represent the main features of the country traversed in a general way, leave much to be desired in the matter of accuracy.

Subsequent history of the Stikine.

In 1873, Messrs. Thibert and McCullough, travelling westward from the Mackenzie, discovered gold in the Cassiar region, and fell in with the miners already engaged in placer work on the Stikine in the autumn of that year. The subsequent history of the river depends on that of the Cassiar mining district, and need not be further followed in detail.

Some years after the acquisition of Alaska by the United States, the Stikine came prominently into public notice for a time in connection with difficulties respecting territorial jurisdiction which occurred in regard to customs and other matters. A full account of these difficulties, together with a report by Mr. J. Hunter of his survey of the lower part of the river, made for the purpose of approximately determining the position of the line of boundary between Alaska and the province of British Columbia, is given in the Canadian Sessional Papers, Vol. XI, No. 11, 1878.*

A description of the Stikine is given in the U. S. Pacific Coast Pilot, previously quoted, as well as an itinerary of the river, but as no correct survey of the Stikine existed at the time (1883), the distances and details are only approximately correct.

Published Maps of the Stikine.

The following reference-list of published maps of the Stikine is based on that given by Mr. Dall in Appendix I to the Coast Pilot of Alaska, 1879.—

Russian maps.

Russian Hydrographic Office chart No. 1396, Pacific Ocean on the North-west coast of America (published 1848). Also, Russian chart No. 1493-4 (published 1853), Alexander Archipelago. [These two charts, Mr. Dall informs me, show a part of the Stikine in such a way as to prove that it must have been surveyed.]

Plan of the Stikine River from observations by officers of the corvette *Rynda* in 1863. Russian Hydrographical Department, 1867.

Blake's map.

Sketch-map of the Stickeen River from the mouth to the Little Cañon, W. P. Blake, *Op. supra cit.*, 1868.

Wright's map.

Map of Cassiar District in Report of Minister of Mines of British Columbia, 1876. [This has remained the most complete map of the river up to the present time, and is a very praiseworthy sketch.]

Hunter's map.

Plan of Stachine (Stikine) River, by J. Hunter. [This, with other subsidiary maps, is contained in the Sessional Papers, Vol. XI, No. 11, 1878. It includes the lower part of the river only, but is from actual

* See also Report by W. G. Morris, elsewhere referred to, p. 48 *et seq.*

survey and on a scale of 8000 feet=1 inch It shows the provisional boundary line adopted without prejudice until the true line shall have been determined.]

Morris' map. Map showing boundary line in Morris' Report on Alaska. U. S. Senate, Ex. Doc. No. 59, 1879.

The river is shown on a small scale, according to the result of surveys here reported on, in a map accompanying a summary of the results of the expedition, in Science, Vol. IX, April 2, 1888.

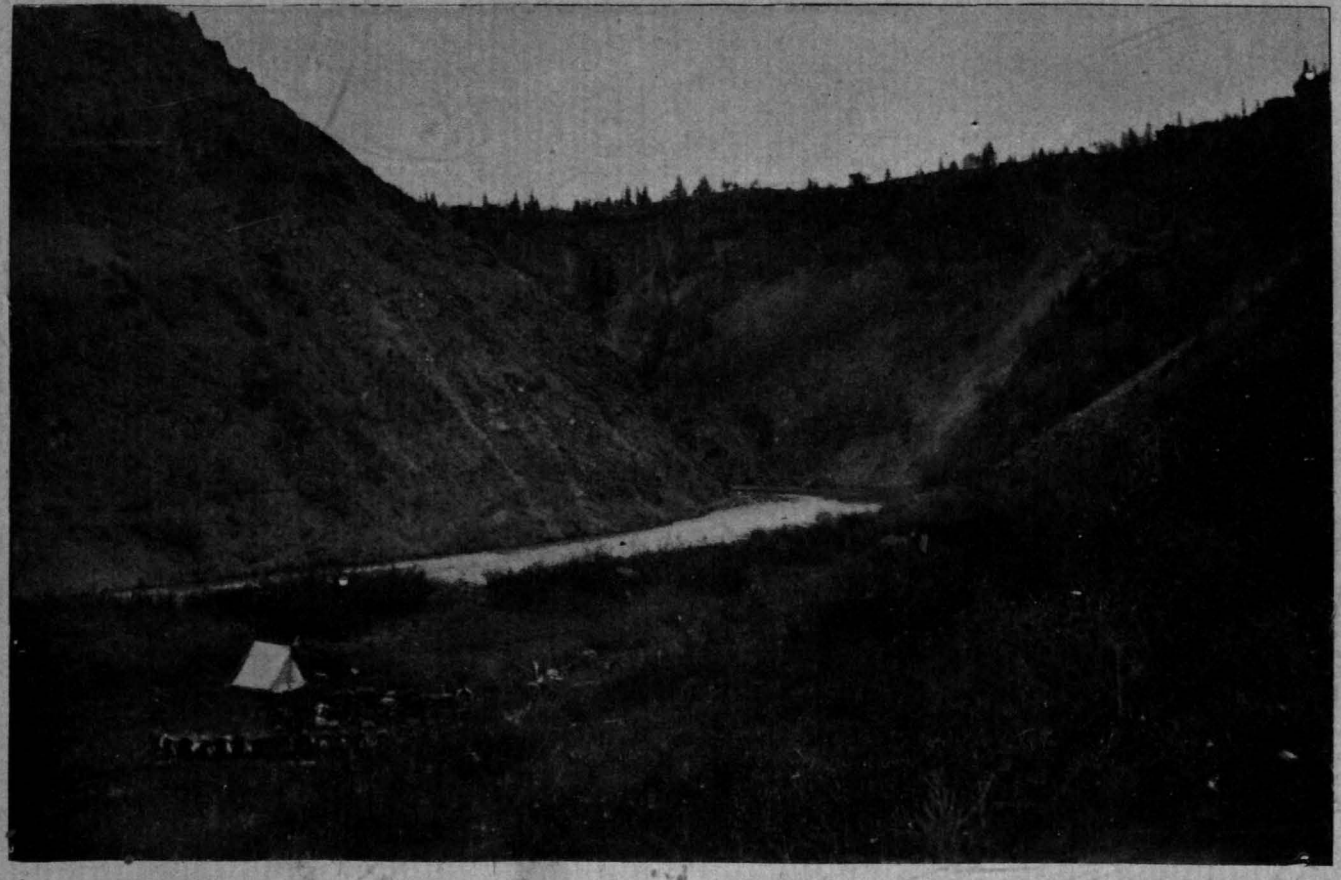
CASSIAR TRAIL* (*Telegraph Creek to Dease Lake.*)

Route followed The trail from Telegraph Creek to the head of Dease Lake was opened by the Government of British Columbia in 1874. It has since been kept in a fair state of repair, and is a good route for pack animals. It follows the north side of the Stikine and Tanzilla valleys, and is sixty-two miles and a-half in total length As already mentioned, the same important valley which is occupied by the Stikine below Telegraph Creek, continues in a north-eastward direction to Dease Lake, the main stream of the Stikine entering it from the southward about midway between these two points.

Telegraph Creek to Tahltan. On leaving Telegraph Creek, the trail makes a steep ascent to the level of a broad terrace, and runs along at a considerable height above the river, and often at some distance from it, till it descends again, at eleven miles, to the valley of the Tahl-tan or First North Fork, near its mouth. The main valley of the Stikine is here about four miles in width, and is bordered by high hills and by mountains of rounded forms, those to the north often nearly bare, while those on the opposite side are generally either wooded or strewn, where fires have passed, with burnt logs. The river occupies a cañon, with precipitous banks often 300 feet in height, which has been cut in the bottom of this great valley. It is very rough and rapid, but there are no true falls. Terraces are well developed at several levels on both sides of the river, which is frequently bordered by vertical basaltic cliffs. The basalts have manifestly filled the bottom of the ancient valley in a series of nearly level flows, which have since been cut through by the present river, while the bordering hills are all composed of much older and probably Palæozoic rocks. A general summary of the geology of the country from Telegraph Creek to Dease Lake is given on a later page.

The country traversed by the trail between Telegraph Creek and the Tahl-tan is wooded only in patches, the trees being chiefly black pine (*Pinus Murrayana*) and aspen (*Populus tremuloides*), with occa-

* See note in Appendix II (p. 198) on the origin of the name Cassiar.



G. M. DAWSON, PHOTO., MAY 31, 1887. G. E. DESBARATS & SON, ENGRAVERS & PRINTERS, MONTREAL.

TAHL-TAN VALLEY, AT TRAIL-CROSSING.

Bank on the right shews basalt, capping old gravel deposit. Hill on the left composed of older crystalline rocks.

sional specimens of white birch, and alder and willow in the hollows. The soil is reddish and rather sandy, and appears very dry, being but scantily clothed with thin, tufty grass and bear-berry (*Arctostaphylos uva-ursi*). The strawberry (*Fragaria Virginiana*) was abundant and in full flower on May 31st, while *Polemonium pulchellum* was also very conspicuous, and *Linnæa borealis*, *Echinospermum Redowskii* and *Arnica cordifolia* were also locally abundant. Thickets are composed principally of *Shepherdia Canadensis*, high-bush cranberry (*Viburnum pauciflorum*), roses, service-berry (*Amelanchier alnifolia*), red dog wood (*Cornus stolonifera*) and willows.

Indian village.

The Tahl-tan Indian village is seen near the trail, about a mile before the river of the same name is reached, but was at the time we passed quite deserted.

Tahl-tan River.

The Tahl-tan River is crossed near its mouth by a good bridge. It is a large and rapid stream, which rises about thirty miles to the north-westward. Its valley is narrow and almost cañon-like where it reaches the Stikine, and has cut through basalt flows and heavy underlying gravel deposits to a depth of about one hundred and fifty feet, though its right bank, just above the crossing, is composed of the older rocks. It is resorted to by the Indians for salmon fishing during a part of the summer, and there are several temporary houses and a number of graves. The angle between this river and the Stikine, on the right bank, shows three clearly defined, superposed, columnar basalt-flows. The opposite angle, up which the trail zig-zags, is in the form of a long, narrow point, the surface of which is extremely rough, being composed of large pieces of basalt lying in great confusion, with deep interspaces and crevices. This is generally known as the "lava bed," but its broken character appears to have been produced by the washing out of the underlying gravelly deposits, resulting in slides and irregular settlement of a once uniform basalt sheet. Notwithstanding its relatively recent appearance, the basalt here, as elsewhere along the Stikine, is of pre-glacial age, and was found, like the other basalt flows, to pass beneath the higher terraces. Gold mining was at one time carried on successfully for some miles up the Tahl-tan valley.

Sources of Tahl-tan

According to M. W. Byrnes, one of the Telegraph Company's explorers, the sources of the Tahl-tan are at a distance of about thirty miles from its confluence with the Stikine. It occupies a portion of an important valley which, still further to the north-westward, carries the upper branches of the Taku and the furthest sources of the Lewes River. The Indians travel along this valley, and it appears worthy of attention as a route from the navigable waters of the Stikine to the Yukon basin.

Tahl-tan to Tooya.

The distance from the Tahl-tan to the Tooya, or Second North Fork, is about six miles. For about half this distance, to Ward's house, (now, like other places of call along this route abandoned) the trail runs near the Stikine River, the immediate valley of which still continues to be occupied by basaltic flows. Above these, however, the sides of the valley are generally formed of very regular and high terraces, composed of horizontally stratified sands, gravels and earthy deposits, which though generally very fine, are rather silts than true clays. The gravels frequently include large boulders. At Ward's, the trail turns away from the river and cuts across a high point to the Tooya, the highest terrace-level crossed being about 1000 feet above the river. On these high terraces the vegetation was perceptibly less advanced than in the lower parts of the valley. Swampy spots are frequent, and the country, as we recede from the vicinity of the Coast Mountains, has evidently a somewhat more humid climate and is more subject to summer frosts. Potatoes and other crops are successfully grown at Ward's, situated on one of the lower terraces, but irrigation is there necessary.

Tooya valley.

The Tooya valley, where it is crossed by the trail, is a great gorge, about 600 feet in depth, cut out through the terrace deposits. The river, which is spanned by a small bridge, is a wild torrent—almost a series of cascades. Its scarped banks show a section of about 400 feet of the terrace deposits, which are of the character above noted, but include rough, bouldery and gravelly layers, and a number of large granite boulders occur in the bottom of the valley, resembling in their lithogical character the granites of the Coast Ranges.

Sources of Tooya.

Scarcely any authentic information is available regarding the headwaters of the Tooya, though these have been reached by prospectors from Dease Lake. A lake of considerable size is reported to exist on its upper part, as indicated in the accompanying map, and the volume of water in the river is such as to lead to the belief that it must drain a large area to the south of the Yukon watershed.

Plateau beyond Tooya.

About a mile beyond the Tooya, on the summit of a wide, undulating terrace, is Wilson's house. Here turnips and potatoes have been grown, but the potatoes do not fully mature. From Wilson's to Caribou Camp, about twelve miles, the trail crosses an extensive high terrace or plateau, with a nearly level or slightly undulating surface, which is generally wooded with aspen, black pine and white spruce of fair growth. A few very small streams, which flow toward the main valley, are crossed, but the river is generally some miles distant and scarcely visible from the trail. The Tooya valley is here said to run nearly parallel with the main valley of the Stikine and at no great distance from it, but is invisible from the trail. No mountains were

FIG. 2. VIEW OF THE TANZILLA RIVER, LOOKING SOUTH-EASTWARD FROM 'CARIBOU CAMP.'
Illustrating the character of the level terrace-country, based on stratified later-glacial deposits. (From sketch by J. McEvoy.)

here seen to the north-eastward, but high, rounded mountains, with broad, bare summits, continue to border the south-east side of the Stikine valley. About midway between Wilson's and Caribou Camp, the Stikine, or Too-dessa of the Tahl-tan Indians, coming from the southward, enters the main valley, cutting through the bordering mountains in a narrow cañon, which the Indians report impassable. Their route to the upper waters of the river crosses the mountains to the west of this cañon. They state that after again reaching the Stikine, above the cañon, they can ascend it in canoes without difficulty for a long distance.

Head of Stikine.

No rock exposures were seen along this part of the trail, and only occasional groups of boulders. The soil appears to be excellent, but the altitude is probably too great for the successful cultivation of any but the most hardy crops. The vegetation and appearance of the country afford evidence that the climate is still a rather dry one.

Tanzilla.

The trail reaches the edge of the valley of the Tanzilla, or Third North Fork, about a mile south-westward from Caribou Camp. This valley is cut out to a depth of 450 feet below the level of the plateau, and is about a mile in width from rim to rim. The sides show evidence of extensive landslips, both old and recent. The river is a comparatively small though swift and muddy stream, with an estimated width of 180 feet and depth of about three feet. No rocks are exposed in the valley, the entire depth of which appears to be excavated in bedded clays and silts, which weather to grey, earthy slopes. No true boulder-clay was seen, but the occasional presence of large granitic boulders, with the singularly contorted character of some of the clay-beds, appear to indicate the existence of floating ice in the body of water in which the deposits were originally laid down. The clays and silts are evidently the same with those seen in the Tooya, but here, so far as observed, want the rough bouldery and gravelly beds which are there intercalated, and which are doubtless connected with the entry of the former representative of the Tooya into the lake in which the silty deposits have been formed. Flat or lenticular calcareous nodules are abundant at certain horizons in both places, and are also reported to occur at some distance up the Tahl-tan, where the same silty deposit is probably continued. The level country based on these deposits has a width of several miles on both sides of this part of the Tanzilla.

Silt and clay terraces.

From Caribou Camp to the vicinity of Dease Lake, or for about twenty-six miles, the trail runs along the north-west side of the Tanzilla. The valley of the stream gradually loses its depth, owing to the fact that, while the grade of the stream is considerable, the terraces at its sides continue at about the same level. These consist, so far as can be seen, of similar silty and clayey materials, but the edges

Tanzilla valley.

of the terraces are less marked, and they show a tendency to merge into slopes, which rest upon the bases of the mountains bordering the valley. The mountains which extend to the south-east of the river here become higher than before, and take the form of a well-marked range, which is known to the Indians as *Ho-tai'-luh.** Swampy spots become frequent and the vegetation more alpine in character, with evidence of a considerably greater rainfall. The white spruce is relatively more abundant, and *Betula glandulosa* and *Ledum latifolium* were here met with for the first time. A great part of the forest all along this portion of the valley has been destroyed by fire. Rock is seen in place only on approaching the bases of the mountains.

Valley connecting Tanzilla with Dease Lake.

Opposite the head of Dease Lake, the Tanzilla turns off abruptly, and is seen to take its rise in a high range of mountains, holding much snow and running in a north-east and south-west bearing, at a distance of seven or eight miles. The main valley, which has heretofore been occupied by the river, turns northward, through a right-angle, and becomes continuous with that of Dease Lake. The distance from the head of the lake to the Tanzilla, at the nearest point, is about three miles, the level of the Tanzilla being somewhat lower than that of the lake. The height of land is about seventy feet above the lake, or 2730 feet above the sea, and constitutes the watershed between the Arctic and Pacific slopes.

Origin of the valley.

The part of the valley which connects the Tanzilla with Dease Lake is floored by terrace deposits, and is without doubt very deeply filled with such material, as no solid rock is seen in it. It has evidently been part of a through river-course of very ancient date, but in which direction the stream which originated the valley flowed, it is now difficult to surmise. It has, however, been again occupied by a river in comparatively recent post-glacial times, subsequently to the formation of the terrace deposits, as it is traversed by a well-marked river-bed, filled with rolled stones and gravels. This old channel appears to rise slightly toward Dease Lake, and there can be little doubt that the stream by which it was formed flowed out of the lake.

Geological Notes on the Cassiar trail.

Rocks chiefly Palæozoic.

Respecting the older rocks which characterize the greater part of the country between Telegraph Creek and Dease Lake, few details were noted, and no approach to a general section was obtained, as they are not usually exposed except along the bases of the mountains, which are, as a rule, at some distance from the route of travel. They

* The names of geographical features which have not been previously recognized, whether Indian names or names applied by myself, are throughout the descriptive portion of this report printed in italics, on the occasion of their first occurrence.

may be described as consisting of grey and greenish-grey quartzites and grauwackes, with a large proportion of altered volcanic materials, generally felspathic, but passing into diabases and becoming in some cases more or less schistose. Rocks originally of volcanic origin notably preponderate in the vicinity of Telegraph Creek, while near Dease Lake they are less abundant, and at about two miles from the lake, on the trail, massive grey fine-grained limestone occurs, in exposures which are nearly continuous for about a mile. None of the mountains in sight on either side of the valley are distinctly granitic, and rocks of this character were observed only in one locality, where they occupy a relatively small area.

Limestone.

Hornblende-rock and granite.

At about two miles along the trail to the south-west of the Tahl-tan, a dark, blackish-green, highly crystalline hornblende-rock occurs in considerable mass, and is much broken and shattered by a grey porphyritic and hornblendic granite, which appears to be of later date, and which may have a width of about two miles on the trail. In the bed of the Tooya River rocks differing in appearance from any seen elsewhere on this trail were found. They are reddish and purplish in colour, fine-grained, and in some beds slightly porphyritic, and appear to be chiefly felspatic in composition.* One of these is identical with a rock met with in the lower part of the bedded series, a short distance above "Grand Rapid," on the Stikine. No fossils were found in the limestones above alluded to, and the rocks, as a whole, can at present only be classed as Palæozoic, though showing many points in common with those of the Câche Creek group of southern British Columbia, which is believed to be, in great part at least, of Carboniferous age.

Purple felsites.

Basalts filling old river-valley

The pre-glacial age of the basaltic rocks is shown, as already noted, by their relation to the terraces of the valley, and also by the occurrence upon them of large granitic boulders, the transport of which must be attributed to glacial action. This is seen particularly in some places between Telegraph Creek and the Tahl-tan. The basaltic rocks, at the period of their eruption, have filled the old river-valley, and may very probably have at one time done so continuously from below Glenora to the Tooya, or perhaps considerably further. There is no reason to suppose that the basalts were erupted from a single volcanic centre, and indeed the existence of basaltic dykes cutting the older rocks at Telegraph Creek would appear to lead to an opposite conclusion. Subsequent to the period of basaltic eruption, the river, still flowing in the same great valley, has cut down through the basalts in several places, exposing sections of the gravel deposits of the ancient river. The new channel thus formed is not, however, coincident

* See Appendix V. (Cassiar Trail No. 4.)

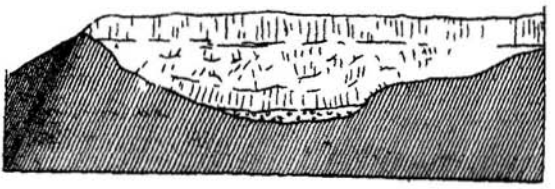


FIG. 3.—SECTION SHOWING OLD RIVER-CHANNEL CAPPED BY BASALTS. EAST BANK STIKINE RIVER BELOW TAHL-TAN.

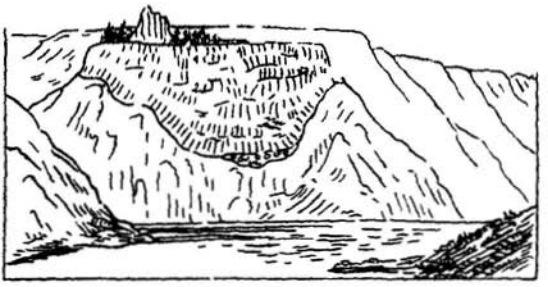


FIG. 4.—SECTION SHOWING OLD RIVER-CHANNEL FILLED WITH BASALT MOUTH OF TAHL-TAN.

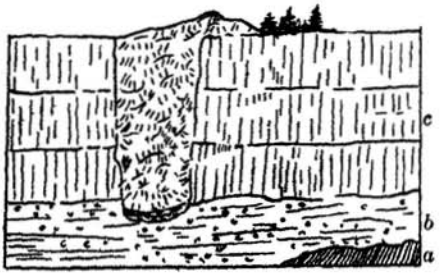


FIG. 5.—SECTION SHOWING RELATIONS OF BASALTS AND GRAVELS. STIKINE RIVER, EAST BANK, ABOVE TAHL-TAN.

a. Old basal rocks.
b. Old gravels.
c. Superposed basalt flows.
d. Basaltic filling of a later gorge.

with the old, but cuts across it at several points, and above Telegraph Creek, the excavation of the new bed has been carried to a depth estimated at from forty to seventy feet below the earlier one.

A few miles below Glenora, where the basalt filling of the old valley has been cut across, it seems, however, that the old river-bed is below the present water-level, indicating, in connection with the previous observation, that the grade of the original river was greater than that of the present.

Basalts near Tahl-tan.

Directly opposite the mouth of the Tahl-tan River, on the left bank of the Stikine, a good section of the old river-bed is exposed, in the truncated end of a point which forms a spur of the plateau to the south, the basalts filling it like a great ingot and resting, at the bottom, on the old gravels, at the sides, directly on the rocky banks of the old channel.

The angle between the Tahl-tan and the Stikine, on the upper side, has already been referred to in connection with the peculiarly disturbed character of the basalt layer by which it is capped. Beneath the basalt at this place is a great thickness (apparently not much less than one hundred feet) of well-rounded gravel and boulders. It is probable that this deposit does not reach to the water-level, but its disintegrated material has formed a slope which conceals any basis of old rocks which may be beneath it. The eruption of basalt has, moreover, not been confined to a single period, but must have occurred at several different times separated by rather wide intervals. The occurrence in some places of three or more superposed flows, shows this to have been the case, but a still more striking proof of the same fact is found in a section observed from a distance, on the left bank of the Stikine above the Tahl-tan. At this place a thick and apparently extensive deposit of gravels has been covered by three superposed basaltic flows. Through these, a narrow vertical-sided cañon has been cut by some tributary stream, which has even excavated a portion of the gravels beneath the lowest basalt. A fourth basaltic flow has then occurred, which has completely filled the cañon and partly overflowed on the surface of the highest of the three earlier basaltic layers.

Basalts of several dates.

Though the basalts of Tertiary age actually seen by me are confined to the Stikine valley, it is highly probable that further explorations will prove their occurrence in other valleys, and possibly also the existence of similar rocks, in the form of plateaux of some size, in the region east of the Coast Ranges.

Old Channel and gold placers.

The basaltic formation of this part of the Stikine has been described in some detail, on account of the importance which it possesses in respect to the distribution of gold. The gold along the Stikine was said by the miners to be "spotted," or irregular, in its occurrence, but the greater part of the "heavy" gold was found just along that

portion of the stream now characterized by the basalts, and it appears even possible to trace a connection between the richer bars which have been worked and those places in which the present river has cut through or followed the old basalt-protected channel. This being the case, it seems very desirable that the old channel should be fully prospected, which I cannot learn has ever been attempted. If gold should be found in it in paying quantity, it might easily be worked, and would give rise to a considerable renewal of activity in mining. It is not known to what extent similar conditions may occur up the Tahl-tan valley, where also remunerative bars were worked some years ago.

Superficial Deposits and Terraces.

Boulder-clay not observed.

No true boulder-clay was recognized either on the Lower Stikine or in the country between Telegraph Creek and Dease Lake, neither were any striated rock surfaces actually seen. The last-mentioned fact is to be attributed to the want of suitable localities for observation in the vicinity of the route followed and to the necessarily cursory character of the examination, as evidence of glaciation of a general character, shown in the rounding of rocky hillocks and the transport of large boulders, is abundant. The most characteristic later formation of the country between Telegraph Creek and Dease Lake, is the silty and clayey deposit which has already been referred to in several places. The whole of the great valley has evidently in later-glacial times been filled with this deposit, which must have been laid down in a comparatively tranquil lake-like body of water, into which coarser material was in some places washed by entering torrents, as in the case of the Tooya. It appears to me possible that this body of water was held in by means of glacier-ice accumulated on the Coast Ranges on one side and those of the Cassiar Mountains on the other, and the increased height of the terraces in the vicinity of Dease Lake, as compared with those near Telegraph Creek, may show that the terrace-deposits have been laid down near the front of a retreating glacier mass, the water-level of the lake being reduced *pari passu.* with its recession. The highest terrace-level observed near the Tahl-tan, is at an approximate elevation of 1700 feet above the sea, while half way between the Tooya and Dease Lake the terraces run up to a height of about 2800 feet. At the head of the lake a well-marked terrace edge was observed at 520 feet above the lake, or 3180 feet above the sea. The irregular surface of the same terrace sloped upward to a further height of about 100 feet, and granite boulders were found on the summit of a limestone hill 1000 feet above the lake, or 3660 feet above the sea. If the supposition of the considerable inland extension of the glaciers of the Coast Mountains at one epoch of the glacial period be

Thick silty and clayey deposits.

Heights of terraces.

correct (and it is strictly paralleled by similar circumstances in the more southern part of British Columbia), the greater part of the granitic erratics met with may probably have been derived from the Coast Ranges, though the Cassiar Mountains, and possibly other ranges in the region, are characterized by similar rocks.

Route for Waggon-road or Railway.

District naturally easy of access.

Dease Lake is the central point of the Cassiar district, and though, as shown by statistics subsequently quoted, the yield of gold has greatly fallen off since the palmy days of its first discovery, it is very probable that further placer mines of value may yet be found in this region, (of which a great part still remains to be carefully prospected) and there is every reason to believe that quartz mining and other industries will before long be developed on a considerable scale. Even at the present moment this district is more easily accessible than that of Cariboo, and when a waggon-road shall have been built from the head of navigation on the Stikine to Dease Lake, it should be easy to lay down goods at the latter point at very reasonable rates.

Route for waggon road.

The construction of a waggon-road, with moderately favorable grades, between Telegraph Creek and Dease Lake, would not be very difficult or expensive. The first ascent from Telegraph Creek is steep, but might easily be overcome. Between eight and ten miles from Telegraph Creek, or for a distance of about two miles, the road would have to follow a rough hill-side above the cañon, where some blasting and grading would be required. The descent to the Tahl-tan would entail some heavy side-hill cutting in rock and earth and a bridge would be necessary. The ascent and crossing of the "lava bed" would entail about a mile of rough work on the opposite side of the Tahl-tan, and should the line of the present trail be followed, a long and steep ascent, with grading in gravel and clay, would be required at Ward's, and again in descending to and ascending from the Tooya valley, but no rock work would be necessary. It seems quite probable, however, that a better route might be found for a road, at a lower level, from Ward's to the mouth of the Tooya, in following along the side of the main valley. In either case a good bridge would be required at the Tooya. Beyond this, all the way to Dease Lake, no further serious obstacle is met with. Portions of the route are clayey and swampy, and to render these easily passable, from eight to ten miles of corduroy in all would be required, for which suitable material could be obtained near by in all cases.

Railway route.

Should the construction of a railway be contemplated, the difficulties to be surmounted would be greater in proportion, particularly

between Telegraph Creek and the Tahl-tan, where the line would have to follow the side of the cañon, which is very rough and rocky. Beyond this point, so far as the valley could be seen from the trail, it presents no very serious impediments. Below Telegraph Creek, to Glenora, or a little further, a railway would involve some moderately heavy side-hill work; but further down the Stikine, to the sea, it might follow the river-flats at a nearly uniform level. The greatest difficulty to be apprehended on this part of the line would be that likely to arise in winter from the very heavy snow-fall on that part of the river below the Little Cañon.

It may be pointed out in this connexion that the survey of the Stikine and of the valley leading by the Tanzilla to Dease Lake shows that the route is an exceedingly direct one to Dease Lake, and that, taken in conjunction with the valleys of the Dease and Liard Rivers, it affords almost an air-line from the Pacific Coast to the great Mackenzie River. (See p. 19 B.)

Freight rates.

The present rates for goods, from Wrangell to Dease Lake are about as follows:—Wrangell to Telegraph Creek by steamer, 2½ cents per lb. Thence to Dease Lake by pack animals, 6 cents. Thence by lake to Laketon, ¾ to 1 cent. Total, about 9½ cents per lb., or $195 per ton. The result of such high prices is to discourage prospecting in the district and seriously to retard its further development.

Dease Lake.

Proceedings at Dease Lake.

We reached the head of Dease Lake on June 5th, and eventually left the lake on the morning of June 19th, spending thus thirteen days in all upon the lake. At the date of our arrival the lake, with the exception of a small area at its head, was still covered with the decayed but unbroken ice of the previous winter, and this did not finally break up and disappear till the 16th. Meanwhile, almost all our time and attention were devoted to sawing out boards and building three boats. It would have been impossible to have left sooner, even if we had had boats ready at the outlet of the lake, which had long been open, in consequence of the entire exhaustion of supplies in the district, from which it was necessary that we should depart provisioned for the greater part of the summer's work. As it was, our boats were finished a few hours before the final disruption of the ice, which occurred in the end with extraordinary rapidity, under the influence of a strong wind. It will easily be understood that we had but little time or opportunity for the examination of the surrounding country, which is nevertheless of considerable interest on account of the rich gold-producing character of some of the streams.

Opening and closing of lake.

The disappearance of the ice must always be late in this lake, in consequence of its high altitude, the want of any large entering streams and its contracted outlet. It was, however, in 1887 later than ever before known since mining operations began. The following dates, obtained from Mr. Robert Reid, of Laketon, are those of the opening and closing of the lake for the past few years.—

Year.	*Lake opened.*	*Lake closed.*
1882	June 9	December 5 or 6
1883	May 30 (Clear from end to end.)	December 5
1884	June 2	December 2
1885	June 3	December 1 (Frozen completely across.)
1886	June 5	December 16 (Crossing on 17th.)
1887	June 16	

Further particulars respecting the climate of Dease Lake will be found in Appendix VI.

Dease Lake.

Dease Lake has an elevation of 2660 feet above the sea, and lies nearly due north-and-south on the 130th meridian. It has a total length of twenty-four and a-third miles, with an average width of rather less than one mile, being somewhat narrower at the northern than at the southern end. Dease Creek, on the delta of which is situated Laketon, the chief place of the Cassiar district, enters on the west side at sixteen miles and three quarters from the head of the lake, and is the largest tributary stream. It is also the most important, as being that on which the richest of the gold deposits were discovered, and on which gold is still worked to a limited extent. A certain amount of business is still carried on here, and it is the head quarters of the present Gold Commissioner, Mr. Crimp. At the south end, or head of the lake, there are a few buildings, now virtually abandoned, and at Porter's Landing, on the west side of the lake near its north end, goods are landed for Thibert's Creek. The old Hudson Bay Post was situated about two miles from the lower end of the lake, on the east side. A small steamer was put upon the lake when the mines were in a flourishing condition, and is still employed in making occasional trips up or down the lake with supplies.

Mining camps.

Country surrounding the lake.

The country about the lake is everywhere wooded, though trees large enough for lumber are found only in sheltered valleys or on low land. It is not roughly mountainous, though several prominent summits occur. The most conspicuous of these lies four miles back from the lake, about half way between the head of the lake and Laketon. As I could not ascertain that this is recognized by any name, I propose

naming it *McLeod Mountain*, in honour of the discoverer of the lake. Its height is about 6300 feet. Between McLeod Mountain and Dease Creek is *Mount Sullivan*,* not so elevated as the last, but nearer the lake-shore and very conspicuous from it. On the opposite, or east side of the lake, a couple of miles back from the shore, is a group of rounded and wooded mountains, somewhat exceeding 1000 feet in height above the lake, or about 3800 above the sea. *Beady Mountain*, another notable landmark, is also on the east side of the lake, about three miles from its lower end and near the creek of the same name. Its height was not determined, but is less than that of McLeod Mountain. With the exception of these and some other nameless mountains, the country near the lake is merely hilly, or rises in long, light slopes from the shores to undulating wooded uplands, a few hundred feet only above it, which coalesce with the bases of the mountains. Only near the northern end of the lake do the mountains begin to crowd down more closely to the water's edge. The lake is shallow and marshy at both ends, but is elsewhere evidently very deep, though no soundings have been made in it. Mountains.

Rock-exposures are infrequent along the margin of the lake, which, when scarped, generally shows only stratified, sandy, clayey and gravelly terrace-deposits, like those seen on the trail to the south-eastward. None of these were recognized as true boulder-clay. The lake is probably held in at its northern end by the accumulated delta deposit of Thibert Creek.† It is much constricted, further up, by the similar deposit of Dease Creek, and has narrowly escaped being divided at this place into two lakes. It is rimmed round at its head by somewhat irregular terrace deposits, which have already been alluded to as filling the ancient valley which communicates with that of the Stikine. Superficial deposits.

The vegetation gives evidence of a greater rainfall and conditions more alpine and less favorable than those met with on the trail to the south-eastward, and sharply contrasting with that of Telegraph Creek and the Tahl-tan. The effect of the ice upon the lake in spring, in retarding the vegetation in its immediate vicinity, was extremely apparent. Agriculture can scarcely be regarded as practicable in this region, and the results of gardening, however carefully conducted, are small. Potatoes can be grown, but in some years they are much injured by frost, and carrots, lettuce, cabbage, cauliflowers and turnips may be made to afford a fair return. Vegetation and cultivation.

Such rock-exposures as could be reached near the shores of the lake were inspected, and the material brought down from the hills by sev- Rocks.

* So named for Mr. J. H. Sullivan, first Gold Commissioner of the district, lost in the wreck of the *Pacific* in 1875.

† A stream about fifty feet wide.

eral streams was examined, the evidence afforded being in favor of the belief that the whole country is underlain by Palæozoic strata resembling those described to the south-eastward. In addition to the limestone already noted as occurring at the head of the lake, there are grey and greenish rocks, representing altered materials of volcanic origin,* associated with leek-green serpentine, in which some minute veins of chrysotile or asbestos were noted. Besides these, and probably predominant as a whole in the valley of the lake, are argillite-schists, which vary from a black plumbaginous to a grey, finely micaceous character, and are often lustrous and not unfrequently highly calcareous. The rocks, as a whole, closely resemble those of parts of the gold bearing series of Cariboo district.

Dease Creek.

Dease Creek, is said to be about twelve miles in length and to rise in a lake about five miles long. It has cut a deep, narrow V-shaped valley through a series of terraces, which have evidently been formed at its mouth when the lake stood at various levels higher than the present. The ancient pre-glacial valley has, at the same later-glacial period, been filled with clayey and gravelly deposits, among which large and often glaciated boulders are common. These deposits frequently resemble boulder-clay, and are possibly entitled to be so called. The present valley has been cut down through them, and often to a considerable depth into the rock beneath them. The mining has occurred chiefly in the bed of the stream, along the surface of the solid rock, in the sides of the valley, and in various places in the gravel deposits which still remain; also at the head of the flat on which Laketon stands, where the stream issues from the narrow recent valley. Much quartz occurs in the wash of the stream, and the gold, being "coarse," is evidently of local origin and has been liberated by the disintegration of the rocks in the immediate vicinity of, if not entirely within, the actual drainage-area of the stream.

Gold Mining in Cassiar District.

Yield of gold.

The following table, based on the reports of the Minister of Mines of British Columbia, clearly illustrates the sudden rise and gradual decadence of the gold yield of Cassiar district.—

Estimated value of Gold produced by Cassiar District, from 1874 to 1887.

1873	Not known.
1874	$1,000,000
1875	830,000

* One of these, representing a numerous class having a more or less distinct schistose structure, is described in Appendix V. (Dease Lake, No. 8.)

1876	556,474
1877	499,830
1878	519,720
1879	405,200
1880	297,850
1881	198,900
1882	182,800
1883	119,000
1884	101,600
1885	50,600
1886	63,610
1887	60,485
Total	$4,886,069

No estimate has been formed for the yield of the mines in the first year of their operation (1873,) but as that for the following year appears probably to be overstated, it may, for the purpose of arriving at a general estimate of the whole, be assumed that the sum of one million includes both years. The value of the gold may be stated as from $16 to $17 per ounce, though that of Dease Creek is usually priced at about $15·50 only.

Sources of information on mining.

In the Report of Progress of the Geological Survey for 1886-87, I was enabled to give a general note on the various creeks worked for gold in Cassiar and on the Stikine.* The information there given was chiefly furnished by Mr. G. B. Wright. I am now able to add to this, particulars as to the actual condition of the workings in 1887. These were largely obtained through the kindness of Mr. J. S. Crimp, the present Gold Commissioner for Cassiar district, though facts were also gathered from several old miners who were among the first to enter the country. As explained on a previous page, my opportunities of personally investigating the Cassiar district were restricted by the necessity we were under of pushing on to our main field of exploration. Chiefly from the sources above-mentioned the following summary account of the different localities is derived.

Summary of Facts relating to Gold on the Stikine and various Creeks in the Cassiar District (1887).

Localities of gold mining.

Stikine River.—Gold discovered, 1861. Very fine gold can be found on almost all parts of the river, but very little profitable work was ever done below the mouth of the Clearwater. The rich ground may be said to have begun about nine miles below Glenora, and to have extended thence to the Grand Cañon, above Telegraph Creek. Here Sheck's or Shake's Bar, and Carpenter's, Fiddler's and Buck's

* *Op. cit.*, pp. 138-140.

Localities of gold mining, continued.

Bars were situated, the richest being between Glenora and Telegraph Creek, though gold was also worked in a few places in the Grand Cañon. With the exception of a few spots in the lower part of the cañon, below the Tahl tan, and one nearly opposite Wilson's, all the gold was very fine. Coarse gold was also found on the lower part of the Tahl-tan, which proved quite profitable, and bars were worked for a distance of ten or fifteen miles up the river. Pellets supposed to be of silver but probably of arquerite or silver-amalgam were also found on the Tahl-tan. The bars on the Stikine at first averaged $3 to $10 a day to the hand, and as much as two to three ounces was sometimes obtained, but not more than $1 to $3 can now be got, and work has practically ceased. It is stated that none of the higher benches so far prospected will pay for hydraulic work, but it is doubtful whether these have been examined with sufficient care, as the area of such benches is very considerable.

Dease Creek.—The bed of this creek has been gone over several times, and is now nearly worked out. It formerly yielded $8 to $50 a day to the hand, and paid well from the head of the flat, at its mouth, for six miles up. Above this a few isolated good claims were found, particularly the Cariboo Company's claim, eight miles up, from which much heavy gold was obtained. This claim has been worked over four times. The best remaining claims are bench claims on the south side of the creek, some of these being upon an old high channel which yields well in places. Some hydraulic work on a small scale is being carried on. In 1886 there were sixteen whites and thirty-five Chinese at work, and the total amount produced was about $15,000. The gold is generally well water-worn and somewhat mixed in character, varying in value from $15·50 to $16 per ounce.

Thibert Creek.—The bed of this stream is also worked out. It paid for about six miles up from the mouth, yielding at about the same rate as the last. Bench claims are now being worked, two by the hydraulic method, the rest by tunnelling. An old high channel had also been found on the south side of this creek, upon which two claims are being worked, one paying very well. Yield in 1886, nearly the same with Dease Creek, about twenty-two whites and twenty-five Chinese being employed. Gold valued at $16 per ounce. On a tributary named Mosquito Creek very good prospects have lately been obtained,—as much as $40 to a six-foot set of timbers. Work is now going on here.

Defot Creek.—A tributary of Cañon Creek, on the same (west) side of Dease River with the last. It rises on a plateau high above the river, where great numbers of quartz reefs occur, and the gold found is quite rough and full of quartz. Large nuggets have been obtained, including one of fourteen ounces in weight. Some work is still in

progress, though the creek-bed is worked out. Gold worth $17 per ounce. Localities of gold mining, continued.

Cañon Creek.—No paying deposits found.

Cottonwood Creek.—This large stream heads in the same mountains with the last, but no paying deposits have been found upon it.

Beady Creek.—A little mining was done here in 1874 and 1875, but nothing of importance ever found.

Eagle River.—No mining ever developed.

McDame Creek.—Discovered 1874. The highest average daily yield varied from $6 to $100 to the hand when mining was at its best. Most of the gold was obtained in what appeared to be an old high-level channel, which crossed points of terraces or benches on both sides of the present stream. A very small proportion of the yield was from the stream-bed. Four or five Whites and forty Chinese are now at work here, the greater number of the Chinese being employed on wide flats, which occur about nine miles up the creek. Bench claims run for about seven miles up the creek or to Holloway's Bar. Gold worth from $17·75 to $18 per ounce.

Snow Creek, a tributary of the last.—The richest claim found in Cassiar was near the mouth of this creek, yielding for a week 300 ounces for six to eight men Only two men now at work.

Quartz Creek, a branch of Trout Creek, which is also a tributary of McDame Creek. Good claims were worked here, yielding rough gold full of quartz. Much quartz in the vicinity. Two miners now at work.

Rosella Patterson and Dennis Creeks.—Yielded moderate amounts of gold, paying "wages," say, at $6 a day. Now abandoned.

The remaining creeks mentioned in the report cited, *viz.*, *Gold Creek*, *Slate Creek*, *Somer's Creek* or *First North Fork of McDame*, *Third North Fork of McDame*, *Spring Creek* and *Fall Creek*, are now abandoned, though several of them yielded a considerable amount of gold at one time.

Sayyea Creek. Near the head-waters of the Upper Liard, yielded excellent prospects, but has never been properly examined. The gold obtained was found in the benches, and some of it was very coarse. The creek yielded at the rate of $10·90 a day to the hand for a short time, to three miners who discovered it.

Walker Creek.—Said to be distant about seventy miles in an easterly direction from the mouth of McDame Creek. Some work has been done here, but no great quantity of gold obtained.

Black, Turnagain or "Muddy" River.—Reached by trail running easterly from a point opposite the mouth of McDame Creek, and said to be ninety miles distant. Fine gold stated to have been obtained to the value of $20 per day to the hand, and it is generally believed that coarse

gold may occur on its head-waters. In 1874 prospectors found streams about seventy miles south-east of Dease Lake, which are supposed to be tributaries of this river, and yielded $6 a day in coarse gold, but at the time this was considered too poor to work.

Frozen ground.

Considerable difficulties were experienced in mining operations in some parts of the Cassiar district on account of frozen ground, often met with below the wooded and mossy surface. It is on record that on Dease Creek, the ground continued to be frozen to the end of a tunnel driven in one hundred and fifty feet from the slope of the hill, and at a depth of forty feet from the surface. After the woods and moss had, however, been burnt off little further complaint was heard of frozen ground.

Metalliferous veins

Very little has yet been done in the way of prospecting for metalliferous veins in this district, but from what I have been able to learn it would well repay a thorough examination, and the comparative ease with which it may be reached from the coast, together with the facility it affords for the construction of a good road to the very centre of the district, should not be forgotten. A specimen of galena, holding a little copper and iron pyrites, from the "Acadia Claim," South Fork of McDame Creek, was given to me some years ago by Mr. J. W. McKay. This has since been assayed by Mr. C. Hoffmann, and proves to contain 75 ounces of silver to the ton of 2000 lbs. A piece of native copper, fifteen pounds in weight, was at one time found in Boulder Gulch, Thibert Creek.

Prospects of further placer mining.

Taking into consideration the great extent of generally auriferous country included in the Cassiar district, it must be conceded, that apart from the immediate vicinity of the well known productive camps, it has been very imperfectly prospected. A great part of the district has in fact merely been run over in search of rich diggings, the simplest and cheapest methods of prospecting only, having been employed in the quest. It is not improbable that additional rich creeks like those of the vicinity of Dease Lake, may yet be discovered elsewhere and it may be considered certain that these are great areas of poorer deposits which will pay to work with improved methods, and will eventually be utilized. It is also to be anticipated that "quartz mining" will ere long be inaugurated and will afford a more permanent basis of prosperity than alluvial mining, however rich.

Discovery and Exploration of Cassiar District.

Discovery.

The Cassiar district of the northern interior of British Columbia may be said to have been twice discovered, first by officers and employees of the Hudson Bay Company, and again, after a considerable interval, by the gold miners.

Exploration by McLeod.

The unsuccessful attempt made by the Hudson Bay Company in 1834, to reach the trade of the interior country west of the Rocky Mountains from the mouth of the Stikine, has already been noted. (p. 61 B). Efforts were at the same time being made to open up routes from the eastward. In the summer of 1834 Mr. J. McLeod, chief trader, was employed exploring the Liard River above Fort Halkett, and in endeavoring to discover some stream flowing to the westward. He found and named Dease Lake,* crossed to the head-waters of the Stikine, which he proposed to name the "Pelly River," and travelled westward in the valley apparently as far as the Tooya or Second North Fork. The Indian bridge (afterwards named Terror Bridge by Mr. R. Campbell), by which this river was crossed at the foot of "Thomas' Fall," was of such a character that neither McLeod nor any of his eight men dared to attempt it, and from this point he and his party retraced their steps.

McLeod's route and map.

The geographical information obtained by McLeod is incorporated in Arrowsmith's map of 1850, on which, however, the upper part of the Stikine, which McLeod had proposed to call the Pelly, is named "Frances River," and is placed much too far north and is not connected with the Stikine. The name Frances is still retained as an alternative one to "Stikeen" on the edition of 1854, though it has since fallen entirely into disuse. McLeod's route from the head of Dease Lake, as shown on these maps, crossed the Tanzilla within a few miles of the lake, and followed its left bank, recrossing before the main Stikine enters the valley, probably by an Indian suspension bridge, which is reported still to exist, within a mile or two of this point. On careful consideration of the facts there can scarcely be any doubt that the Tooya River was McLeod's furthest point, and the Indian bridge probably crossed it near the position of the present bridge, though it may have been at some point further up the stream which has not yet been mapped.

Second abortive expedition

In 1836, McLeod's successor at Fort Halkett was instructed to establish a post across the mountains and to extend the trade down the Stikine, or "Pelly," as it was then called from McLeod's naming. For this purpose he left Fort Halkett early in June, with a party of men and two large canoes, but the expedition entirely miscarried. The appearance, or reported appearance, of a large force of hostile Indians at Portage Brulé, ten miles above Fort Halkett, so alarmed the party that they turned back in great haste, abandoning their goods, and lost no time in running down stream to Fort Simpson.

* Dease Lake and River were so named by McLeod after Peter Warren Dease, the Arctic explorer.

Exploration by Campbell.

For most of the above particulars I am indebted to Mr. Robert Campbell, who was at the time of the return of the last-mentioned party in temporary charge of Fort Simpson. The news brought back by these expeditions was of a character to discourage further enterprises in the region, the extremely difficult and dangerous navigation of the Liard River, which constituted the avenue of approach from the Mackenzie, being an additional deterrent. In 1838, however, Mr. R. Campbell volunteered his services to establish a trading post at Dease Lake, and in the spring of that year succeeded in doing so. He was accompanied by a half-breed and two Indian lads only. After ascertaining that the "Pelly" of McLeod was identical with the Stikine, he returned to Dease Lake, where, to employ his own words, "we passed a winter of constant danger from the savage Russian [coast] Indians, and of much suffering from starvation. We were dependent for subsistance on what animals we could catch, and, failing that, on '*tripe de roche*.' We were at one time reduced to such dire straits that we were obliged to eat our parchment windows, and our last meal before abondoning Dease Lake, on 8th May, 1839, consisted of the lacing of our snow-shoes."* After being thus abandoned, the post was not again re-occupied. It had become unnecessary, owing to the leasing of the "coast strip" of Russian America by Sir George Simpson for the Company, in consequence of which the trade of the interior was entirely controlled on both sides by the Company.

Further history

From this time the country appears to have been practically forgotten for many years. The furs produced by it found their way, through the Coast Indians down the Stikine, by the Liard to the Hudson Bay posts on that stream, or across country southward to Fort Connelly (established by Douglas in 1826), on Bear Lake, at the head of the Skeena River. The exploration of the Telegraph Survey in 1866-67, has already been referred to. It did not extend inland as far as Dease Lake.

Gold discovery.

Such was the state of the Cassiar district when Messrs. Thibert and McCulloch, by the discovery of gold in 1872, brought about an entire change in its conditions. Henry Thibert, a French-Canadian, left the Red River country in 1869 on a hunting and respecting expedition to the west. In 1871 he met McCulloch, a Scotchman, and together they passed the winter near the abandoned site of Fort Halkett, on the Liard River, suffering no ordinary hardships from scarcity of food. Near this place, probably on what was known afterwards as McCulloch's Bar, gold was first found. In 1872 they reached Dease Lake, having been informed that it was a good locality for fish, with the intention

* The Discovery and Exploration of the Yukon (Pelly) River. Winnipeg, 1885.

of securing a sufficient supply for the ensuing winter. Being told, however, by the Indians, that white men were engaged in mining on the Stikine not far off, they crossed by the trail from the head of the lake and reached the mining camp of Buck's Bar. Early in 1873 they set out on their return to the original discovery of gold, but meeting with success on Thibert's Creek, at the lower end of the lake, they were deterred from going further and remained working there during the summer, being joined afterwards by thirteen other miners from the Stikine. Dease Creek was discovered during the same season, and Capt. W. Moore was among the first to begin work there. Thibert is still mining in Cassiar, but McCulloch lost his life some years since on a winter journey on the Stikine.

The subsequent history of Cassiar is that of a mining district.

In 1874 the population, exclusive of Indians, was estimated to have reached 1500. The placers of McDame Creek were discovered. Miners descended the Liard a long distance, and worked McCulloch's Bar and other river-bars. Prospectors ascended the same river, and reported having been within sight of Frances Lake. The little town of Laketon was built at the mouth of Dease Creek, and beef cattle were for the first time brought across country from the Upper Fraser. The total yield of gold from the district (which, from a mining point of view, includes the Stikine) is roughly estimated to have been equal to $1,000,000. Gold mining, 1874.

In 1875 the population is estimated to have been 1081, and the yield of gold equalled about $830,000. Three hundred head of cattle were brought from the Fraser overland. This and the preceding season were the best years of the district. Of a small party which spent the winter of 1874-75 far up the Liard River, four died of scurvy. Prospecting was actively carried on in outlying regions, Sayyea Creek being discovered near the Liard head-waters, and the Frances River also apparently examined. 1875.

Owing to the flattering accounts sent out, a great influx of miners occurred in 1876, the population being at one time estimated at 2000. Profitable work could not, however, be found for so many men, and the yield of gold fell to $499,830. Walker Creek, said to be seventy to eighty miles east of McDame Creek, was discovered, but this stream never proved very remunerative. Defot Creek was also found, and in 1878 proved rich for a limited area. 1876.

Since this time the production of the district and the number of miners employed have gradually declined, and no important new creeks have been discovered, though reports to that effect have from time to time been circulated. The Black or Turnagain (Muddy) River is the most recent of these, some attention being drawn to it in 1886. Decline of gold mining.

It appears, indeed, that after the first few years very little prospecting or exploring has been done at a distance from the main creeks, of which Dease, Thibert and McDame have throughout been the most important and permanently productive.

Dease River.

We left Dease Lake with quite a little flotilla, consisting of the three boats we had built, with an Osgood canvass boat, which it had been intended to keep in reserve, but which the amount of dead weight which we had to carry obliged us to press into the service. Besides myself, the party consisted of Messrs. McConnell and McEvoy, four white men, five Coast Indians and one Indian woman, the wife of the leading Indian boatman.

Cassiar Range. Though the region about Dease Lake is as a whole rather low, with isolated mountains and ridges here and there prominent, that to the east and north-east is very different, being studded with rugged mountains, and in effect constituting an important mountain range with north-west and south-east trend, and a transverse width of nearly fifty miles. This range appears to represent a continuation of that which in various maps has been named the Peak Mountains or Blue Mountains, but as its connection to the south-eastward is as yet quite uncertain, and as neither of these names possesses either a distinctive character or any special fitness, I believe it will be most appropriate and convenient to call the range the *Cassiar Range*, and shall accordingly so designate it.

Lower end of Dease Lake. Looking down the Dease River from Porter's Landing, near the north end of the lake, the view is one of the most picturesque possible, embracing a portion of the lake itself, bordered by the marshy flats of the mouth of Thibert Creek and bounded by the rugged and extremely varied forms of the eastern ridges of these mountains, towards which the Dease River flows, and through which it cuts in a direction almost directly transverse to the run of the range.

Three main courses of the Dease. The Dease River has, up to the present time, been very inaccurately represented upon the maps. My survey of the river, as shown on the accompanying map, proves that its course is somewhat remarkable. Disregarding minor flexures, which are numerous and sometimes involved, it may be described as following three principal directions.—From Dease Lake its general course is N. 56° E. for forty-seven miles, to a point near the valley of Rapid River. Here, before it has freed itself from the Cassiar Range, it turns nearly at a right-angle to a bearing of N. 15° W., which it maintains for thirty-one miles. Thence it again turns for a second time through a right-angle to a course of

N. 55° E., which it follows to its junction with the Liard. Its entire length, thus measured in three straight reaches, is one hundred and ten miles, but measured in straight lengths of one mile it is one hundred and twenty-seven miles, or, following all the sinuosities of the stream, one hundred and eighty miles.

Fall of the river, and current.

The height of Dease Lake, as previously stated, is 2660 feet, within small limits of error. That of the confluence of the Dease and Liard about 2100 feet. The last mentioned elevation is a fair approximation only, as no simultaneous barometer readings were available for purposes of comparison, and the weather during our stay at the forks was rather unsettled. The total fall of the river, according to these figures, is 560 feet, giving a slope of four feet to the mile for its entire length, which, judging from analogy with other western rivers, is about what might be expected from the appearance of the stream. The velocity of the current was estimated at about three miles an hour, as a general average, but there are several little rapids, as well as some rather long tranquil reaches.

Navigability of the river.

The river, from Dease Lake to the Liard, may easily be descended in two days, but the ascent is a comparatively slow process, depending much on the height of the water, and when the bars and beaches are not bare for tracking is a tedious affair. It is possible that the river might be navigated by small stern-wheel steamers of good power, as there are no insuperable obstacles, but doubtful whether such an enterprise would be a remunerative one, even if the traffic were to assume proportions much greater than at present. Such goods as are now required at McDame Creek (fifty-five and a-half miles below Dease Lake by the course of the stream) and at the little trading post at the mouth of the river, are easily taken down stream in large flat-bottomed boats, which go back light, by poling and tracking, without great difficulty. The boating on the river has been done principally by crews of Coast Indians, who are engaged and brought into the interior for the purpose.

Upper part of the river.

On leaving Dease Lake, the river is a small stream, estimated to average from 100 to 150 feet only in width, with a general middle depth of about three feet. It is extremely tortuous and rather swift, meandering in a wide, flat valley. At about eight miles from the lake, it may be said distinctly to enter the mountains, the valley at the same time gradually narrowing and becoming bordered by mountains from 4500 to 5000 feet in height, which, on the 19th of June, still bore much snow on their summits. At about thirteen miles from Dease Lake, it expands into a little lake about a mile and three-quarters in length, and between this and the mouth of Cottonwood Creek it flows through three more similar lake-like expansions, which are, respectively, a mile and a-half, two miles and one mile in length. These are probably formed

in all cases by the partial blocking of the valley by *débris* brought in by tributary streams, of which Cottonwood Creek itself is the last and most important. These lakes constitute somewhat serious impediments to navigation, as they freeze over in the autumn long before the ice takes on the river, and remain frozen till late in the spring.

Small lakes.

The mountains by which the valley is hemmed in on both sides from *First Lake* to the Cottonwood are very rough and high, and chiefly, if not entirely, composed of granitoid rocks. About three miles and a-half north-west of *Second Lake* is a remarkable broken summit, with a height estimated at 7500 feet, which, from the peculiarity of its form, has been named *Anvil Mountain*. Running parallel with this and *Third Lake* is a straight, well-defined range, the higher peaks of which attain an equal elevation, and which, for the sake of distinction and in consequence of the long slopes of broken rocks which descend from it, has been indicated on the map as the *Skree Range*. It is probable that actual measurement will show that several of the peaks in this vicinity exceed 8000 feet. The vegetation was observed to be further advanced as soon as the Dease River was fairly entered, showing how great must be the effect of the ice which lingers on Dease Lake, in its immediate vicinity. There is also evidence of a less abundant rain-fall along the river.

Tributaries.

Dease River rapidly increases in size, and after the lake is left, soon doubles its volume, owing to the number of affluent streams, of which Cottonwood Creek is the first which may be called a river. This stream occupies an important valley, which may be observed to run for many miles in a north-westward direction, bordered by continuous high ranges. It is remarkable that no paying deposits of gold have ever been found either on this or on Eagle River, which enters the Dease from the south about four miles further down. Eagle River also flows between high mountains, and its valley appears to be parallel to, and analogous with, that occupied by Dease Lake. It is evidently the "Christie River" of McLeod,* but this name has entirely passed out of use, and it appears hopeless to endeavor to reinstate it. Cottonwood Creek is shown on Arrowsmith's maps, according to McLeod and Campbell, but is not named.

Terraces.

Rock exposures are unfrequent in the banks of the portion of Dease River above described, though stratified gravel deposits are often cut into. There is also a considerable development of terraces at high levels on the sides of some of the mountains, particularly in the part of the valley which runs along the base of the Skree Range. Well-

* I have endeavored in all cases to identify the original names given by the first explorers in this country, and to ascertain as well the native names of places, but where these have passed entirely out of use by the miners and traders now in the country, it becomes necessary to drop them, though in so doing the strict law of priority is, no doubt, transgressed.

marked terraces were here seen on the west side of the valley, at an estimated height of 2000 feet above the river, or about 4600 feet above the sea.

Cottonwood Creek to McDame.

Immediately below the mouth of Cottonwood Creek is the Cottonwood Rapid, in which the course of the river is impeded by a number of boulders. The rapid is not a formidable one, or at all dangerous to run, with ordinary care. The river below Cottonwood Creek runs nearly due east for about ten miles, with a rather strong current. It then turns more to the northward, and after making several large flexures, reaches Sylvester's Landing, at the mouth of McDame Creek, in about eight miles. In this reach the current is slack, and the river averages 300 feet in width. The flat land of the river-valley is rather wide in this part of its length, but the mountains to the north and south are high and bold, many of the summits ranging from 6000 to 7000 feet. The lower slopes of the mountains are usually light, and in general thickly wooded, but their higher parts are treeless, and from the quantity of snow borne by them in June, must retain some snow throughout the summer. Immediately opposite the mouth of McDame Creek is a remarkably prominent and abrupt rocky mountain, which it is proposed to name *Sylvester Peak*. It height was estimated at 7000 feet, but the circumstances did not admit of its measurement.

Sylvester's Landing.

Sylvester's Landing is the point of supply for the miners on McDame Creek, also a post for Indian trade, and there are here a few log-houses and store buildings. Mr. R. Sylvester has been resident here for a number of years, and readily gave us all the information and advice in his power. McDame Creek was discovered to be auriferous in 1874. It has since been constantly worked, and, with its tributaries, has yielded much gold, but is now believed to be nearly exhausted. Its valley is wide and important, running north-westward for about seven miles, and then turning nearly due west. At the angle thus formed a low, wide pass leads through the mountains to the north-eastward, where it connects with the valley of the Dease. The appearance of this pass, as seen from a distance, is such as to suggest that the Dease River itself may at some former period have flowed through it.

McDame Creek Mountains.

The mountains bordering McDame Creek, viewed from Sylvester's Landing, are singularly different from any before met with. They are evidently composed for the most part of limestone, and characterized by the occurrence of long, bare slopes of shattered rock-fragments. They are scarcely at all wooded, and in this respect resemble the bare limestone crests of parts of the Rocky Mountains in more southern latitudes.

Cultivation.

Potatoes and turnips of large size are grown every season without difficulty on McDame Creek.

Tributaries below McDame

Nine miles below Sylvester's, the Dease makes its great bend toward the north, the intervening portion of the river somewhat changing its character from that above described, rock exposures being comparatively frequent in its banks and bed, where they produce several little rapids. Four-mile Creek enters from the south at somewhat less than the specified distance below Sylvester's. It appears to be the "Stuart River" of McLeod, shown on Arrowsmith's map of 1850, but neither on this nor on that of 1854 is McDame Creek indicated. Sylvester's trail to Turnagain or Black River (Muddy River of miners) runs up this valley, and follows a tributary—Sheep Creek—to the south-eastward, passing near the base of *Sheep Mountain*, a high rugged peak estimated at 8000 feet, situated about five miles and a-half south of the Dease. The distance to the trading outpost on Turnagain River is estimated at ninety miles, but is probably less. Horses are employed in packing over the trail.

Trail to Black River.

Rapid River.

The valley of the Rapid River joins that of the Dease at its great bend, just alluded to, but the stream, running parallel with the Dease for some distance, enters it several miles lower down, and its actual confluence was not observed. Beyond the great bend the mountains near the river decrease rather notably in height and abruptness, and at the same time retreat from the vicinity of the river, the valley becoming very wide, and long, hummocky slopes, or groups of low hills, coming in between the river and the mountains.

Dry belt east of Cassiar Mountains.

The northerly course of the river here carries it very obliquely through the eastern portion of the Cassiar Range. The precipitation in this part of the valley is evidently inconsiderable. The quantity of snow resting upon the mountains was observed to be very small, and here Sylvester successfully winters his horses, without cutting hay or otherwise providing for them, the depth of snow in winter being so small that it does not seriously interfere with grazing. This favored district is, in fact, homologous with that in the vicinity of Telegraph Creek, being in the dry lee of the Cassiar Range, just as that is in a similar situation with respect to the Coast Mountains. Much of the valley, with the slopes of the hills, is open or partially wooded with groves of black pine (*P. Murrayana*) and aspen poplar. The grass has the tussocky bunch-grass character usually found in dry regions, and it is intermixed with the small sage (*Artemisia frigida*). The bear-berry (*Arctostaphlyos uva-ursi*) is not uncommon, and the strawberry and lupin (*Lupinus Nootkatensis*) were in flower. *Anemone patens* was here also observed for the first time, but long past flowering. Making allowance for the time occupied in reaching this place from Telegraph Creek, the progress of vegetation here was palpably less advanced, but the showing was still a remarkable one for the latitude, elevation and distance from the sea of the region.

Below the Rapid River the Dease changes its character considerably, becoming relatively wide, with numerous gravel-bars and in some places many islands, with frequent "drift piles" or accumulations of timber. Terraces are well shown on the sides of the mountains and reach a height of about 2000 feet above the river. Dease below Rapid River.

A few miles before reaching the second great bend, a stream joins from the west, which has become known to the miners as French Creek, and is probably the "Detour River" of old maps. It rises on the north-east slope of the Cassiar Mountains, and is not large. French Creek.

The last main reach of the Dease is that which extends from the second great bend to its mouth, a distance of thirty-one miles in a direction of N. 55° E. Though the course of the river is far from being direct, the general bearing leaves the base of the Cassiar Range nearly at a right-angle. The country becomes low and uninteresting, and assumes a rather dreary aspect, being covered generally with forest of inferior growth, often degenerating into swamp on northern aspects, and with only occasional grassy openings on slopes with sunny exposures. In descending this part of the river, the mountains soon become invisible from the river-valley, which is bordered by undulating lowlands, or low diffuse hills which rise to a plateau at some miles distant, from 400 to 500 feet above the stream. Banks of frozen soil were seen in one or two places beneath a peaty or mossy covering. The climate is evidently somewhat more humid than before and less favorable to vegetation. The current of the river is rather swift, and there are two or three inconsiderable rapids, but none of importance till within about four miles of the mouth, where there are several strong rapids, which at certain stages of the water are reported to be dangerous, and in which all our boats shipped more or less water. Terraces, as much as 300 feet in height, approach the river in some places in this part of its course, and when cut into generally show stratified gravels which sometimes rest directly on low exposures of rock. Lower part of the Dease.

The larch (*Larix Americana*) was first seen five miles below the second great bend, and below this place becomes quite abundant in cold, swampy spots, where it grows with the black spruce (*Picea nigra.*) Larch.

Blue River (the "Caribou River" of Campbell) joins the Dease twelve miles below the second great bend. It is a stream fifty feet wide at the mouth, with clear water, and derives its supply from the north-eastern slopes of the Cassiar Range, to the north of French Creek. Blue River.

The "Lower Post," which is the furthest outwork of "civilization" or trade in this direction, is situated at the edge of a terrace forty "Lower Post."

feet in height on the left bank of the Liard, about half a mile above the mouth of the Dease. It is of a very unpretentious character, consisting of a few low log buildings, in the vicinity of which the woods have been entirely destroyed by fire.

The soil is poor near the post and the climate evidently unfavorable, but potatoes and turnips have been grown here in small patches.

Opening and closing of the river.

The Liard River is here said to open, as a rule, from the 1st to the 5th of May, though in 1887 this did not occur till the 18th of that month. In the autumn of 1886 it was frozen over on November 21st.

Mr. Egnell, in sole charge, received us on our arrival here with all distinction possible, displaying his Union Jack and firing a salute from his fowling piece. Before leaving we were indebted to him for many other courtesies, all of which are here gratefully acknowledged.

Geology of the Dease River.

Rocks west of granite range.

It would be impossible, without the expenditure of much time, to make anything like a complete geological section on the line of the Dease, in consequence of the infrequency of rock-exposures on the river itself and the distance and rough character of the bordering mountain-slopes. The main geological features are, however, sufficiently apparent. For about twelve miles below the lake the rocks composing the mountains seem to be referable to the same Palæozoic series, which has been described as occurring on Dease Lake, but the exposures examined appeared to be somewhat more highly altered, and in some cases to approach the character of crystalline schists. One bedded rock is probably a diabase, with somewhat lustrous division planes and kernels of epidote.

Granitic rocks of Cassiar Mountains.

Beyond the point above defined, at the first little lake, a granitic area is entered on, which may be regarded as constituting the axis of the Cassiar range, and which extends on the river to the mouth of the Cottonwood, constituting the entire Skree Range, and apparently also Anvil Mountain and the surrounding high mountain region, with a tranverse width of about thirteen miles. The granite here seen differs somewhat from that found on the Stikine in being more highly quartzose and occasionally garnetiferous. Mica is present in great abundance, and is in some specimens black, in others of characteristic pale, silvery colours. The existence of distinctly gneissic rocks was not ascertained, but the lithological character of the series resembles that of the lowest rocks of Shuswap Lake and other districts in the interior of British Columbia to the south, which have been provisionally referred to the Archæan.

East edge of granites.

The valley of Cottonwood Creek appears to coincide with the north-eastern edge of the granites for a number of miles. The mountains to

the north of it, and extending eastward along the north side of the Dease, are evidently composed of stratified rocks, including important beds of limestone, the average dip being about N. 45° E. < 30°. The northern spur of the mountain which terminates the Skree Range, opposite the mouth of Cottonwood Creek, shows the overlap of the stratified rocks upon the granites at a considerable height above the river. The mountains which run southward on both sides of Eagle River valley seem to be also granitic for the most part, though a greenish-grey felsite was collected on the river from the northern spur of the mountain to the east of the valley.

Rocks of McDame Creek Mountains.

Little was ascertained respecting the rocks composing the mountains between Eagle River and Sylvester's Landing, but granite does not reappear in them. The range to the east of McDame Creek is largely composed of limestone, which, striking in a north-west and south-east direction, constitutes also the mountains on the south side of the Dease. The dip is generally westward, at varying angles, and the limestones are associated with reddish shales, and near the mouth of Rapid River were observed to be interbedded with dolomitic layers and calcareous schists. The total thickness of the strata brought to the surface along this part of the river must be very considerable. The lithological resemblance is close to the upper part of the Palæozoic section on the Bow Pass, including the Banff, Intermediate and Castle Mountain limestones of Mr. McConnell (Annual Report, 1886, part D). Limestones near the western or upper part of the river-section contain numerous obscure fossils, including brachiopods, corals, and apparently a sponge-like organism. I also satisfied myself of the occurrence of *Fusulina* on weathered surfaces, proving the Carboniferous age of the rocks in question. The pure limestones are usually grey and are not highly crystalline.

Fusulina.

The mountains bordering the valley in the north-and-south part of its course, between the first and second great bends, appear to be composed throughout of similar rocks, though those on the west side are much better exposed than those on the east.

Confused exposure.

Eleven miles south of the second great bend, on the right bank of the river, is a low, rocky cliff, about fifteen feet above the water, capped by about ten feet of bedded white silts. The rocks are blackish, sandy shales, rather hard in some places, carbonaceous, and holding a little impure lignite. They are extremely irregular in dip, and are broken and jumbled up with a hard, grey quartzite, which is seen in places as the underlying rock, but is even then singularly shattered. The aspect of the shales is that of those of the Tertiary rocks, and it is possible that this locality represents an old shore-line, but more probable that the rocks form part of an ancient slide, or are upon the line of disturbance of a fault.

Possibly Triassic rocks.

At the second great bend there are a few exposures of a peculiar character, consisting of regularly bedded, dark, calcareous, flaggy argillites, alternating with grey, flaggy and massive limestones. Lithologically, these much resemble the Triassic of the West Coast, but no fossils could be found, though carefully sought for, and the evidence is quite too imperfect for the reference of the beds. The limestone is rather cherty, and gives out a fetid odor on being struck. The beds, as a whole, appear to form a synclinal.

Schists and slates of lower river.

From the second great bend to the mouth of the Dease, the underlying rocks consist of grey and black schists, the former generally calc-schists, and the latter more or less highly carbonaceous. They are interbedded with thin limestones, which often weather brown. The calc-schists are frequently glossy, and in some places form very thin, paper-like layers. Some of these rocks closely resemble those met with at the "Grand Rapid" on the Stikine p. 55 B. The general strike is north-west by south-east, but the direction and angle of dip is very varied, and the beds are frequently much disturbed and twisted, and traversed by veins of quartz and calcite. There are probably frequent repetitions of the same horizon, but the general arrangement may be synclinal, the dark shales and schists occupying the higher position, and being most abundant about the middle of this length of the river-section. Graptolites were found in the dark shales, particularly at a locality in a north bend of the river, eleven miles westward in a direct line from the mouth, and in appearance the whole series is much like that of the Cambrian calc-schists and Cambro-Silurian graptolite-shales of the Kicking Horse (Wapta) valley, west of the summit, on the line of the Canadian Pacific Railway.

Comparision with rocks to south.

The general aspect and association of the rocks to the east of the granite axis of the Cassiar Range closely resembles that of the Rocky Mountains about the 51st parallel, but differs in the large proportion of metamorphic materials of volcanic origin, which, from the *débris* brought down by streams, must be even more abundant than the exposures along the river would indicate. This difference is paralleled by the similar change which is met with on the 51st degree of latitude, in passing from the Rocky Mountains proper to the interior plateau of British Columbia.

Note on graptolites by Prof. Lapworth.

A small collection of graptolites, made at the point above indicated, has been submitted by Mr. J. F. Whiteaves to Prof. Charles Lapworth, of Mason College, Birmingham, who has kindly examined them, and furnishes the following note.—

"The graptolites collected by Dr. Dawson from the Dease River are identical with those examined by me from the rocks of the Kicking Horse Pass, some time last year. The species I notice in the Dease River collection are :—

Diplograptus euglyphus (Lapworth).
Climacograptus, comp. *antiquus* (Lapworth).
Cryptograptus tricornis (Carruthers).
Glossograptus ciliatus (Emmons).
Didymograptus, comp. *sagittarius* (Hall).
New form allied to *Cœnograptus*

"The graptolite-bearing rocks are clearly of about middle Ordovician age. They contain forms which I would refer to the second or Black River Trenton period, *i.e.*, they are newer than the Point Levis series and older than the Hudson and Utica groups. The association of forms is such as we find in Britain and Western Europe, in the passage-beds between the Llandeilo and Caradoc limestones. The rocks in Canada and New York with which these Dease River beds may best be compared are the Marsouin beds of the St. Lawrence valley and the Norman's Kill beds of New York. The Dease River beds may, perhaps, be a little older than these. Age of the fauna.

"Mr. C. White described some graptolites from beds in the mountain region of the west, several years ago, which may belong to the same horizon as the Dease River zones, though they have a somewhat more recent aspect.

"The specific identification of the Dease River fossils I regard as provisional. While the species correspond broadly with those found in their eastern equivalents, they have certain peculiarities, which may, after further study or on the discovery of better or more perfect specimens, lead to their separation as distinct species or varieties.

"It is exceedingly interesting to find graptolites in a region so far removed from the Atlantic basin, and also to note that the typical association of Llandeilo-Bala genera and species is still retained practically unmodified."

Overlying these old rocks, in several places at about eight miles from the mouth of the Dease, are shaly clays and coarse, soft sandstones, associated with which a thin bed of lignite was observed. These are evidently Tertiary, and referable to the series afterwards found more extensively developed on the Liard, above the mouth of the Dease. Some very obscure remains of leaves were noticed, but none were collected. The beds dip at various angles, sometimes as high as 15°, and thus appear to have been, to some extent, affected by flexure subsequent to their deposition. It is not improbable that a considerable part of the higher plateau by which the river is here bordered on both sides, is composed of these newer rocks resting upon the upturned edges of the schists. Tertiary strata.

Drift deposits and terraces.

Some notes respecting the superficial geology of the Dease have already been given in connection with the general description of the river. It now only remains to add the following general observations.

The scarped banks along the upper part of the river, to the first great bend, generally show stratified sands and gravels only, all or most of which may be classed as old river-gravels. Between the first and second great bends, well-bedded, yellowish-white silts appear and are frequently exposed. The bedding is sometimes inclined and large boulders are occasionally enveloped in the silts, which are in some places seen to rest upon and pass into true boulder-clay, while they are generally capped by a variable thickness of stratified gravels. The silts, occasionally, rest directly upon the underlying rocks, and in other places have been removed, so that the gravels lie upon the boulder-clay or upon the underlying rocks. Below the second great bend, the silts still occur, but are not so important, being largely replaced by stratified sands and gravels. The approximate level of the highest observed beds of the silt formation may be stated at 2400 feet above the sea. The highest observed terraces on the sides of the mountains have an estimated elevation of about 4600 feet. Glaciated rock-surfaces were observed in a single locality, a few miles below the mouth of McDame Creek. They appeared to indicate a flow of ice eastward or down the valley, but were not sufficiently distinct to afford completely satisfactory evidence on this point.

Upper Liard River.

Proceedings at mouth of Dease

We arrived at the little post at the mouth of the Dease on June 23rd, in rain, which continued during the whole of the next day, rendering it impossible to obtain observations, which were here necessary. On the morning of the 25th, however, I secured a fair series of observations, and having completed such arrangements as we had to make before entering the entirely untravelled country to the north, left the same afternoon. Mr. McConnell was here detached with two men and a boat for the examination of the Lower Liard. We had arranged that a couple of local Indians should accompany each party for the purpose of assisting at portages and acting as guides, but those who went with us deserted after a few days, and we afterwards learned that Mr. McConnell's Indians behaved in the same manner.

Country near the confluence.

The country about the confluence of the Dease and Liard is low and uniform, rising from the rivers in a series of more or less regular terraces, to a plateau 400 feet or more above the water-level, or approximately 2500 feet above the sea. The extent of this low country is considerable.

The name of the Liard River, or Rivière aux Liards, refers to the abundance of the cottonwood or poplar, and was no doubt originally given to its lower portion. This name has been corrupted to "Deloire," in which form it is generally in use by the miners of the Cassiar country. It is often spoken of as the West Branch by traders on the Mackenzie, and has also been named the Mountain River, and sometimes the Great Current River or Courant-fort. It is called Too-ti' by the Indians of the country along its upper part, while, according to Petitot, the Indians nearer the Mackenzie name it Eréttchichié and Thèttadéssè * The name Liard

The Liard River, though one of the principal affluents of the great Mackenzie, has remained up to the present time practically unknown, or at least undescribed, though sketched from observations by officers of the Hudson Bay Company on Arrowsmith's maps, and copied from those on other maps. It has long been in use as an avenue of communication by the Company, but since the abandonment of the posts to the west of the Rocky Mountains, its upper part has been traversed only at rare intervals, by a few prospectors and miners from the Cassiar district. With Mr. McConnell's work on the lower part of the river, and the examination of its upper part here reported on, we now have a survey extending from Fort Simpson, at its mouth, to one of its furthest sources, in Finlayson Lake. Rivers hitherto unsurveyed.

This river and the Frances appear to have been ascended by McLeod, about 1834, as far as Simpson Lake, but in 1840 Mr. R. Campbell explored the same route to Frances and Finlayson Lakes (as subsequently mentioned in greater detail), and obtained the most accurate geographical information available to the present time. Sir J. Richardson, however, in his Arctic Searching Expedition (1851) gives such particulars of the Liard as he was able to gather from hearsay (Vol. I, p. 167; II, p. 203), and mentions having received in 1848, while on the Mackenzie, Honolulu papers of late date by this route from the Pacific. On the older maps, the Black or Turnagain River is designated as the main continuation of the Liard, but it is much smaller than the "North-west Branch" of these maps, to which the name is now applied. In the present report that part of this branch above the confluence of the Dease is, for purposes of description, distinguished as the Upper Liard. Previous knowledge of the Liard.

The Upper Liard, just above the mouth of the Dease and opposite the post previously referred to, is 840 feet in width, and on the 24th of June 1887 was found to have a maximum velocity of 4·54 miles per hour. The river was not cross-sectioned, but, with an estimated depth of six feet for one-third of its width, the quantity of water car- Size of the river.

* Bulletin de la Société de Géographie, vol. x, p. 152.

ried would amount to about 19,000 cubic feet per second.* This may be regarded as a rough approximation for the mean stage of the river, which, when in flood, probably carries at least double this volume of water. It is a turbid yellowish stream, and contrasts in this respect with the clearer water of the Dease, which river, at its confluence with the Liard, probably carries about half the volume of water above assigned to the latter.

Character of Liard and Frances Rivers.

From the mouth of the Dease River to the confluence of the Frances River, the general bearing of the Liard is nearly due north-west, the distance, in a straight line, being thirty-three miles, or following the course of the river, forty-five miles. The Frances River, which was followed from the last-named point, disregarding its minor flexures, has a nearly direct north-and-south course. A straight line drawn from the mouth of the Dease to the lower end of Frances Lake is ninety-four miles in length, but the distance between these points, following the flexures of the river, is one hundred and thirty-five miles. Almost every foot of this distance had to be made by poling or tracking against the rapid stream, and as our boats were heavily laden and not as well suited in build as they might have been for the work, the ascent to Frances Lake occupied twelve days, or an average distance of about eleven miles a day only. As the river was entirely unknown to us and some time was unavoidably lost in reconnoitering rapids and selecting portages, besides the delays incident to surveying work and geological examination, I believe, that with a good boat and crew, the ascent to the lake might be made in about half the above time at the same stage of water. In very high water it would be extremely difficult to pass through some parts of the cañons, while at exceptionally low stages of water, when it would be possible to substitute tracking for poling in many places, the distance might be accomplished in even less time.

Lower Cañon.

Six miles above the mouth of the Dease, by the course of the river, the entrance of the *Lower Cañon* is reached. The full height of the plateau through which the river here cuts, is about 500 feet, but banks of this height seldom abut directly on the river. The upper parts of these banks are composed of stratified sands and gravels, but the lower part of the gorge is cut through shaly and slaty rocks, which are perpendicular or form very steep slopes, averaging about a hundred feet in height. The cañon is three miles in length, and at high water it is said to be necessary to portage the whole of this distance. We were obliged to lighten the boats and make four small portages over rocky points, where the current was dangerously swift. The latitude,

* Estimated by approximate formula, Trautwine's Engineers' Pocket-book, 1882, p. 562. The depth above assigned to the river is probably too small.

observed at noon near the middle of the cañon, was 60° 01′ 06″. Finding that we were so near the northern boundary of British Columbia (Lat. 60°), we made a small cairn of stones on a prominent rocky point, in the centre of which a post was erected, on which the latitude was marked. The 60th parallel may be said to coincide almost exactly with the lower end of the cañon.

Rocks of Lower Cañon.

The rocks seen in the Lower Cañon resemble those described as characterizing the lower part of the Dease River and Dease Lake, being shales or schists, which in some places show slaty structure They are generally dark with plumbaginous matter. With these are associated grey, somewhat glossy schists, and calcareous schists which pass in some places into pretty pure, thin-bedded limestones. Quartzites are also present, and all the rocks are occasionally locally silicified. The whole series is much disturbed and contorted, and is broken by innumerable small, irregular seams and veins of quartz and calcite, with some dolomite, though no well-marked or important lodes were seen. Galena is reported to have been found in some of the veins, and to have yielded a small return in silver on assay.

River from Cañon to Frances.

Above the Lower Cañon the river continues swift, the current averaging about four miles an hour, and much exceeding this rate in many reaches. It is wide and shallow, and in places becomes a complete maze of islands and gravelly, half-submerged bars, causing much difficulty and loss of time from the frequent necessity of crossing from one to another of these to avoid under-cut banks, with water too deep for poling. Our actual travelling time from the Dease to the mouth of the Frances, deducting all stoppages, was thirty-eight hours and a-quarter.

The river-valley averages about two miles in width, and is cut out to a depth of 300 feet or more in the plateau, which occasionally rises directly from the river-bank to its full height, though the stream is usually bordered by terraces of inferior height, alternating with low flats, which occupy the concave sides of the bends. The higher ground is generally wooded with spruce, while the black pine (*Pinus Murrayana*) is abundant on dry terraces, and groves of cottonwood of medium size often occur on the flats. Aspen poplar is not uncommon, and a few birch and larch trees were seen. Little of the timber is of useful size or quality. The dry bars and gravelly flats were, when we passed, gay with *Epilobium latifolium*, *Oxytropis campestris*, *O. Lamberti* and *Dryas Drummondii*, and the wild roses were rapidly coming into flower.

Rancheria River.

About midway between the Dease and Frances a small river enters from the south-westward, which has been called the Rancheria River, but of which I do not know the native name. It appears to debouch by several mouths when in flood, and apparently rises in the eastern

slopes of the Cassiar Range. A few miles above this, on the opposite side of the river, a small lake, reputed to be well stocked with fish, is reported. About seven miles below the mouth of the Frances, on the south west bank, is an old Indian camping place, which is said to be frequented at certain seasons by the Tahl-tan Indians for purposes of trade. It is reached by these people by some overland route which crosses the Cassiar Mountains to the north of the Dease River.

Confluence of Liard and Frances.

The Liard is full of islands at its confluence with the Frances, rendering it difficult to estimate the relative importance of the two streams, but they appeared to carry about an equal quantity of water. The Liard is, however, evidently more subject to freshets; Frances Lake doubtless serving to regulate the flow of the Frances River, the water of which is a clear, pale, amber color, and does not thoroughly mingle with the yellowish, turbid water of the Liard for some miles. Above the confluence, the Liard valley is seen to trend off in a south-westerly direction for ten miles or more, after which it again turns to the northwestward, and, from the scanty information available concerning it, seems to flow along the eastern side of the northern continuation of the Cassiar Range, from which it receives most of its water.

Sayyea Creek.

On comparing the statements of the few miners I have seen who have ascended this river, it appears that Sayyea Creek, which is an inconsiderable stream, flows in from the west about fifty-five miles above the mouth of the Frances. Good gold "prospects" were found on this creek in 1875, a number of pieces worth ten dollars having been obtained, but little work has ever been done. Of a party of miners who spent the winter of 1874-75 in its vicinity four died of scurvy. Of the other tributaries of the Liard, which must be numerous, I have been unable to ascertain anything authentic.

Names of Liard and Frances Rivers.

Respecting the names of the Liard and Frances rivers, it should be mentioned that Campbell called that which is now known as the Liard the "Bell River," after Mr. J. Bell, of the Hudson Bay Company. Under this designation it appears on Arrowsmith's map of 1854, the name Liard being applied to the branch now known as the Frances. Usage has, however, changed the first nomenclature, and it is undesirable to attempt to revert to the original names, as, irrespective of the question of relative size, the physical characteristics of the Liard below the confluence are undoubtedly continued on the west rather than on the east branch above that point. The Indian name of the Frances is identical with that of the Dease, being Too-tsho-tooa', or "Big Lake River."

Rocks above the Cañon.

Rocks like those of the Lower Cañon are seen at intervals for about two miles above its head, beyond which, for about three miles, stratified gravels and sands only appear in the banks. Six miles from the cañon

Tertiary clays of whitish and grey colours, and associated with impure lignite, are first met with, and these continue to appear here and there along the river as far as the Frances. The thickest bed of lignite observed was about three feet, four miles below the Frances. The lignite is generally impure and often very distinctly laminated. It resembles in character the lignites of the Miocene of British Columbia, and the associated clays and soft shales are similar in character to those of that formation. Numerous boulders of basalt are found along this part of the river, and the basalt was observed to form a mural cliff, at a height of about 300 feet above the river, at a place just below the mouth of the Rancheria River. This rock evidently overlies the lignite-bearing beds. The shaly clays and lignites show evidence of considerable disturbance, and dip in some places at rather high angles. This may be due to the action of old land-slides along the banks of the river, but appears to be rather too constant to be satisfactorily accounted for in this way. Lignite. Basalt.

Near the mouth of the Frances the white silts again become a prominent feature, though scarcely seen lower down the river. They overlie the Tertiary rocks and hold concretions of various forms here and there. They are capped by the usual stratified sands and gravels, which generally have a yellowish or rusty colour. White silts.

The gravel bars and the shores of this part of the Liard are almost half composed of rolled quartz pebbles, which have evidently been derived from veins traversing relatively soft schistose rocks like those of the cañon. The great quantity of such vein material present in this district may be regarded as a favorable indication in respect to mineral development. Some small bars have paid to work along this part of the river, and gold is also found in some layers of the gravel deposit which overlies the older rocks along the cañon and above it, where "wages" at $4 a day can be made. The amount of cover which it soon becomes necessary to remove in following the paying layers, has prevented extensive mining, but probably these gravels might be advantageously worked as a whole, by sluicing or by the hydraulic method. Gold.

No general view of the country can be obtained from the river, owing to woods and the depth of the valley, but from high points of banks above the river, near the Frances, a large area may be overlooked. Thus seen, the country is found to be a wide, rolling plateau, with an average elevation of about 500 feet above the river, or say 2700 feet above the sea. It rises here and there, however, in broad, rounded swells, or flat-topped higher plateaux with steep edges, and a considerable part of this higher ground is at an elevation of about 1000 feet above the river. The plateau is everywhere wooded, except General appearance of the country.

where intersected by grassy or mossy swamps of small area. There is a large triangular region of country of this kind between the Upper Liard and Dease, which is bounded to the westward by the front of the Cassiar Range, the sharp, rocky peaks of which carry a considerable quantity of snow and run along the horizon line for many miles, but which, with the exception of a few outlying summits, is at a minimum distance of about twenty-five miles from the mouth of the Frances. The same low country runs in a north-north-westward direction, without apparent limit, forming the upper part of the Liard valley. To the eastward it is bounded, at a distance of about ten miles, by a comparatively low range of rounded mountains and hills, which, from the Indian name of one of its salient points to the northward, may be called the *Tses-ī-uh Range*. The part of this range nearest to the confluence of the Frances and Liard has an elevation estimated at about 3500 feet above the sea. Like other main features of the country, it runs in a north-north-west by south-south-east direction, but dies out completely before reaching the Upper Liard River, which, if continued, it would do at the Lower Cañon. It is probable, indeed, that the cañon is produced by the river cutting across the extension of the same ridge of rocks which produces these hills. The general uniformity of the plateau appears to be largely due to the Tertiary rocks, which doubtless underlie almost its entire area. The appearance of some of the flat-topped hills above alluded to is suggestive of the occurrence of sheets of basalt overlying the softer rocks. The forms of the Tses-ī-uh Mountains show that they are not thus composed, but Tertiary rocks may again occur beyond them, in the valley of the McPherson or Highland River, which is not far off.

Cassiar Range.

Mountains to the east.

Tertiary plateau.

Frances River.

The general direction of the Frances, for nine miles from its mouth, is north-north-west. It then bends to the north-eastward, and in four miles the lower end of the Middle Cañon is reached. For the first few miles above its mouth the Frances is extremely tortuous, so much so that the distance following the actual course of the river to the foot of the cañon is twenty-two miles. This river, like the Liard, was at a medium stage near the end of June, 1887. Marks along the banks showed that it had been about six feet higher in the spring, and that it had since been falling. Its average width in this part is about 600 feet, and the rate of the current, at the medium stage above referred to, about four miles and a-half an hour.

Mouth of Frances to Middle Cañon.

The highest land immediately bordering on this part of the river is a terrace at a height of about 150 feet above it, the surface of which is

Terrace.

in some places composed of almost pure sand, upon which open woods of *Pinus Murrayana* grow. Larch was observed to be moderately abundant in damp, shady localities and the banks were in some places diversified with flowers, of which *Potentilla fruticosa* and *Primula mistassinica* were specially noted.

Numerous small exposures of Tertiary shales and clays, of grey, blackish and yellowish tints, occur along this part of the river. Lignite is strewn in great quantities over some of the bars, and though thin seams occur in places in the banks, it is probable that thicker ones exist in the bed of the river. The lignite often holds drops of fossil resin or amber. The Tertiary rocks are very generally covered by silts, like those already several times alluded to. In a bank near the mouth of the river, which gives a complete section from the top of the terrace above described, the lowest deposit consists of roughly stratified gravel and clay, with some glaciated boulders. This is followed by the silts, which are again in turn covered by stratified sands and gravels. The lowest deposit probably represents the boulder-clay, and resembles that of the Upper Pelly River, subsequently described. Exposures in the banks.

Quartz is not so abundant a constituent of the gravel of the river bars on this part of the Frances as it is on the Liard below, and no basalt blocks or boulders were observed here.

The *Middle Cañon*, as it may be called for the purpose of distinguishing it, is about three miles in length, the river being hemmed in by broken, rocky cliffs of 200 to 300 feet in height for the greater part of this distance. We took our boats up along the south-east bank, making four short portages of part of the stuff, and two of both boats and load, across narrow, rocky points. One portage of greater length, on the opposite bank, would overcome all the really bad water, but the banks on that side are rougher, and the whole force of the current sets against the cliff in one place in a dangerous manner. The total fall in the cañon is estimated at about thirty feet. Middle Cañon.

This cañon is evidently produced by the southern extremity of a second range of mountains parallel to the Tses-ī-uh Mountains, but to the west of that range. This southern spur, though submerged in the Tertiary and drift materials by which the general surface of the country is covered, nevertheless presents a rocky barrier to the passage of the river, and in this place constitutes the eastern margin of the Tertiary basin, no beds referable to which are seen further up the Frances. The range of mountains here referred to may, for convenience, be named the *Simpson Mountains*.

The exposures in the lower part of this cañon show limestones, some of which are moderately pure, but others are nearly half composed of small, more or less rounded fragments of siliceous and schistose rocks. Rocks of the Cañon.

These weather to rough surfaces, and have a very peculiar aspect, as an intense pressure appears to have flattened the contained fragments parallel to a single direction. These limestones are associated with several varieties of calc-schists, with hard, greyish-blue, cherty quartzite, with schistose breccia, which appears to have been originally of volcanic origin, and with some pretty evident volcanic agglomerate. Further up, the rocks have been completely shattered and variously changed in appearance by solfataric or some similar action, some parts being bleached, while others are reddened by the deposition of iron, forming cliffs of a remarkably varied appearance. The upper gate of the cañon is composed of white cliffs of marble and quartzite, all much shattered. The marble and limestones are in places associated with red shales, resembling those found in a similar association on the Dease, near the eastern edge of the Cassiar Range, and the rocks of this part of the section are probably like those, of Carboniferous age. Specimens of *Fusulina*, with polyzoa, etc., are found in some of the limestones on microscopical examination. Stratigraphically, the rocks seen in the sections are all much confused and broken, and the angles of dip are very varied, though the strike may, in a general way, be given as north-north-west. The Simpson Mountains which are upon this line of strike are doubtless composed of rocks of the same character.

Fusulina.

Above the Middle Cañon, the general course of the river is again north-north-westward for about twelve miles. It is here usually bordered by quite low land on both sides, and the valley between the southern end of the Simpson Mountains and northern part of the Tsea-Tuh Range is about three miles in width. The wide, uniform plateau country is now, however, left behind, and we enter a generally mountainous region, though the highest summits in this immediate vicinity scarcely exceed 3000 feet above the river. Their forms are rather rounded and flowing, and the slopes of those on the east bank are nearly bare of trees, while the opposite range is generally wooded, but evidently with trees of small growth. The river itself is wide and deep, with a rather slack current. A single exposure only, composed of grey-green, silvery schist, was seen along this part of the river.

Beginning of mountainous country.

Near the end of this reach of the river, two considerable streams enter on the west side, and on one or other of these, at no great distance from the river, Simpson Lake of McLeod and Campbell is situated. As the Indians who had accompanied us from the mouth of the Dease had deserted before we reached this place, I was unable to ascertain any definite particulars respecting the lake, though it is reported to be a good one for fish. The position of Simpson Lake, as indicated by broken lines on the map, must therefore be regarded as quite uncertain. The same doubt applies to the Indian names of

Simpson Lake.

several rivers tributary to the Frances above this point, for although one of the local Indians had made for us, upon a sheet of canvas used as a boat cover, an elaborate charcoal drawing of the whole system, it proved to be extremely difficult to recognize the features represented. The Indian map, such as it is, serves to show that the streams tributary to the Frances River rise in a number of lakes, some of which are reported to be of considerable size, and offer a most attractive field for further exploration. We were told, however, that none of the lakes in this region are equal in size to Frances Lake, for which we were heading, a statement borne out by the circumstance that both this and Dease Lake are known in their respective districts as Too-tsho, or "big lake," while the Frances and Dease rivers are, as already mentioned, both similarly named Too-tsho-tooa', or "big lake river." Tributaries of the Frances.

From the point just noted, the direction of the river changes to north-east, cutting across the direction of the Tses-ī-uh range, which terminates at the edge of the river in low, wooded hills. The current is moderately swift throughout, and in one place the river is bordered on both sides by low, rocky banks, but no rapids are met with. This we named the *False Cañon*. One or possibly two streams enter from a valley which runs to the east of the range just mentioned, but they are not of large size. Greyish-green, quartzose mica-schist and greenish silvery schists were seen in one or two places, and in the low rocky banks above alluded to, blackish argillites and grey quartzites, of a less altered appearance than usual, but from which no fossils were obtained, occur. False Cañon.

From the end of this reach the general course of the stream again becomes north-north-west for about thirteen miles, running for the greater part of this distance parallel to, and a mile or two miles from the base of a mountain range, which comes in to the east of the Tses-ī-uh Range. The country to the west of the river is here either flat or characterized merely by low, rounded and wooded hills for many miles back, the eye ranging across this country to the continuation of the Simpson Mountains, which, with generally rounded forms and no striking summits, reach elevations of 6000 to 6500 feet. These mountains do not form a strictly connected range, but appear rather as a series of mountainous areas, separated by wide, low passes. The Indian map above referred to shows three or four lakes in this region, supplying a stream named *Too-tshī-too-a*, which flows into the Frances, reaching it probably just above the Upper Cañon. None of these lakes were visible from any point reached by us. On the opposite side, one stream of considerable size joins the Frances. This is supposed to be the *Agā-zī-za* of the Indians, and, if so, is represented as rising in a chain of small lakes, some of which drain in an easterly direction River above False Cañon. Lakes.

to the Macpherson (*Eg-is-e-too'-a*) River. The valley occupied by these lakes is a travelled route employed by the Indians.

Granitic rocks.

The current is swifter in the upper than in the lower portion of this part of the Frances, and there are numerous islands in the river, but no rock-exposures occur. The mountains to the east of the river are high, but have blunt, rounded forms. Much bare rock shows in their sides, but there is no appearance of stratification, and this, with their form and color, and the great abundance of that material found in the streams in this vicinity, renders it nearly certain that they are composed of granite.

Character of the mountains.

The mountains so far met with in the vicinity of the Frances form rather isolated ranges or masses, which rise somewhat abruptly from generally low country, or are separated by wide valleys, the appearance being that of a mountain system partly buried in later deposits; though no Tertiary rocks, either in place or as loose fragments, are met with above the Middle Cañon. The granitic mountains last referred to form an outlying spur or buttress of the most important range of the district, the axis of which is here about twelve miles east of the river. This it is proposed to designate the *Too-tsho Range* * The southernmost high summit observed was named, from its form, *Tent Peak* It is situated in latitude 60° 52′ 45″, and has an altitude of 7860 feet above the sea.

Upper Cañon.

The river next makes an abrupt turn to the west for four miles, a mile and a-quarter of this distance being occupied by a series of rapids, which are rocky and rather strong, and have a total fall of about thirty feet. The banks rise steeply from the river to heights of 100 to 200 feet, though the rocky cliffs along the water are of inconsiderable height, scarcely anywhere exceeding fifty feet. This place may be named the *Upper Cañon*, and is the last serious impediment to the navigation of the river. We found it necessary to make several short portages, but with a large boat and at a good stage of the river, it is probable that one portage of about 1000 feet in length, on the south bank, would overcome all the dangerous water, while the boat might be tracked up light. A stream, with moderate current at the mouth and about fifty feet wide, enters a short distance below the cañon, coming from the mountains to the north of Tent Peak. The rocks of

Rocks of Upper Cañon.

the Upper Cañon comprise black, glossy calc-schists, black quartzite or chert, bluish limestone, and some green-grey, silvery schist. Similar rocks are seen again a couple of miles up the river, above the cañon, where a rapid occurs. The dips are all low, and so far as observed, uniformly in a northerly direction. Some of the schists are highly

* From the native name of Frances Lake. I was unable to ascertain the Indian name of this range, if indeed it has any such.

silicified by action subsequent to their deposition, and parts of all the rocks, including the limestone, are reticulated with narrow quartz seams. Near the upper part of the cañon some hard conglomerates occur, holding schistose fragments, as well as limestone pebbles, in which crinoidal joints are observable. It is not improbable that two unconformable series of rocks occur here, but I was unable to find means of distinguishing them in the sections.*

Upper Cañon to Frances Lake.

From the Upper Cañon to Frances Lake, a distance of twenty one miles and a half in a straight line, the river maintains a northerly direction with considerable uniformity. It is deep, with a moderate current, for about eight miles, or to *Moose Island*, above which for ten miles the current is again swift, averaging from four and a-half miles to five miles an hour. It again becomes slack for a short distance below the lake. Some portions of this part of the river are much broken up by islands and gravel bars The river-valley averages about ten miles in width, extending to the slopes of the Too-tsho Range on the east, and being bounded to the westward by a series of rounded mountains, which diverge to the northward from the direction of the first-mentioned range, and run to the west of Frances Lake. These I propose to name the *Campbell Mountains*, for Mr. R Campbell, whose initial exploratary trip through this country for the Hudson Bay Company is elsewhere referred to at length.

The valley is partly occupied by terrace-flats, and partly by wooded hills or ridges with rounded or flowing forms but which rise in some places to heights of several hundred feet. The Too-tsho Range is here very compact and regular, and runs due north-and-south, the higher summits reaching 6500 to 7000 feet, and carrying some snow, though nothing like true glacier-ice was anywhere seen. The lower slopes of the range toward the river-valley are singularly uniform and light. Two or three streams of some size enter the river from the eastward in this part of its course. All that could be gathered respecting these is shown on the map. The furthest north was named Tyer's River by Campbell, and is known to the Indians as *Pas-ka'*. The exact position of its mouth was not definitely ascertained.

Too-tsho Range

On approaching the lake, low ridges and irregular mounds begin to appear in the vicinity of the river, projecting through the lower terraces and suggesting the existence of morainic deposits. Large boulders also become abundant in the river-bed. No rock-exposures whatever were seen along this part of the river.

Morainic ridges.

Our actual working time on Frances River, from its mouth to the lake, was sixty-seven hours and a-half. The difference of level between

Travelling time on Frances River.

* If so, the rocks here noted may represent the Cretaceous to which they are lithologically similar.

Frances Lake and the mouth of the Dease is 477 feet. By assigning ninety feet of this to the fall in the three cañons, and dividing the remainder by the total length of the river (less the aggregate length of the cañons), we obtain an average rate of descent very slightly exceeding three feet to the mile, which is about what might be anticipated from the current met with in the river, as compared to that of other streams in the district.

Frances Lake and Vicinity.

Frances Lake.

The elevation of Frances Lake above the sea, as determined by a series of barometer observations extending from the 8th to the 16th of July, is 2577 feet. Three miles from its lower end, the lake bifurcates, forming two approximately equal and nearly parallel arms, with lengths of about thirty miles. The two arms are about eight miles apart, and are separated by a group of low, rounded mountains, the culminating point of which, with an elevation of 5230 feet, was named Simpson's Tower by Campbell, the lake itself receiving its name at the same time in honour of Lady Simpson. The eastern side of its east arm is bordered by the Too-tsho Range or hills attached to it, while the country to the west of the west arm rises more gradually to the bases of the Campbell Mountains, some miles distant. Though so far referred to as a single lake, this body of water is in reality entitled to be considered as a group of lakes. The upper end of the west arm, with a length of five miles and a-half, is separated from the main portion of the same arm by a river-like constriction over a mile in length, while the east arm is entered by a narrow and inconspicuous opening with a strong current flowing out, and the real extent of this arm is seen only after passing, for about seven miles, through a series of irregular basins and small lake-like expansions connected by narrows, in which a very perceptible current is found. It appears best, however, to retain Campbell's original name for the whole body of water, rather than to multiply names for which there is no immediate call.

Character of its valley.

Except in its bifid form, for which there are several parallels, and which results merely from the convergence of two valleys of similar character, Frances Lake closely resembles a large number of lakes in the mountainous regions of British Columbia, and has the long narrow parallel-sided outline characteristic of lakes which occupy old valley-excavations, the drainage of which has become interrupted in various ways. In this case, as in a number of others, there can be little doubt, that the lake is held in by morainic accumulations. The great number of boulders near its outlet has already been referred to, and the lumpy, irregular mounds and ridges composed of detrital matter, on the lower

seven miles of the east arm, as well as on the corresponding portion of the west arm, appear without doubt to represent moraines in a more or less degraded condition. The average width of the upper portions of both arms, above these interruptions, is pretty uniformly maintained at about a mile and a-half, such irregularities as occur being produced by gravelly and sandy flats a few feet above the water-level, which have been formed at the mouths of entering streams. The extent and uniformity of these points, is such as to show that the lake must have remained, during a long period, approximately at its present level. The most important of these low points is that which separates the upper part of the west arm, already referred to, and is due to the Finlayson River.* The next is produced by a second stream which enters on the same side five miles and a-half below. This stream is somewhat smaller than the Finlayson, and is known to the Indians as the *Il-es-too'-a*.

Country surrounding the lake.

Except along the upper part of the eastern side of the east arm, the mountains do not slope down abruptly to the shores of the lake. Elsewhere, the lake is almost continuously bordered by a terrace-like plateau, which is widest to the west, and has an average elevation of about 300 feet. This resembles the low country found about Dease Lake, though even more uniform and less sloping in character, and is not far from the same actual elevation above the sea in both cases. The streams entering the lake generally cut down through the edges of this plateau-like margin, in deep narrow gorges, the sections in which show that it is composed largely of rock, though levelled up to some extent by the addition of superficial gravelly deposits. This fact appears to indicate that the lake or the drainage level of the country was maintained for a very prolonged period at or near the height of this plateau before the base-level of erosion was so lowered as to permit of the excavation of the lower valleys in which the lake now lies. There is, in addition to this, a second lower terrace, not so well marked, and not often of great width, at an elevation of ninety feet above the lake. This is seen on both arms, and is composed of gravel and other detrital deposits. It is specially conspicuous about the mouths of the entering streams, and marks a later stage at which the water of the lake stood, for a relatively short time, subsequent to the glacial period.

Origin of terraces.

Picturesque scenery.

Few lakes which I have seen surpass Frances Lake in natural beauty, and the scenery of the east arm, bordered on the east by the rugged masses of the Too-tshp Range, is singularly striking. The mountains of this range are very varied in form, and a number of points surpass 7000 feet in height, while one was found to attain an elevation of about

* So named by Campbell after Chief Factor Duncan Finlayson, afterwards a member of the H. B. Co. Board of Directors.

G. M. D. delt.

FIG. 6. OUTLINE SKETCH OF PART OF THE TOO-TSHO RANGE, FROM WEST SIDE OF FRANCES LAKE, AT ITS OUTLET.

(The figures placed above the various summits are true bearings.)

9000 feet. This is named *Mount Logan*, for the late Sir W. E. Logan. Heavy masses of snow rest in some of the valleys, but no true glaciers are produced, a fact indicating a comparatively small snow-fall. The broken outlines of this range contrast strongly with the rounded forms of the mountains to the west of the west arm, with which Simpson's Tower and associated hills, separating the two arms, also conform.

Terminations of the lake.

The west arm terminates in a nearly circular basin about a quarter of a mile in diameter, at one side of which a fair-sized river, easily navigable for boats, flows in. The east arm was not followed to its head, though its termination in low land was seen. Here also, according to Campbell's sketch, a considerable river, which he has named Thomas River, enters.

Upper parts of tributary valleys.

The two valleys, the lower parts of which are occupied by the east and west arms of the lake, run on far beyond the heads of these arms. Each of the rivers flowing in these valleys (according to the Indian sketch already referred to) eventually bifurcates, and all four streams thus formed rise in lakes. The river flowing into the head of the west arm is named *Yus-sez'-uh*, and the lake on its western branch is known as *Us tas'-a-tsho*. No name was obtained for the lake on its eastern branch, which is evidently, however, Macpherson Lake of Campbell.

Henry Thibert, who made a prospecting expedition up the west arm of Frances Lake and far up the river in question, some years ago, has kindly supplied me with some notes on it. He estimated the river, from the head of the arm to Macpherson Lake, to be about thirty-six miles in length, while Macpherson Lake is ten miles long. The first distance was, however, intended to include the windings of the stream. He did not visit Us-tas'-a-tsho, which, however, from the termination tsho (=big) is probably large. Us-tas is the name of the mythical culture-hero of the Tinné. The Indian name of Thomas River is *Too-tlas'*, the lake in which its eastern branch rises being named *Tus-tles-to*, the source of its western branch *Til-ē-i-tsho*. These lakes and connecting rivers are indicated by broken lines on the map, from Thibert's account and the Indian sketch of the country, combined with the observed positions of several of the mountain ranges.

Mountains to the north.

The mountains to the north in which these rivers rise, were too distant to enable us to fix them with any great accuracy from points occupied by us on Frances Lake, but the whole country in that direction, from such views as were obtained of it, appeared to be rugged and high. It was with great regret that we were obliged to abandon the idea of exploring these rivers further, but the summer was already so far advanced, that this was impracticable, in view of the journey still before us.

The water of Frances Lake is clear and of a pale, brownish tint, and the lake is evidently very deep in its upper portions, though rather

Rock exposures

shallow where encumbered by the morainic accumulations already alluded to. Rock exposures are, as a rule, quite unfrequent along its shores, which are generally composed of gravel and sand. At the time of our visit it was about six feet below its extreme high-water level, and it does not appear to be subject to very great fluctuations. Drift-wood is very abundant along some parts of the shores, particularly in the west arm, and it is probable that much of this is brought down by the river entering at the head of this arm. Lake-trout, white-fish, pike and suckers were found in the lake in considerable abundance.

Old Hudson Bay post.

The site of the old Hudson Bay post is just above the narrow entrance to the east arm, on the edge of the bank, facing westward. Though Mr. Campbell had given me an accurate description of its position, it was so completely overgrown with bushes and small trees, that it was discovered with difficulty. The outline of the old stockade, with bastions at the corners, is still visible, though all traces of the structure itself has disappeared. This post has been abandoned since 1851.

Forest.

All the lower country about Frances Lake is well wooded, and the mountains are also covered with forest, save where exceptionally steep and rocky, to a height of at least 1500 feet above the lake, while trees of smaller growth extend in the valleys considerably higher. The most abundant tree, here as elsewhere in the region, is the white spruce (*Picea alba*). It frequently attains a diameter of two feet, growing tall and straight on low ground and in sheltered places. The black spruce (*Picea nigra*) is also abundant. The larch (*Larix Americana*) is characteristic of damp, cool, northern slopes, and birch (*Betula papyrifera*) is moderately abundant, though not large. The shores, and particularly the delta-flats at the mouths of streams, are characterized by groves of cottonwood (probably all referable here to *Populus balsamifera*) and black pine (*Pinus Murrayana*).

Burnt country.

Large tracts of country have been burnt over, many years ago, and extensive recent fires have swept the western side of the upper part of the east arm. Where a second growth has had time to spring up, it consists generally of mixed spruce, aspen and birch. Alders are common, but scarcely arboreal, along the borders of the lake. In the middle of July thickets of wild roses were seen in many places in full bloom.

General aspect of country.

Taken as a whole, the growth of the forest and appearance of the country is remarkably pleasing, considering the high and northern position of the lake. The only characteristic difference of the woods here, as compared with those of the interior of British Columbia about the 54th parallel, is the great abundance and depth of the soft, mossy and lichenous floor which is everywhere found in them. The trees are also often well bearded with moss, affording evidence of a continuously

moist atmosphere, to be accounted for by the almost daily occurrence of light showers and the great prevalence of clouded skies, which was found throughout this part of the country. As before noted, however, the snow-fall cannot be great, nor is there any indication that the total annual precipitation is very considerable.

Geology of shores.

The infrequency of rock exposures along the shores rendered it difficult to obtain any connected idea of the geology of the lake, both arms of which appear, however, to occupy valleys excavated along the strike of comparatively soft black and greyish glossy schists, which are often calcareous and frequently interbedded with bluish limestone. In lithological appearance these rocks resemble those of the Cambro-Silurian, in which graptolites were found on Dease River, though no fossils were obtained here. The strike is parallel, so far as observed, to the directions of the arms, the prevailing dips being westward on the west arm, eastward on the east arm. The character of the harder and doubtless older rocks which occupy the centre of the anticlinal thus formed and compose Simpson's Tower and connected hills, was not ascertained.

Quartz veins numerous.

The high rugged central parts of the Too-tsho Range are composed largely or entirely of grey granite, pebbles and boulders of which are everywhere abundant, and particularly so along the beaches of the east arm. There is, too, a notable abundance of quartz along all the beaches of the lake, this material being derived from innumerable veins which traverse the schists in all directions, though most often found parallel to the bedding-planes, and generally assuming forms more or less lenticular. The largest of these are often several feet in width, and those seen in the cañon of the Finlayson, near its mouth, are of workable dimensions, if only moderately rich in gold. Specimens of quartz veins, containing some iron and copper pyrites, from the east side of the east arm about midway up it, were found to contain traces of gold on assay by Mr. Hoffmann.

Prospects for gold mining.

In general appearance the rocks of Frances Lake very closely resemble those from which the rich placer gold deposits of Dease Lake are derived, and they are probably of about the same age. Several "colours" to the pan were obtained from surface gravel at the mouth of Finlayson River, which struck me as specially promising in aspect and there seems to be no reason why some of the streams flowing across the schistose rocks into the lake or in its vicinity should not prove to be richly auriferous. This entire district well deserves careful prospecting. After my return to the coast, in the autumn, I ascertained from Charles Monroe that he and some other miners had actually done some prospecting in the vicinity of the lake at the time when the Cassiar mines were yielding largely, and the more enter-

prising men were scouring the country in search of new fields. He reached the lake from Cassiar by the same route we had followed. On comparing notes we found that he had worked for a short time at the mouth of the Finlayson, where he found the gravel to pay at the rate of from $8 to $9 a day.

Country between Frances Lake and Pelly River.

Proceedings at Frances Lake.

We reached Frances Lake an the morning of the 8th of July, and had we been able to find any local Indians to serve as guides and assist in carrying over our stuff, we should have proceeded at once to the best point for that purpose and continued our journey overland toward the Pelly. As it was, it became our first object to endeavour to find the trail used many years previously by the Hudson Bay Company, of which a general description had been furnished by Mr. Campbell. This necessitated a careful examination of the west shore of the west arm to its head, which enabled us to identify, with tolerable certainty, the stream which Campbell had named the Finlayson. It was supposed that the Indians might have employed the same route in the periodical journeys which they were known to make from the Pelly down the Frances to the little trading post at the mouth of the Dease; but though the remains of an old log *câche* of the Hudson Bay Company were eventually found, together with the nails and iron work of a large boat which had evidently been burnt on the beach near it, no sign of a trail could be discovered. It thus appeared very doubtful whether we should be able to make our way across to the Pelly, with sufficient provisions and the necessary instruments for the continuation of our survey in the Yukon basin.

Search for Indians.

In order to exhaust the possibility of obtaining further assistance before making the attempt, I made a light trip in one of our boats round into the east arm, which was known to exist from Campbell's report, but the narrow entrance to which had not even been observed on our way up the lake. This also enabled me to sketch the east arm, but no Indians were found; in fact, we discovered traces of only a single camp which had been made during the same summer, most of the Indian signs being two or more years old.

Arrangements for journey to Pelly.

All that now remained to be done was to make the best of our own resources. We, therefore, went carefully over all our stuff, separating out everything which was not absolutely essential, and making up the remainder in packs, together with as much food as could be carried. This done, we stowed a great part of our camp equipage, together with some provisions, in a strong log *câche*, which was constructed for the purpose in the bay immediately south of the mouth of the Finlayson,

and moved round to the north side of the delta of that stream, to what we believed to be the best point from which to start. We then hauled out our two boats, and on the 17th and 18th of July carried our remaining stuff to a point some miles up the Finlayson and above the cañon and cascades, which render its lower part utterly impassable. Here we set up the Osgood canvas boat, which we had also carried over. Into this a portion of our stuff was put, and two of our Coast Indians were instructed to endeavor to track it up the shallow and winding stream, while the rest of the party found their way as best they could along the valley, with heavy packs. The walking was extremely fatiguing on account of the deep moss, alternating with brush and swamps, and as in addition, the weather was very warm and the mosquitoes innumerable, our rate of progress was slow. On arriving at the forks of the stream we unfortunately took the wrong branch for several miles, leading to some loss of time, but we eventually reached a lake which we recognized as Finlayson Lake, on July 24th. The canvas boat did not arrive till the evening of the next day, as great difficulty was met with in getting it up the shallow stream, which was badly blocked with fallen trees. In the meantime, observaations for latitude and time were taken, and a raft was constructed on which the stuff might be floated to the head of the lake, which lay in the general direction of our route.

Difficult land carriage.

The lake proved to be nine miles and a-half in length, and near its head we again found the ruins of a Hudson Bay *câche*, but no appearance of a trail. Having selected the most promising looking place from which to continue our journey, we took out the raft-sticks, in order that they might remain dry and serviceable for our Indians on their return, and made a second small *câche* of provisions. The Osgood boat being almost worn out by its hard usage on the Finlayson, and being besides quite too heavy to carry overland in addition to our other stuff, was also drawn up and abandoned.

Reach Finlayson Lake

Soon after leaving the lake we fell upon small streams which evidently drained toward the west, and about noon on the 29th of July we had the satisfaction of reaching the bank of the Pelly River. From this place our five Coast Indians were sent back with instructions to take back to Mr. Reed, at Dease Lake, the articles left in the *câche* on Frances Lake, and this duty, we subsequently learned, they faithfully performed.

Reach the Upper Pelly.

Having constructed a canoe from the canvas brought over for that purpose, we began the descent of the river on the 1st of August.

The above is a summary of our proceedings from Frances Lake to the Pelly. I now feel convinced, that if we had had Indian guides, we might in all probability have shortened the land carriage and possibly

Probable better route.

have found a travelled Indian trail, by following up the waters tributary to the west arm of Frances Lake. It remains to give some notes of the country actually traversed.

Mountains.

Though the region between Frances Lake and the Pelly may be described as a mountainous one, no very high summits were seen, the elevations being, as a rule, rounded and regular in outline, and forming broad, plateau-like areas above the timber-line in some places. The Too-tsho Mountains, which run along the east arm of Frances Lake nearly due north, appear to turn more to the westward beyond the head of the lake, but the line of travel followed toward the Pelly still diverged rapidly from this, the culminating range of the district, and the general direction of the principal ridges in the vicinity of the Finlayson River is not far from east-and-west.

General character of the country.

It is probable that the general character of the country here met with fairly represents that of a wide belt to the west of the Frances River and north of the Liard, including the Campbell and Simpson Mountains and their vicinity. The mountains are about equal in altitude to those last mentioned, averaging from 5000 to 6000 feet. The country is traversed by wide, wooded valleys, of which that occupied by the Finlayson is here the principal. The climate evidently becomes less moist as Frances Lake and the vicinity of the Too-tsho Mountains are left, and dry, gravelly terrace flats, with *Pinus Murrayana*, are not uncommon on the upper part of the Finlayson. Larch was observed in places for about half the distance up the river toward Finlayson Lake, but was not seen further west. White spruce is still the most abundant tree, and grows as large as along Frances Lake. The black spruce also, however, occurs, and *Abies subalpina* becomes the common and characteristic tree near the upward limit of forest growth on the mountains, which here occurs at about 4200 feet. Grassy swamps are found in a number of places, and a good growth of grass is also met with, where areas have been denuded of forest by successive fires, so that should it ever become desirable to use horses on this portage, they might be maintained without difficulty.

Character of Finlayson River.

The lower part of the Finlayson for about four miles, near its mouth, forms a series of rapids and small cascades in a narrow, rocky gorge, making in this distance a total descent of 300 feet to the lake. Above this cañon it is rapid for several miles, with gravelly bars, and quite shallow, but further up it becomes a narrow and often deep stream, flowing between muddy or sandy banks. At twenty-two miles from its mouth it divides into two nearly equal branches, the northern of which comes from *McEvoy Lake*, the southern from Finlayson Lake. Each of these streams, at their confluence,

is from twenty-five to thirty feet in average width and about two feet deep. The northern branch, however, soon becomes shallow, rapid and stony, while that coming from Finlayson Lake is extremely crooked, winding in all directions in a flat valley about a mile in width, and is besides, as already mentioned, very badly blocked by fallen trees.

View from a mountain.

From the summit of an isolated, bare-topped hill, which occupies the angle between the two streams, and rises about 1200 above the valleys, an excellent view of the surrounding country was obtained. To the north-eastward, broken masses of high, rugged mountains, patched with snow, limit the horizon. These are evidently connected with the Too-tsho Range, but appear to form an irregular western spur, which is not continued to the west of north. The intervening district, as well as the whole country to the south, is occupied by bare-topped, rounded mountains and ridges of less elevation Amid these hills the round or flat-bottomed valleys of the streams extend, showing here and there the paler green of a patch of meadow. The most remarkable feature is, however, a tract of low, level country, in which McEvoy Lake and the head of Finlayson Lake lie. This runs nearly due east-and-west, and appears to continue in the former direction till it intersects the northern continuation of the valley of the west arm of Frances Lake, and is also observable to the west of the head of Finlayson Lake. It is intersected throughout by numerous small lakes or ponds and swampy meadows.

Character of Finlayson Lake

Finlayson Lake (*Tle-tlan'-a-tsoots* of the Indians) is nine miles and a-half in length and rather irregular in form. Its elevation above sea-level is 3105 feet, as determined by our barometer readings, and it may be regarded as occupying the summit of the watershed between the Mackenzie and the Yukon, as no stream of any importance enters it. The country about it is all rather low, but is diversified, to some extent, by wooded ridges and hills, which rise highest near its upper end. The water is apparently shallow throughout, and had, in consequence, a much higher temperature than that of Frances Lake. It is well stocked with white-fish and lake trout, and also, no doubt, with the other species found in Frances Lake. A dead amia, eighteen inches long, was also found on the shore.

The immediate shores of the lake are generally quite low and often swampy, and the country is covered with small, poor timber, much of which has been killed by fire. A pretty well marked terrace, at 100 to 150 feet above the water, runs nearly all round the lake, and at the head are irregular, low, lumpy ridges and islands, which evidently represent moraine accumulations. No rock-exposures were anywhere seen along the lake-shore.

The watershed.

The distance from the head of the lake to the nearest point on the Pelly, in a straight line, is about fifteen miles, but the low tract of country already referred to runs some miles to the south of such a line for the greater part of the way. The actual watershed in this low country is probably not fifty feet above the lake, but there is no evidence that the lake ever discharges toward the Pelly. Its height above sea-level is about 3150 feet. Small streams rising to the west of the lake, flow together to form a respectable brook about half way across. This occupies a wide, terraced valley, the ridges bordering which gradually diverge as the Pelly is approached, and the river itself is bordered by undulating terrace-flats several miles in width.

Country west of Finlayson Lake

On ridges west of the head of Finlayson Lake *Abies subalpina* becomes moderately abundant, but the white and black spruce are still the characteristic trees, and the former is well grown in sheltered valleys. No larch or black pine were seen on this part of the portage. The western yellow pond-lily (*Nuphar polysepalum*) was observed in great abundance in a small inlet of Finlayson Lake, and on the hills beyond *Polymoneum pulchellum* and *Mertensia paniculata*, with *Potentilla fruticosa*, were noted as specially abundant flowering plants. The vegetation in the vicinity of the Pelly was much further advanced than any we had yet seen, and the climate of the valley is evidently more favorable than that of the watershed region. The soil of the river-terraces is a fine, silty material, which, judging from the luxuriance of plant growth, must be very fertile.

Geological notes.

In consequence of the width of the valleys and the mantle of drift deposits, few rock-exposures were met with along the whole route from Frances Lake to the Pelly, and those examined consisted wholly of schists or schistose argillites, associated with cherty quartzites in some places, and generally of blackish or grey colors. The gravel wash in the various smaller streams and the rock *debris* met with on slopes of hills and elsewhere, consisted also predominantly of similar materials, and it would appear that the whole of this country is underlain by rocks resembling those described on Frances Lake and part of the river of the same name. A reddish argillite was noted as locally abundant in some streams entering the Finlayson on the south. Pebbles and small boulders of grey granite are not uncommon, but all appear to have been transported from a distance. In addition to the

Rocks of Finlayson Lake

rocks above described, the gravel beaches on Finlayson Lake show numerous fragments of grey-blue limestone, some of which contain obscure fossils. Green serpentine, like that of the vicinity of Dease Lake, and exhibiting minute veinlets of serpentine-asbestos, also a few pebbles of reddish serpentine, were also noted here, and fragments of a peculiar white quartz-porphyry are not uncommon. Large pieces of

the same stone were afterwards found on the hills to the west of the lake, but it was not anywhere seen in place. Quartz-vein-stuff is everywhere very abundant, and on the terrace overlooking the Finlayson, on the north side, three miles below the lake, a large mass of quartz occurs in place. The extent of this mass of quartz could not be ascertained, as it protruded from the soil only in isolated spots over an area several hundred feet in length and breadth. A few specimens were collected, but on assay proved to contain neither gold nor silver. Massive quartz.

One of the most notable features of this watershed region is the great quantity of detrital material or drift with which the whole is covered. On the lower part of the Finlayson, irregularly bedded, clayey, gravel deposits, containing large glaciated stones and resembling boulder clay, were seen; but elsewhere stratified gravels and sands are generally shown in any scarped banks which occur. Well rounded gravel was found scattered over the very summit of the isolated mountain at the forks of the Finlayson, above referred to, at a height of 4300 feet above the sea, the material being of varied origin and including granite. No distinct terraces were found on this mountain, but terraces were noted further down the valley on the slopes of higher hills, at a height equal to, or greater than, that of this place. The evidence appears to be conclusive that a body of water in later glacial times extended quite across the Pacific-Arctic watershed in this region, standing at a level more than 1000 feet above it. Glacial striation, in a bearing parallel to that of the valley, was noted on the surface of the quartz mass previously alluded to, but the direction of motion of the ice could not be determined. Superficial deposits of the watershed.

Upper Pelly River.

Our first camp on the Pelly was situated in lat. 61° 48′ 52″, long. 131° 01′ 06″, the height of the river being at this place, as approximately determined from the mean of a number of barometer observations, 2965 feet. The river is here 326 feet wide, with a current slightly exceeding two miles and a-half an hour, and a middle depth of seven feet. An approximate estimate of the discharge placed it at 4898 cubic feet per second. The river had evidently fallen very considerably since the early summer and was probably at or below its mean stage. The water is here nearly clear, with a light brownish tinge. From explorations made at the time of the existence of the Hudson Bay post, as well as from Indian report, the river is known to be navigable by boats for a considerable distance above this point, and to rise in two lakes, the position of which is approximately indicated on the map, according to Upper Pelly River

Mr. Campbell's sketch. Our camp was about two miles above the mouth of the stream which has already been mentioned as rising on the portage near Finlayson Lake, at the angle between which and the Pelly the old post named "Pelly Banks" was situated. We saw no trace of the buildings which formerly existed, though the old site might, no doubt, have been determined by a little search, had we thought it worth while to devote the necessary time to it.

"Pelly Banks" to Hoole Cañon.

Appearance of the country.

From our initial point, above mentioned, to Hoole Cañon and Cañon, is a distance of thirty-one miles in a straight line, the direction of which is a few degrees north of west. The river, however, forms a wide curve to the south of this line, and is besides very tortuous in detail, the actual distance, following its course, being fifty miles. The main orographic river-valley is here not confined, as is so often the case, between parallel ranges of mountains. There is on the contrary a wide tract of irregularly hilly country, which is bounded to the south by a well-defined mountain range at a distance of ten to twelve miles. This range is crowned by a series of square-outlined pyramidal peaks, which are probably composed of stratified rocks. It is proposed to distinguish it as the *Pelly Range*. To the northward, no definite boundary to the low hilly region can be seen. The actual trough in which the river meanders, however, is scarcely more than a mile in average width, and is generally bordered by terraces a hundred feet or more in height.

Hoole River.

Thirty-three miles, by the course of the river, below our starting point, a tributary comes in from the mountains to the southward, about fifty feet wide by one deep, and very rapid. This is identified as Hoole River.* Its water is bluish in tint, and clearer than that of the Upper Pelly, which by this time has become slightly turbid from material derived from its soft, silty banks. The river, between our first camp and Hoole River, has a rather moderate current, scarcely exceeding four miles and a-half an hour, though with several little "riffles" or small rapids.

Rapid.

Just below the mouth of Hoole River is a rapid about 600 feet long, with a total fall estimated at about ten feet. There is an easy portage on the right or north bank, but a fair-sized boat might run through without danger at most stages of the water. As a precautionary measure, we lightened our canvas canoe, of the behavior of which

* So named by Mr. Campbell after his interpreter. Mr. Campbell, on his original sketch and on Arrowsmith's map, in the construction of which it was used, has named a number of the tributaries of the Pelly. It has been found difficult to identify some of these, but all have been placed on the accompanying map, after a careful comparison.

in bad water we had had at the time no experience. From this rapid to Hoole Cañon the water is swift, and there are several little rapids.

The banks and beaches of the Pelly above Hoole River, are generally silty or muddy, though the strength of the current is sufficient to produce well-washed gravel-bars in mid-stream. Below that point the banks and beaches are also as a rule gravelly, in conformity with the swifter flow of the stream.

Vegetation.

The banks along the south side of this part of the river, are for the most part densely wooded, and where shady and damp the growth of timber is small and scrubby, with much black spruce. The banks on the opposite side are very different in appearance. Those above Hoole River show numerous open, grassy patches, and below that place grassy slopes preponderate over the wooded area, the grass having the characteristic growth and dry, tufted appearance of "bunch-grass." The trees are similar to those found along the rivers previously described except that *Pinus Murrayana* and larch do not occur, and but a single white birch was noted, near the mouth of Hoole River. Groves of cottonwood of medium size cover some of the flats.

Frozen soil.

In one or two banks into which the river was cutting, and where the surface was covered with a dense, mossy growth, frozen soil was observed. The depth to which it extended could not be ascertained, as it went below the water-level of the stream.

Rocks represented.

Above the mouth of Hoole River the rock exposures are few and inconsiderable. Near the mouth of Campbell Creek a yellowish-weathering irregularly silicified dolomite was observed in several low outcrops, together with green-grey, slightly lustrous schists, and similar schists were seen in one or two other places on this part of the river. The composition of the gravel of the river-bars may be accepted as indicating in a general way the character of the formations of the drainage area of the upper river. These include fragments of schists, quartzites and argillites of the same kind as before described on the Frances, with grey, fine-grained limestone, some pieces of coarse white marble, and occasional small pebbles of the same peculiar quartz-porphyry seen on Finlayson Lake. There are also represented several varieties of granitoid rocks, the most abundant of which has a coarse gneissic lamination, with whitish or greenish mica and large, white, porphyritic felspar crystals, round which the layers of the rock bend. This peculiar granite or gneiss is probably derived from the head-waters of the main river, and often occurs in large boulders, which can scarcely have been carried by the stream, and have probably been transported during the glacial period.