of the Pelly at "Pelly Banks," that of the Macmillan as equal to the combined waters of the Pelly and Ross.

† For the purpose of comparison, the following extract from a table of various rivers, contained in the General Report of the Minister of Public Works for the fifteen years from 1867 to 1882, is quoted :—

NAMES.	Area of drainage in square miles.	Length in miles.	Discharge in cubic feet per second.		
			Low Water.	Mean.	High Water.
Mississippi	1,226,000	4,400	447,200	.....	1,270,000
St. Lawrence	565,000	2,600	.....	900,000	.....
Ganges	432,000	1,680	36,300	207,000	494,200
Nile	520,200	2,240	23,100	220,000	.....
Thames	5,000	215	1,330	.....	7,900
Rhone	38,000	560	7,000	21,000	204,000
Rhine	88,000	700	13,400	33,700	164,000
Ottawa (Grenville)	80,000	700	35,000	85,000	150,000

Navigable Waters and Routes of Travel.

Navigable rivers.

The numerous large and important rivers by which the Yukon district and the adjacent northern portion of British Columbia is intersected, constitute the principal routes of travel, and during the summer months render inter-communication comparatively easy. The Stikine is navigable by stern-wheel steamers for a distance of 138 miles, as more fully stated in a subsequent part of this report, where also details respecting the connecting trail to Dease Lake are given (pp. 46 B, 64 B). This constitutes the travelled route to the Cassiar mining district. A trail was, at one time, opened from Fraser Lake overland to Dease Lake by which cattle were driven through, but of late no travel has occurred on it (p. 89 B). The Dease River can scarcely be considered as navigable *for steamers, though constituting a fairly good boat route* (p. 91 B). The Upper Liard and Frances rivers, above the mouth of the Dease, are also passable for large boats, with occasional portages, but not so for steamers (p. 102 B). The difficulties of the Lower Liard, however, are such as to render it an undesirable route, even for boats, and scarcely suitable as an avenue of trade between Cassiar and the Mackenzie. Numerous tributary streams in this district may also be ascended by boat or canoe for considerable distances, though with many interruptions from rapids and bad water.

Possible railway route.

Communication may easily be established by railway from the mouth of the Stikine to the centre of the Cassiar district and beyond, when this shall be called for, and it is probable also that this district might, without difficulty, be connected by rail with the more southern portions of British Columbia by one or more routes of which the main outlines can already be indicated. Following the river-valleys, by a route practicable for a railway, from Rothsay Point at the mouth of the Stikine to the mouth of the Dease, the distance is found to be 330 miles. Thence to Fort Simpson on the Mackenzie, is a further distance of 390 miles, making the total distance by this route, from the Pacific to the navigable waters of the Mackenzie about 720 miles only.

Taku River and trails.

Little is yet known of the Taku River, but the Indians ascend it in canoes to a point at a distance of about eighty miles from the head of Taku Inlet, and Indian trails lead south-eastward from this vicinity to the Tahl-tan, eastward to Tes-lin Lake and north-eastward to the lakes near the head of the Lewes. From what has been ascertained of these, it is probable that it would not be difficult to construct a trail suitable for pack-animals, if not a waggon road, from the vicinity of the head of navigation on the Stikine to these lakes connecting with the navigable waters of the Lewes.

Tributaries of Yukon.

The rivers draining the Upper Yukon basin, have in general lower grades, and afford better navigable water than those above referred to, and are in consequence likely to prove of greater importance in connection with the exploration and development of the country. The distance to which they may be respectively ascended by boat or canoe, has as yet been determined in only a few cases.

Navigable lengths of rivers.

It may, however, be stated that the Yukon is continuously navigable for small steamers from its mouth, on Behring Sea and following the Lewes branch, to Miles Cañon. Thence, after an interruption of about three miles, to the head of Bennett Lake and to an additional considerable—though not precisely determined distance—by the waters extending south-eastward from Tagish Lake (p. 165 B). The Tes-lin-too is probably navigable for stern-wheel steamers for a hundred and fifty miles or more from its mouth, (p. 154 B) while the Tahk-heena and Big Salmon rivers may probably both be ascended by steamers of the same class for some distance. From the site of old Fort Selkirk, again, the Pelly might be navigated by small steamers of good power to within about fifty miles of the site of old Fort Pelly Banks, (p. 133 B) and the Macmillan branch is also navigable for a considerable, though not ascertained distance (p. 129 B). The same may be said of the Stewart River, but White River is, so far as known, very swift and shoal.

Aggregate length of navigable waters.

The total length of the waters which may be utilized for navigation by light stern-wheel steamers on the main river and its branches to the east of the 141st meridian or Alaskan boundary, measured in straight lengths of fifty miles, is therefore at least 1000 miles, and following the sinuosities of the various streams would be very much greater. This does not include the Porcupine River, and with the exception of the single break above referred to on the Lewes, forms a connected system, all parts of which lie to the east of the above meridian. If the upper portion of these rivers, above the first obstacles to such navigation, were included, the total here given would doubtless be greatly added to.

Means of access to Yukon District.

At the present moment but three routes of access to the Yukon district are employed. (1). That of the portage by the Chilkoot Pass from the head of Lynn Canal to the navigable waters of the Lewes. (2). That from Peel River, near its confluence with the Mackenzie by portage to La Pierre's House on a branch of the Porcupine. (3). That from Behring Sea by the main river. The first is that almost exclusively used by the miners, the second is employed only by the Hudson Bay Company, and the last is that of the Alaskan traders.

There are now three small stern-wheel steamers on the lower river, which ascend each year as far as the trading post at Forty-mile Creek,

bringing the greater part of the goods used in trade with the Indians and for the supply of miners. It is not possible, however, for miners to reach the scene of their operations by this route in time to make a season's work, and the chances of reaching or leaving the Yukon mouth are few and precarious. Particulars relating to the Chilkoot Pass and Lewes River will be found on pages 173 B, 174 B. The character of the pass is such that it would scarcely be possible to construct a useful trail across it for pack-animals, but the White Pass appears to offer a better opportunity for making a trail or road which, if constructed, would render the entire region much more easy of access. Another route, also leading from the head of Lynn Canal to navigable water connecting with the Lewes, is that by the Chilkat Pass. This was formerly much employed by the Indians, but entails a much longer land carriage, one which is said to occupy the Indians for twelve days when carrying packs, as against two days of packing by the Chilkoot Pass.

Indian routes

The Indians inhabiting the region to the south and east of the site of old Fort Selkirk are poor boatmen and follow the various rivers in the course of their periodic journeys to a very limited extent. Most of their travelled routes appear, indeed, to run nearly at right-angles to the direction of drainage, the rivers being crossed in summer on rafts, the remains of which may frequently be observed. In travelling thus they carry their entire small camping outfit on their backs.

Climate, Agriculture and Flora.

General character of climate.

While the available information as to the climate of the northern portion of British Columbia and the Yukon district is necessarily as yet very imperfect, its general features are sufficiently obvious, repeating as they do those met with in the similarly circumstanced region to the south, with such modification as is produced by their higher latitude. The coast and coastward slopes of the Coast Ranges constitute a belt of excessive humidity and great precipitation, with somewhat equable temperatures, while the interior region to the eastward of these ranges is relatively dry, with a temperature of extremes.* In the interior, however, the climate is largely influenced by the altitude of each particular district, and in consequence of the general lowering of the country beyond the 60th parallel (constituting the north line of British Columbia), it is certain that the climatic conditions are there much more favorable than in the Cassiar district.

Regions of heavy and light rainfall.

The mean annual temperature of the coast region is considerably higher than that of the interior; yet, in consequence of the great

* A mean of the total annual precipitation for Fort Tongass, Wrangell and Sitka gives a general mean for the coast of 86·81 inches.

depth of the snow-fall and persistently clouded character of the skies, the Coast Ranges are found to support numerous and massive glaciers, while these are almost or altogether absent in the Cassiar Mountains, in the mountains about Frances Lake and in the other ranges seen by us in the interior. The heavy accumulation of snow upon the Coast Mountains and in their valleys, retards the progress of spring, as is very clearly evidenced on the Stikine, and explained more fully elsewhere. (p. 58 B). The depth of snow in winter continues to be inconsiderable or moderate, at least as far down the Pelly (Yukon) as the mouth of Stewart River and Forty-mile Creek, while at Nulato, on the lower river and in a similar latitude, but 500 miles further west, the depth of snow from April to November is said to average eight feet and often to reach twelve feet.* Mr. Dall also writes: "The valley of the Lower Yukon is somewhat foggy in the latter part of summer; but as we ascend the river the climate improves, and the short season at Fort Yukon is dry, but pleasant, only varied by an occasional shower." Relatively to the country of the Upper Yukon basin, the advent of spring is much retarded in the country to the west, and it is stated that on the river below Nulatto alder buds were found just opening and tender leaves beginning to appear on the 4th of June. These and other facts seem to show conclusively, that in the absence of a continuous mountain barrier in that region, the humid winds of the Pacific are enabled to push eastward a long way up the Yukon valley, carrying with them the belt of heavy snow-fall, which ceases to be conterminous with the Coast Mountains, as it is to the south-eastward.

Progress of spring.

Dry belts.

As in the more southern parts of British Columbia, the dryest country is found to occur in a belt bordering the eastern or lee side of the Coast Ranges, and this phenomenon recurs, though in a less marked degree, in connection with each of the well-defined mountain ranges of the interior. Thus a region of greater humidity is found near Dease Lake, on the western side of the Cassiar Mountains, with a dry belt on the east side of the range; while humid conditions, with recurrent showers in summer, characterize the district in the vicinity of Frances and Finlayson lakes. Further illustrations of this fact, with other climatic observations, will be found in the body of this report and in Appendix VI.

Summer and winter winds.

A noteworthy circumstance in connection with the Stikine valley, the passes leading from the head of Lynn Canal, and doubtless in all the low gaps in the Coast Ranges, is the change in direction as between the summer and winter winds. During the summer strong winds blowing up these valleys inland, are of very frequent occurrence and they commonly freshen in the afternoon and die away toward night. In

* Alaska and its Resources. W. H. Dall, 1870, p. 437.

the winter months the conditions are precisely reversed, the strongest winds blowing seaward. The summer winds are doubtless homologous with the sea breezes observed in many other regions, while the direction of the winter winds probably depends on the existence of a persistent anti-cyclonic area in the interior during that season.

Temperatures of coast and interior.

The temperature of Wrangell, just off the mouth of the Stikine, may probably be taken as fairly representative of that of the coast in these latitudes. For the interior region, here particularly treated of, we are unfortunately without a series of thermometer readings extending even over a single year, but some idea of its climate may be formed from that of Fort Yukon, which is, however, situated far to the north, almost exactly on the Arctic circle. The mean seasonal temperatures for these two stations may be compared as below.*—

	Wrangell.	Fort Yukon.
Spring	40.4	14.6
Summer	57 1	56.7
Autumn	43.0	17.4
Winter	28.3	—23.8
Year	42.2	16.8

Comparison with Russia.

In the central provinces of European Russia the thermometer descends to —22° and —31°, and occasionally even to —54°, in the winter months, but rises at times to 104° and even to 109° in summer. The rain-fall is small, varying from sixteen to twenty-eight inches, the maximum precipitation taking place during the summer months, and not, as in western Europe, in the winter, while the months of advanced spring are warmer than the corresponding months of autumn.† So far as our information goes, the above statement might almost be adopted as characterizing the climate of the southern half of the Yukon district.

Crops and cultivation.

At Telegraph Creek and in its vicinity on the Stikine, to the east of the Coast Ranges (lat. 58°), wheat, barley and potatoes are successfully grown with the aid of irrigation. Their cultivation has so far been attempted on a limited scale only, on account of the want of any market, and wheat has been grown only experimentally, as it cannot, like barley, be employed for feeding pack-animals. None of these crops can be successfully grown or ripened on the coastward side of the mountains. At Fort Yukon (situated, as above noted, on the Arctic circle) Mr. Dall states he was informed that barley had once or twice been tried in small patches and had succeeded in maturing the grain, though the straw was very short.‡ A few cattle were also

* From the United-States Coast Pilot, Alaska, Part I, 1883, p. 269.
† Encyclopedia Britannica, vol. xxi, p. 67.
‡ *Op. cit.*, p. 441.

kept here at one time, when the post was in the possession of the Hudson Bay Company. Petroff, in his Census Report on Alaska, endeavors to discredit Dall's statement as to the growth of barley at this northern point, but I am fortunately in possession of independent evidence as to its accuracy, the late Mr. James Anderson, of the Hudson Bay Company, having noted in an official report on the district that both potatoes and barley have been grown at the fort.

Conclusions as to possible agriculture

Taking into consideration all the facts which I have been able to obtain, as well as those to be derived from an examination of the natural flora of the country, and the observed advance of vegetation, which, in the absence of actual experiments, are capable of affording valuable data, I feel no hesitation in stating my belief that such hardy crops as barley, rye, turnips and flax can be successfully cultivated in the Yukon district as far north as the former position of Fort Selkirk, near the 63rd parallel, or in other words about 1000 miles north of Victoria. Taken in conjunction with the physical features of the region, this means, that chiefly within the drainage area of the Yukon, and for the most part to the north of the 60th parallel, there exists an area of about 60,000 square miles, of which a large proportion may, and doubtless in the future will—be utilized for the cultivation of such crops, and in which cattle and horses might be maintained in sufficient number for local purposes, without undue labor, as excellent summer grazing is generally to be found along the river-valleys and natural hay-meadows are frequent. I do not maintain that the country is suitable for immediate occupation by a large, self-supporting agricultural community, but hold that agriculture may before many years be successfully prosecuted, in conjunction with the natural development of the other resources of this great country, of which by far the most valuable portion lies to the east of the line of the Alaskan boundary.

Trees.

A note on the distribution of the various species of trees and on that of some of the herbaceous plants forms a separate section of this report (Appendix I), while in Appendix III, Prof. Macoun gives a list of the plants collected.

Timber.

Remarks on the quantity and quality of timber along the various routes are given under the local headings. It may suffice here to state, in this connection, that the country is generally wooded,* and that in all portions of it, in valleys and on low lands, there is an abundance of white spruce, of fair to good quality, well suited for purposes of construction. The other species of trees present are of inferior economic importance.

* No areas of *tundra* or frozen morass, such as are stated to be characteristic of the country of the Lower Yukon, were found in the region here reported on.

Fauna.

The fauna of the region traversed by us, does not differ notably from that of other parts of the northern country which are already moderately well known. There are, no doubt, many interesting points yet to be determined in respect to distribution, but our opportunities for obtaining information of this kind were very limited. The smaller black-tailed deer (*Cariacus Columbianus*) occurs on the islands of the southern portion of Alaska and the adjacent mainland coast, but is nowhere found on the inland side of the Coast Ranges. The mountain goat is moderately abundant in the Coast Ranges, and is also found in the mountainous inland regions, probably throughout. The big-horn or mountain sheep occurs, together with the last-mentioned animal, on the mountains about the head of the Lewes and other parts of the inland spurs of the Coast Ranges, but does not inhabit the seaward portions of these ranges. It is also found generally in the mountains of the interior, including the Rocky Mountains. Larger animals noted.

The moose is more or less abundant throughout the entire inland region, and together with the caribou, which is similarly ubiquitous, constitutes a great part of the food of the Indians. We found the moose particularly plentiful along the Upper Liard River, and it is stated that the country drained by the White River is noted among the Indians as a moose and beaver region. The caribou is everywhere common, but is scarcely seen in the valleys or lower country during the summer, when it ranges over the high, alpine moors and open slopes of the mountains.

The black and grizzly bears roam over the entire region and are often seen along the banks of the rivers in the latter part of the summer when dead or dying salmon are to be obtained with ease. Wolves are not particularly abundant, but the cross-, black- and silver-fox are more than usually common.

The smaller fur-bearing animals, being similar to those found generally in the northern parts of the continent, do not require separate enumeration. The entire Upper Yukon basin, however, yields furs of exceptionally high grade. Some notes as to the quantity of furs annually obtained from the region will be found in a subsequent paragraph (p. 28 B). Smaller fur-bearing animals.

Among a few skins brought back by us, is that of a mouse which Dr. C. H. Merriam has found to be a new species, and has described under the name of *Evotomys Dawsoni*.*

The salmon ascend the Lewes River as far as the lower end of Lake Marsh, where they were seen in considerable numbers early in Sep- Salmon.

* American Naturalist, July, 1888.

tember. They also, according to the Indians, run almost to the head-waters of the streams tributary to the Lewes on the east side. Salmon also run up the Pelly for a considerable distance above the mouth of the Lewes, but their precise limit on this river was not ascertained. The lakes and rivers generally throughout the country are well supplied with fish, and a small party on any of the larger lakes would run little risk of starvation during the winter, if provided with a couple of good gill-nets and able to devote themselves to laying in a stock of fish in the late autumn.

Other fishes.

As might be anticipated from the interlocking of streams tributary to the Mackenzie and Yukon in this region, the fishes in both drainage-areas appear to be identical, so far as I was able to observe, with the exception of the salmon, which is, of course, confined to the Yukon tributaries. The principal fishes noticed are white-fish (*Coregonus Nelsoni*), lake trout (*Salvelinus Namaycush*), grayling (*Thymallus signifer*), pike (*Esox lucius*), and sucker (*Catostomus catostomus*). The names above given are on the authority of Dr. T. H. Bean, of the U. S. Commission of Fish and Fisheries, who has very obligingly examined for me the photographs of fishes which were taken. No photograph, unfortunately, was obtained of the salmon seen on the Lewis, etc., but Dr. Bean informs me, from my description of its size, that he has little doubt it was the king salmon, *Oncorhynchus chuicha*.

Insects.

Appendix IV includes a list by Mr. James Fletcher, F.R.S.C., of the species of insects collected

Mining and Minerals.

Placer gold-mining.

Mining has so far been confined within the Cassiar district and in the Upper Yukon basin to the working of gold placers, and in the latter, almost entirely to river-bar mining, the inception of which indeed dates only from 1880. Particulars with reference to the rich creeks of Cassiar will be found on page 83 B, and facts relating to the rivers tributary to the Yukon on page 181 B. Almost all the large streams which have been prospected in the Yukon basin have been found to yield placer gold in greater or less quantity and the aggregate length of the rivers thus already proved to afford gold is very great, but little has been done toward the examination of their innumerable smaller feeders. Similar river-bar mining on the Stikine and Liard rivers proceeded the discovery of the smaller creeks in which the richer deposits of "heavy" gold were obtained, and a few miles in length each of Dease, Thibert and McDame creeks produced the greater portion of the $2,000,000 worth of gold credited to Cassiar in 1874 and 1875. Discoveries similar to these may be expected to occur at any time in

the Yukon district, the generally auriferous area of which already proved is very much greater than that of Cassiar. Scarcely anything has been done as yet even in the Cassiar district toward the search for or proving of metalliferous veins, and practically nothing in the Yukon district, but there can be no reasonable doubt that such deposits exist.* The present activity in mining enterprise in the southern part of British Columbia will, before long, spread to this northern region also, and then, if not before, its valuable character as a portion of the metalliferous belt of the continent will be realized. Metalliferous veins.

The Yukon district with the northern part of British Columbia, measured from the vicinity of Dease Lake to the intersection of the Pelly (Yukon) with the 141st meridian comprises a length of over 500 miles of the Cordillera belt of the west, which, wherever it has been examined, has been found rich in minerals and particularly in the deposits of the precious metals. The width of this particular part of the Cordillera belt is also great, as it appears, so far as our explorations have gone, to extend from the coast to the eastern ranges of the Rocky Mountains in the vicinity of the Mackenzie River. This portion of the Cordillera region, together with that of the more southern part of British Columbia, gives an aggregate length of between 1200 and 1300 miles, almost exactly equal to the length of the same metalliferous belt contained by the United States, and in all probability susceptible of an eventual mining development equally great. Importance of Metalliferous belt.

In the northern districts here reported on, it is true that the winter climate is a severe one, rendering the working season for ordinary placer-mines short and likely also to present some special difficulties in the way of "quartz mining." There is, however, on the other hand an abundance of wood and water, matters of great importance in connection with mining, and means of communication once provided, mining operations should be carried on here at less cost than in dry and woodless regions such as are great portions of Arizona. Bearings of climate on mining.

Statistics of the former and present gold production of Cassiar are given in connection with that district, on page 82 B. It is difficult if not impossible to arrive at even an approximate statement of the total amount of gold which has been so far afforded by the Yukon district, but from such enquiry as I was able to make in 1887, I estimated the value of gold obtained in that year at a minimum of $60,000; the number of men engaged in mining at 250. Statistics of gold

A specimen of asbestus (chrysotile) being part of a small vein of that material about half an inch in thickness, has been brought from Asbestus.

* A specimen of galena obtained from McDame Creek, Cassiar, was found to contain 75 ounces of silver to the ton (see p. 86 B) and of seven specimens of vein stuff collected by us on the Upper Pelly and Lewes, five proved to contain distinct traces of gold on assay

the Stewart River, and the occurrence of serpentine in large mass elsewhere, tends to show that workable asbestus deposits may yet be found in the region.

Platinum. Platinum is found in small quantities along all or nearly all the tributaries of the Yukon, in association with the gold. It has also been observed in the Cassiar district.

Fur Trade.

Exports of furs. Gold and furs are at present the only articles of value derived from the great region here referred to as the Yukon district. It is impossible to secure accurate information as to the value of furs annually obtained, but sufficient is known to show that it must be very considerable. Petroff, in his report, states that the total annual value of the furs shipped by the Yukon probably does not exceed $75,000,* and it is known that a great, if not the greater, portion of this total is derived from the region lying east of the 141st meridian Dall states, that at the date of his visit (1867), the value of furs annually obtained at Fort Yukon, then maintained by the Hudson Bay Company, was not less than $50,000. Captain Raymond notes that the total number of skins collected in 1869, at this place, was stated at 10,000, but adds that he believes this estimate to be excessive.† Practically the whole of these may be regarded as having been brought by Indians from the region east of the Alaskan line. An approximate estimate of the furs derived from Canadian territory and taken down the Yukon, obtained from Mr. François Mercier, who spent many years trading on the river, places the annual value at about $27,000. The annual catch is made up, according to the same authority, about as follows:—

Beaver	1200 to 1500	skins.
Cross fox	100	"
Black fox	100	"
Red fox	300	"
Bear	300	"
Marten	4000	"
Otter	200	"
Mink	2000	"
Lynx	600	"
Wolverine	150	"
Wolf	100	"
	9350	"

* Report on the Population Industries and Resources of Alaska, p. 5, U. S. 8th Census, vol. viii.

† *Op. cit* p. 115.

In addition, however, to the furs taken from the Yukon district by this route, the Hudson Bay Company obtains a large quantity of skins from their posts on the Porcupine, which reach the market by the Mackenzie River route. A certain number of skins derived from the country north of British Columbia is, further, annually traded at the little post at the mouth of Dease River, and taken out by the Stikine. A considerable quantity of furs also each year finds its way by the Chilkoot and Chilkat passes to the head of Lynn Canal, and some are brought down by the Taku River to the coast, though the greater part of these last is probably derived from the north-western corner of the province of British Columbia. Information obtained on the spot indicates that the value of the furs reaching Lynn Canal from the interior is from $12,000 to $15,000 annually. Routes of export of furs.

Economic Importance of the Region.

Without including the northern part of British Columbia, respecting which more has already been made known, but restricting ourselves to the great area of 192,000 square miles situated to the north of the 60th parallel and west of the Rocky Mountains, which I have referred to as the Yukon district, it may be said that the information now obtained is sufficient to warrant a confident belief in its great value Very much yet remains to be learned respecting it, but it is known to be rich in furs, well supplied with timber, and it is traversed by a great length of navigable rivers. It is already yielding a considerable yearly product in gold, and presents every indication of a country rich as well in other metals, and including deposits of coal. In its southern portion, situated between the 60th and 65th degrees of latitude, is comprised an area of probably not less than 30,000 square miles, suitable for eventual agricultural occupation, and presenting none of the characters of a sub-Arctic region, which have, in advance of its exploration, been attributed to it by some writers. In each of these particulars and in climate it is greatly superior to the corresponding inland portion of the territory of Alaska. It may, in fact, be affirmed with little room for doubt, that the region here spoken of as the Yukon district surpasses in material resources the whole remaining northern interior portion of the continent between the same parallels of latitude. Value of the Yukon district.

The winter climate of the whole of this great region is known to be a severe one, and its northern extremity lies within the Arctic circle, but it must be remembered that the climatic conditions on the western and eastern sides of the continent are by no means comparable, and that the isothermal lines, representing the mean annual temperature, Isothermal lines.

trend not westward but north-westward from the Manitoba region. The lines, in particular, which would represent the mean summer temperature would assume, in the far north-west, a proximate parallelism with the Pacific coast, instead of tending to follow lines of latitude. It is needless here to recapitulate the well known causes which produce this remarkable difference in climate, but the lines as already approximately drawn upon the maps, represent in a generalized form the aggregate of influences which, working together, produce at the site of old Fort Selkirk on the 63rd parallel of latitude in the Upper Yukon basin, an attractive landscape, decked with well-grown forests and with intervening slopes of smiling meadow, while in the same latitude in Hudson Strait we find, even at midsummer, merely a barren waste of rocks and ice.

Comparison with province of Vologda.

To instance a region which reproduces the general conditions of the Yukon district and adjacent northern portions of British Columbia, we must turn to the inland provinces of Russia, to which allusion has already been made in connection with climatic features. (p. 23 B.) The province of Vologda, in European Russia, appears to offer the nearest parallel. It is circumstanced relatively to the western shores of Europe, as is this district to the western shores of the North American continent. Its area is 155,498 square miles, situated between the 58th and 65th degrees of latitude. The climate in both cases is a continental one, in which severe winters alternate with warm summers, and the actual degrees of cold and heat, so far as our information goes, are not dissimilar. There is no very heavy rainfall in either region, such as we find near the western coasts bordering on the Atlantic and on the Pacific respectively. The agricultural products from the province of Vologda are oats, rye, barley, hemp, flax and pulse. The mineral products comprise salt, copper, iron and marble, but the precious metals do not appear to be important, as in the Yukon district. Horses and cattle are reared, and the skins of various wild animals, as well as pitch and turpentine, are among the exports. The population of the province is stated at 1,161,000.

Ultimate development assured.

While the Yukon district and the northern portion of British Columbia are at present far beyond the limits of ordinary settlement, we may be prepared at any time to hear of the discovery of important mineral deposits, which will afford the necessary impetus, and may result, in the course of a few years, in the introduction of a considerable population into even its most distant fastnesses. To-day it may well be characterized by the term which has been employed in connection with the Mackenzie basin, a portion of "Canada's Great Reserve." It appears meanwhile eminently desirable that we should encourage and facilitate, in so far as may be possible, the efforts of the miners

and others who constitute our true pioneers in the region, and to whom, in conjunction with the fur companies and traders, the peaceful conquest of the whole of our Great West has been due. In the future, there is every reason to look forward to the time when this country will support a large and hardy population, attached to the soil and making the utmost of its resources.

General Geology.

Difficulties of the field.

In a reconnaissance carried out along a single line, in which the greater part of one's time is necessarily occupied in overcoming the difficulties of the route and in securing the necessary geographical data, it is difficult to obtain any very complete knowledge of a region geologically complicated. In the present case this difficulty is increased by the circumstance that the geology of the corresponding portion of the Cordillera belt in the southern part of British Columbia, is as yet very imperfectly understood, though considerable attention has been devoted to it; while with respect to the older rocks of the analogous region in the western part of the United States very little published information of a systematic kind is available.

General similarity British Columbia.

Speaking broadly, however, and with reference to the general features of the region, the rock-series represented are evidently similar to those found in the southern portion of British Columbia between the Rocky Mountains and the coast, and an important general result of the work here reported on, is the further demonstration of the great constancy in lithological characters of the several formations, when followed in the direction of the main north-west and south-east axes of uplift—a constancy which contrasts markedly with the diversity found when comparisons are made as between localities situated at right angles to this direction.

Rocks of the Coast Ranges.

The Coast Ranges, where traversed by the valley of the Stikine, and again where crossed still further north by the Chilkoot Pass, are found to consist, for the most part, of granite and granitoid rocks, almost invariably of gray colour and frequently rich in hornblende. With these are occasionally included stratified or stratiform masses of mica- and hornblende-schists, and both these and the granites are frequently traversed by pegmatite veins, diabase dykes and intrusive masses of coarse diorite. The schistose portions of these ranges may possibly represent the still recognisable remnants of rocks of Archæan age, or may be merely portions of much newer series which have suffered extreme alteration.

No demonstration of the date of the origin of the granitic rocks of the Coast Ranges was obtained in this region, but there is every reason

to believe that it is comparatively recent, and due to a time lying between the Triassic and the Cretaceous, as has been found to be the case with their continuation to the south, near the northern part of Vancouver Island. *

Rocks of the coast archipelago.

The argillites of Wrangell, together with those met with near Juneau, and at Sitka, on the Alaskan coast, and also in various places along the east side of Lynn Canal, together with the altered volcanic rocks found in association with these on Lynn Canal and elsewhere (examined by me particularly in the vicinity of Seduction Point), closely resemble rocks of the same class composing the Vancouver group of the Queen Charlotte and Vancouver Islands. Though no fossils were obtained at these northern localities, the rocks may, like those just referred to, be provisionally classed as Triassic, with the reservation, (as made in the case of the similar series of the Queen Charlotte and Vancouver Islands), that Palæozoic strata may also be represented.

General features of coast belt.

The width of the belt of granitoid rocks composing the Coast Ranges is, on the Stikine, about sixty-five miles, measured from their sea border inland at right angles to the main direction of the mountains. It is somewhat less in the latitude of the Chilkoot Pass, but may be assumed to occupy a border of the mainland about fifty miles in width along the whole of this part of the coast. Broadly viewed, however, the coast archipelago in reality represents a partly submerged margin of the Coast Ranges, and granitic rocks are largely represented in it also. The examination of these two northern cross-sections of the Coast Ranges, serves, with observations previously made, to demonstrate the practical identity in geological character of this great orographic axis, from the vicinity of the Fraser River to the 60th parallel of north latitude—a length, in all, of about 900 miles.

Formations of the interior region

East and north-east of the Coast Ranges, the interior region traversed is, for the most part, floored by Palæozoic rocks of very varied appearance, and probably referable to several of the main sub divisions of the geological scale. In so far as the information obtained in the region here in question enables conclusions on the subject to be formed, the lowest part of the rocks, (1) consists of greenish and grey schists, generally felspathic or hornblendic, but often quartzose and including distinctly micaceous and talcose schists, with some bands of limestone; the lithological character of this sub-division being exceedingly varied. Apparently overlying these are, (2) grey and blackish, often lustrous and sometimes more or less micaceous calc-schists and quartzites, including beds of limestone of moderate thickness, which are often more or less dolomitic. These are associated with, or pass up into, (3) black

* See Annual Report Geol. Surv. Can., 1886.

argillites or argillite-schists, also containing thin beds of limestone, which, at one locality on the Dease, have afforded a small number of graptolites of Cambro-Silurian age (see p. 99 B). Next above these is a series (4) consisting chiefly of massive limestones, generally of grey or blue-grey colour where unaltered, but often locally changed into white or variegated crystalline marbles. These are closely associated with quartzites which usually show the peculiar fine grained cherty character of those of the typical Câche Creek series on the Fraser and Thompson rivers. The thickness of this sub-division cannot (any more than that of those previously mentioned) be stated with precision, but that of the limestones alone must be several thousand feet in some places. On the Dease, on the Frances, and again on Tagish Lake fossils of Carboniferous age, including more particularly a species of *Fusulina*, have been detected in some beds of this limestone series, probably belonging to its upper portion. Forms of the genus *Fusulina* are characteristic in certain zones of the Carboniferous limestone in California. They have been found by the writer in a number of places in British Columbia, which, with the discoveries here reported on, occur at intervals along a belt of country to the north east of the Coast Ranges for a distance of over 800 miles. The limestone last-mentioned appears to be conformably followed or even in part interbedded with (5) a great mass of more or less evidently stratified rocks of volcanic origin, comprising amygdaloids, agglomerates, and other more massive materials which apparently represent old lava-flows. All these are highly altered, so much so that in some cases their original physical character is scarcely demonstrable, while they have suffered changes also in constitution, having been converted for the most part into diabases.

Fusuline limestones

Analogy with the southern portions of British Columbia which I have examined, leads me to believe that the greater part of these volcanic materials are also to be classed as of Carboniferous age, but it is quite probable that here, as to the south, they comprise as well rocks of similar appearance which are of Triassic age, but which we are at present unable to separate from them. This is further rendered probable by the occurrence in certain black argillites at Glenora, on the Stikine, of Triassic fossils (p. 56 B) and by the discovery by Mr. McConnell of fossils of this age on the Lower Liard River, some distance to the east of the region covered by this report.*

Altered volcanic materials.

No unconformity has been proved to occur throughout the whole of the above Palæozoic series, but the examinations made were scarcely of a sufficiently detailed nature for the detection of any stratigraphical break unless of a very obvious character. Respecting the first-mentioned of the above sub-divisions, I feel some doubt as to whether

Relations of the rock series.

* See Summary Report of the Operations of the Geological Survey for 1887, p. 11.

it really constitutes a lower member of the series or whether it may represent some of the other members—particularly the rocks of volcanic origin—in a highly altered state, as seems, from late observations, to be the case with rocks of similar appearance in southern British Columbia. The proximity of the rocks classed under the first sub-division to certain granitic axes is equally explicable on either hypothesis. It must also be added that there appears to be a recurrence of rock materials originally volcanic in greater or less force in several parts of the series, and that important beds of serpentine occur at one or more horizons.

Geological notes on map.

For the purpose of assisting future more complete enquiry, and in view of the tentative character of the classification here offered, the more important details observed are noted on the face of the map accompanying this report, for which it would be premature to attempt a geological colouring.

Interior granitic axes.

The preponderantly Palæozoic floor of the region east of the granites of the Coast Ranges, is broken through on two main lines by granitic axes. The first of these is cut across by the Dease River, a short distance below Dease Lake, and was again met with—over 300 miles north-westward—on the Pelly near the mouth of the Macmillan. Though referred to as a single granitic axis, this uplift probably consists rather of a series of alternating and more or less irregularly shaped granitic masses, which, however, preserve a general alignment. There are on the Upper Pelly in fact three separate granitic ridges in place of the single one met with on the Dease. In close association with these granites are some gneissic rocks and holocrystalline mica- and hornblende-schists, which have not been referred to in previous paragraphs as they are regarded as probably Archæan, rather than as representing highly altered Palæozoic rocks. A small tongue of granite occurs on the Lewes a few miles above the mouth of the Little Salmon, which may be connected with the south-western side of this granitic axis, but with this exception its continuity between the Dease and Pelly is indicated merely by the statement of Mr. J. McCormick that granites and mica-schists occur on the south-west side of Quiet Lake and near the Big Salmon River, below that lake. Its further extension in a north-westerly bearing is, however, proved by the occurrence of a great preponderance of rocks of the same character in the collection made by Mr. Ogilvie* on the lower Pelly or Yukon, between the mouth of the Lewes and Forty-mile Creek.

Connexion of gold with the rock series.

On comparing the position of this irregular granitic axis and its surrounding altered rocks (in part referable to several of the Palæozoic sub-divisions previously described) with that of the richer deposits of

* Sent out by him in charge of the latest party of miners in the autumn of 1887.

placer gold so far discovered and worked, it will be found that they are closely associated. The chief placers and river-bars are, in fact, scattered along this line or belt, and extend, like it, all the way from Dease Lake and MacDame Creek to Forty-mile Creek. Evidence was moreover found on the Pelly, to show that the development of quartz veins in the Palæozoic rocks had occurred contemporaneously with the upheaval of the granites, and probably by some action superinduced by the granite masses themselves while still in a formative condition. While cutting the stratified rocks, the quartz-veins seldom or never cut the granite masses in this district. These observations should afford an important clue to the further search for auriferous ground, as well as for the lodes from which the placer gold has itself been derived.

Granites of Too-tsho Range.

Of the second granitic axis of the interior region very little is yet known, but it is probable that it is still less regular in character than the last. It occurs in the mountainous region to the east of Frances Lake and River, and probably also in the vicinity of the Pelly Lakes (see p. 121 B). Its lithological characters and those of the rocks in its neighborhood are similar to those of the last described, and here again in its vicinity, on Frances Lake and on the Liard (pp. 105 B, 113 B) paying gold placers have been found. The district is, however, so difficult of access that it can scarcely as yet be said to have been at all prospected.

Age of granites.

I am inclined to believe that the two granitic axes of the interior region above described are of much greater age than that of the Coast Ranges. The reasons for assigning a comparatively late date to the latter have already been alluded to. It is found, too, that while the stratified rocks usually conform to an ascending order in receding from these granitic axes, there is evidence along the north-eastern flanks of the Coast Ranges of an irregular line of junction, and though on the Stikine the Palæozoic rocks appear to rest upon the granites of the Coast Ranges, the supposed lower members of the series are not seen, while on the lakes near the head of the Lewes some of the upper portions of the Palæozoic are directly in contact with and have apparently been broken through by the granites. The granitoid rocks of the interior region are, moreover, different in general appearance from those of the Coast Ranges, and resemble more closely the probably Archæan granites of the Gold Ranges in southern British Columbia.

Lithological character.

Lithologically the granites and granitoid rocks of the Coast Ranges are generally fresh and unaltered in appearance, grey in colour and not often distinctly foliated, while those of the ranges of the interior show evidence of considerable alteration subsequent to their formation, are more highly quartzose and often reddish in tint. Some particulars respecting a few of the granites of the region which has been microscopically examined by Mr. F. D. Adams will be found in Appendix V.

Cretaceous and Laramie rocks.

Besides the Triassic rocks previously referred to, the Mesozoic period is represented also by strata of Cretaceous and Laramie age. These rocks are distinctively more recent in appearance than, and rest quite unconformably on all the older formations, though they have since been to some extent involved in their flexures. On the lower part of the Lewes, below the mouth of the Little Salmon, these rocks are cut across by the river for a distance of at least thirty-five miles. Some fossil molluscs and plants have been obtained from this area, from which it would appear to include beds referable to the Middle or Lower Cretaceous and to the Laramie period (p. 146.B), and it is not improbable that the series is a consecutive one between these limits, as the total thickness represented must be very great. The strike of these beds varies much in direction, and the angles of dip are so irregular that no even proximate estimate of thickness could be formed, and it is impossible to arrive at any definite conclusion with respect to the trend of the basin in which they lie. The rocks comprise, in their lower portion, coarse conglomerates, grauwacke-sandstones, yellowish and grey quartzose sandstones and dark calcareous slates. The upper portion, in which Laramie plants are found, consists chiefly of rather soft sandstones, shales and clays, generally of pale colours. Evidence of contemporaneous volcanic action is observable in both parts of the series, and the higher beds include lignite coal of good quality (p. 148 B).

Some miles further up the Lewes, midway between the Little and Big Salmon rivers, peculiar green, grauwacke-sandstones and green, highly calcareous conglomerates occur, which are also provisionally referred, though with some doubt, to the Cretaceous. They are at least newer than the Palæozoic rocks, being composed of fragments of these and of the granites.

Cretaceous of Lake Labarge.

Conglomerates and sandstones similar to the last are again found near the lower end of Lake Labarge, on the east side, and are associated with black calcareous slates, which recur in several places along the same side of the lake, further up, and from which a few fossils have been obtained. These seem to show that the beds are on or near the horizon of Series C. of the Queen Charlotte Islands, which is of Middle Cretaceous age, approximately equivalent to the Gault (p. 158 B).

Cretaceous of Upper Pelly.

On the Upper Pelly River, forty-three miles below Hoole Cañon, a single low outcrop of hard, dark shales, containing fossil plants of Cretaceous or Laramie, age was found, but in the absence of further exposures along the river in that vicinity, nothing can be said of the extent of this area, except that it must be quite limited in width. Again, on the Stikine River, between Glenora and Telegraph Creek, there are local occurrences of conglomerates and soft sandstones which

may be regarded as probably Cretaceous, though no palæontological evidence is forthcoming.

Relations of the Cretaceous.

The position of these last-noted areas, as well as that of those along the Lewes River, occurring as they do in a zone of country immediately within the line of the Coast Ranges, is analogous to that held by Cretaceous rocks on the Skeena and in other localities still further southward in British Columbia. Further investigation will probably show that rocks of this age occur in many additional places, and occupy somewhat extensive areas in this belt of country. In the vicinity of the Lewes, particularly, it is noted that the plane of the original base of the Cretaceous, now thrown into a number of folds, is about that of the present surface of the country, and these rocks may therefore be expected to recur frequently in the form of troughs or basins, more or less strictly limited and only to be discovered in detail by thorough examination. The loose material brought down by the Big Salmon River, appears to indicate the existence of a considerable development of these rocks not far up the valley of that stream.

Tertiary rocks.

No wide-spread Tertiary areas like those of the southern interior portion of British Columbia appear to occur in the region here described. The most important occurrence of beds of this age met with, is that which occupies the wide valley of the Upper Liard, but its extent to the north-west and south-east was not ascertained. The rocks are soft shales, sandstones and clays, generally of pale color, and holding beds of lignite in some places. Flows of basalt either cap these rocks or are included in their upper portion, and from the considerable angles of dip observed, the formation would appear to have suffered some flexure subsequent to its deposition (p. 101 B).

Basalts.

In the Stikine valley, east of the Coast Ranges, important local basalt-flows are met with, overlying old river- and valley-gravels (p. 57 B), and the lignite reported to exist some miles up the Tahl-tan is, doubtless, also of Tertiary age and inferior in position to the basalts. Basalt effusions of a sporadic character may be frequent in other places in the region, as such were actually noted in three other widely separated localities, viz., above Hoole Cañon on the Pelly, at Miles Cañon on the Lewes, and again at the confluence of this river with the Pelly.

Age of basalts.

The basalts are at least pre-glacial in age, and though no characteristic fossils were observed in the associated bedded deposits, both may be provisionally classed from their analogy with similar deposits in the more southern portion of British Columbia, as Miocene.

Occurrence of Jade on the Lewes.

Occurrence of jade pebbles.

Having become interested in the question of the origin of nephrite or jade, on account of its former extensive employment by the natives of the west coast for the manufacture of implements, * I kept a close watch for this mineral along our route, and ultimately succeeded in finding several rolled pieces of it in gravel-bars along the Lewes (p. 147 B). Of the pebbles collected by us, at least five have the specific gravity and other physical characters of jade, though they have not yet been subjected to chemical or microscopical analysis. Several of these are evidently, however, pure and typical jade, of which the finest and most characteristic was found by Mr. W. Ogilvie, near Miles Cañon. This specimen is a pale-green translucent to sub-transparent variety weighing a pound and three-quarters, after a piece, probably equal to about one-fourth of the original mass, had been broken off and unfortunately lost. Some of the specimens collected, but not referred to in the above remarks, appear to show the passage, by admixture of other materials, of the pure jades into various altered rocks of volcanic origin, as described in the publication above referred to. So far as I have been able to ascertain, the discovery of jade here noted is, with one exception, the first actually direct one made in the region of the Pacific slope. The exception above alluded to is that of jade found at the Kwichpak mouth of the Yukon during Captain Jacobson's stay in that vicinity and which was obtained by him and taken to Berlin †

Glaciation and Surface Deposits.

Such details as appear to be of interest respecting glaciation, and the superficial deposits, are given in the subsequent descriptive portion of this report. The general bearings of these are here merely summarized in the briefest possible manner.‡

Previous observations in British Columbia

Previous observations in British Columbia§ have shown that at one stage in the Glacial period—that of the maximum glaciation—a great confluent ice-mass has occupied the region which may be named the Interior Plateau, between the Coast Ranges and the Gold and Rocky Mountain ranges. From the 55th to the 49th parallel this great glacier has left traces of its general southward or south-eastward movement, which are distinct from those of subsequent local glaciers. The southern extensions or terminations of this confluent glacier, in

* See Canadian Record of Science, vol. ii No. 6, April, 1887.

† See paper by Prof. A. B. Meyer, Jahresbericht des Vereins für Erdkunde zu Dresden, 1884.

‡ The substance of this summary has been published in advance in the Geological Magazine. Decade III, vol. v. p. 347 (Aug. 1888).

§ Quart. Journ. Geol. Soc. vol. xxxi. p. 89. *Ibid.* vol. xxxiv. p. 272. Canadian Naturalist, vol. viii.

Washington and Idaho Territories, have quite recently been examined by Mr. Bailley Willis and Prof. T. C. Chamberlin of the U. S. Geological Survey,* and their observations tend to confirm the views above outlined, which had previously been stated by the writer. There is, further, evidence to show that this inland-ice flowed also, by tranverse valleys and gaps, across the Coast Ranges, and that the fiords of the coast were thus deeply filled with glacier-ice, which, supplemented by that originating on the Coast Ranges themselves, buried the entire great valley which separates Vancouver Island from the mainland, and discharged seaward round both ends of the island. Further north, the glacier extending from the mainland coast touched the northern shores of the Queen Charlotte Islands. The observed facts on which these general statements are based have been fully detailed in the publications already referred to, and it is not here necessary to review former work in the region, further than to enumurate the main features developed by it, and to connect these with the observations made during the summer of 1887, in the more northern region described in the present report.

Glaciation of the coast.

The littoral of the south-eastern part or "coast strip" of Alaska, presents features identical with those of the previously examined coast of British Columbia, at least as far north as lat. 59°, beyond which I have not seen it. The coast archipelago has evidently been involved in the border of a confluent glacier which spread from the mainland and was subject to minor variations in direction of flow dependent on surface irregularities, in the manner described in my report on the northern part of Vancouver Island. † No conclusive evidence was here found, however, in the valley of the Stikine River or in the pass leading inland from the head of Lynn Canal, to show that the inland-ice moved seaward across the Coast Ranges, though analogy with the coast to the south favours the belief that it may have done so. The front of the glacier must have passed the outer border of the archipelago, as at Stika, well-marked glaciation is found pointing toward the open Pacific ‡ (average direction about S. 81° W. astr.).

Glaciation of the interior region.

It is, however, in the interior region, explored and examined by us in 1887, between the Coast Ranges and the Rocky Mountains proper, and extending northward to lat. 63°, that the most interesting facts have come to light respecting the direction of movement of the Cordilleran glacier. Here, in the valleys of the Upper Pelly and Lewes, traces were found of the movement of heavy

* Bulletin U S. Geol. Survey, No. 40, 1887.

† Annual Report Geol. Surv. Canada, 1885, p. 100 B.

‡ Mr. G. F. Wright has already given similar general statements with regard to this part of the Coast of Alaska. American Naturalist, March, 1887.

glacier-ice in a northerly direction. Rock-surfaces thus glaciated were observed down the Pelly to the point at which it crosses the 136th meridian and on the Lewes as far north as lat. 61° 40′, the main direction in the first-named valley being north-west, in the second north-north-west. The points referred to are not, however, spoken of as limiting ones, for rock exposures suitable for the preservation of glaciation are rather infrequent on the lower portions of both rivers, and more extended examination may result in carrying evidence of the same kind further toward the less elevated plains of the Lower Yukon, as elsewhere detailed. Neither the Pelly valley nor that of the Lewes is hemmed in by high mountainous country except toward the sources, and while local variations in direction are met with, the glaciation is not susceptible of explanation by merely local agents, but implies the passage of a confluent or more or less connected glacier over the region.

On Lake Labarge, in the Lewes valley, both the sides and summits of rocky hills 300 feet above the water were found to be heavily glaciated, the direction on the summit being that of the main (north-north west) orographic valleys, while that at lower levels in the same vicinity followed more nearly the immediate valley of the river, which here turns locally to the east of north.

Glaciation was also noted in several places in the more mountainous country to the south of the Yukon basin, in the Dease and Liard valleys, but the direction of movement of the ice could not be determined satisfactorily, and the influence of local action is there less certainly eliminated.

Deposits of the glacial period.

While the greater part of the area traversed is more or less completely mantled with glacial deposits, it will be observed, in referring to subsequent pages, that true boulder-clay was found in certain parts only of the southern and more mountainous portion of the region, while it spreads over almost the entire length of the Upper Pelly and Lewes valleys, though not found exposed quite to their confluence. The boulder-clay generally passes upward into, and is covered by, important silty beds, analogous to the silts of the Nechacco basin, further south in British Columbia, and to those of the Peace River country to the east of the Rocky Mountains. It may be stated also that the country is generally terraced to a height of 4000 feet or more, while on an isolated mountain-top near the height of land between the Liard and the Pelly rivers (Pacific-Arctic watershed) rolled gravel of varied origin was found at a height of 4300 feet, a height exceeding that of the actual watershed by over 1000 feet.

Mastodon remains.

No remains of mastodon or mammoth were observed in the country traversed by us, but according to Campbell such remains occur not far

from the site of Fort Selkirk, and they are known to be moderately abundant at points further down the river. Sir J. Richardson speaks of a tibia of *Elephas primigenius* sent to England by Roderic (Robert) Campbell from this region.*

Reverting to the statements made as to the direction of the general glaciation, the examination of this northern region may now be considered to have established that the main gathering-ground or *névé* of what I have called the great Cordilleran glacier or confluent glacier mass of the west coast, was included between the 55th and 59th parallels of latitude, a region which, so far as explored, has proved to be of an exceptionally mountainous character. It would further appear that this great glacier extended, between the Coast Ranges and the Rocky Mountains, south-eastward nearly to lat. 48°, and north-westward to lat. 63°, or beyond, while sending also smaller streams to the Pacific Coast. General facts established.

In connection with the northerly direction of ice-flow here ascertained, it is interesting to recall the observations which I have collected in a recently published report of the Geological Survey, relating to the northern portion of the continent east of the Mackenzie River.† It is there stated that for the Arctic coast of the Continent, and the Islands of the Archipelago off it, there is a considerable volume of evidence to show that the main direction of movement of erratics was *northward*. The most striking facts are those derived from Prof. S. Haughton's Appendix to M'Clintock's Voyage, where the occurrence is described of boulders and pebbles from North Somerset, at localities 100 and 135 miles north-eastward and north-westward from their supposed points of origin. Prof. Haughton also states that the east side of King-William's Land is strewn with boulders of gneiss like that of Montreal Island, to the southward, and points out the general northward ice-movement thus indicated, referring the carriage of the boulders to floating-ice of the glacial period. Other instances of northward glaciation

The copper said to be picked up in large masses by the Eskimo, near Princess-Royal Island, in Prince-of-Wales Strait, as well as on Prince-of Wales Island,‡ has likewise, in all probability been derived from the copper-bearing rocks of the Coppermine River region to the south, as this metal can scarcely be supposed to occur in place in the region of horizontal limestone where it is found.

Dr. A. Armstrong, Surgeon and Naturalist to the *Investigator*, notes the occurrence of granite and other crystalline rocks not only on the south shore of Baring Land, but also on the hills at some distance

* Am. Journ. Sci. and Arts, vol. xix., 1855, p. 132.

† Notes to accompany a Geological Map of the Northern Portion of the Dominion of Canada East of the Rocky Mountains, p. 57 R., Annual Report Geol. Surv. Can., 1886.

‡ De Rance, in Nature, vol. xi. p. 492.

from the shore. These, from what is known of the region, must be supposed to have come from the continental land to the southward.

Dr. Bessels, again, remarks on the abundance of boulders on the shore of Smith's Sound in lat. 81° 30′, which are manifestly derived from known localities on the Greenland coast much further southward, and adds: "Drawing a conclusion from such observations, it becomes evident that the main line of the drift, indicating the direction of its motion, runs from south to north."*

It may further be mentioned that Dr. R. Bell, has found evidence of a northward or north eastward movement of glacier ice in the northern part of Hudson Bay, with distinct indications of eastward glaciation in Hudson Strait.† For the northern part of the great Mackenzie valley we are as yet without any definite published information, but Sir J. Richardson notes that Laurentian boulders are scattered westward over the nearly horizontal limestones of the district.

Two great glacier-masses.

Taken in conjunction with the facts for the more northern portion of the continent, already pretty well known, the observations here outlined would appear to indicate a general movement of ice outward, in all directions, from the great Laurentian axis or plateau which extends from Labrador round the southern extremity of Hudson Bay to the Arctic Sea; while a second, smaller, though still very important region of dispersion—the Cordilleran glacier-mass—occupied the Rocky Mountain region on the west, with the northern and southern limits above approximately given, and a length, in a north-west and south-east direction, of at least 1200 miles.

It is inexpedient at the present moment to enter into any detailed discussion of the glaciation of the extreme north-west, as Mr. McConnell's observations, made in the prosecution of his portion of the work of the expedition, are likely to add much to our store of facts bearing on the subject.

Economic importance of facts elicited

It may be added, that while the study of the phenomena of the glacial period is one not without its bearings on economic problems even in the eastern part of the continent, it has, in British Columbia and the Yukon district, a direct value in its connection with the distribution of the placer gold deposits and on the existence and position of the buried channels of rivers and streams, in which some of the richest of those deposits are often found to occur. Thus the greater part of the "fine" gold found along the river-bars and banks of the larger streams in the Yukon district is doubtless proximately derived from the gravels

* Nature, vol. ix.

† Annual Report Geol. Surv. Canada, 1885, p. 14 D.D. and Report of Progress, 1882-84, p. 86 D.D.

and other superficial deposits in which these streams have re-excavated their beds since the period of glaciation. By the general dispersion and intermixture of these materials, composed of the *débris* of the older rock formations, it is even possible that the existence of a few comparatively limited areas of great richness might account for the wide-spread auriferous character of the alluviums of the Upper Yukon basin. In the former direction of ice-movement, and consequently that of its transport of material, we obtain an important clue as to the source of the finer gold which may now be found in any particular area. This subject is too wide in its ramifications to be followed out here, but it is one to which considerable attention has been devoted, and to which I hope to return at an early date in greater detail.

Volcanic Ash Deposit.

Extent of the deposit.

A circumstance of some interest in connection with the later superficial deposits of that part of the Upper Yukon basin drained by the Lewes and Pelly rivers, is the occurrence of a wide-spread layer of volcanic ash or pumiceous sand. The existence of a peculiar white line or band in the upper parts of scarped banks along the river, was first remarked not many miles below the point at which we reached and embarked on the Pelly. As its character was not at first understood, I omitted to note the precise point at which it was first seen but am of opinion that it probably extends to the east of the place where we reached the river. After recognizing its character and importance, however, it was looked for and noticed almost continuously along the whole course of the Pelly, as far down as the mouth of the Macmillan, beyond which, to the site of Fort Selkirk at the mouth of the Lewes, it was not distinctly recognized, but according to Mr. McConnell (1888) it extends down the river for about ten miles below Fort Selkirk. It is likewise seen along nearly the whole course of the Lewes, being last noted at the narrows between Lake Nares and Bennett Lake, known as Caribou Crossing. *

Origin of the deposit.

This ash deposit appears to be entirely due to a single period of eruption. It is homogeneous in character wherever seen, forming a single layer not divided by intercalations of other material, and has been spread everywhere over the entire area characterized by it. It is much more recent in date than the white silt deposits, which are the last of those properly referable to the glacial series, having been deposited after the river-valleys were excavated in the glacial materials, and at a time when the rivers had cut down nearly or quite to their

* I found subsequently that Schwatka had observed this peculiar layer along the Lewes and correctly characterized it as a volcanic ash. Along Alaska's Great River, p. 196.

present levels, a fact rendered evident by the circumstance that it overlies the deposits of river- and valley-gravels and sands in all cases, except in those of some low river-flats, where these deposits sometimes cover it to a depth of several feet. In most places it is overlain merely by the surface soil with a depth of six inches to two feet, and in a few instances it was noted as constituting the actual surface of terraces of moderate height, the present forest being rooted in it.

Mode of deposition and thickness.

The ash appears to have fallen tranquilly, much in the manner of snow deposited from a calm atmosphere. The examination of scarped banks along the two rivers showed it to occur near the surface of terraces about 200 feet in height, as well as on lower terraces and river-flats down to within about ten feet of the actual river-level in August and September. It was also detected in some places on the sloping fronts of terraces. The thickness of the layer was no doubt originally pretty uniform, and it still retains this uniformity where it rests upon wide flat terraces. Its average normal thickness for the Pelly, as a whole, was estimated at about five inches, but this is somewhat exceeded along the part of the river immediately above the Macmillan. On the Lewes, below Rink Rapid, its normal thickness is about a foot, but above this point it becomes much less and where last seen, at Caribou Crossing, is not over half an inch thick, and only to be recognized when carefully looked for.

Local accumulation.

In addition to these differences in normal thickness, however, and much more striking than them, is an irregularity due to local circumstances. Thus in hollows, and particularly when these occur at the foot of steep slopes, the material has evidently been washed together by rains occurring shortly after its deposit, and sometimes attains a thickness of as much as three feet. In correspondence with this it has been completely removed from some sloping or exposed surfaces. The same local circumstances explain the varying depth in different localities of the soil or ordinary sand which overlies the ash deposit.

Where the ash deposit rests undisturbed upon the original surface, this appears very generally to be a yellowish or reddish quartzose sand. There are, in some cases, remains of burnt trees at the base of the layer, and traces of similar forest fires are found as well in the sand or soil overlying it.

Source of the ash deposit.

So far as the observations I was able to make go, the volcanic ash is thicker on the lower part of the Lewes than elsewhere, and the thickest part of the deposit on the Pelly lies nearly due east of the portion of the Lewes just referred to. The greater mass of the deposit in that direction, seems to show that it was derived from the westward, and a line drawn across the portions of the Pelly and Lewes above defined, lies between the 62nd and 63rd parallels of latitude, with a nearly east-and-

west bearing, so that if produced to the westward it would pass, at a distance of about 200 miles, through the mountain region near the Copper River, of Alaska, which includes Mount Wrangell. Mount Wrangell is the nearest known volcano,* and this or one of the

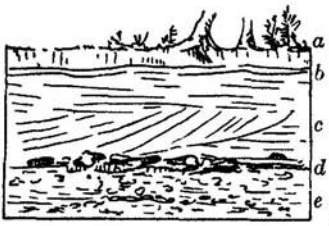

FIG. 1. RELATIONS OF ASH-BED ON THE LEWES RIVER.

a. Soil. *b*. Ash-bed. *c*. Stratified sands and gravels. *d*. Buried drift-wood. *e*. Stratified gravels.

neighbouring mountains in the same group, may not improbably have been the source of the material which has been so widely spread over the Upper Yukon basin. It should be stated, however, that the Indians report the existence of a burning mountain near the head-waters of the White River, and that it is uncertain whether this report refers to Mount Wrangell or to some still unknown mountain which may be even nearer to the district here described.

Respecting the date of the eruption to which the ash-bed is due, very little can be said with certainty. As already noted, the rivers have not certainly cut their beds perceptibly deeper since the deposit occurred on their flood flats, so that the period to which it belongs cannot be an exceedingly remote one. It was further observed in one place, on the Lewes, to rest upon stratified sands a few feet thick, which in turn overlie a mass of drift logs still quite sound and undecayed. This fact, with the general appearance and mode of occurrence of the deposit, leads me to believe, that while the eruption must have happened at least several hundreds of years ago, it can scarcely be supposed to have taken place more than a thousand years before the present time. Dall, in his work on Alaska, gives a list of volcanic eruptions (derived from Grenwingk) which have occurred in the Aleutian Islands and along the western part of the Alaskan Coast from the year 1690. † While it is quite improbable that any of these was connected with the formation here described, it is interesting to note that great quantities

Date of the eruption.

* See Lieut. H. T. Allen's Reconnaissance in Alaska, Washington, Government, 1887.

† Alaska and its Resources, 1870, p. 466.

of ash were observed to fall on several occasions, notably in 1825, when the whole peninsula of Alaska was covered with black ashes.

Volume of ash ejected.

That the eruption of which the occurrence is marked by the ash-bed of the Lewes and Pelly, was on a great scale, is sufficiently evident from the extent of the deposit; which must necessarily be very much greater than the area to which the present observations refer. By drawing a line such as to include the outer limits of the observed extent of the ash, a roughly triangular area of about 25,000 square miles is outlined, and if we assume the average depth of the layer over this area alone to be three inches, the mass represented would be equivalent to a prism one mile square, with a height of 6240 feet or (making allowance for interspaces in the comminuted material) equal to nearly a cubic mile of rock.

Lithological character.

It has not been considered necessary to make a complete examination of the character of this ash. In appearance it is a fine, white, sandy material, with a harsh feeling when rubbed between the fingers Microscopically it is found to consist chiefly of volcanic glass, part being merely frothy and pumiceous, but of which the greater portion has been drawn out into elongated shreds, frequently resembling the substance known as "Pele's hair," in which the enclosed vesicles become more or less completely tubular. In addition to this glass, fragments and small perfect examples of sanadine felspar crystals occur together with portions of minute crystals of hornblende and probably of other minerals.

The Stikine River.

General Features.

River cuts across the Coast Ranges.

Since the year 1873, when the placer gold mines of Cassiar were first developed, the Stikine River has become a somewhat important avenue of communication from the coast to the interior of the northern part of British Columbia. Like the Fraser, the Skeena, the Nass and several other smaller streams, it rises to the east of the broad belt of mountains which constitutes the Coast Ranges, and cuts completely through this belt with a nearly uniform gradient. In size and general character the Stikine closely resembles the Skeena, which reaches the coast 200 miles further south. It is navigable for stern-wheel steamers of light draft and good power, to Glenora, 126 miles from Rothsay Point, at its mouth, and under favourable circumstances to Telegraph Creek, twelve miles farther. Above Telegraph Creek is the "Great Cañon" which extend for many miles and is quite impassable either for steamers or boats, though traversed by miners in winter on the ice. The head-waters of the Stikine are unknown, but lie for the

Route to the interior.

most part to the south of the 58th parallel of north latitude, in a country said to be very mountainous, interlocking there with northern branches of the Nass and western feeders of the Black or Turnagain River, a tributary of the Liard. From Telegraph Creek, the head of navigation, a pack-trail sixty-two miles and a-half in length, constructed by the British Columbian Government, follows the valley of the Stikine, generally at no great distance from the river, and eventually crosses from the Tanzilla or Third North Fork to the head of Dease Lake, which may be regarded as the centre of the Cassiar mining district. This route has long been known to the Indians, the Stikine having been to them from time immemorial an important avenue of trade, by which, as by the Skeena, the coast tribes penetrated a considerable distance inland.

Information obtained.

My personal acquaintance with the Stikine, as far as Telegraph Creek, was such only as could be made from the deck of the little steamer in which we ascended the river to that point, and merely enabled me to note the main features of the valley. This was supplemented, however, by the observations of Mr. McConnell, who remained behind for the purpose of making a micrometer survey of the river from the furthest point reached by Mr. Hunter's survey of 1877 to Telegraph Creek. Mr. McConnell's notes and map with specimens collected by him have been consulted in the following sketch of the river, and are drawn upon particularly in respect to its geological features.

Map of the river.

As the result of Mr McConnell's survey, taken in conjunction with that of Mr. Hunter, we are now for the first time in possession of a correct map of the river to the head of navigation. The best general map of the river and route to Dease Lake previously in existence, was a sketch made by Mr. G. B. Wright and published in the report of the Minister of Mines of British Columbia in 1875. This map also includes Dease Lake and part of the Dease River, and I may take this opportunity of stating that much credit is due to Mr. Wright for its general accuracy, taking into consideration the circumstances under which it was made.

Trend of the main valley.

The general trend of the Stikine valley for twenty miles from the sea, is east-and-west, corresponding in direction to Bradfield Canal, which penetrates the coast thirty miles to the south, and also to part of the northern portion of Behm Canal and Burroughs' Bay, still further south. At this distance from the coast the river bends through a quadrant of arc, and assumes a nearly due north direction, which it maintains for about sixty-six miles, beyond which the valley is continued in a nearly direct north-eastward course to the vicinity of Dease Lake, but in its upper portion is occupied, not by the main river, but by the Tanzilla or Third North Fork, the main river entering this continuous valley from the southward.

The Coast Mountains.

The particular range of the Coast Mountains, which locally assumes a culminating or axial character on the Stikine, is that which is traversed by the river-valley near the great bend above alluded to. As seen from the sea, at some distance off shore, it is notably higher and rougher to the north of the river-valley than to the south of it, and is surmounted by sharp, jagged, rocky pinnacles in some places. The highest summits in this range here probably average about 8000 feet. It carries much snow throughout the year, and in it are the sources of the principal glaciers which debouch along the north-and-south part of the river above the great bend. The inland border of the Coast Mountains may be said, on the Stikine, to be near Glenora, giving a transverse width, from the coast, for this rugged belt of country of nearly eighty miles.

Current of the river.

The current of the navigable portion of the Stikine is swift throughout, but there are no rapids properly so called, though the Little Cañon (fifty-three miles above the great bend) forms a serious impediment to navigation when the river is at its highest stage in June or July, in consequence of the great velocity of the current in this narrow and rocky though deep gorge. Near the mouth of the river the current scarcely surpasses two miles an hour, but it increases as the river is ascended, till it attains a rate of six to seven miles in many places between the great bend and Telegraph Creek, the swifter water being chiefly met with above the Little Cañon. The average rate of flow of the navigable portion of the river must be about five miles an hour. The width of the Stikine immediately opposite Telegraph Creek was found on May 29th to be 480 feet only, but it is here deep, and had a velocity of 6·08 miles per hour, as determined from several observations. A few days later it was rising fast, and the velocity was considerably greater.

Navigation

Stern-wheel steamers for the navigation of the river should have good engine power, and should draw not more than four feet of water when loaded.

The height of the river above sea-level at Telegraph Creek, as deduced from simultaneous barometric observations at the mouth and at this place, is 540 feet, giving an average fall of over four feet to the mile by the course of the stream. The actual fall on the upper part of this length of the river must, however, considerably exceed this figure, while that of the lower portion is inconsiderable. Under ordinary circumstances the ascent of the river to Telegraph Creek, with a suitable steamer, occupies about three days, and it is generally necessary to carry a line ashore at a few places. The extensive flats near the mouth of the river render it necessary to enter it about high-tide. Mr. Hunter ascertained that the channel across these

flats has from one to two feet only of water at low tide. A considerable proportion of the traffic is carried on by Indians with canoes, and the Stikine Indians are very expert in all the necessary operations of tracking and poling in swift water.

Notes on the dates of opening and closing of the river will be found on page 60 B.

Lower part of river at one time an inlet.

The entrance to the Stikine from the sea is not distinguishable in its main orographic features from that of many of the salt-water inlets by which this part of the West Coast is dissected. The lower portion of this river valley may, in fact, be regarded, like that of the corresponding part of the Skeena, as an inlet which has become filled with detritus in consequence of the great size and sediment-carrying capacity of the river which has emptied into it. Unlike the Skeena, however, the *debris* brought down has in this case been projected seaward so as to completely block the wide channel between the mainland coast and Mitkoff Island with shallow tide-flats and bars, above which several smaller, high, rocky islands project. The mountains immediately bordering the valley of the Stikine at its seaward entrance are from 2000 to 3000 feet in height, and rise abruptly from the wide alluvial flats, through which the river there winds, often without even touching the lower spurs of the hills.

Character of valley to Little Cañon.

The flats are generally covered with fine groves of cottonwood, mingled with spruce and other trees, and are often cut through by sloughs and channels, which become so numerous in some places as to render it difficult to decide which is entitled to rank as the main stream. The valley-bottom maintains an average width of from two to three miles as far up as the Little Cañon, which place may be regarded as nearly marking the head of the old salt-water inlet which has been silted up by the river. The cañon is about three-fifths of a mile long, and in places not more than fifty yards wide. It is bordered by massive granite cliffs, 200 to 300 feet in height, above which, on the west side, rugged mountain slopes rise. On the east, are low rocky hills representing part of a former spur of the mountain, through which the cañon has been cut. A tract of low land separates these hills from the eastern side of the main valley, and it is difficult to explain under what circumstances the river has taken its present course.

Valley above Little Cañon.

For some distance above the Little Cañon the Stickine valley appears to cut very obliquely through a series of somewhat irregularly parallel ranges. Eight miles further up is the "Kloochman Cañon," which to some extent repeats the features of the last, but it is nearly 300 feet in width and offers no impediment to navigation. At four miles above the "Kloochman Cañon" is the so-called "Grand Rapid," which, in consequence of recent changes in the river, is now by no means formid-

able, though the water is still particularly swift and the river wide and shallow. Here the valley begins very markedly to open out, the mountains retiring further from the river and decreasing in altitude, while irregular, basaltic hills, of no great height appear between the river and the bases of the mountains. This, taken in conjunction with the dry climate which characterizes the country to the east of the mountains, and the fact that most of the slopes have been bared of timber by fire, gives an entirely different aspect to the landscape.

Iskoot River.

The Stikine is joined by some important tributaries in the part of its course above described, though none of those have yet been examined in detail. The Iskoot or Skoot, which flows in from the eastward about thirty-five miles from the mouth, or just within the locally culminating range of the Coast Mountains, is known to be navigable for some distance by canoes, and one branch is said to head not far from the extremity of Portland Canal, to the southward. By following this river to its head and there making a portage, the Indians are reported to be able to reach the Nass River without difficulty. The Iskoot has been prospected by a few miners, but apparently without any notable result, though the Indians report the occurrence of coal. The northern branch of the Iskoot, to the east of the Coast Mountains, was traversed in 1867 by P. J. Leech, of the Western Union Telegraph Exploration Survey, who crossed from it to the head of the First South Fork of the Stikine. The valley is there reported to be from 2500 to 3700 feet above sea-level, generally timbered, but with some open, grassy slopes.

Scud River.

About seven miles below the Little Cañon, the valley of the Scud River opens to the east, but the exact position of the mouth of the stream has not been fixed on the map. Some gold has been found by prospectors on this stream, but no workable placer deposits. It is said to head in a low country behind the Coast Mountains, and if this be correct, must nearly inosculate with branches of the Iskoot and First South Fork of the Stikine.

Clearwater River.

Six miles above "Kloochman Cañon," the Clearwater River enters the Stikine on the west side, by several mouths. This is a stream of considerable size, and is navigable for canoes for some distance. It is said to head near the sources of one branch of the Taku River, and is noted by the Indians on account of the great number of salmon which ascend it.

First South Fork.

The First South Fork joins the Stikine about a mile and a-half below Telegraph Creek. It is a large turbid stream, and for a number of miles from the main river, flows in a rough narrow gorge, between high hills and mountains. Further up, according to the Telegraph Exploration sketch, it is bordered by level, partly timbered terraces or

"benches." The summit between its head-waters and those of the Iskoot, on the route followed by Mr. Leech, is given on his authority at 5000 feet. Salmon do not ascend this stream.

Telegraph Creek and Glenora.

Telegraph Creek is an inconsiderable stream, which falls rapidly to the river through a narrow rocky cleft in the bordering hills of the right or north-west bank of the Stikine. Its name is due to the fact that here the Western Union Telegraph line was intended to cross the Stikine. The little town of Telegraph Creek occupies the narrow delta of the stream and the lower terraces bordering it on both sides, its site being identical with that of "Fort Mumford" of the older maps. Glenora, twelve miles below Telegraph Creek and on the same side of the Stikine, consists of a single row of houses built along the edge of the river at the foot of a steep bank. Both places were at one time busy little towns, but are at present very much reduced in importance, though I believe it will probably not be long before further mining developments in the Cassiar district will lead to the renewal of their activity.

Glaciers.

Previous notes on the glaciers.

The glaciers constitute one of the most remarkable features of this part of the Stikine valley. There are a number of these on both sides of the river, in its lower part; but four only of special importance, all of which are situated to the west of the river, and all but the first on the eastern slopes of the most massive central ranges of the mountainous region. The only detailed previous notice of these glaciers is that given in a report by W. P. Blake.* Mr. Blake's account of the glaciers is transcribed in the Fifth Annual Report of the United States Geological Survey, where it is placed under the somewhat misleading title of Glaciers of "Alaska." Two of the glaciers are illustrated in the last-mentioned volume by reproductions of photographs taken under the direction of Dr. J. W. Powell, Superintendent of Indian Affairs in British Columbia. That named the "Orlebar Glacier" represents part of the front of the Great Glacier of the miners and of Mr. Blake's map. The "Bernard Glacier" I am unable to identify with any certainty, but the illustrations evidently represents part of either the Flood or Dirt Glacier.

Mr. John Muir, who spent some time on the Stikine in 1879, gives an interesting popular description of its glaciers in a letter dated from Sitka in December of that year, and published in the San Francisco Bulletin. Mr. Muir informs me that no more systematic account of his observations in this region has yet been made public. The glaciers

*Geographical notes upon Russian America and the Stikeen River. W. P. Blake, Washington, Government. 1868.

are also noticed at some length in an account of a trip on the Stikine by Mr. W. H. Bell in Scribner's Monthly. 1879, Vol. XVII. The accompanying illustrations, though striking and artistic, have been idealized so far as to be scarcely recognizable.

Little Glacier. The glacier known as the First or Little Glacier by the miners (named the Popoff Glacier by Blake) fills a high valley on the north side of the river, about ten miles from its mouth. As seen from a distance it offers no features of particular interest, resembling many other minor glaciers of the Coast Mountains.

Great Glacier. The next and most important glacier, is that universally known on the river as the Great Glacier, and so named also by Mr. Blake, who gives an excellent description of its main features. The high snow-fields from which this glacier must take its rise are not seen from the river, the glacier entering the wide valley of the Stikine nearly at right-angles, through a break in the mountains two to three miles distant from the river bank. Before entering the Stikine valley, the glacier has a width estimated at from one-half to three-quarters of a mile, but upon freeing itself from the bordering mountains immediately expands in a fan-like manner, its actual front upon the river being from three to three and a-half miles in width. The slope of the surface of the glacier where it issues from the mountains was estimated — as seen at right angles — at above five degrees. Beyond this point it flattens out, and portions of the surface become extremely rugged, breaking off near the front in series of descending steps, as described by Mr. Blake. When seen by us, on the 20th of May, much of the surface was still covered by the new snow of the preceding winter, but notwithstanding this, a great quantity of rocky *débris* was visible, giving a grey tint to portions of the ice. The front of the glacier appears to be quite close to the edge of the river, but is actually about a third of a mile distant at the nearest points. This interval is occupied by moraines and marshy pools, the outer tier of moraines, or that nearest to the river, forming wooded hills about one hundred and fifty feet high. The newer moraines were partly covered and overridden by the front of the decaying ice. Large streams issue from beneath the ice, the position of outflow frequently changing from year to year.

Next to its size, the most remarkable feature about this glacier is the regularity of the fan-like form in which it terminates. It resembles in this respect the Davidson Glacier on Lynn Canal.

Recession of the glacier. The miners state, that during the few years which they have known the Stikine the Great Glacier has steadily and notably receded, though the total amount of such recession can evidently not have been more than the distance from the wooded bordering-moraine to the present

ice-front. The Indians relate as a tradition, that at a former period the glacier stretched completely across the valley, the Stikine passing beneath the ice through a tunnel-like opening. It is, however, impossible to determine whether this is a remembered fact or a fancied inference. Curiously enough, a copious hot spring is situated immediately opposite the glacier on the east side of the Stikine valley.

Dirt Glacier.

Ten miles above the Great Glacier, and also on the west side of the valley, is the Dirt Glacier, so named by the miners because of the great quantity of rocky *débris* with which its surface is covered.* This is much smaller than the last, having a width estimated at a quarter of a mile, but possibly greater than this. Like the Great Glacier, it comes quite down on the river-flats.

Flood Glacier.

The last important glacier, sixteen miles still further up the river, is the Flood Glacier. This also comes down to the level of the river-flats, but does not closely approach the river. From the valley of this glacier a great rush of water occurs almost every year towards the end of the summer. This, no doubt, arises from the blocking by the glacier of the mouth of some lateral valley in which a lake is formed and from time to time breaks through the glacier dam. The quantity of water thus liberated is so great as to raise the river from a low stage to half-flood level for a short time. There is a large quantity of *débris* also on this glacier, though less than on the last.

Geological Notes on the Stikine.

Mr. Blake's observations.

The only information as to the geology of the Stikine, up to the present time, has been that embodied in notes in Mr. Blake's report, already referred to,† and these include the lower portion of the river alone, as his furthest point was a few miles above the Little Cañon. The results of Mr. Blake's examination are by himself summed up in the following terms:—"The mountains of the Stikine valley, from the Little Cañon down to near the coast, are formed of syenite and granite, with some metamorphic beds at intervals. The walls of the Little Cañon are granite. At the mouth of the river, and below the Indian villages, the rocks are quite different, being formed of the great sandstone and shale formation already described. The direction of uplift of these strata is about N. 80° W. magnetic. This formation is some thousands of feet thick, and resembles the rocks of San Francisco, but is more changed by metamorphic action. They are probably of the secondary period. It appears to pass into mica-

* Also so named on sketch map in Report on Customs District, Public Service and Resources of Alaska Territory, by W. G. Morris, 1879.

† Mr. Blake's notes on the geology of the river are also given in Petermanns Mitteilungen, vol. x, 1864.

slate just above the site of an old stockade or fort of the Hudson Bay Company, where I found a locality of garnets like those of Monroe, in Connecticut."*

Rocks of Wrangell Island.

The rocks seen along the west shore of Wrangell Island, in the vicinity of the town and harbor, are chiefly black, flaggy argillites, remarkably uniform and regular in their bedding and with a westward dip. They are considerably indurated and contain small staurolite crystals in some layers, while on the surface of others crystals of mica have been developed. Similar rocks are found on other parts of the coast, both to the north and south, and from a lithological point of view, they much resemble the Triassic argillites of the Queen Charlotte Islands, though no fossils were found at this place. The ridge behind the town of Wrangell is chiefly composed of rather fine-grained grey granite, which is probably intrusive and may have been the cause of the incipient crystallization observed in the argillites. The north point of the island is formed of similar granite, probably a continuation of the same mass.

Rocks at mouth of river.

On crossing to the mainland, to the eastward, mica-schists and granites are met with, and beyond Rothsay Point (which may be regarded as the entrance to the Stikine River) granitic rocks only were seen for some miles. Near Rothsay Point, at a short distance from the shore,

Garnets.

is the locality from which are obtained fine claret-colored garnet crystals, sometimes an inch or more in diameter. The matrix of these, as seen in hand specimens, is a dark, highly crystalline mica-schist, but the locality was not visited. The general strike of the rocks west of Rothsay Point is about S. 35° E., with prevailing westward dips.

Rothsay Point to Great Glacier.

From Rothsay Point to the Great Glacier, the mountains bordering the river are chiefly composed of granites and granitoid rocks. These alternate with gneissic and schistose rocks of similar composition, including mica-schists; but massive granites probably form much the greater part of the whole. The granites are usually grey in colour, and contain both hornblende and mica, with white felspars, which are often porphyritic, giving the rock a spotted appearance.† Some varieties become granitoid diorite, while others are highly quartzose, and contain little or no hornblende. The series as a whole closely resembles that cut across by the Fraser River in its lower course, and generally characteristic of the Coast Ranges of British Columbia.‡

Rocks brought down by the glacier.

The Great Glacier, rising many miles back in the higher ranges of the mountains, in the material which it has brought down and deposited in its moraine, affords a mode of ascertaining the gen-

* This does not appear to be the locality near Rothsay Point, subsequently mentioned.
† See note on the lithological character of the granites, Appendix V.
‡ Compare Annual Report Geol. Surv. Can., 1886, p. 11 B.

eral composition of the central ranges. This material was found by Mr. McConnell to consist almost entirely of grey granite of medium grain, composed of felspar, quartz and hornblende in nearly equal proportions, but holding also a little mica and occasional crystals of sphene. Diorites and mica schists occur in smaller quantity, together with coarse pegmatite, which is evidently derived from veins intersecting the granite.

Kloochman Cañon to Grand Rapid.

Similar granitoid rocks, with occasional schistose areas, constitute the whole of the rock-exposures seen along the river to the so-called Grand Rapid, about four miles above "Kloochman Cañon". The mountains bordering the valley also appear to be entirely, or almost entirely, composed of the same materials, though at one place, (nearly opposite the site of the Hudson Bay Company's old post) the upper portion of a mountain seems to show a massive bedding, recalling that of the Cretaceous quartzites of Tatlayoco Lake, which occur there in a similar position relatively to the Coast Ranges.* No further evidence was, however, met with tending to show that rocks of this age occur here.

Stratified rocks at Grand Rapid

A short distance below the "Grand Rapid," distinctly stratified rocks of dark colour are seen capping some of the mountains and resting upon the granites. These beds have a dip of N. 70° E. $< 30°$, which brings them down to the level of the river near the rapid. They are there found to consist of hard argillites and grauwacke-quartzites, interbedded with shaly, grey and brownish impure limestones, the whole being considerably disturbed and cut near the granites by coarse grey porphyritic dykes of that rock. The argillites were not observed to hold staurolite, mica, or other crystalline minerals like those of Wrangell, and otherwise differ somewhat in appearance from these, though their relation to the granitic rocks appears to be similar. They are followed in ascending order by a massive grey-blue subcrystalline limestone of considerable though undetermined thickness, which can be traced in the mountains for some distance on both sides of the valley. These limestones are believed to represent those afterwards noted on the Dease and there referred to the Carboniferous period.

Altered volcanic rocks.

About two miles and a-half above "Grand Rapid," near the mouth of the Clearwater, the limestone is followed—apparently still in ascending order—by a series of altered volcanic rocks which are, for the most part of grey and greenish colours. These are apparently chiefly diabases, but include also porphyrite-like rocks. The rocks are generally rather fine grained, and would require microscopic examination before they can be named in detail.† Though clearly forming a

* Report of Progress, Geol. Surv. Can., 1875-76, p. 253.

† One of these which has been microscopically examined by Mr. F. D. Adams is described in Appendix V. as a diabase-porphyrite (Stikine No. 16.)

stratified series, evidence of bedding can seldom be detected in the exposures, in consequence of their homogeneous composition and shattered state. They seem to be identical with those forming a part of the Câche Creek group, in the southern interior of British Columbia, and though no fossils were found in the limestones previously mentioned, they, and possibly also the argillites beneath them as well, may be referred with considerable probability to the same Upper Palæozoic age.

Argillites and limestones.

Altered volcanic rocks only, like those above noted, were seen along the river for about twelve miles above the Clearwater, but there is reason to believe that outliers of Tertiary basalt also occur in this part of the valley. At the distance just mentioned above the Clearwater, and about six miles and a-half below Glenora, exposures are found of slaty argillites and dark shaly rocks, containing some impure limestone, all very much broken and disturbed, and associated with altered volcanic materials. Some beds of these shaly limestones prove on microscopical examination to consist chiefly of organic fragments which are not, however, sufficiently distinctive for the reference of the beds.

Triassic fossils.

Dark shaly rocks occur near Glenora which were not specially examined. It is probably from these that some specimens containing Triassic fossils, which were given to me some years ago by Mr. J. W. McKay, were derived. The form represented is a species of *Halobia*, probably a finely sculptured variety of *H. Lommeli*.

Tertiary volcanic rocks.

From this point to Telegraph Creek, basaltic and other comparatively modern volcanic rocks become prominent features, the basalts appearing as remnants of horizontal flows, the broken edges of which form scarped cliffs. These rocks are due to a period antecedent to that of the glacial deposits, and are of Tertiary age. Analogy with neighboring parts of British Columbia indicates that they may be assigned with probability to the Miocene. The basalts have evidently flowed along and partially filled the old river-valley, and unconformably overlie the old altered volcanic rocks previously alluded to, as well as all the other rock series.

About two miles below Glenora, the basaltic rocks were noticed in one place to have filled the old river-bed, conforming in their lower layers to the slopes of its sides, and to have been subsequently cut across obliquely by the present river. Other examples of this character are mentioned on following pages and are of special interest in connection with the occurrence of placer deposits of gold.

Palæozoic and Cretaceous rocks.

Between Glenora and Telegraph Creek, the rocks seen below the basalts include at least two distinct series. The first and oldest of these is represented by a number of occurrences of altered volcanic rocks, like those previously referred to, as well as by considerable exposures

(beginning about a mile above Glenora) of grey and blackish, rather cherty quartzites, often nearly on edge. The second consists of slightly indurated conglomerates, sandstones and shales, the conglomerates being often very coarse and containing pebbles both of the older volcanic series and of the granites and granitoid rocks. These lie at comparatively moderate angles of inclination. No fossils were observed in them, but in their lithological character as well as in their position relatively to the Coast Ranges, they resemble rocks of Cretaceous age met with in other parts of British Columbia, both to the south and north of the Stikine, and may be provisionally referred to that period.

Rocks near Telegraph Creek.

In the immediate vicinity of Telegraph Creek, the prevalent rock is a grey-green, speckled, altered volcanic material, which proves to be a fine-grained diabase-tuff. * The high hill immediately opposite Telegraph Creek, on the other side of the river, is composed of similar old volcanic rocks, comprising compact diabase and a massive diabase-agglomerate.

Basalt flows.

About two miles below Telegraph Creek, on the right bank of the river, a portion of the basaltic filling of the old valley forms a range of columnar cliffs about 200 feet above the present water-level. A second similar remnant occurs just above Telegraph Creek, on the same side, and a portion of it extends up Telegraph Creek itself for a mile or more. Basaltic dykes, which may have served as sources of supply of molten material at the time of eruption, are found cutting the older rocks. Though in some cases simulating the appearance of terraces, the basaltic shelves along the sides of the valley are quite distinct from, and of earlier date than these.

Notes on map.

Notes on the various rocks met with will be found on the face of the map accompanying this report. The country to the east of the granitic rocks of the Coast Ranges would require much time and attention before its somewhat complicated geological structure could be properly defined.

Fossiliferous limestone.

In the gorge of Telegraph Creek, a large boulder of grey sub-crystalline limestone was found, closely resembling in character and degree of alteration that seen near the "Grand Rapid," but in this case containing large branching corals and numerous *Fusulinæ*, indicating its Carboniferous age. It is of course impossible to state with certainty whence this boulder was derived, but it may very probably have come from the mountains to the north within the drainage-area of Telegraph Creek.

The portion of the Alaskan coast which I have seen, viz., that to the south of the 59th parallel, shows the same general absence of

* See Appendix V. (Stikine No. 25.)

Terraces.

terrace deposits which has already been noted and commented on in the case of the British Columbian coast. In the vicinity of the mouth of the Stikine, terraces fifteen to twenty feet in height are found, resembling the wooded flats met with further up the river, but as they are here upon tide-water, indicating, doubtless, an elevation of the coast-line to that amount. Further up the river, the first appearance of high-level terraces is at about two miles below the Great Glacier. Those here seen are quite narrow, and were estimated to be 500 and 700 feet, respectively, above the river. The river, for the first time, shows bordering-terraces of from thirty to fifty feet in height, about six miles below the Little Cañon, and similar terraces are frequently seen above this point. On the mountain above Glenora a distinct but small terrace was seen from a distance at an estimated height of 1500 feet above the river. At Telegraph Creek the two principal terraces are 90 and 200 feet respectively above the river-level.

Gold.

The mode of occurrence of gold on the Stikine, and the placer mining which has occurred along the river, are described on a subsequent page, in connection with facts on gold mining in the Cassiar region generally. (See p. 79 B)

Climate.

Two distinct climatic regions.

The traverse of the Coast Ranges by the Stikine River, from its mouth to Telegraph Creek, affords an excellent illustration of the difference between the coast and inland climates, repeating to a great extent the phenomena met with in making a similar traverse of the same ranges in the southern part of British Columbia. It is here, however, all the more remarkable, as so great a difference between these climates would scarcely be anticipated in this northern latitude. Some records of observations in Appendix VI may be referred to for details, but it may be stated here, as showing the broad general contrast, that while the annual precipitation at Wrangell, at the mouth of the Stikine, is over sixty inches,* that in the vicinity of Telegraph Creek on the inland side of the mountains, is so small that it is necessary to irrigate cultivated land.

Nor does this comparison of rain-fall sufficiently mark the great diversity which actually obtains between the two climates, the prevalence of clouded skies in the coast region being accompanied by a saturated state of the atmosphere, while precisely opposite conditions are found on the eastern side of the mountain belt, at not more than

* U S. Coast Pilot, Alaska, Part I, 1883, p. 271. The precipitation at Wrangell is moreover much less than that at more exposed parts of the Coast, for at Tongass and elsewhere it exceeds 100 inches annually.

eighty miles inland from the general line of the coast. The coast climate is, of course, much more temperate than that of the interior, which, even no further off than Telegraph Creek, becomes one of extremes. It is probable that the total annual precipation is even greater in the vicinity of the culminating and central ranges of the Coast Mountains than at Wrangell, and as a large proportion of this occurs as snow, it sufficiently accounts for the existence of the important glaciers and the heavily snow-covered appearance of the mountains till late in the summer. Miners state that the snow accumulates on the river-flats of the lower part of the Stikine, within the mountains, to a depth of from eight to ten feet, while at Telegraph Creek and on the Tahl-tan River it seldom exceeds eighteeen inches, and at the latter places horses and mules have been wintering out for a number of years. The great depth of snow retards the advance of spring all along the portion of the river where it occurs, and thus by a cumulative effect conserves the already large quantity of snow for the supply of the glaciers, which are consequently due rather to the extremely heavy snow-fall than to the actual latitude of the region.

Bearing of snowfall on existence of glaciers.

When we left the coast, on the 19th of May, the hills near the sea were generally denuded of snow to a height of several hundred feet, but on entering the river patches of snow began to appear on the low flats, and a few miles further on these flats and the gravel-bars of the river were almost entirely covered with the old snow, quite down to the water's edge. The quantity of snow was observed to diminish somewhat where the river first turns to the north, but was again greater in the vicinity of the glaciers, and it was not till the Little Cañon was reached that the flats were found free from snow From this point on, the improvement in the climate became quite marked, and the limit of snow retreated far up the mountain sides.

Observations on depth of snow.

In correspondence with the above facts, the vegetation is much further advanced in spring on the inland side of the Coast Ranges than elsewhere. Thus, at the date above mentioned, the cotton-woods and other deciduous trees at the mouth of the Stikine and along its lower part showed merely a general faint greenish tint as the buds opened. Four days later, in the vicinity of Telegraph Creek, the appearance was almost that of early summer. *Shepherdia Canadensis*, *Amalanchier alnifolia*, *Corydalus aurea* var. *occidentalis*, *Actæa spicata* var. *arguta*, *Prunus Virginiana*, *Arnica cordifolia*, *Viburnum pauciflorum*, *Saxifraga tricuspidata*, *Androsace septentrionalis*, amongst other plants, were in flower, and butterflies and humming-birds were abundant.

Climate and vegetation.

The change in species of plants met with in ascending the river is also clearly indicative of that from a very moist to a dry climate, as a reference to the lists in an appendix to this report will show. The

devil's club (*Fatsia horrida*) extends only a few miles above "Kloochman Cañon," while *Elægnus argentea* and other forms characteristic of a dry region were first seen at Telegraph Creek. The state of progress of the season at this place appeared to be nearly, if not quite, equal to that found at a similar date in the vicinity of Ottawa or Montreal.

Local climatic differences.

The local differences of climate are, however, quite important. Thus Glenora, though about twelve miles only from Telegraph Creek, is said to experience much greater cold in winter, and the snow-fall is also greater, being estimated at three feet and-a-half. Less snow falls on the Tahl-tan than elsewhere, the amount increasing both to the east and west of that place. Strong winds blowing up stream or inland are prevalent in the Stikine valley in summer, but occur in the reverse direction, as a rule, in winter. Further observations on the winter climate of the Stikine are given in Appendix VI.

Notes at Telegraph Creek.

During the few days spent at Telegraph Creek, in the latter part of May, the wind generally blew up the river and was often strong. The high distant ranges of the Coast Mountains to the west, were usually enveloped in clouds and heavy showers were there evidently of constant occurrance The sky at Telegraph Creek was also as a rule largely obscured, but after passing over the Coast Mountains the clouds were more broken and produced merely a few drops of rain now and then, the conditions being similar to those met with in the dry country to the east of the same range in the Fraser valley, much further south.

Cultivation.

Cultivation in the vicinity of Telegraph Creek and Glenora is practically confined to the raising of small quantities of vegetables and of barley and fodder for animals. There is, however, in this vicinity, in the aggregate, a considerable area of land which might be tilled if there were sufficient local demand to warrant it. Excellent potatoes are produced, and though the leaves are occasionally touched by frost, the crop is seldom affected. It has further been ascertained by actual trial on a sufficient scale that not only barley, but wheat and oats will ripen, and that all ordinary garden vegetables can be produced. The record is a remarkable one for the 58th degree of north latitude.

Opening and closing of the river.

According to Mr. J. C. Callbreath, of Telegraph Creek, the Stikine generally opens for navigation between April 20th and May 1st.* Ice or 'sludge' usually begins to run in the river about the 1st of November, but has been noted in some years a fortnight earlier. The river generally freezes over before the end of November. Mr. Callbreath

* The season of 1887 was unprecedentedly late, the first canoe from the upper river reaching the coast only on May 18th.

states that the first sludge ice coming down from the smaller tributary mountain streams ceases to appear in the Stikine for a time after these are frozen over. As in the case of other rivers rising in the interior, the highest water occurs in the early summer, generally in June. Horses and mules find grazing on the Tahl-tan from April 20th, or May 1st to about December 1st, after which date they require some hay.

Discovery and Exploration of the Stikine.

Early notices of the river.

Though the position of the Stikine* is indicated on Vancouver's charts by the open channels of the river, and the shoals about its estuary are mapped, the existence of a large river was not recognized by that navigator, who visited this part of the coast in 1793. According to Mr. W. H. Dall,† the river was first found by the fur traders "The sloop *Dragon*, Captain Cleveland, visited the Stikine delta in April, 1799,‡ and in the journal of the sloop *Eliza*,§ Captain Rowan, for the same year, we find the locality alluded to as 'Stikin'." It was, no doubt, visited as well by many of the trading vessels which about this time frequented the coast. In 1834 the Hudson Bay Company fitted out a vessel named the *Dryad* for the purpose of establishing a post and colony at the mouth of the Stikine, but the Russians being apprised of this circumstance sent two small armed vessels to the spot, and constructed a defensive work which they named Fort Dionysius, on the site of the present town of Wrangell. Finding themselves thus forestalled, the Company retired. This dispute was compromised in 1837, when an arrangement was made by which the Company leased for a term of years all that part of the Russian territory which now constitutes the "coast strip" of Alaska, and the "fort" was handed over to the Company, the British flag being hoisted under a salute of seven guns in June, 1840. In the same year, the post, which had been renamed Fort Stikine by Sir James Douglas, was attacked by the Indians, and in the following year a still more serious attack was threatened, and averted only by the timely arrival of Sir George Simpson, as recorded in his "Narrative of a Journey Round the World" (II, p. 181). In 1847, the coast Indians (Thlinkit) are stated to have attacked and taken possession of the fort. In the spring of 1840, the

Establishments of the Hudson Bay Co.

* The modes of rendering the native name of this river has been very varied, Mr. Dall enumerates *Stakeen*, *Stahkin*, *Stickeen*, *Stachin* and *Stikine*. (Pacific Coast Pilot, Alaska, Part I, 1883 p. 109; foot note.) The last mentioned has been generally employed by good authorities and is adopted here. Mr. J. W. McKay informs me that the name Stikine is a corruption of the native (Thlinkit) word *sta-kane*, meaning "the river," and equivalent to "the great river."

† U. S. Coast Pilot, Alaska, Part I, 1883, p. 119. From this work, and from Bancroft's History of the Pacific Coast, vol. xxxiii, several of the facts mentioned below are also derived.

‡ Cleveland's Voyages, Cambridge, Mass. 1842.

§ MS. in possession of Mr. Dall, but unpublished.

Hudson Bay Company established also a second fort on this part of the coast which was named Fort Durham. This fort was situated at a place named by the late Sir James Douglas, "Locality Inlet," about thirty miles southward from the mouth of Taku River and near the entrance of the Inlet of the same name, in sight of Douglas Island. It was abandoned in the spring of 1843, and is sometimes referred to as Taku Fort.

Discovery of upper part of river.

Previous to this time, in 1834, Mr. J. McLeod, had in the interest of the Hudson Bay Company, reached the banks of the upper part of the Stikine, near Dease Lake, coming overland from the Mackenzie River. Subsequently, Mr. R Campbell spent the winter of 1838-39 on Dease Lake, but established no fort on the Stikine.

Discovery of gold.

No further events of importance appear to have occurred in connection with the river till, in 1861, two miners named Choquette ("Buck") and Carpenter, discovered placer gold on its bars. In the following spring, some excitement being created by the announcement of this discovery, several prospecting parties were fitted out in Victoria, and a number of men passed the summer in mining on the river. In 1863, the Russian authorities, hearing of the discovery of gold, despatched the corvette *Rynda* to ascertain whether the mining was being carried on in Russian territory. A boat party from this vessel, under Lieutenant Pereleshin, ascended the river to a point a few miles above the Little Cañon, occupying May 23rd to June 1st on the expedition. Mr. W. P. Blake accompanied this party, and in addition to the sketch-map published by the Russians, his report on the Stikine, previously alluded to, is based on it.*

Hudson Bay Company's post.

A Hudson Bay post was established on the east side of the river in 1862 or 1863 and maintained till about 1874, when it was moved to the vicinity of Glenora, were it remained till 1878, when it was abandoned.

Telegraph exploration.

In 1866, explorations for the line of the Western Union or Collins' Telegraph Company were extended to the Stikine under Major Pope. These were continued in 1867 by Messrs. M. W. Byrnes, Vital Lafleur, W. McNeill and P. J. Leech, and embraced most of the principal tributaries of the river. The results of this work were not separately published, and the whole enterprise of which they were a part was, as is well known, abandoned. The sketch-maps then made were, however, partly embodied in the small map accompanying Mr. W. H. Dall's work on Alaska (1870), and with greater completeness in other subsequent maps of the region. The surveys made at this time, while doubtless sufficient for the object in view, and serving to

* Geographical Notes upon Russian American and the Stikeen River; Washington, 1866. Also, Am. Journ. Sci. and Arts, vol. xliv, 1867, p. 96.