GEOLOGICAL SURVEY OF CANADA.

ALFRED R. C. SELWYN, F.R.S., F.G.S., DIRECTOR.

# GENERAL NOTE

ON THE

# MINES AND MINERALS

OF

## ECONOMIC VALUE

OF

# BRITISH COLUMBIA,

WITH A LIST OF LOCALITIES,

BY

GEORGE M. DAWSON, Assoc. R.S.M., F.G.S.

*(Reprinted, with Additions and Alterations, from the Canadian Pacific Railway Report,* 1877.)

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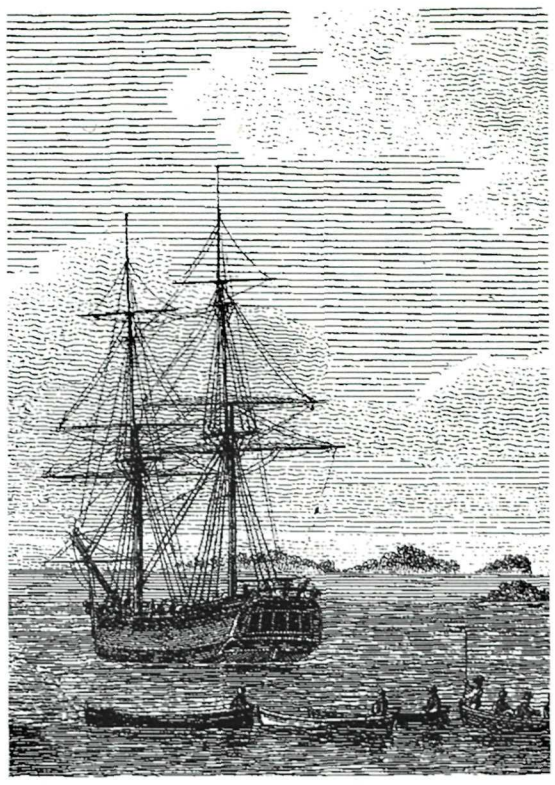

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Mountainous belt of the Pacific coast.

Beyond the elevated western margin of the Great Plains, and intervening between it and the Pacific Ocean, is a region which may be characterized as one of mountains and disturbed rock formations. This runs north-westward and south-eastward, with the general trend of the coast, and is divided into two subordinate mountainous districts by an irregular belt of high plateau-country running in the same direction. South of the 49th parallel, this region, from the Rocky Mountains to the Pacific, in various parts of its length, has been found to contain valuable metalliferous deposits of many kinds, and already appears to be the most important metalliferous area of the United States. In the Province of British Columbia is included over 800 miles in length of this mountain- and plateau-country, with an average breadth of about 400 miles. North of the 49th parallel the Rocky Mountains are now known to extend to the Peace River, and even further northward, to near the mouth of the Mackenzie, and to maintain throughout much the same geological character with that of their southern portion. The Purcell, Selkirk, Columbia, Cariboo, and further north, the Omineca Mountains, may be taken collectively as the representatives of the Bitter Root Ranges of Idaho. The interior plateau of British Columbia represents the great basin of Utah and Nevada, but north of the southern sources of the Columbia this region is not self-contained as to its drainage, but dis-

Correlation of mountain ranges.

Cascade or Coast Range of British Columbia.

charges its waters to the Pacific. The Cascade, or Coast Range of British Columbia, though in a general way bearing the same relation to the interior plateau country as the Sierra Nevada Mountains of California and the Cascade Mountains of Oregon, forms a system distinct from either of these. The main period of uplift of the Sierra Nevada in its typical region probably antedates that of the British Columbia mountains, while the Cascade Mountains of Oregon are described by Professor LeConte and others, as chiefly composed of comparatively modern volcanic materials, which scarcely occur in the main ranges of the west coast of British Columbia. The parallel ranges of Vancouver and the Queen Charlotte Islands may, as far as their structure is yet known, be included with the Coast Range of the mainland.

Auriferous belt.

In British Columbia a belt of rocks, probably corresponding more or less completely with the Gold Rocks of California, has already been proved to be richly auriferous, and I think it may be reasonably expected that the discovery and working of rich metalliferous deposits of other kinds will follow. Promising indications of many are already known. With a general similarity of topographical features in the disturbed belt of the west coast, a great uniformity in the lithological character of the rocks is found to follow, so that while in a comparatively short distance from south-west to north-east considerable lithological change may be found, great distances may be traversed from south-east to north-west and little difference noted. In British Columbia, so far as geological explorations have yet gone, they have tended to show a general resemblance of the rocks to those of the typical sections of California and the Western States, and though metalliferous veins, individually, are very inconstant as compared with rock formations, belts characterised by metalliferous deposits, and dependent on the continuance of some set of beds, are apt to be very much more constant.

Uniformity of rocks in north-west and south-east bearings.

Circumstances retarding development of mining.

In the discovery and development of her mineral riches, British Columbia labours under many disadvantages, chief among which may be mentioned the comparatively short time during which the country has been settled, with the inaccessibility of the known mining regions, and cost of labour and supplies. In addition, a great part of the country is densely forest-clad, and the surface much encumbered with glacial drift, which, though often tending to produce a more fertile soil, conceals the indications to which the prospector trusts in more southern latitudes.

All these circumstances tend to retard the development of British Columbia as a mining country. It is slowly advancing, however, and it is my opinion, that when the country is opened up and the cost of labour

and supplies reduced, it will be found capable of rapid development, and may soon take a first place as the mining Province of the Dominion. It must not be omitted to state that, in one very important particular, the rocks of this part of the Pacific Coast differ from those further south—the Cretaceous series changes considerably in its character, and at the same time becomes coal-bearing, furnishing the fuels mined at Nanaimo and Comox.

In the following pages, I have endeavoured to give a somewhat systematic, though brief account, of the mineral resources and mines of British Columbia, applying, where necessary, to the published Memoirs of the Geological Survey, and entering into somewhat greater detail with localities of which no published accounts are yet accessible.

## Gold.

Gold widely distributed.

It may, I think, be said without exaggeration, that there is scarcely a stream of any importance in the Province of British Columbia in which the "colour" of gold can not be found. The discovery of gold, first made known in 1858, led to the great influx of miners of that and the following year. Gold, thus the first cause attracting attention to the country, has ever since been the chief factor in its prosperity.

Statistics of gold production.

The annexed tabular statement shows the annual yield of gold from 1858 to the end of 1876. As no official record of the gold export has been kept, the only means of arriving at an approximate result is to add to that actually known to have been shipped by the banks and express companies, an estimated amount to represent that carried away in private hands. A great part of the gold leaving the country unrecorded, is carried away by Chinamen, and a portion goes from the Kootenay district, without reaching Victoria.

When in Victoria, with the kind assistance of Mr. C. Good, Deputy Minister of Mines, and by reference to the various banks, I revised these figures, which had been variously given by different authorities; and I think, though not absolutely correct, they may be accepted as being as near the truth as we are now likely to attain. Mr. Good has added to the figures in the table, from his books, the number of miners known to have been employed, and calculated the average yearly earnings per man, giving the very high general average of $658 per annum.

*TABLE from the Second Annual Report of the Minister of Mines of British Columbia, showing the aciually known and estimated yield of gold; the Number of Miners employed; and the average earnings per man, per year from* 1858 *to* 1875. [*To which is added the known and estimated yield of gold in* 1876.]

| Year. | Amount actually known to have been exported by Banks, &c. | Add one-third more, estimate of gold carried away in private hands. | Total. | Number of Miners employed. | Average yearly earnings per man. |
|---|---|---|---|---|---|
| | $ | $ | $ | $ | $ |
| 1858 (6 months.) | 390,265 | 130,088 | 520,353 | 3,000 | 173 |
| 1859 | 1,211,304 | 403,768 | 1,615,072 | 4,000 | 403 |
| 1860 | 1,671,410 | 557,133 | 2,228,543 | 4,400 | 506 |
| 1861 | 1,999,589 | 666,529 | 2,666,118 | 4,200 | 634 |
| 1862 | 3,184,700 | 1,061,566 | 4,246,266 | 4,100 | 517 |
| 1863 | | | | 4,400 | 482 |
| 1864 | 2,801,888 | 933,962 | 3,735,850 | 4,400 | 849 |
| 1865 | 2,618,404 | 872,801 | 3,491,205 | 4,294 | 813 |
| 1866 | 1,996,580 | 665,526 | 2,662,106 | 2,982 | 893 |
| 1867 | 1,860,651 | 620,217 | 2,480,868 | 3,044 | 814 |
| 1868 | 1,779,729 | 593,243 | 2,372,972 | 2,390 | 992 |
| 1869 | 1,331,234 | 443,744 | 1,774,978 | 2,369 | 749 |
| 1870 | 1,002,717 | 334,239 | 1,336,956 | 2,348 | 569 |
| 1871 | 1,349,580 | 449,860 | 1,799,440 | 2,450 | 734 |
| 1872 | 1,208,229 | 402,743 | 1,610,972 | 2,400 | 671 |
| 1873 | 979,312 | 326,437 | 1,305,749 | 2,300 | 567 |
| 1874 | 1,383,464 | 461,154 | 1,844,618 | 2,868 | 643 |
| 1875 | 1,856,178 | 618,726 | 2,474,904 | 2,024 | 1,222 |
| 1876 | 1,339,986 | 446,662 | 1,786,648 | | |
| | | | 38,166,970 | | |

Average number of miners employed yearly..... 3,220
Average earnings per man, per year..... $658
Total actual and estimated yield of gold, 1858 to 1875.... $38,166,970

Total yield.

Adding the product of 1876, the whole amount of gold exported from the Province, in eighteen and a-half years, is computed at $39,953,618, or stated in round numbers, forty millions, a very remarkable result from a colony, the total European population of which probably did not average during the same period, 10,000.

Fluctuation in yield.

The gold yield shows a fluctuation from year to year, which is due not only to the uncertainty of the deposits worked, and number of miners employed, but depends also on climatic conditions. Thus the decrease of 1876, as compared with 1875, may be attributed in the Cariboo District to the great quantity of snow falling on the mountains during the preced-

ing winter, and more than average rainfall of the summer; circumstances preventing the clearing of the deep claims from water till late in the season. In Cassiar, the unfavorable spring prevented the miners from reaching their claims till late, and heavy floods impeded their operations during the summer.

Sources of the gold in placers.

The very general distribution of alluvial gold over the Province, may indicate that several different rock formations produce it in greater or less quantity, though it is only where "coarse" or "heavy" gold occurs that the original auriferous veins must be supposed to exist in the immediate vicinity of the deposit. "Colours," as the finer particles of gold are called, travel far along the beds of the rapid rivers of this country before they are reduced by attrition to invisible shreds; and the northern and other systems of distribution of drift material have, no doubt, also assisted in spreading the fine gold. The gold formation proper, however, of the country, consists of a series of talcose and chloritic, blackish or greenish-grey slates or schists, which occasionally become micaceous, and generally show evidence of greater metamorphism than the gold-bearing slates of California. Their precise geological horizon is not yet determined, no geological survey to that end having been made; but I am inclined to believe that they will be found to occupy a position intermediate between the more distinctive members of the Lower Cache Creek group of Mr. Selwyn's first provisional classification of the rocks of British Columbia,* and the base of the overlying Mesozoic rocks, called in my report for 1875† the Porphyrite series. If this be so they are not improbably the geological equivalents of some of the richest auriferous rocks of California. By the denudation of the auriferous veins traversing these rocks the gold has been concentrated in the placer deposits.

Areas of gold-bearing rocks.

The greatest areas of these rocks appear in connection with the disturbed region lying west of the Rocky Mountain Range, known in various parts of its length as the Purcell, Selkirk, Columbia, Cariboo and Omineca Ranges. Other considerable belts of auriferous rocks, however, probably belonging to the same age, occur beyond this region, as in the vicinity of Anderson River and Boston Bar, on the Fraser; at Leech River, Vancouver Island, and elsewhere.

Cariboo District.

The Cariboo District, discovered in 1860, has been the most permanent and productive. The fifty-third parallel of latitude passes through the centre of the district, which has been described as a mountainous region,

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* Report of Progress Geologi cal

† Report of Progress, 1875-76.

Physical characteristics.

but is rather to be regarded as the remnant of a great high-level plateau with an average elevation of from 5,000 to 5,500 feet, dissected by innumerable streams which flow from it in every direction, but all eventually reach branches of the Fraser River. These streams, falling rapidly about their sources over rocky beds, descend into great V-shaped valleys, and with the lessening slope, the rock becomes concealed by gravel deposits, which increase in thickness and extent till the valleys become U-shaped or flat bottomed, and little swampy glades are formed, through which the stream flows tortuously and with gentle current. The steep-sloping banks of the valleys are densely covered with coniferous forest, of which comparatively little has been destroyed by fire, owing to the dampness of the climate at this great altitude. The surface of the broken plateau above is often diversified by open tracts, affording good pasture in summer; and the whole country is more or less thickly covered by drift or detrital matter, concealing the greater part of the surface of the rocky substratum.

Shallow and deep placer mining.

As in all new gold mining districts, the shallower placer deposits, and gravels in the present stream-courses first attracted attention, but with the experience of California and Australia, it was not long before the "deep diggings" were found to be by far the most profitable. Williams' and Lightning Creeks have, so far, yielded the greater part of the gold of Cariboo. They were known from the first to be rich, but have been found specially suited for deep work, in having a hard deposit of boulder clay beneath the beds of the present watercourses, which prevents the access of much of the superficial water to the workings below. By regular mining operations the rocky bottom of the valley is followed beneath fifty to 150 feet of overlying clays and gravels, the course of the ancient stream being traceable by the polished rocks of its bed, and the coarse gravel and boulders which have filled its channel. In the hollow of the rocky channel the richest "lead" of gold is usually found, but in following the rock surface laterally, side-ground, rich enough to pay well, is generally discovered for a greater or less width. The old stream-courses of the Cariboo district are found to have pursued very much the same directions that their present representatives follow, crossing often from side to side of the valley with different flexures, and occasionally running through below a point of drift material projecting into the modern channel, but never, I believe, actually leaving the old valley or running across the modern drainage system, as is so often the case in the deep placers of California and Australia.

Ancient buried river channels.

As an example of the methods employed, and extent of mining opera-

tions required to reach the buried channels, the Van Winkle Mine, on Lightning Creek, which is the most successful now in operation, may be taken. This mine is briefly noticed in the Descriptive Catalogue, published in connection with the Geological Survey's collection at the late Philadelphia Exhibition. Van Winkle mine.

The claim covers about 2,050 feet in length of the valley, the deepest part of the old channel of which had been cleared out to a length of between 1,600 to 1,700 feet in October of 1876. Much side ground, however, yet remains, and the workings sometimes attain a width of from 200 to 300 feet, in following this up as far as it can be made to pay. The claim yielded the first dividend in December, 1873, $40,000 having been expended before gold was found in the channel. It has since continued to pay handsomely, having produced in one week gold worth $15,700, and on other occasions at the weekly "clean up," sums of $14,000, $12,000, &c. At the date above mentioned the total product of gold had amounted to the large sum of $500,964.99. Outlay and product.

In reaching the buried channel, a shaft is usually sunk at the lower, or down-stream end of the claim, on the sloping side of the valley, where after having gone through a moderate depth of clay or gravel, the slaty rock of the district is reached. The shaft is then continued through this, till a depth supposed to be sufficient is attained, when a drift is started at right angles to the course of the valley, and if the right depth has been chosen—either by rough estimation, or calculation based on that required in other neighbouring workings—the old channel is struck in such a way as to enable the subterranean water collecting in it from the whole upper part of the claim, to be pumped to the surface by the shaft. On cutting out of the slate rock, however, into the gravel, so much water is frequently met with that the pumps are mastered, rendering necessary a cessation of work till the dryest part of the season, or the application of more powerful machinery. When the drift is not found to be at a sufficient depth to cut the bottom of the old channel, it is generally necessary to close it, and after continuing the shaft to a greater depth, to drive out again. The old channel once reached, and cleared of water, is followed up its slope by the workings, to the upper part of the claim, and where paying side-ground occurs it is also opened. Shaft sinking. Drifting for the old channel.

In the Van Winkle Mine the average depth of the workings is only about seventy feet, the lowest shaft being placed 300 feet from the creek, on the opposite side of which the rock is seen to rise to the surface, forming steep cliffs. The water is raised to within forty feet of the surface, when it is discharged into an adit 3,000 feet long, which is also

Water. used by other claims. There are two pumps, ten inches in diameter, with wooden pipes, making about twelve four-foot strokes a minute, the power being supplied by an eighteen-foot breast-wheel. This does not adequately represent the volume of water pumped, however, as the ground of this claim is partly drained by others lower in the series, in which work cannot be carried on till later in the season. The richest pay is obtained in the rock channel of the old stream, but where this is much contracted the force of the water has swept the gold away to those places where its width is increased. The harder rocks still preserve their polished and water-worn forms, but most of the slates are rotten and crumbling to a considerable depth, and in cleaning up in the bottom, a thickness of one to two feet is taken out with a pick and shovel, and sent up to the

Side work. surface with the overlying gravel, for treatment. In the side-work, as in the central channel, the greater part of the gold is found lying directly on the "bed rock" and only occasionally are paying streaks seen in the gravel a few feet above it. The side ground is worked up from the channel in successive breasts parallel to it. The average yield of the part being worked at the time of my visit may be stated at from two and a-half to three ounces to each set of timber; the set uncovering about thirty-five square feet of bed rock, with a height of six feet.

Lowest deposits. The lowest layers of gravel contain many larger boulders of quartz and slaty fragments not much water-worn, which must have come down from the hill-sides; the appearance being that of deposit by torrential waters to a depth of four to six feet in the channel, above which the gravel is generally better rounded, and more evenly spread, though still mixed with little clayey matter.

In consequence of the unconsolidated nature of the gravel, the pressure on the suports of the workings is excessive. The sets of timber are in some places only a few inches apart, and the whole of the workings are lined with complete lagging. The timber used is very massive, being from one to two feet in average thickness, and consisting of the spruce of the country, simply barked and sawn into lengths. It costs, delivered at the mine, eight cents per running foot, all suitable sizes being taken at the same rate. The lagging, which is merely split out, four feet long, five inches wide, and two thick, costs seven dollars a hundred pieces. With every precaution, the timbers are frequently crushed by the pressure, or the uprights even forced downward into the slate. Where large boulders are removed from the sides, or "slum" is found, spruce brush requires to be extensively used behind the lagging, and in

many parts of the mine the water streams from the roof like a heavy shower of rain.

The auriferous gravel is raised to the surface by bucket and rope, with friction gearing and water power.

Pumps.

The whole of the deep workings are annually filled with water at the time of the spring floods, and it is sometimes late in the summer or autumn before the pumps again acquire the mastery. In October of 1876 the following companies on Lightning Creek were driving their pumps day and night, the Van Winkle being the only mine clear of water.

*Costello Claim.*—Pump, twelve inches diameter, nine-foot stroke, making ten strokes a minute.

*Vulcan Claim.*—Pump, twelve inches diameter, six-foot stroke, making eighteen strokes a minute.

*Vancouver Claim.*—Pump, twelve inches diameter, nine-foot stroke, making ten strokes a minute (double acting).

*Van Winkle Claim*—Pump, ten inches diameter, fourteen-foot stroke, making ten strokes a minute (two pumps).

The quantity of water being raised at this time would, therefore, amount to about 13,870 gallons a minute, or 19,874,000 per diem.

Mines developed without foreign capital

In many cases the machinery and appointment of the mines is very creditable, and almost the whole expense of the mining enterprises is borne by the miners of the district themselves, without the aid of foreign capital, and with labour and materials of all kinds at exorbitant rates. Money earned in one venture is embarked in another, and some of the shareholders of a mine are frequently at work themselves below ground.

Lightning Creek.

On Lightning Creek about 16,000 feet of the valley may be said to be worked out, in so far as the deep channel is concerned; and though some bench claims and tributary creeks have paid well, the material on sides of the valley is not rich enough to pay for hydraulic work at present. In endeavoring to "bottom" the old channel further down the valley, very great difficulties are encountered, owing to the great quantity of water met with and the increased depth of the sinking required. There is no reason to believe, however, that the lowest part of the channel holding good pay has been reached.

The following table, supplied by Mr. James Evans to the Minister of Mines of British Columbia, gives as correct a statement as he has been able to compile of the amount of money taken from some of the more prominent claims on Lightning Creek, up to November 1st, 1875:—

Yield of various mines.

| | |
|---|---|
| Dutch and Siegel (now Perseverance) | $130,000 |
| Dunbar | 30,000 |
| Discovery and Butcher | 120,000 |
| Campbell and Whitehall | 200,000 |
| South Wales | 141,531 |
| Lightning | 153,962 |
| Point | 136,625 |
| Spruce | 99,908 |
| Costello | 20,476 |
| Vulcan | 56,955 |
| Vancouver | 274,190 |
| Victoria | 451,642 |
| Van Winkle | 363,983 |

Williams' Creek.

On Williams' Creek, on which the towns of Barkerville and Richfield are situated, the chief workings have been in a space of about two and three-quarter miles in length. In this the deep channel has been worked through, and also as much of the side ground as would pay at the time at which the mining took place. Many of the lateral creeks and gullies here have paid remarkably well; and the hillsides, in some places to a height of 100 feet or more, have proved to be sufficiently rich for the hydraulic method of working, which is now extensively practised. Williams' Creek, however, will not compare with Lightning Creek in richness, its yield for 1875 being, according to Mr. Bowren's estimate, only $68,000. Barkerville, however, has a certain importance in being the centre of a number of outlying mining districts.

Distribution of gold in the valley.

The "cañon" between Barkerville and Richfield divides the creek into two parts. For about half-a-mile above it, the ground was shallow, and has been worked open to the bed rock. Further up, deep drifting was practised in former years; hydraulic work is now carried on. Below the cañon all the work has been deep, in the old channel. Though streaks of "pay" were sometimes found after getting down about twenty feet, these were usually disregarded in early days. In the Cameron claim, however, half-a-mile below Barkerville, the dirt paid nearly to the surface, and was worked in stages from below after the old channel had been cleared out. The workings were about sixty feet deep at Barkerville, only thirty-five feet at the former site of Cameronton, and at the Ballarat claim,—three-fourths of a mile below Barkerville—eighty feet. This is the lowest claim in which the old channel has been bottomed, and most of the gold obtained was light and scaly. The valley is here wide, the present stream turning abruptly to the west, while a wide, low hollow, known as Pleasant Valley, runs off in the opposite direction, to

Lower part of Williams' Creek.

Antler Creek. It is supposed by many that the main channel of the ancient watercourse turns off in this direction, but, owing to the great quantity of water and loose character of the ground, neither this nor the present valley of Williams' Creek, below the Ballarat, has yet been proved, though much money has been expended in the attempt. The Lane and Kurtz Company imported expensive machinery and erected very complete works some years ago, but have not succeeded in proving their ground, and have, for the present, abandoned the attempt. As some of the tributary streams have paid well, there is reason to believe that a part, if not the whole, of the deep channel of the lower part of Williams' Creek must be rich, notwithstanding the generally fine character of the gold in the Ballarat mine.

Inadequate machinery.

As already stated, Lightning and Williams' Creeks have been specially favourable ones for deep working, but even in these it has often been barely possible, with the appliances which can at present be obtained, to bottom many parts of their upper reaches, while the more difficult lower portions of the channels have not been proved in either case. As Mr. Evans very wisely remarks:—"Had many of the companies machinery of powerful capacity at first, one-third of the expense would have sufficed to prospect their ground, but unfortunately many of them were poor, struggling for existence, and coping with enormous difficulties."

Great cost of supplies and labour.

Owing to the isolation of the district, and length and character of the road by which it is reached, the price of food—the whole of which is imported—and of labour is excessively high. The average rate of freight from Yale—the head of navigation on the Fraser—to Barkerville, according to Mr. Bowren, is from seven and a-half to eight cents per pound in spring, and about twelve and a-half cents in autumn; or may be said to average nine cents a pound—a heavy tax on mining machinery and other weighty articles.

The prices current of some staple articles in Cariboo, are as follows:—

| | |
|---|---|
| Flour per lb. | 8 cents. |
| Beans do | 15 " |
| Bacon do | 35 " |
| Grain, for horse feed, per lb | 7 " |
| Hay do | 5 " |

Ordinary labourers receive $5 per day; mechanics, from $5 to $7; Chinamen and Indians, $3. These prices, though a great reduction on those ruling before the construction of the waggon road, preclude the working of any but the richest deposits, which necessarily bear but

Gold remaining in ground worked over.

a small proportion to those with a moderate or small amount of gold; and in working over the deep ground in early days much was left that would even now pay handsomely, but cannot be found or reached on account of the treacherous nature of the moved ground, filled with old timbering and water. I do not think it would be an extravagant statement to say that the quantity of gold still remaining in the part of Williams' Creek which has been worked over, is about as great as that which has already been obtained. With regard to Lightning Creek, this statement would scarcely hold, though there must be a great quantity of gold in ground of medium richness even here. To render this gold available, however, and to prove successfully the lower and more difficult parts of the valleys, greater and more exact engineering knowledge, better and larger machinery, and, above all, cheaper labour and supplies, dependent on greater facilities of transport, are required.

Proposed flume.

As an illustration of what might be done in this way, it may be mentioned that it is already suggested, that by cutting a flume to Antler Creek—part of which would require to be a tunnel—free drainage of the whole upper part of Williams' Creek would be obtained; enabling the valley from its sources to the flume level, with all its old workings, and the great depth of tailings holding more or less gold, which have accumulated, to be completely stripped by extensive hydraulic works.

Promising creeks.

So far, mention has been made of Williams' and Lightning Creeks only, but there are many other localities in the Cariboo district which have yielded much gold in surface work or shallow diggings, which it is believed by those best able to form an opinion, would prove rich in their deep ground, if properly explored. Owing, however, to the great cost of prospecting, and of suitable machinery, this has not yet been done. Antler, Cunningham, Jack of Clubs, and Willow River, are supposed to be especially promising, and attempts are now being made to bottom some of them. Mr. Bowren states, however, that the Nason Company have already spent $30,000 on their claim on the first-named stream without having been able to test their ground.

Alluvial deposits only worked.

In most gold-bearing countries the placer mines, though often rich, have eventually led to the mining and treatment of the auriferous quartz from which the alluvial gold has been derived. In British Columbia the alluvial deposits have so far absorbed the mining energy of the country, but in view of the already diminished yield of the best known placers, and the inevitable more or less complete exhaustion of deposits of this kind, within, at best, a moderate term of years, attention can not too soon or too carefully be turned to the more permanent quartz-mining.

Though much of the gold accumulated in the beds of the old streams of Cariboo may have been derived from veins too small to work individually, it seems scarcely to admit of doubt, that in a region where so large a quantity of gold has been obtained within so small an area, rich lodes will be discovered and worked. Indeed, notwithstanding the want of attention to these deposits, and the very difficult nature of the country to prospect, several are already known, which in other parts of the world might justify extensive mining operations. Some of these have been traced with considerable and well-maintained width for several miles. Specimens collected from several of the outcrops in October, 1876, proved, on analysis, the average content of gold and silver to be low, probably too low to repay work at present Cariboo prices. By selecting for crushing, however, only the richer portions of the ore, it is possible that the percentage might be raised to a remunerative figure. A praiseworthy effort is now being made, under the auspices of the Local Government, to test the better known lodes on a practical scale, and it is to be hoped that this, coupled with the energetic prospecting of the many more or less important veins in the surrounding country, will he persisted in, till that eventual success, which in this district may almost be regarded as assured, shall be achieved. The remarks made in connection with the placer mines, as to the cost of labour and provisions, apply in this connection with even greater force. Vein mining, once initiated, will, I believe, rapidly develop, giving to the district a permanent character which it does not now possess, and indirectly tending to cheapen labour by affording employment summer and winter. The gold occurs, as is usual, in association with iron pyrites, but also often with considerable quantities of galena, through crystalline masses of which the precious metal is sometimes strung.

Prospects for quartz mining.

Association of the gold.

Of the districts of Kootenay, Omineca, and the new Cassair region, I know nothing personally, nor have they ever been visited by any member of the geological staff. Situated on the same belt of auriferous rocks, they, no doubt, in the main features of their deposits resemble those of Cariboo. There are also several other localities on the line of the main development of the auriferous rocks, which have from time to time attracted attention and yielded more or less gold; but from their inaccessible position, limited character, poor pay, or depth of cover, they have been abandoned or allowed to fall into the hands of Chinamen. The greater part of the Gold Range, especially toward the north, is very densely timbered, and covered with moss, peaty swamp and tangled vegetation, rendering its examination very difficult, and the discovery of the rich

Other auriferous districts.

spots a matter requiring time and labour; in this respect it differs altogether from the bare slopes of California. It is to be remarked, however, that the recognised areas of all the gold-fields will be very much extended when altered conditions render deposits of the lower grades remunerative, and that many of those which have now fallen out of notice will again spring into importance.

Kootenay.

The yield from Kootenay, for 1875, is stated by the Minister of Mines to have been about $41,000—forty White and fifty Chinese miners being employed; the yield for 1876, according to the same authority, was only about $25,000. Much labour and money is being expended to bring in water at a sufficient height to work the hills and benches of Wild Horse Creek.

Omineca.

The Omineca district has certainly not proved as rich as it was at one time supposed to be, and has in great part been abandoned for the new field of Cassiar. In 1875 the total population was sixty-eight; the estimated gold product, $32,000. The number of miners in 1876 was still smaller. I have spoken to several men who have left this district, but who still appear favourably impressed with its prospects. The transport of supplies from Yale costs eighteen cents a pound, causing provisions of all sorts to be so dear that a miner cannot afford to stay unless he has a rich paying claim. Extensive prospecting is quite out of the question as a private enterprise, and, in consequence, great areas remain yet untried. Mr. Page, late government agent in the district, believes the Findlay Branch to be specially worthy of examination.

Argentiferous galena from Omineca.

A sample of quartz, with some galena, obtained on a stream running into Manson Creek, thirty miles from Dunkeld, which was transmitted by Mr. Gavin Hamilton, of Stuart's Lake, proved on examination by Mr. Hoffman, in the laboratory of the survey, to contain 8.971 oz. of silver to the ton, with traces of gold; the silver being contained in the galena, which is confined to a small portion of the vein-stone examined, and must be highly argentiferous.* Other veins reported in this district have not been examined.

Native silver.

Nuggets and pellets of native silver, generally worn and rounded, but occasionally rough, and seeming as though recently freed from the matrix, have been found in considerable abundance in some streams during gold-washing operations. They are specially noticeable in Vital Creek, I believe, but have attracted little attention, and have not been traced to their source. On analysis, the nuggets are found to contain a few per cent.

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* Report of Progress, 1875-76, p. 430

of mercury in combination, and may, therefore, be more correctly classed as native amalgam.

Cassiar district.

The Cassiar district is the latest and most northern discovery on the auriferous belt of British Columbia, being situated about north latitude 59°, and separated from Omineca by over 300 miles of rough country, unknown geographically, and scarcely, if at all, prospected. Gold has long been known on the lower part of the River Stickene, by which Cassiar is approached from the coast; but it occurs there in light scaly particles, like those obtained on many of the bars of the Fraser. The rich deposits lately discovered, lie on the sources of the River Dease and about Dease Lake, the upper end of the latter being separated by only a few miles of low country from a part of the Stickene. The Dease empties into the Mackenzie, and thus passes to the Arctic Sea. The discovery of this district is due to Mr. Thibert and a companion, who reached it from the east in 1872, after three years spent in trapping and prospecting. Mr. Good, in the report already referred to, states that the area of the Cassiar gold-field, as at present developed, comprises a tract of country of at least 300 square miles. The number of miners employed during the summer of 1875 was over 800, and the gold obtained is estimated at a little less than a million of dollars. In 1876, according to the Report of the Minister of Mines of British Columbia, the estimated gold yield was $556,474, and 1,500 miners and others visited the mines. The yield for 1877 is estimated by Mr. Vowell, Gold Commissioner, at $499,837. The number of men at the mines, exclusive of Indians, is said at no time to have exceeded 1,200, of whom 300 to 400 were Chinese. Dease and McDame Creeks, the two most important in the district, are about one hundred miles apart, while discoveries have been pushed northward and eastward on river systems connected with the Dease to a distance estimated at 370 miles, in a region which probably lies beyond the Province of British Columbia, and in the as yet unorganised North-west Territory. A promising quartz vein, containing gold, silver and copper, has been discovered on McDame Creek, and a lode of argentiferous galena on the River Francis or Deloire.

Gold yield.

Difficulties of gold mining in Cassiar.

The Cassiar mines are worked under enormous disadvantages, situated in an almost arctic climate, where the soil is permanently frozen at a small depth below the surface on the shady sides of the valleys, with a short season during which the water-courses are liable to floods, disastrous to the mines; reached after a sea voyage from Victoria, by the River Stickene, only a part of which is navigable even under the most favorable circumstances, and with supplies of all sorts at famine prices—only the

highly auriferous character of some parts of the district continues to render it attractive. It is scarcely likely that any improvement in the means of communication in the more settled portions of British Columbia will materially affect Cassair, but the existence of its rich deposits is important as showing the continuity of the auriferous belt of the country; and if rich metalliferous veins can be proved to exist, on which more permanent mining may be carried on, Cassair may yet rise on its own merits to be an important mining district, drawing its supplies by improved trails, or by a road, from the central portions of the Province. Beef cattle are even now driven overland from the Lower Fraser to Cassiar.

Placers of the Fraser River.

It will be unnecessary to refer at any length to the Fraser River gold deposits, the first to attract notice, but rich in only a small portion of their extent. It is estimated by Mr. Good, that about $50,000 worth of gold was produced on the Fraser during 1875, the mining being chiefly in the hands of Chinamen and Indians. For 1876 a partial return gives a yield of about $42,000. The gold occurs along the whole course of the Fraser, irrespective of the formation over which the river may pass. Heavy gold has been chiefly found from a few miles below Boston Bar to Siska Flat, near Lytton, and on the Thompson, near Nicommen. It is no doubt derived from the rocks of the neighbourhood. The richest deposits are supposed to be worked out, though it is quite probable that many of the benches would pay for hydraulic working properly appointed.

Occurrence of gold on Vancouver Island.

In Vancouver Island, the Leech River District, situated about twenty miles from Victoria, attracted much notice at one time, and yielded a considerable quantity of gold in a small area. The total product has been estimated at $100,000. It is interesting in having been discovered by a government prospecting expedition fitted out for the purpose. The rocks I believe to be of the same age as those of the other gold regions, and if this be so it proves the persistent auriferous character of this horizon over a great area, embracing, it may be said, the whole of British Columbia. Gold in small quantities has also been found in other parts of Vancouver Island, but, owing to the impenetrable character of the forests, comparatively little is known of any part of its interior.

## Coal and Lignite Bearing Formations.

Coal-bearing formations of east and west coasts.

A line drawn on the ninety-seventh meridian separates pretty exactly the coal-bearing formations of America into two classes. West of Eastern Nebraska, the Carboniferous formation, properly so called, which yields the coals of Nova Scotia and the States east of the Mississippi, ceases to be productive. The shales and sandstones associated with the coals of the east are gradually replaced by limestones, which underlie the Great Plains, and, though the formation does not preserve its purely calcareous nature on the west coast, it still shows little tendency to resume its coal-bearing character. The coals and lignites of the west are found at various horizons in the Secondary and Tertiary rocks, which in the eastern regions are developed on a comparatively small scale, and are not coal-producing.

Possibility of discovery of Palæozoic coals.

Valuable coal deposits may yet, however, be found in the Carboniferous formation proper of the far west; and where, as on some parts of the west coast, calcareous rocks of this age are largely replaced by argillaceous and arenaceous beds, the probability of the discovery of coal is greatest. I believe, indeed, that in a few localities in Nevada, coaly shales, used to some extent as fuel in the absence of better, are found in rocks supposed to be of this age. The discovery of certain fossils in 1876 in the limestones of the Lower Cache Creek group now allow these and probably also the associated quartzites and other rocks to be correlated with this period; and it is worthy of mention that black shales, with a considerable percentage of anthracitic carbon, occur in connection with these in several places, and may yet be found, in some parts of their extension, to become of economic value. Mr. Richardson has also found small fragments of true anthracite, in rocks which are very probably of this age, on the shores of Cowitchen Bay; and inland, seams of anthracite, with regard to which nothing certain is yet known, are reported to exist. Of these, several specimens have been brought out, and though probably inconsiderable in thickness, they seem to deserve examination.

The coal-bearing rocks of British Columbia.

The formations known to produce fuels of economic value in British Columbia may be classed in three divisions, as follows:—1. *Lower Cretaceous or Cretaceo-Jurassic rocks of Queen Charlotte Islands, etc., holding anthracite;* 2. *Cretaceous rocks of Vancouver Island, etc., with bituminous coal;* 3. *Tertiary rocks, with bituminous coal and lignite.*

The first-named series of rocks is only as yet known to hold coal on the Queen Charlotte Islands, where, at a place named Cowgitz, the Queen Charlotte Coal Mining Company, formed by some gentlemen in Victoria, began mining operations some years ago, but eventually abandoned them

Anthracite of Queen Charlotte Islands.

on account of the irregularity of the deposit. This locality has been examined and reported on by Mr. Richardson,* who made a short visit to the island for that purpose. The best seam had a thickness of a little over six feet for a distance of about sixty or seventy feet, but became mixed with shale and limestone, and was eventually lost. A second bed of good anthracite, two feet five inches in thickness, also occurs, with other thin seams. A man who was afterwards employed by the company to undertake explorations on their behalf, traced the continuations of the beds for three or four miles, and reports having observed outcrops of coal seams on most of the streams he crossed. It is also reported by the Indians that a well-marked coal seam occurs about fourteen miles from the original locality in a south-easterly direction, on the south side of Skidegate Channel, which would give an extent of at least twenty miles to this area of the coal-bearing rocks in that direction; the facts indicating, as Mr. Richardson remarks, the general permanence and continuity of the coal beds, however variable they may be in detail. Between Cowgitz and Masset, on the north end of the island—from which samples of anthracite coal have also been brought—a level country is reported to exist, below which Mr. Richardson supposes the coal formation may also extend, and should it be found to do so, the total length of the coal area on the Queen Charlotte Islands would be little short of one hundred miles.

Analysis of anthracite.

In composition, the anthracite of the Queen Charlotte Islands compares favourably with that from Pennsylvania. The following analyses by Dr. Harrington† were from samples collected by Mr. Richardson; No. 1 being from the six-foot seam; No. 2 from the so-called three-foot seam (2 feet 5 inches):—

| | I. | II. |
|---|---|---|
| Water | 1·60 | 1·89 |
| Volatile combustible matter | 5·02 | 4·77 |
| Fixed Carbon | 83·09 | 85·76 |
| Sulphur | 1·53 | 0·89 |
| Ash | 8·76 | 6·69 |
| | 100·00 | 100·00 |

Equivalents of Queen Charlotte Island rocks elsewhere.

Rocks of the same age with the coal-bearing series of the Queen Charlotte Islands are probably present also on the mainland, where fossils indicating a horizon both somewhat higher, and a little lower in the geological scale have already been found, and apparently occur in different parts of a great conformable rock series, though this cannot yet be confidently stated. These rocks are extensively developed on

* Report of Progress, 1872-73, p. 56.

† Op. cit., p. 81.

the eastern flanks of the Coast Range, near the head waters of both branches of the Homathco, and probably occur in considerable force, with a similar relation to this axis of disturbance throughout its length, as the explorations of last summer have led to the discovery of rocks near the same horizon, on the Iltasyouco and Salmon Rivers, in latitude 52° 50′. To what extent these lower Mesozoic rocks may continue to hold coal on the mainland, or whether they entirely cease to do so, remains as a matter for future enquiry, though it may be stated here that on Tatlayoco Lake and elsewhere, some carbonaceous matter, with broken fragments of plants, occurs in connection with shaly beds. The rocks of this group well deserve a more careful and extended examination; and for the purpose of ascertaining their thickness and real character, the coast sections of the Queen Charlotte Islands are probably best adapted, and once worked up would serve as a standard of comparison for other and less accessible regions.

Cretaceous coal measures of Vancouver.

The rocks of the second class are best represented in the coal-fields of Nanaimo and Comox, on Vancouver Island, and are now well ascertained to be of Cretaceous age. Coal is said to have been discovered at Nanaimo by the Indians about twenty-two years ago. Through them the Hudson Bay Company heard of its existence, and subsequently began to work it. In 1861 they sold their mine, now known as the Vancouver Colliery, to an English Company.

The Comox and Nanaimo areas have been thoroughly examined by Mr. Richardson. They are described in his reports for 1871–72, 1872–73, 1873–74, and will be more completely treated of in a forthcoming report.

Extent of coal basins.

Quoting from the report of 1871–72, the coal measures are described as resting in a "narrow trough, which may be said to extend to the vicinity of Cape Mudge on the north-west, and to approach to within fifteen miles of Victoria on the south-east, with a length of about 130 miles." The surface of the country is, generally, rolling, with no elevations rising to a greater height than 800 feet, and, in some places, is comparatively level. The rocks accompanying the coals are sandstones, conglomerates and shales, and are often false-bedded on a large scale. They hold abundance of fossil plants and marine shells in some places, and in appearance and degree of metamorphism much resemble the true Carboniferous rocks of some parts of Eastern America.

Nanaimo are

On the Nanaimo area there are three companies now at work, the mines being known respectively as the Vancouver, Wellington and Harewood. The two first carry their coal to the wharf by short railways on which locomotives are used; while the last named is provided with an

Number and thickness of seams.

aërial wire tramway. Two seams are worked in the Vancouver Company's Mine, respectively six feet and three feet in thickness, and probably averaging, together, eight feet of clean coal. The seams were lately lost at a fault, but have been recovered at a slightly increased depth by boring, the thickness of the upper seam being reported at nine feet in the bore-hole. The coal bed worked by the Wellington Company, at Departure Bay, averages nine feet six inches, while a second seam, stated to be six feet thick, is known, but is not used. The seam at the Harewood Mine averages five to six feet in thickness, and three and a-half feet below it is a seam three feet thick. It is difficult to ascertain the precise equivalency of the different beds, but Mr. Richardson is of opinion that those of the Vancouver and Wellington areas represent each other.

Statistics of labour and out-put.

The coal is worked, I believe, on the pillar and stall system, though parts of the seams have been so steeply inclined as to require stoping. The miners employed are Whites, Chinese and Indians. Mr. Good states the number of each, for the year 1875, to be as follows:—Whites, 396; Chinese, 176; Indians, 51; giving a total of 623. The wages earned by the Whites vary from $2.00 to $5.00 a day; by the Chinese and Indians, from $1.00 to $1.50. The total out-put of coal for 1875 is given at 110,145 tons, being an increase of 28,597 tons 12 cwt. over that of 1874. During 1876 the out-put is stated to have been 140,187 tons, showing an increase of 29,942 tons over 1875. At the mines the coal sells at $5.00 to $6.00 a ton; in San Francisco it commands about $10.00.

Comox area.

The Comox area has probably a greater extent of productive measures, and may eventually become more important than the Nanaimo, and at the present time a company are in a position to ship coal there, having constructed a railway and the necessary wharves and works. Mr.

Sections across the basin.

Richardson gives a number of carefully measured sections of the Comox area,* showing their character along various parts of a line, which, following the direction of the outcrop of the beds, is about thirty miles in length. On Brown's River, furthest north, almost the entire mass of the productive measures is exposed in a thickness of 739 feet 6 inches of beds. In this section nine coal seams occur, with an aggregate thickness of 16 feet 3 inches, the thickest bed being the lowest in the series, and averaging 7 feet. In a section of 122 feet at the Union mine, ten coal seams, with an aggregate thickness of 29 feet 3 inches occur, the thickest seam being 10 feet. This section represents only a

* Report of Progress, 1872-3, p. 85 *et seq.*

small part of the productive division. In a third section, on Trent River—again embracing nearly the entire thickness of the productive measures—thirteen seams are found, with an aggregate thickness of only 18 feet 1 inch, the thickest bed being 3 feet 8 inches. On the area of the Baynes Sound Company, in 220 feet 10 inches of measures, two seams of 6 feet and 5 feet 10 inches, respectively, occur.

Extent of basin

Mr. Richardson * estimates the extent of country underlain by the productive measures at 300 square miles, without taking into consideration that which may lie beyond the shore; and computing the total thickness of workable coal in the Union Company's property at a little over twenty-five feet, calculates the quantity of coal underlying the surface at 25,000 tons per acre, or 16,000,000 tons per square mile for this part of the region.

Character of the seams.

It will be seen, from the outlines of sections given above, that the productive coal rocks of Comox, though throughout preserving their carboniferous character, probably vary considerably in the number of seams contained, and even more widely in the thickness of the individual seams in different parts of their extent. This variability appears to be equally found in all parts of the Vancouver coal fields which have been examined, and contrasts with the greater comparative regularity of those of many parts of the Palæozoic Carboniferous formation. In the working of these beds, the next most important exploration after the mere definition of the coal-basins, will be the proving of the seams from point to point by boring operations. To this end the diamond drill has already been used with good result.

Quality of Vancouver Island coal.

In quality the Vancouver coals are found superior for all practical purposes, to any worked on the Pacific coast, and command, in consequence, a higher price. The comparatively limited scale on which the workings are at present carried on, is owing to the small demand for local purposes and the high duty imposed on the coal entering San Francisco, the chief foreign market. In spite of this, however, Nanaimo coal is used on the western section of the Central Pacific Railway.

As an impartial estimate showing the superiority of the Vancouver Island coals, the following table establishing the comparative value of these and other fuels for steam raising purposes, by the War Department of the United States, will be interesting.

One cord (8 feet by 4 feet by 4 feet) of merchantable oak wood is there said to be equal to:—

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* Report of Progress, 1871-2, p. 80.

Comparative value of coals of west coast.

1,800 lbs. Nanaimo Coal (Vancouver Island.)
2,200 " Bellingham Bay Coal (Washington Territory.)
2,400 " Seattle Coal (Washington Territory.)
2,500 " Rocky Mountain Coal (Wyoming, &c.)
2,600 " Coos Bay Coal (Oregon.)
2,600 " Mount Diablo Coal (California.)

Average composition of Vancouver coals.

Dr. Harrington has given the following statement of the average composition of the coals of Vancouver Island, as deduced from his analyses : *

| | Slow coking. | Fast coking. |
|---|---|---|
| Water | 1·47 | 1·47 |
| Volatile combustible matter | 28·19 | 32·69 |
| Fixed carbon | 64·05 | 59·55 |
| Ash | 6·29 | 6·29 |
| | 100·00 | 100·00 |

In a sample from the Union Mine, Comox, the percentage of ash is only 2·83.

Other coal areas of Vancouver Island.

Nanaimo and Comox are not the only known coal fields of Vancouver Island. Coal occurs, and was worked at one time by the Hudson Bay Company, near Fort Rupert, on the north-eastern coast of the island. A low, flat country is reported to stretch from here to Quatseno Sound on the west coast, where the coal rocks are again known. Some examination of the latter locality was made at one time for an English Company, who had acquired property there, by Mr. Landall. Mr. R. B. Brown, the botanist, also visited the region in 1866, and writes regarding it : " My opinion is decided that the Koskemo (Quatseno) coal field is the best yet discovered in Vancouver Island, though unopened out, not only on account of the superior quality of the coal, but the ready accessibility of the mines from the Pacific, without the tedious inland navigation requisite for reaching the mines on the eastern seaboard of the island." The main seam is stated by Mr. Landall to be four feet six inches in thickness, and the quality of the coals, as shown by his analyses, is good. He estimates the coal of the part of the Quatseno basin he examined, making allowance for faults, &c., at 33,600,000 tons.

Mr. Richardson also describes the occurrence of rocks of the coal series at the head of Alberni Canal, opening into Barclay Sound on the west coast. Specimens of coal have been procured there, but the mode of its occurrence is not known ; neither this locality nor those on the

* Report of Progress, 1872-3, p. 79.

northern part of the island having yet been examined by the Geological Survey.

Probability of further discoveries.

The interior of Vancouver Island being comparatively unknown, even in regard to its main topographical features, it is not improbable that a geological examination may bring to light coal areas, which may be extensive and important, in the valleys of the interior. A considerable part of the crumpling and metamorphism of the older rocks is of post-cretaceous date, a fact which renders it quite possible that outlyers of the coal rocks may be found folded into other synclinals, besides those already known along the coast-line.

The question of the possible occurrence of coal-bearing rocks of the age of those of Vancouver Island on the mainland of British Columbia, is one on which little can be said. The equivalents of these rocks have not yet been distinctly rocognized, nor is it known whether it will eventually be possible to separate them by any well marked line from the lower rocks of the Queen Charlotte Islands and their representatives on the mainland.

The coast sections of Vancouver and the Queen Charlotte Islands will probably afford the means of determining the relations of the two series.

Tertiary coal-bearing rocks.

The Tertiary rocks of British Columbia appear to hold both true coal and brown coal or lignite, though this series is better known in its extension southwards in Washington Territory than within the limits of the province.

Coals of Washington Territory.

At Bellingham Bay, and at Seattle, on Puget Sound, it has been worked for a number of years, and the mines of the latter locality are now in a flourishing state, and ship large quantities of coal to San Francisco, which, though inferior to that of Nanaimo, can compete with it, owing to the protective duty. The Seattle coal seams are said to be five in number, and to vary from four to twelve feet in thicknes. In quality they may be considered equal to the better class of lignites from the western plains and Rocky Mountain Region, which are found to be sufficiently good for steam raising and most ordinary purposes, but compare unfavorably with true coals. Mr. Macfarlane, in his work on coals, gives the following analysis of that of Seattle:—

| | |
|---|---|
| Water | 11·60 |
| Volatile combustible matter | 35·49 |
| Fixed Carbon | 45·97 |
| Ash | 6·44 |

The Tertiary rocks of Puget Sound have never been thoroughly examined, but it is believed by those who have studied them for the

purpose of tracing the seams of coal, that, leaving out of consideration the minor irregularities, they lie in a wide trough between the Olympic and Cascade Mountains. In the central part of this trough, and stratigraphically the upper part of the series, the fuels are lignites; lower down in the series these are replaced by fuels more closely resembling true coals, and on the outer edges of the trough by coals in some places so much altered that they have been called anthracites. It is possible that all these Tertiary rocks rest unconformably on the Cretaceous, and are separated from it by a lapse of time during which folding of the older beds and elevation of mountains took place; but it is not improbable that in some places there may be a more or less complete series of passage beds between Cretaceous and Tertiary, as occurs on the eastern slopes of the Rocky Mountains; or that there may even be two uncomformable series of Tertiary rocks.

Same measures continuous on Lower Fraser.

The Tertiary coal measures of Puget Sound and Bellingham Bay are continuous north of the 49th parallel, and must underlie nearly 1,000 square miles of the low country about the estuary of the Fraser and in the lower part of its valley. Lignite has been found in connection with these rocks at Burrard Inlet and other localities, and specimens of a fuel resembling true bituminous coal (and coking on the application of heat) have been obtained near the Fraser above New Westminster. The remarkably good specimen of coal from the River Chilliwack, of which an analysis by Dr. Harrington is given on page 99 of the Geological Survey Report for 1873-74, is probably from this series. The seams, so far as known, are quite thin, but the low country underlain by the formation is deeply covered with drift and alluvium, and exposures are few. Mr. Richardson has made a slight examination of the coast sections on the shores of Burrard Inlet, but the rest of this district has not been worked out. A geological examination, embracing all the known outcrops, would probably have to be supplemented by boring operations in well-chosen localities before the value of the coals and lignites of these rocks can be ascertained.

Tertiary rocks elsewhere on the coast.

Tertiary rocks holding lignite, are found fringing other parts of the coast in greater or less width. They have been seen near Sooke, and at various places on the south-west coast of Vancouver Island. They also occur at Clallam Bay on the south side of the Strait of Fuca, in Washington Territory. None of these localities have been particularly examined, nor are they likely to be of importance in view of the accessibility of the superior coals of the Cretaceous, unless in some place thick beds of lignite, somewhat resembling bituminous coal in its properties,

like that of Seattle, should be found to occur. If such beds should prove to exist they may acquire some importance from their less disturbed and more easily workable character.

Tertiary coal-bearing rocks of the interior.

Lignite and coal formations of Tertiary age are known to cover great tracts of the interior of British Columbia, and it can now be shown, from several sections examined last summer, that in most places the horizontal, or slightly-inclined basaltic, and other igneous flows of the interior plateau, are attached to, and form the latest rocks of the lignite-bearing Tertiary. From this fact, and the known relations of the beds in a number of localities, it is highiy probable that sedimentary Tertiary deposits underlie a great part of the area, showing only the later igneous rocks at the surface, and wherever extensive exposures of these Tertiary deposits occur, more or less coal or lignite has been found in association with them. Very roughly, in our present comparatively slender knowledge of the region, it may be estimated that this formation occupies between the 54th and 49th parallel of latitude, an area not less than 12,000 square miles.

Nicola Valley coals.

In the Nicola Valley, near the junction of the Coldwater, the occurrence of coal has been known for some years, and on analysis it has proved to be a bituminous coal of very high class. The average of two determinations, by Dr. Harrington, gives the following result:

| | |
|---|---|
| Volatile combustible matter and moisture | 36·065 |
| Fixed carbon | 61·290 |
| Ash | 2·645 |
| | 100·000 |

Exposures.

I made a cursory examination of this locality in November of 1876, and a more detailed survey has been made during the past summer, of which the results will be published in the next Report of Progress. The chief exposure of the coal is in the west bank of the Clearwater river, which joins the Nicola from the south, and down which one of the proposed lines for the Canadian Pacific Railway passes in its way from Hope to Kamloops. The original opening on the coal was almost in the bed of the river, and is now quite filled up. A second small opening has, however, been made a little higher up the bank, and here a thickness of five feet three inches of nearly pure coal is exposed, separated by six inches of sandstone from a second underlying seam, one foot four and a-half inches thick. The coal-bed passes below a considerable thickness of pale-yellowish, rather coarse-grained, soft sandstone, which crumbles under the weather and appears to dip here about north, at an angle of 10° to

15°. In a second exposure, at the distance of about a mile, in a ravine in the south bank of the Nicola, similar sandstones occur, associated with blackish shales and again holding coal, of which several beds are seen. Beyond the Coldwater Valley to the east, on the Nicola, older crystaline rocks appear, cutting out the coal measures; but westward the coals, with associated sandstone, pass beneath a great thickness of the rocks of the Tertiary volcanic series, dipping, on the whole, at low angles to the south-west. In following the Nicola Valley westward, the volcanic rocks are found to form the mass of the hills which rise steeply on either side, well stratified tufaceous sandstones, probably connected with those of the coal formation, are seen to rise from time to time in the lower parts of the slopes. These rocks are also seen—presenting much the same characters, but without again showing the lower sandstones—for about thirteen miles below the mouth of the Nicola, on the Thompson, making the width of the belt of country here covered by them about thirty-seven miles.

Relations to volcanic rocks.

Extent of the field.

It has not yet been ascertained whether the sandstones and associated coals underlie the whole breadth occupied by the volcanic rocks, which may be considered as the upper part of the same formation. It is now known, however, that the coals really pass beneath the great volcanic formation, and may reasonably be expected to occur over a considerable portion of its area. This question is well worthy of careful investigation, especially in view of the possible passage of the railway in the vicinity of these newer coal-measures. In the local absence of sections sufficient for the satisfactory definition of the rocks of the lower part of the series —as on the lower Nicola Valley—they are generally so situated that they can be tested with comparative ease by boring in well-chosen localities. The coal-bearing rocks of the Nicola region are also now known to extend far up the Coldwater, and though not satisfactorily exposed, contain more or less coal. Similar rocks have also been examined on the North Thompson, about forty-five miles above Kamloops. They contain coal of excellent quality, but, so far as the present small exposures allow them to be seen, in thin seams. These, and other localities visited during the past summer, will be reported on in detail in the next Report of Progress.

Lignite coals of other localities.

Lignites or brown coals, are found abundantly in the upper part of the same formation. Near Marble Cañon a bed of this material surpasses forty feet in thickness, and important deposits also occur on the North and South Forks of the Similkameen. The lignites and lignite formation of Quesnel will be found described in Mr. Selwyn's

preliminary report of 1871-2, and in my own for 1875-6. These beds are interesting on account of the plant and insect remains preserved in them, but the lignites here are, I believe, of no economic value. They are mixed with clayey matter, and are otherwise poor in quality; and are, apparently, the result of the rather tumultuous deposition of drift-wood and other vegetable matter, by rapidly-moving waters. Lignite of better quality, and apparently, in some instances at least, still resting in the locality where the wood producing it grew, is, however, found in other places. Drift fragments of this fuel, of quality good enough for ordinary purposes, are found on the Nazco, Blackwater, Lower Nechacco, Parsnip, Chilacco, Fraser River at Lillooet, the Thompson below Kamloops Lake, &c., and lignite is known to occur in place on Lightning Creek (Cariboo), the Upper Nechacco (p. 82), and Ko-has-gan-ko Brook (p. 76), besides a number of localities on and near the Fraser River, between Quesnel and Soda Creek, which have not been examined.

Lignite at Quesnel.

Drift lignite.

These lignites do not, of course, compare favourably as fuels with the coals of the Nicola Valley, and would scarcely be of value unless found in thick and accessible seams, and then for local use or in the absence of other fuels. Comparatively little is yet known about their distribution, for though, as already stated, they probably underlie a great part of the basaltic plateau, the soft character of the associated beds allows them to be easily worn away, leaving hollows into which the basalts and other hard over-lying volcanic rocks, readily crumbled by the weather, fall, concealing the lignite out-crops.

Value of lignites.

## Iron.

The most important deposits of iron yet known in British Columbia are those of Texada Island, which have been examined and briefly reported on by Mr. Richardson.* The ore is a coarsely granular magnetite, containing, according to analysis by Dr. Harrington, 68·40 per cent. of iron, with only ·003 per cent. of phosphorous. It is associated and interbedded with limestones, epidotic and dioritic rocks, supposed to be of Carboniferous age; and is well situated for mining, smelting, and shipment, occurring within twenty miles of the point of shipments of coals of the Comox area, and contiguous to deep harbours; while charcoal in unlimited quantities could be prepared in the immediate vicinity. The largest exposure is on the south side of Texada Island, about three miles north-west of Gillies Bay. Here the ore-bed is

Iron ore at Texada.

* Report of Progress, 1873-4, p, 99.

seen to be from twenty to twenty-five feet thick, and to rest on grey crystalline limestone, with which, for about two feet down, are interstratified bands of ore of from half-an-inch to an inch in thickness. From this point to the north-west, for nearly a mile, the bed is occasionally seen, and at one place there is a continuous exposure about 250 feet long, and from one to ten feet thick. To the north-east it is also said to have been traced for more than three miles.* With the present high price of labour on the Pacific coast, and especially in British Columbia, the profitable manufacture of iron may appear to be a contingency of the remote future only; especially in view of the low rate of freight at which the west coast is supplied with coal and iron from Britain, by vessels coming out nearly light, for return cargoes of wheat from California and Oregon. In the neighbouring State of Oregon, however, the manufacture of charcoal iron has been instituted for some years on a small scale, a single blast furnace being in operation with a product in 1874 of 2,500 tons, for 1875 of 1,000 tons.† Where iron ore and fuel of first rate quality can thus be obtained together, it is often possible to compete successfully, for many purposes, with the lower classed and priced iron most abundantly produced in Britain. On the Pacific Coast, too, Chinese labourers can be procured in unlimited numbers, at prices so low as to compare favourably with those of any part of the world; and the Chinese are notably apt in acquiring proficiency in the more skilled mechanical arts.

Possibility of iron smelting.

Iron smelting in Oregon.

Clay iron-stones are of frequent occurrence in the coal rocks of Vancouver and Queen Charlotte Islands. They might, no doubt, in some cases, be profitably worked in conjunction with the coal seams, as they occur at but small distances beneath them, and in some instances are even associated with the coal. The nodules vary in weight from a pound or less up to many tons, and Mr. Richardson says that at the Baynes' Sound Mine a sufficient quantity could probably be obtained for the regular supply of a blast furnace.‡

Clay ironstones.

Iron has been found in smaller quantities in many other localities, but little attention has been paid as yet to these deposits, under the impression that, under present circumstances, they are of no value. The formation containing the iron ore of Texada is believed to be the same as that constituting the greater part of Vancouver and its adjacent islands.

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* Descriptive Catalogue of Economic Minerals of Can., Phil. Inter. Exhib., 1876.

† Journ. Iron and Steel Inst., No. 1, 1876, p. 238.

‡ Dr. B. J. Harrington in Appendix III. to Mr. Richardson's Report, 1872-73, p. 82.

## Silver, Copper, Mercury and other Ores.

Difficulty in opening mines.

No work but such as may be classed as prospecting or preliminary exploration, is, or has been carried out on the deposits of metalliferous ores in British Columbia. Various unfortunate circumstances have prevented the testing, on a large scale, of the localities known to be promising, and much money has been lost from time to time in injudicious enterprises, which with a comparatively small amount of knowledge of mining and metalliferous deposits in other countries would have avoided. These circumstances, coupled with the difficulty and expense incurred in exploring the more rugged and tree-clad portions of the Province, have tended, of late years, to discourage enterprise in this direction, and to throw discredit on even the best of the known deposits. As soon as one or two properly conducted and paying mines can be seen in operation, I feel convinced that the growth of mining industry will become as rapid as it has heretofore been slow.

Silver at Hope.

*Silver.*—The best known argentiferous locality is that about six miles from Hope, on the Fraser River, which was discovered about 1871. It has not been visited by any member of the Geological Survey, and from its great elevation, is only easily accessible during the summer season. The formation in which the lodes occur consequently remains unknown, but from what I have heard, I am inclined to believe that they may traverse an outlyer of the Lower Cretaceous, which caps the Cascade Crystalline rocks of the region. The Minister of Mines, of British Columbia, describes it as follows:—

Eureka Mine.

"The first lead, called the Eureka mine, crops out about 5,000 feet above the river level, is well defined, four to seven feet in thickness, and has been traced 3,000 feet. A tunnel has been driven into this lead 190 feet. The ore is described as argentiferous grey copper, and has yielded, under assay, $20 to $1,050 worth of silver to the ton.

Van Bremer Mine.

"During the time the above lead was being worked, another, about 3,000 feet distant, was discovered; this is of a far more valuable character, and is called the Van Bremer Mine. The ore is described as chloride of silver, and has yielded, under assay, from $25 to $2,403 of silver per ton of rock. A quantity from the outcrop sold at San Francisco at $420 a ton. The lead is distinctly traceable for half a mile."

Specimens assayed by Dr. Harrington and Dr. Hunt gave, respectively, 271·48 oz. and 347·08 oz. of silver to the ton of 2,000 pounds. Lead, copper, antimony, iron, arsenic and sulphur, are also present. As above

stated, the ore from this locality has been sold at a remunerative price in the rough state, as extracted from the mine, and carried to the river by the present rude appliances. Certain unfortunate difficulties, with regard to the ownership of the property, now only appear to prevent the successful working of this deposit.

Quite lately lodes, which are supposed to be either the continuations of those above described, or others running parallel to them, have been discovered near the water level of the Fraser, apparently in a granitic matrix. These contain silver and copper, but the former in smaller quantity than in the Eureka veins.

**Silver at Cherry Creek.**

Cherry Creek, a tributary of the Shushwap or Spillemeechene river, between Okanagan and Arrow Lakes, is noted as a locality from which specimens of remarkably rich silver ore have been brought, and where somewhat extensive exploratory works have been carried on with the hope of finding it in paying quantity. The district has now been examined, and though not yet prepared to report upon it in detail, I may say that, though the vein originally worked on was reported as lost, I am by no means hopeless as to its eventual recovery, and that the number and character of veins in the Cherry Creek country lead to the belief that it may eventually be an important mining region.

**Native silver.**

As already mentioned, native silver, or silver amalgam, has been found in the Omineca district, and argentiferous galena ores occur in many parts of the Province, but have not yet been developed.

*Copper.*—Masses of native copper have been found from time to time in various parts of the Province, and though they have never been observed in their matrix, they are probably derived from some of the volcanic rocks. Small cupriferous veins have also been observed in volcanic rocks of Tertiary and Mesozoic ages, in the gold rocks, the crystalline rocks of the Coast Range, and those already referred to as of supposed Carboniferous age in Vancouver Island.

**Copper at Howe's Sound.**

The most promising locality at present known is situated among the mountains between Howe's Sound and Jarvis' Inlet, at a height of about 3,000 feet above the sea. Very fine specimens of purple copper ore, associated with quartz, mica and molybdenite, are brought from this place, which is now in course of development. The county-rock is a granite or diorite of the Cascade Crystalline series.

**Knight's Inlet, &c.**

Fine specimens of similar ore have been procured further north at Knight's Inlet, and specimens of copper pyrites have also been obtained from rocks of this series at several localities on the Homathco during the railway explorations.

*Mercury.*—The discovery of this metal has been several times reported in British Columbia, but generally, I believe, on insufficient evidence. It appears certain, however, that small quantities of cinnabar have been obtained in gold-washing on the Fraser River, near Boston Bar, and I am also informed that minute globules of mercury are seen in some decomposed parts of the Hope silver ores. In the autumn of 1876 I received a small but well-authenticated specimen of rich cinnabar ore from Mr. Tiedemann, of the railway survey, which he obtained himself in the vicinity of the located line of the railway, on the Homathco. From Mr. George Webb I learn that the country-rock is slate, the lode well defined, being seen in the front of a steep southward-facing bluff, and traceable for nearly a mile in length. I have also seen lately a rich specimen of cinnabar and native mercury from the west side of the Fraser River near Clinton. Whether mercury occurs, however, in deposits at all comparable with those of California, which are found in rocks of similar age to some of those occurring in British Columbia, remains to be proven.

Mercury.

Cinnabar on the Homathco.

On the Fraser.

*Lead.*—Galena has been found in many parts of the province, and appears in connection with gold, both in the lodes and superficial gravels of the Cariboo district. Lead ores, as such, will not probably pay to work in the interior, even if found in large quantity, till cheaper means of transport are introduced. Highly argentiferous galenas would pay to smelt as silver ores, if found in moderately accessible localities.

Lead.

*Platinum.*—This metal has been found in small quantity in several localities in association with alluvial gold.

Platinum.

*Nickel.*—Dr. Blake has found nickeliferious sand among the heavy materials separated from the fine gold of the Fraser.

Nickel.

## Building and Ornamental Stones.

The Coast Range will probably furnish, in all parts of its length, good grey diorites and granites. These might be quarried at the water's edge in many of the inlets. Sandstones and freestones occur abundantly in association with the coals of Nanaimo, &c. A sandstone, quarried I believe on Newcastle Island, was employed in the Treasury building at San Francisco, but has not proved very satisfactory, owing to its tendency to exfoliate. By judicious selection, however, no difficulty will probably be found in obtaining building stones of this class in unlimited quantity. Over a great part of the interior, the harder rocks are so fissured and jointed, as to be incapable of yielding sound building stones of large

Granite and freestone.

size. Many localities are known, however, where good stone can be obtained, and it is probable that some of the basalts and other igneous rocks of late date will answer well for building, if proper care be taken to avoid those varieties apt to crumble under the weather. The rocks occurring in the vicinity of the various proposed railway lines are described more fully elsewhere.

**Marble.** Marble of good quality is known to occur at Texada Island, Metla Katla Bay, on the Nimpkish River and other localities.

**Serpentine.** Serpentine is found abundantly in association with some of the older rocks.

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## List of Localities in the Province of British Columbia Known to Yield Gold, Coal, Iron, Silver, Copper, and Other Minerals of Economic Value.

(This list makes no pretension to completeness, the object of its publication being rather to elicit than to impart information. It will show, however, in some degree, how numerous the discoveries have already been; and may, I hope, be largely extended in the course of a few years. Most of the statements made with regard to the various localities are derived from trustworthy sources, though I cannot undertake in all cases to vouch for their absolute accuracy.)

### GOLD.

#### *Cariboo District.*

*Williams' Creek.*—Described in the foregoing pages. Its tributaries, in order, down stream, are as follows:—

*McCallum's Gulch.*—Joins from the east; nearly worked out; no deep ground.

*Mink Gulch.*—Joins from the west, and prospects not considered very encouraging by owners, who are waiting for the Bed-rock flume, with intention of hydraulic work.

*Walker's Gulch.*—Joins from the west at Richfield Court House; deep work; good prospects at different times, and some quantity of gold taken out about its mouth, but has not held out. Not yet thoroughly prospected.

*Grub, or Black Jack Gulch.*—Joins from the west; a mere ravine of no great length, being all embraced in one claim; good pay for hydraulic method, and still worked.

*Stout's Gulch.*—Joins from the west, below the cañon; very rich, but now worked out for drifting; hydraulic method now employed; ground enough for many years.

*Conklin Gulch.*—Joins from the east, opposite Barkerville; very rich; still worked by drifting; ground very deep for so small a valley, being ninety feet in lower part and twenty in highest; drifting claim, one and a-half miles up; probably rich for hydraulic working.

*McArthur's Creek.*—Two miles below Barkerville and one mile above Lane and Kurtz shaft-house; joins from the south-west; paid well in drifting deep ground, but now worked out for this method; no hydraulic work in progress.

*Lowhee Creek.*—Runs northward, nearly parallel to Williams' Creek, and empties into Jack of Clubs Lake, which also receives Jack of Clubs Creek, and is the source of the Willow River; good pay found in both shallow and deep diggings, and some good ground still being worked; gold, especially near source of creek, very coarse and rough, often including fragments of quartz; found difficult to obtain water for hydraulic work here.

*Jack of Clubs Creek.*—All deep work on this creek, gravel being 150 feet in depth near the mouth, where a few claims paid well; this creek is a favourite among those which are considered yet unproven, the impression being that an old channel exists which has not yet been found.

*Creeks entering Willow River.*—

*Mosquito Creek and Red Gulch.*—Entering Willow River from the south below the last; the former has been very rich, and was fifty feet deep at mouth; now worked out for drifting; hydraulic work paying well.

*Whipsaw Creek.*—Three miles below Mosquito Creek, on the same side; in former years from $10 to $12 per day per hand taken out, and more or less work carried on ever since by ground-sluicing and drifting.

Several creeks below Whipsaw Creek, on the south-west side of Willow River, have afforded no pay; fair prospects have been obtained in several creeks on north-east side, but no paying ground found.

*Sugar Creek.*—Twelve miles below Mosquito Creek, joining from the north. Some good prospects, but never much pay.

Creeks lower down Willow River are known to hold some gold, but have not yet yielded it in paying quantity.

*Grouse Creek.*—Six miles east of Barkerville, heading with Antler Creek. The deep ground was very rich, and extended for about a mile near the upper part of the creek, giving out farther down. Deep ground worked out.

*Antler Creek.*—Heads in Bald Mountain, opposite Williams' Creek, and was one of the first creeks worked in this part of the country. Shallow ground for two miles, paid well, and has been worked out. The deep ground has not yet been much tested, owing to the absence of clay, and consequent large quantity of water met with in sinking. All the gulches joining Antler Creek from the source down, have paid (Wolf, California, Stevens', and Begg's Gulches). The creek has never been bottomed where these side-valleys fall in. Chinamen are at work, and getting pay on benches 100 feet above the stream, a long way down.

*Pleasant Valley.*—A transverse depression, four miles in length, uniting the valleys of Williams' and Antler Creeks, and joining the former about four miles below Barkerville. Has never been bottomed or much prospected, but might be embraced in a scheme for draining the valley of Williams' Creek.

*Bear Creek*, and country about Bear Lake.—Gold has not been found here in paying quantity.

*Swamp River.*—Has attracted some attention, but no good pay has yet been found.

*Cunningham Creek.*—In early days, a crevice containing 600 ounces of gold, was found on this creek, about twelve miles from its mouth. Several hydraulic claims working. Since 1864 attempts to reach the deep ground have been made, but have not yet succeeded; a third attempt is now being made by the Victoria Company. It has always been supposed that the deep ground in this creek would turn out rich, and if once proved to be so, a large amount of work would immediately be undertaken.

*Harvey's Creek.*—The first gold in paying quantity in the Cariboo District was found here in 1860. One claim—the Minnehaha—has been exceedingly rich. Another, at the junction with swamp river, has paid well. The Cummings Company bottomed it at one place, and drifted up in a small cañon (unsuccessfully,) but found pay on entering wide ground. The upper part of the creek is deep, and has not yet been thoroughly proven.

*Creeks on the North side of Cariboo Lake.*—In Nigger, Pine and Goose

Creeks, small quantities of gold have been found; on the last-named much money was spent in putting in a flume, but with small result.

*Kiethly Creek.*—The main creek has only moderately deep ground, (twenty to twenty-three feet,) of which much is yet unworked; it being expensive to open on account of the great quantity of water. About thirty white men did well here during the summer of 1876; while a number of Chinamen, at work about the mouth, also got good pay. Benches 100 feet above the stream have paid for open work, and some of them for drifting also. Hydraulic method not yet in use here.

*Snow-shoe Creek.*—The east branch of the above is considered to be one of the most promising creeks of which the deep ground is yet unprospected; gold obtained from shallow workings.

*Duck Creek.*—Chinamen have been working here, but not much known as to results.

*Black Bear Creek.* --Much prospecting has been done here, but rich pay never found; not yet considered fairly tested, the ground being hard to work in.

*Cedar Creek.*—One pretty rich claim was worked here,—the Aurora. The creek is now worked by Chinamen.

*Hazeltine's Creek.*—Some encouraging "prospects" have been obtained here.

*Moorhead Creek.*—Some work done here, but without good result.

*Kangaroo Creek.*—Joins North Fork of Quesnel about two miles above its junction with the South Fork. Paid well at one time. Chinamen now at work.

*Quesnel River.*—Most of the work done on bars of river, though many workings on benches one hundred to 150 feet above the water, pay well. The gold is all light. This region is altogether in the hands of Chinamen, who resort chiefly to the Forks and South Branch. About 300 Chinamen work in this district during the summer, and winter at the Forks.

*Swift River.*—Rather inaccessible, and hard to work, being a rapid stream with many heavy boulders. Considerable quantities of gold have been taken from it, from time to time, and Chinamen still at work, though the stream, as a whole, may be considered unprospected.

*French Creek and Canadian Creek.*—Joining Pleasant Valley from the south, have both yielded some gold, which, though run through where the working was carried on, is probably not exhausted.

*Canon Creek.*—A stream running into Willow River far down its course, and reached by a trail twenty miles long from Beaver Pass House.

A company last autumn engaged in attempting to bottom it, with good prospects.

*Canon Creek.*—A second stream of the same name, joins the Fraser from the east above Quesnel. A considerable quantity of gold obtained here formerly, some of it very heavy and mixed with quartz; one nugget worth $700 found by Chinamen on its branch—*Hickson Creek.* An auriferous quartz vein is known.

*Lightning Creek.*—Has been described on a preceding page. Its chief tributaries are as follows:—

*Amador Creek.*—No good pay yet found.

*Van Winkle Creek.*—About 2,000 feet of the lower end of this valley paid well.

*Dead Mans Creek.*—

*Perkin's Creek.*—

*Chisholm Creek.*—Good pay in shallow workings. Deep ground unproved, though great efforts have been made to test it.

*Last Chance Creek.*—Estimated that $250,000 worth of gold taken out of this creek in the distance of half-a-mile. Rich ground now probably worked out.

*Davis Creek.*—Good pay in shallow ground.

*Anderson Creek.*—Good pay in shallow ground.

*Jawbone Creek.*—No good pay found.

*Quartz Veins in the Cariboo District.*—Many are known, some very persistent and of large size. So little has yet been done toward the examination of these that it is scarcely worth while attempting to enumerate them. That known as the *Big Bonanza*, between Lowhee Creek and Stout's Gulch; the *Stedman*, at Richfield; and an irregular vein or mass of quartz, at Mosquito Creek, have so far attracted most notice.

## *Cassiar.*

(For the following very interesting local details, concerning Cassiar District, British Columbia's youngest and least known gold field, I am indebted to Mr. G. B. Wright.)

*Stickeen River.*—54° to 56° north latitude. Discovered in 1867. Highest average yield per day, $4 to $5, bar and bench diggings. A few claims being worked, but nearly exhausted.

*Dease Creek.*—Latitude, 58° 42′ 50″; altitude, 2,750 feet. Discovered in 1873. Highest average yield per day $8 to $50; the gold being

worth $16 an ounce. The richest claims are worked out, but mining will be carried on for a good many years to come. Dease Creek has probably yielded about $700,000 in three seasons. Estimated yield this season (1877) about $125,888.

*Thibert's Creek.*—Latitude, 58° 50′; altitude, 2,750. Highest average yield per day $8 to $50, the gold being worth $16.40 an ounce. Bar, bench, and creek diggings. A portion of the creek worked out, but still paying well. Bench diggings recently discovered very rich. Yield up to this season estimated at $300,000.

*Beady Creek.*—Latitude about 58° 53′. Discovered 1874. Bar diggings. Prospects found, but no extensive mining ever done.

*Eagle River.*—Latitude, 59° 6′ 14″. Discovered 1874. Bar diggings, undeveloped.

*McDames' Creek.*—Latitude, 59° 15′ 54″; altitude of mouth, 2,550. Discovered 1874. Highest average yield per day $6 to $100, the gold being worth $17.75. Bar bench and creek diggings. This is the most important creek in the Cassiar region, the yield continuing about the same each year. It is being worked in places for a distance of fifteen miles, and will yield largely for several years. Estimated yield for two seasons $425,000; for this season probably $250,000. This includes the yield for several of the small creeks and tributaries of McDame—Somers' Creek, Snow Creek, Quartz Creek, Rosella Creek, Davies' Creek and Gold Creek.

*Snow Creek.*—Altitude, 3,400 feet. Discovered 1875. Highest average per day, $5 to $20; gold worth $18 an ounce. Bench diggings, still mined extensively; the richest claim in Cassiar, near the mouth of this Creek; it has paid for a week as high as 300 ounces for six or eight men. Seventy-two ounces washed out of one pan of dirt during the past season.

*Quartz Creek.*—Altitude, 3,550 feet. Discovered 1875. Highest average per day, $5 to $20; gold worth $18 an ounce. Bench and Creek diggings, best claims worked out.

*Rosella Creek.*—Altitude 3,550 feet. Discovered 1876. Highest average per day, $5 to $15; the gold being worth $18.25 an ounce. Bench and Creek diggings, best claims worked out.

*Dennis Creek.*—Altitude 3,500 feet. Discovered 1877. Highest average per day, $5 to $20. Gold worth $18.25 an ounce. Bench and Creek diggings; many miners here.

*Patterson Creek.*—Altitude, 4,380 feet. Discovered 1877. Highest average per day, $5 to $20; the gold being worth $18 an ounce. A few companies at work.

*Gold Creek.*—Altitude, 4,300 feet. Discovered 1877. Highest average per day, $5 to $50. Gold worth $18 an ounce. Bench and creek diggings, a few companies at work.

*Slate Creek.*—Altitude, 4,320 feet. Discovered 1877. Highest average per day, $10; the gold being worth $18 an ounce. Bar diggings, one company at work.

*Somer's Creek, or First North Fork of McDame.*—Altitude, 3,000 feet. Discovered 1876. Highest average per day, $10 to $100. Gold worth $18 an ounce. A large number of tunnels being worked, with good prospects.

*Third North Fork of McDame,*—Altitude, 3,200 feet. Discovered 1877. Creek and Hill diggings; good prospects obtained and several companies testing.

*Sayyeas Creek.*—Latitude, about 62°. Discovered 1875. Highest average per day, $8 to $10. Gold worth $18.25; abandoned last year.

*Spring Creek.*—Altitude, 3,800 feet. Discovered 1877. Highest average yield, $10 to $20; the gold being worth $18.25. Hill diggings; only one company working, but a very rich bench; no prospecting yet in creek.

*Fall Creek.*—Discovered 1877.

*De Liard River.*—Latitude, 60° to 62°. Highest average per day, $6 to $8; the gold being worth $18. Bar diggings. But little mining done—some tributaries being prospected.

*Rapid River.*—Latitude 60°; prospects obtained.

*Omineca District.*

*Germansen Creek.*—Good pay in part of course; some creek claims, and part of work by hydraulic method on the benches.

*Mansen River.*—Only two companies at work in 1875, and making less than wages.

*Slate Creek.*—Miners stated to be making expenses in 1875.

*Elmore Gulch.*—Poor pay in 1875—two companies at work.

*Lost Creek.*—Little work in 1875.

Details of other localities wanting.

*Kootenay District.*

*Wild Horse Creek.*—Discovered in 1863; in 1864 ordinary claims paid $20 to $30 a day per man; work still in progress.

*Perry Creek.*—Discovered 1867. Some good claims, and some work still in progress.

*Findlay Creek.* — Good prospects; but owing to freshets, never successfully mined.

*Boulder Creek.*—

### *Great Bend Country.*

(Now almost abandoned.)

*Carnes' Creek.*—Joins Columbia River from the east. Heavy gold; some pieces weighing as much as $14. Mining on bars; the bed rock not being reached on account of water. For a time, below the cañon, the average earnings were $15.

*French Creek.*—Empties into Downie River about twenty miles from its mouth. (Downie River flows eastward into Columbia.) This was the richest in the district, and was worked both on bars and to the rock. Average earnings as much as $100 to the hand for some time on the "Half Breed" claim. Worked out.

*McCuller's Creek.*—Joins Downie River four miles from French Creek. Working on bars; the bed rock not reached on account of water. Probably as high as $100 a day per man taken out in places, but deposit irregular. Fragments of quartz containing gold were found four miles up the creek.

### *Other Districts.*

*Parsnip River.*—Below its junction with the Nation River, draining the Omineca country. This stream carries fine gold, which has proved highly remunerative in some localities.

*Findlay River.*—Fine gold found on all the bars, but the head waters (where richer deposits may occur) have not been prospected.

*Peace River, east of the Rocky Mountains.*—Fine gold is found in some abundance in places. Mr. Selwyn thinks it may be derived from the Laurentian Axis to the north-east.

*Fraser River.*—Fine gold from its sources to the sea. Heavy gold does not extend far below Boston Bar, but is found in many places from here to Lytton, and also, as I am informed by Mr. D. McIntyre, in spots from Lytton to the mouth of the Chilicotin. Much gold is still obtained by Chinamen and Indians on the Fraser, and I think it probable that, eventually, many of even the higher flats and benches will pay for hydraulic work. The heaviest gold pretty nearly coincides in its distribution with that of the slaty rocks of the Anderson River and Boston Bar series. The largest nugget found above Lytton was obtained ten miles below Lillooet and was worth $22.

*McLennan Creek.*—(Thirteen miles from Tete Jaune Cache, running

into Cranberry Lake and thence to the Fraser.)—Gold found in 1876. Giving wages of $4 to $5 a day, but, owing to heavy boulders in stream and expense of all supplies, will not pay to work.

*Nechacco River.*—Colours obtained near Fort Fraser, and also abundant near its junction with the Fraser River.

*Chilacco River.*—In certain banks near its mouth, eight or nine colours to the pan may be obtained A small quantity of heavy gold found in a lateral creek by one of the men connected with the Canadian Pacific Railway survey in 1876.

*Chilicotin River.*—Gold in some quantity said to have been found near the mouth of this stream.

*Bridge River.*—Gold found in heavy pieces, sometimes weighing one to two ounces, and affording excellent mining on this stream for ten miles up from its mouth. One nugget is said to have been worth $300. River prospected to its source in early days, and though gold found in several streams, not enough to justify work at that date.

*Lillooet River.*—Flowing into Harrison Lake. Some gold found here and also at various points on the portages toward Lillooet.

*South Thompson River.*—Colours, it is said, can be obtained in all the streams joining this river.

*North Thompson River.*—Colours found along its whole course, and at Louis Creek, thirty miles from its mouth, on the east side, gold has been found in paying quantities.

*Tranquille River.*—Joining Kamloops Lake, from the north. Heavy and light gold obtained here; about sixty Chinamen at work last summer, getting good pay; is said to have paid half an ounce per diem at the mouth.

*Scotch Creek.*—Joining Shuswap Lake from the north. Coarse gold mined here a few years ago.

*Main River Thompson.*—Heavy gold found on this river up to *Nicommen*, where, it is believed, the first gold in paying quantity in British Columbia was found. This region chiefly worked by the Indians of the country, who, I am assured, have obtained many thousand dollars in specially favourable years.

*Anderson River.*—Some heavy gold at one time found ten miles above mouth, but not enough to pay.

*Coquihalla River.*—More or less heavy gold along whole course of this stream.

*Nicola River.*—"Scale gold" found for about eighteen miles up the Nicola from its mouth.

*Bonaparte River.*—A little mining done on a tributary east of Clinton, but without encouraging result.

*Hat Creek.*—Small quantities of gold have been found here.

*Horse-fly River.*—Good "prospects" here, and in 1876 a considerable influx of miners, but without good returns.

*Skagit River.*—Colour found in several places in 1858, but no favourable indications.

*Similkameen River.*—Gold found in sharp and unwashed particles at mouth in 1853 by Captain McLennan's party. In the canon near the 49th parallel, considerable quantity of gold got in 1858-59-60; the largest piece weighing $22.50. This region, soon abandoned by the Whites, was worked for years by Chinamen.

*Okanagan River.*—Scattered diggings found in 1859-60, but soon abandoned; perhaps as much from want of water as anything else. Miners say colours can be found in every stream running into this valley.

*Mission Creek.*—Joining Okanagan Lake from the east, yielded at a spot five and a-half miles from its mouth, fine and coarse gold, assaying $18.50; paid at one time from two or three ounces to $2 or $3 a day. Colours occur for eight or ten miles above this.

*Rock Creek.*—Rising east of Osoyoos Lake, and failing into the Kettle River; about a mile from its mouth paid well, in some instances yielding as much as $100 a day, but generally from one to two ounces. Some of the benches also paid, in one case yielding half an ounce a day to the hand during the season's work. The best paying ground was where the creek crossed a belt of soft slate rock; in following it up, the cover was found very soft and deep.

*Boundary Creek.*—Joins Kettle River from the east. Some very heavy gold found here, and a good deal of prospecting done, but too much "spotted" to be profitable.

*Kettle or Nehoialpitkwa River.*—Colours and small quantities of gold found in several localities on the main stream and on tributaries.

*Seymour Creek, Burrard Inlet.*—Some gold got here at one time, but work abandoned on account of water and quicksand.

*Prospect Creek.*—East branch Homathco River, above Tatlayoco Lake. Some fine gold found here by men connected with C.P.R.S., 1875.

*Lower Homathco River.*—Colours obtained in various places.

*Other Streams flowing from Cascade Range.*—Details are wanting for most, but it is probable that colours, at least, can be found in all.

*Kelly's Lake Creek*—Near Clinton, Mr. Foster informs me that specimens of quartz found here assayed $25.12 in gold and $3.14 in silver, per ton.

*Vancouver Island.*

*Leech River.*—This stream has proved auriferous for four or five miles of its length, where it runs along the strike of a belt of slates. Estimated that $100,000 taken out, but no work now going on. The rich ground was found in the modern river bed, and is supposed to be exhausted, or, what may remain, too much spotted to pay. Banks of drift and cement might possibly pay for working by hydraulic method.

*Sooke River.*—(Below its junction with Leech River)—Only fine gold found here, and probably derived from Leech River slates.

*Goldstream Brook.*—Runs on strike of Leech River slates, further east; colours, but no pay, found here.

*Jordan River.*—Small quantities of gold have been found here.

*Nanaimo River.*—Attracted some notice in 1877, but does not appear to have paid prospectors.

*Other localities on Vancouver Island.*—Good colours found by the Vancouver Island exploring expedition on a stream entering Cowichen Lake, on rivers falling into Barclay Sound, on the south side, and on streams tributary to Puntledge Lake, near Comox.

*Queen Charlotte Islands.*—Gold-bearing quartz found at Mitchell's Harbour, lat. 52° 25′. Some work done in 1853, but lode appears to have run out.

## Coal and Lignite.

*Vancouver Island.*

*Nanaimo.*—Bituminous coal, worked for many years. Described in foregoing pages.

*Comox.*—Bituminous coal; now worked.

*Quatsino.*—Bituminous coal.

*Beaver Harbour, near Fort Rupert.*—Bituminous coal.

*Head of Alberni Canal.*—Bituminous coal.

*North side Cowitchin Bay.*—Small fragments of anthracite in sandstone. Larger specimens have been brought from the interior.

*Queen Charlotte Islands.*

*Cowgitz.*—Anthracite; described above.

*South side Skidegate Channel.*—Anthracite reported by the Indians.

*Masset.*—(North end of Islands)—Specimens of anthracite have been brought from here.

## Mainland of British Columbia.

*Vicinity of Langley*, and other localities near the Lower Fraser.—Bituminous coal known, but in thin seams only. Probably in Lower Tertiary beds.

*Chilliwack River.*—Five miles from the Fraser. Bituminous coal of remarkably good quality, but of which the thickness and mode of occurrence remain unknown.

*Coal Harbour, Burrard Inlet.*—Here and elsewhere in the flat land at the mouth of the Fraser, lignite, in thin seams, occurs. Probably in upper part of Tertiary formation.

*Junction of Nicola and Coldwater Rivers.*—Bituminous coal. Tertiary. Described above.

*Coldwater River.*—Bituminous coal, of same formation as last, in several places.

*North Thompson River.* (Forty-five miles above Kamloops.)—Bituminous coal of good quality in thin seams.

*Vicinity of Lillooet.*—Bituminous coal said to be found. Thickness or position of seams unknown.

*Ten Mile, or Guichon's Creek.*—Joining Nicola River from the north. Lignite of good quality. Thickness of seam unknown.

*South Fork of Similkameen River.*—(Above the mouth of the Passyton or Pasayten.) Lignite in micaceous sandstone.

*South Fork of Similkameen River.*—(Four miles above Vermillion Fork.) Lignite. See Report for 1876–77.

*North Fork of Similkameen River.*—(Three miles above Vermillion Fork.) Lignite, seven feet thick, with one shaly parting of three inches. See report for 1877–78.

*Boyd's or Cold Spring House.*—Lightning Creek. Lignite bed, six to ten feet thick ; fair quality.

*Fraser River.*—Between Soda Creek and Fort George, and at Quesnel—Lignite seams frequently seen ; that at Quesnel of poor quality.

*Bear River.*—(Near crossing of C. P. R surveyed line, lat. 54°.) Coal reported ; Mr. E. Dewdney says, about eighteen inches thick and covered with water at high stage of river ; on burning, left a hard stony ash. Cretaceous ?

*Peace River and Pine River.*—Beds of bituminous coal (Mesozoic) ; described by Mr. Selwyn in Report for 1875-76.

*Parsnip River.*—Drift fragments of lignite indicating a basin of rocks of the lignite-bearing age.

*Lower Nechacco River.*—East of Fraser Lake. Drift lignite only known.

*Upper Nechacco River.*—South-west of Fraser Lake. Lignite beds known in several places.

*Blackwater River.*—Drift lignites at upper and lower cañons, and intermediate portion of river.

*Chilacco River.*—Drift lignite only known.

*Nazco River.*—Drift lignite found near Cinderella Mountain.

*Pun-chi-as-ko Brook.*—(Joining the Tai-a-taesly.) Lignite of good quality, at least four feet thick, base concealed by water.

*Nasse-Skeena District.*—The Skeena River is said to pass through an extensive coal formation, with coal beds, three to thirty-five feet thick, according to Major Downie. (This may, however, be lignite.)

## IRON.

*Texada Island.*—Magnetite, described above.

*Island near the Walker Group, Schooner Passage, Queen Charlotte Sound.* Exceptionally rich, 71·57 per cent. iron.

*Country between Jordan River and Leech River, V. I.*—Have seen a specimen of magnetite with grains of epidote, from here,

*Yale and Cariboo Waggon Road.*—Ravine half-a-mile below Nicommen. Magnetite vein said to be eight feet thick.

*Knight's Inlet.*—One mile up river, at head of inlet; 1,200 up mountain, on left bank.

*Near Seymour Narrows.*—Six miles west from Menzies Bay, V. I.; iron ore reported.

*Entrance of River's Inlet.*—West side of Fitz Hugh Sound; iron ore reported.

*Bay S.E. of Cape Commerell, V. I.*—Iron ore reported.

*Iron Mountain, Coldwater River.*—Specular iron ore, only known in comparatively thin seams.

*Cherry Bluff, Kamploop's Lake*—Magnetite, in large, but irregular veins. See Report for 1877-78

*Baynes' Sound, Comox, V.I.*—Clay ironstone in considerable quantity in connection with the coal. Two specimens, assayed by Mr. Hoffman, gave 36·83 and 29·78 per cent. respectively of metallic iron.

*Cowgitz, Queen Charlotte Islands.*—Clay ironstone in association with the coal-bearing rocks, according to Mr. Richardson.

SILVER.

*Silver Peak, near Hope.*—Eureka and Victoria, or Van Bremer Mines; veins probably cut Cretaceous or Jurassic rocks, and have been proved rich. Described above.

*Other Localities, near Hope.*—In at least two other localities, deposits containing silver, in greater or less quantity, are known. Country rock probably granite.

*Cherry Creek.*—Rich silver ore, not yet fully prospected, or proved to exist in veins of paying width or regularity.

*Vital Creek, Omineca.*—Rolled, or more or less angular fragments of silver amalgam found in considerable abundance in working placers. Specimen analysed contained 83·30 per cent silver.

*Similkameen River.*—Near junction of North and South Forks. Small quantities of native silver found in gold placers.

*Similkameen River.*—Where just south of, but running parallel with 49th parallel; cuts rocks containing numerous small strings of galena "readily yielding a bead of silver."

*Mission Creek.*—Joins Okanagan Lake from the east; native silver found occasionally with gold.

*River Francis.*—Above its confluence with the Dease, Cassiar; argentiferous galena. A large sample of the ore was sent for assay, but I have not heard with what result.

*Quartz Creek, Cassiar.*—A vein, which has given assays over $200 per ton, exists here.

COPPER.

*Locality between Jervis Inlet and Howe's Sound.*—Purple copper ore (bornite,) and copper pyrites, with mica and quartz. Large and rich masses brought out as specimens. Matrix granite.

*Knight's Inlet.*—Ore similar to the last; very rich in hand specimens, but I believe not yet found in quantity.

*Entrance to Howe's Sound.*—(Three miles north of Atkinson Point Lighthouse.) Copper pyrites; a considerable amount of prospecting work done at one time, but now abandoned.

*Sansome Narrows.*—Copper pyrites. Some work done, but now abandoned. Deposit probably follows cleavage planes.

*Coast two miles east of entrance of Sooke Harbour.*—Shaft sunk 120 feet, at an expense of $80,000; now abandoned. Ore appears to be chiefly iron pyrites. Scales of native copper found in joints of the trap-rocks.

*South-west side Dean Canal.*—Specimens of vein-stone, with yellow and purple copper, were collected by Mr. Horetzky.

*Head of Kitemat Inlet.*—Small deposit of galena, and yellow sulphuret of copper, observed by Mr. Richardson.

*Thompson River, six miles below Spence's Bridge.*—Mr. Murray has given me a small angular fragment of rich purple ore, found loose, from this place.

*Thompson River, nine miles below Spence's Bridge.*—A rough fragment of native copper, weighing several ounces, found here.

*Fraser River, about thirty miles above Fort George.*—Nugget of native copper, weighing several pounds, found loose.

*Bates'*, or 150 *mile House, Waggon Road.*—Nugget of native copper, weighing about fifteen pounds, found near here.

*Fraser River, ten miles below Lillooet.*—Small lumps of native copper in gold placers.

*Quesnel River, near the Forks.*—More than half a ton of native copper found during gold washing, sent down from here a few years ago.

*Copper Island, Shuswap Lake.*—Bed of talcose or nacreous schist impregnated with copper pyrites. See report for 1877-78.

*Copper Creek, Kamloops Lake.*—Viens with purple copper ore; also reported that the Indians, in former days, obtained native copper in this vicinity.

*Moresby Island, Queen Charlotte Islands.*—Copper found, and some money spent in prospecting; now abandoned.

*Small Island off Port Frederick, Queen Charlotte Islands.*—Copper ore reported by Captain Stuart, H. B. Co.

*Homathco River.*—Many specimens of vein stones containing copper pyrites and some purple ore, were brought from this river. Not explored.

Traces, and small veins discoloured with copper ore, found in many localities in rocks of very different ages.

### OTHER MINERALS.

*Platinum.*—Found in scales in association with gold on the Similkameen River.

*Platinum.*—In fine scales, with gold on the Tranquille River, Kamloops Lake.

*Platinum.*—On the Fraser River, ten miles below Lillooet, very fine scales of platinum found with gold.

*Antimony and Arsenic.*—(Arsenical pyrites?) Specimens brought by Indians to Captain Stuart, probably from Kummeshaw, Queen Charlotte Islands.

*Antimony.* — (Stibnite.) — Little Shuswap Lake. See report for 1877-78.

*Iron Pyrites.*—Specimen of massive pyrites, said to exist in large quantity brought from Copper Island, Barclay Sound.

*Plumbago.*—Specimen of Plumbago obtained by the Vancouver Island exploring expedition in the country north-east of Port San Juan.

*Nickel.*—Nickeliferous sand obtained in gold-washing on the Fraser River, consists of magnetite, and pyritous grains attracted by the magnet, which consist of oxides of iron and nickel. (J. Blake, M.D., Proc. Cal. Acad. Sci., V. p. 200.)

*Molybdenite.*—Specimen brought from the upper part of the Cowitchen River by Mr. W. Robertson.

*Molybdenite.*—In association with copper ore at locality between Jarvis Inlet and Howe's Sound.

*Cinnabar.*—Specimen obtained by Mr. Tiedemann on the Homathco River.

*Cinnabar.*—Grains obtained in gold-washing near Boston Bar.

*Cinnabar and Native Mercury.*—A loose fragment of very rich ore, found nearly opposite Clinton, on the west side of the Fraser.

*Lead.*—A large vein of galena reported on Scotch Creek, about twelve miles from Shuswap Lake.

*Lead.*—Galena specimens collected by Mr. Tiedemann on the Lower Chilcotin.

Also occurs in connection with gold and silver in veins in Cariboo, Omineca, Cassiar, &c., with silver at Cherry Creek, and in small quantities in many other localities.

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