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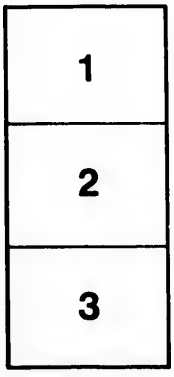

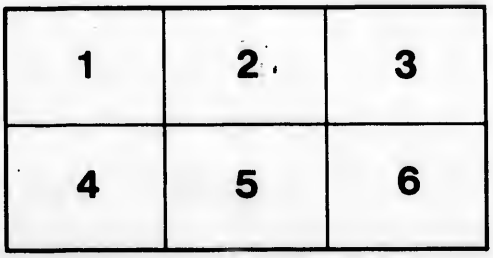

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GEOLOGICAL SURVEY OF CANADA.
ALFRED R. C. SELWYN, F.R.S., F.G.S., DIRECTOR.

REPORT

ON

GEOLOGICAL EXPLORATIONS

IN

BRITISH COLUMBIA.

BY

MR. JAMES RICHARDSON;

ADDRESSED TO

A. R. C. SELWYN, F.R.S., F.G.S.

DIRECTOR OF THE GEOLOGICAL SURVEY.

Extracted from the Report of Progress for 1873-74.

DAWSON BROS.: MONTREAL
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CONTENTS.

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BY

Mr. JAMES RICHARDSON;

ADDRESSED TO

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

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

Sir,—Early in May last I received your instructions to again proceed to British Columbia, for the purpose of continuing and extending the geological explorations which were made there during the two preceding seasons of the coal deposits and other formations on Vancouver Island, as well as on several of the neighbouring smaller islands in the Strait of Georgia. Instructions.

In carrying out these instructions I left Montreal on the 27th of May, and reached San Francisco on the 3rd of June. I there embarked on board the mail steamer Prince Alfred, which left on the 5th, and reached Victoria on the 11th of June. Leave Montreal.

Having hired men, purchased provisions, and made a few necessary additions to the equipment and camping material which were left at Victoria last fall, we embarked on the 17th of June on board the Dominion steamer Sir James Douglas, commanded by Captain Clarke, and arrived on the morning of the 19th at Deep Bay, about 120 miles from Victoria. Leave Victoria.

I may here again express my obligations to Captain Clarke, not only for his courtesy and attention while on board, but also for his many subsequent acts of kindness, especially in landing and embarking me, occasionally under considerable difficulty, on different parts of the shores of Vancouver and of other islands in the straits, and for his great care in transmitting packages to and from Victoria. Acknowledgment of assistance.

Immediately on our arrival at Deep Bay, field work was commenced. A few measurements were made through the woods; but on account of the heavily timbered character of the country and the uniformly thick covering of drift, the beds of streams, which had cut through this drift and exposed the underlying coal rocks, were generally taken advantage of for this purpose. Measurements.

p. 94
(In 1873-4
R.R.)

Area examined.

With the exception of an excursion from Comox to the Union Coal Mine, and thence to the mountains south-east of Puntledge Lake, the work of the season on Vancouver Island was confined to a district extending from Nanaimo north-west, fifty-six miles, to Baynes Sound Coal Mine, and south-east, sixteen and a half miles, to Oyster Harbour. It was also extended to some of the islands in the Strait of Georgia, and to a few points on the main-land of British Columbia. Towards the end of October, the frequent rains rendered a continuance of field work unprofitable, and on the 30th of October I left Nanaimo by the Sir James Douglas and arrived next day at Victoria.

Return to Victoria.

Disposal of equipment.

My attention was then devoted to the repacking of specimens, and five boxes of fossils, minerals and rocks were forwarded to Montreal. The tents and sails were dried, and the camp equipment thoroughly cleaned and stored at the office of the Canada Pacific Railway, while the boat was given in charge of the Hudson's Bay Company, and placed under cover on their premises. The whole of these materials may be valued at about $400, and will be available for next season's exploration. I finally left Victoria on the 13th of November, and arrived in Montreal on the 26th of the same month.

GEOLOGICAL FEATURES.

These portions of the coal-bearing formation of Vancouver Island which were examined and reported on in 1871 and in 1872 were divided into two subordinate troughs; the north-western being described as the Comox, and the south-eastern as the Nanaimo coal-field. (Report of Progress, 1872, page 34.)

Area examined in 1872.

In the former the area examined in 1872 extended from Brown's River, a tributary of the Puntledge, on the north-west, to Sable River on the south-east, on which the Baynes Sound Coal Mine is situated, and it also includes Denman and Hornby Islands. Although measurements were made in 1872 along the coast from the River Sable to beyond the Qualicum River, none were then made inland; and it was therefore necessary to ascertain the extent of the coal-bearing rocks in that direction.

Measurements from the coast to the Beaufort Range.

With this object in view, four lines of measurement, of from five to six miles each, were made through the woods from the coast between Sable River and a point to the north-east somewhat beyond Deep Bay, and extending south-westerly to the Beaufort Range. Measurements were also made along the trail mentioned in the report above cited, page 52, as leading across the island to Alberni. These measurements were extended around and to some distance beyond Horne Lake, and others were made from Horne Lake to Mount Mark and down the Qualicum River, in all about twenty miles. The next traverse was made up the Little Qualicum

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River, which is nearly six miles south-east of the Qualicum River, and though locally known as Little Qualicum is really many times larger than the Qualicum. On account of the difficulty of penetrating the thick woods along its banks, and the only exposures of the rocks being in the bed of the stream, it was ascended by wading in the clear cold water, which is from one to four feet deep; and in this manner a point was reached estimated to be from six to seven miles south-west from its mouth. Traverse of the Little Qualicum River.

The mouth of the Little Qualicum as represented on the published charts is half a mile inland, and this error gradually increases, till at a little more than half a mile to the south-east, the shore line as laid down on the charts is more than a mile inland. Thence the error gradually diminishes to North West Bay, the shores of which are correctly represented.

Measurements were made along the coast from the Little Qualicum River to Englishman's River, a distance of about ten miles; and the examination of the coast was continued, without measurements, to North West Bay, where the south-eastern extremity of the Comox coal area is reached. From this point following around Nanoose Harbour and to Departure Bay, where the north-western boundary of the Nanaimo coal area comes upon the coast, the shores are occupied by crystalline rocks, all of which were examined in detail. Little Qualicum to Englishman's River.

In the neighbourhood of Nanaimo several measurements were made in addition to those of 1872; one being about eight miles in length, from Nanaimo Harbour to a point bearing S 11° W, on the Nanaimo River. The coal-bearing strata were likewise examined along the coast from Nanaimo south-eastward to Dodd Narrows, and thence to Boat Harbour, Chemanis Bay, and to and around Oyster Harbour, which, as already stated, is sixteen and a half miles south-east of Nanaimo, though the distance, following the coast, is probably more than double. Newcastle, Protection, Light House, Gabriola, Mudge and Flat Top, as well as several smaller unnamed islands within the Nanaimo coal area, were carefully examined. Besides these, others in the Strait of Georgia, composed mostly of crystalline rocks, were also examined in considerable detail. The most north-westerly and the largest of these are Texada and Lasqueti. Between these, in the Sabine Channel, a number of small islands were examined, as well as the Sisters to the west of Lasqueti, and Jenkins, Sea Egg, and Sangester to the south of it. The small islands in the Ballinac Channel, known as the Ballinacs, Mistaken, Gerald, Douglas, the Yeo, and Winchelsea groups, Southey and Maude, were also visited and examined. Islands examined.

To the south-east of Nanaimo the coal-bearing strata are much more contorted and folded than they are either at Nanaimo or in the Comox coal-field; and before the structure of this part of the Nanaimo field can be correctly described, further and more extended examinations are

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Further examination required.

required; and you have accordingly thought it desirable that before attempting to do so I should employ another season in the investigation. This it is hoped will be sufficient for the purpose, and in the mean time, while the details of the structure will be deferred for a future report, the minerals of economic value and the fossils which were met with during the past season will be now described.

Collection of fossils.

Considerable time and attention was devoted during the season to the collection of fossils with a view of aiding as much as possible in the identification of the different groups of strata within the area. Collections were made at the following localities from beds belonging to the productive coal measures, Division A of the Report of 1872 :—

1. In North West Bay, about ninety specimens of plants and animals.
2. In a shallow bay immediately north-west of the latter, a small collection.
3. From the east side of Newcastle Island, a small collection of fossil leaves.
4. From the west side of Protection Island, a larger similar collection.
5. From the east side of Protection Island, fossil shells.

Collections were also made as follows from beds which are supposed to represent the Lower Shales, Division B of last year's report :—

1. From about two miles and a-half up the Nanaimo River.
2. From the coast a short distance to the north-east of Dodd Narrows.

A few specimens were procured from the productive coal measures at Nanaimo, and also at about ten miles up the Nanaimo River.

From the rocks which in the report of last year were described under the head of Crystalline Rocks, fossils were collected this season at the following places :—

1. The shores of Horne Lake.

Fossils in crystalline rocks.

2. From the coast near Schooner Bay, between North West Bay and Nanoose Harbour. The fossils, which are poorly preserved, were found here in light grey limestone and in bands of black slate, interstratified with the limestone, and both associated with black hornblendic rock with epidote in small strings. The limestone occurs in beds of from three to

Limestone with tremolite.

five feet thick, which are largely intermixed with masses of beautifully crystalline tremolite, of a yellowish-white colour, and occasionally shewing specks of graphite. These rocks strike with the coast and dip inland at high angles.

The Ballinac Islands.

3. From the Ballinac Islands. These islands, two in number, were carefully examined, and a tolerably good collection of fossils was secured. As the relation of the fossiliferous beds to the other rocks with which they are associated is of considerable interest, I have selected the following section which is exposed on the larger island at the southern extremity of its eastern shore, and in which these sections are well exhibited. The

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rocks have been laid bare by the action of the sea, and there is a continuous exposure of every part of the section for from 50 to 60 yards in length on the strike of the beds; the dip being S. 58°, W. < 58°. The section is given in descending order.

Section on one of the Ballinac Islands.

	Ft.	In.
Epidotic rock, the bedding not well defined	15	0
Pinkish-red bed. This bed is regular and its contact with the overlying bed is well defined	0	6
Epidotic rock, regular and well defined throughout	0	9
Pinkish-red rock passing into epidotic rock, the former from three to four inches, and the latter from 22 to 23 inches thick, the whole very regular	2	2
Epidotic rock, regular throughout	1	8
Green fine-grained diorite passing into epidotic rock; one to two inches of the former and nine to ten inches of the latter	1	0
Red limestone with obscure encrinite stems	0	6
Epidotic rock, very uniform and regular in character throughout	2	3
Reddish very pure limestone in beds of from two to eighteen inches thick, holding well defined fossils stems of encrinites, corals, and brachiopods	50	0

Immediately below the rocks in the above section there is a thickness estimated at from 150 to 200 feet of grey limestone, in some parts interstratified with fine-grained black slate, which seems occasionally to pass into a dark fine-grained dioritic rock. In the limestones numerous silicified fossils are met with, and a single specimen of a portion of a large *Gyroceras* was found in the black slate. Silicified fossils.

These fossils, which are not well preserved, have been examined by Mr. Billings, who has supplied me with the following note on them:—

"1. Fragments of a small coral, apparently a *Zaphrentis*.

2. Fragments of a large *Spirifer*.

3. The impression of one side of a *Gyroceras*. This specimen was from the black slates.

The age of the rocks is either Carboniferous or Permian; most probably the former." Age of the rocks.

ECONOMIC MATERIALS.

Coal.—Beds of coal not previously noticed were observed during the season at the following localities, given as they occur from north-west to south-east:—

1. In the Comox area, on a small brook about one and a-quarter miles south from Fanny Bay. This seam is only three inches thick.

2. On the Nanaimo River, at a point about 8 miles S., 15° W. from Nanaimo Harbour. This is the only workable seam seen during the season. It is from three feet six inches to four feet thick, of good clean coal, and rests on a bed of black carbonaceous shale with impressions of plants. Above it is an exposed thickness of ten feet of brown and grey

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sandstone, in beds of from six inches to three feet in thickness; the dip of the beds is N. 71° E.

Protection Island. 3. On the north-west end of Protection Island there is a small seam of good clean coal of from one to three inches thick.

4. On the same island, the middle a of touhe south-west side, a seam of similar quality and from three to four inches thick was observed.

Oyster Harbour 5. About half-way up Oyster Harbour, on the north-east shore, a seam of not more than half an inch thick is exposed.

In July last Mr. John Jessop, superintendent of schools in British Columbia, sent me a sample of coal from the mainland, accompanied by a note in which he states that the sample was taken from a seam recently discovered in the Chilliwack district about one mile from the Chilliwack

Chilliwack River. River, and less than five miles from the Fraser; but that the seam had not been sufficiently examined to ascertain its thickness or extent. The sample has been examined by Dr. Harrington with the following results:—

"A clean, bright, bituminous coal. By rapid coking it gave,

Analyis by Dr. Harrington.

Volatile matter . . .	35.73
Fixed carbon . . .	63.86
Ash	0.41

"It coked, but the coke was non-coherent and brittle. The remarkably small amount of ash which it contained was of a dark red colour."

Iron ore, Texada sland. *Iron Ore.* On the south side of Texada Island, about three miles north west from Gillies Bay, and, about seventy paces from the shore, a small exposure of magnetic iron ore was met with, associated with a coarse-grained epidotic rock, and grey diorite. Immediately north of this exposure the ground rises steeply to about 450 feet above the sea. Here on the eastern and south-eastern slopes of the hill, for 150 feet down, and extending from 200 to 250 feet in length, is an exposure of rich magnetic iron ore. On the out-crops facing to the north-west the ore-bed, which dips from S. 58° E. to E. <25°—30°, is seen to be from twenty to

Crystalline limestone. 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 one inch in thickness. The hill still rises to the north and north-east, but along the flank, and at about the same elevation, in a north-westerly direction for nearly a mile, the ore is occasionally seen, and in one place there is a continuous exposure of it for about 250 feet, the bed

Epidotic and dioritic rocks. apparently varying in thickness from one foot to ten feet. In the concealed intervals its course appears to be indicated by a coarsely crystalline epidotic rock carrying ore in places, but with the grey limestones apparently overlying it to the north-east, and the grey and green dioritic rock beneath it to the south-west. Where the ore-bed is exposed in this part of the hill a similar arrangement of the beds is observed, and what

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here appears to be the base of the limestone exhibits interstratifications of ore similar to those described at its summit in the first exposure. An overturn dip is probably the cause of the apparent differences in the arrangement of the beds. In a north-easterly direction from the first noticed exposure for a quarter of a mile no ore is seen, after which it is again found, at first in irregular patches mixed with epidotic rocks, and then, its course becoming more northerly, for more than half a mile the bed presents an irregular surface exposure of from 600-900 feet of nearly pure ore. In this part the dip could not be ascertained with certainty, and I am therefore unable to estimate the thickness of the ore. Loose pieces of limestone with interstratified ore-bands were found on the west side, while to the east the ore is bounded by grey and green dioritic rocks. Thickness of the ore-bed.

Circumstances did not admit of my remaining on the island long enough to trace the continuation of this valuable deposit of iron ore. Mr. Henry Trim, of Howe's Sound, however, who has explored the island, informed me that the ore is to be seen occasionally in considerable exposures to near the north-east coast of the island, a further distance of more than three miles.

These iron ores could scarcely be more favourably situated than they are, either as regards mining, smelting or shipment. There is deep water close to the shore, and wharves might be easily and cheaply constructed, at which vessels could always load in safety, except during the heavy south-east winds which occur occasionally from the middle of September to the end of March. But during these, Gillies Bay, only three miles distant, would afford a safe and convenient harbour of refuge. There is also another harbour at the north end of the island about seven miles distant which would afford shelter in all weather. The site of the ore is eighteen miles from Comox Harbour, twenty-one miles from Deep Bay, and about twenty-three miles from Fanny Bay. These are all good and safe harbours, and are only a short distance from the productive coal-seams of the Comox area. In the event of charcoal being required for smelting the ore, abundance of wood suitable for making it can be procured on the island. Safe Harbour Charcoal.

Iron ore is reported to occur also in the following localities:

1. Fifty yards from the Yale and Cariboo waggon road, up a ravine half a mile below Nicoameen in the Lytton district. A sample of this ore was given me by J. W. McKay, Esq., Chief Factor in the Hudson's Bay Company's service at Victoria. It is a magnetic ore, and is stated to occur in a vein eight feet in thickness.

2. About one mile up the river at the head of Knight's Inlet, on the left bank, and about 1,200 feet up the mountain. A specimen of this ore,

and the foregoing particulars, were given me by Mr. Alexander Donaldson, of Victoria.

3. Six miles west from Menzie's Bay, Vancouver Island, near Seymour Narrows. I did not learn the extent of this deposit, but it is said to be considerable, and is close to some of the coal seams of the Comox area.

4. On the west side of Fitz Hugh Sound, at the entrance to River's Inlet.

5. Iron ore is said to occur on the shores of a bay to the south-east of Cape Commerell, at the north-west end of Vancouver Island.

Limestone.—The cliffs of limestone which form part of Mount Mark above Horne Lake are mentioned in the Report of Progress for 1872–73.

Limestone. It is there stated, page 53, that "reaching the west side of Horne Lake, and looking northward to Mount Mark, a drift-covered surface rises between 300 and 400 feet above the lake in the distance of about a quarter of a mile, and from this starts up a wall of limestone with an almost perpendicular face, presenting a thickness of probably 1200 feet, which is again capped by a great mass of brown-weathering diorite." A great variety of excellent ornamental marbles, suitable for almost all purposes, could be procured from these limestones. They are all more or less crystalline, and of white, whitish, dove-grey and bluish colours, but none of the beds, so far as observed, are sufficiently white and fine-grained to afford statuary marble. As a material for building purposes it could not be surpassed as regards durability and the size of the blocks which could be obtained. Some of the beds present faces of from 30 to 50 feet in breadth, without, so far as could be seen, a single flaw or crack. The

Water-power. Qualicum River, which discharges Horne Lake, would afford any amount of water-power—except, perhaps, in unusually dry seasons, during a part of the months of August and September—for driving all the machinery required for cutting, dressing and polishing the marble. The limestone cliffs are from a mile and a-half to three miles from the outlet of the lake, twelve chains below which is the first fall, of about 30 feet. In the next five chains the river falls about 40 feet, and nine chains further down there is a fall of 25 to 30 feet in a length of about one chain. The next and last fall of any importance is 43 chains still lower down. Here the stream is divided into three branches and falls about 100 feet. In the centre channel the lower 60 feet is an unbroken perpendicular fall, away in a deep recess or *canon*, between walls only a few feet apart, of dark, nearly black, dioritic rock.

The constant and regular supply of water in this stream, together with the natural reservoir at its head, and the facilities for utilizing it at so many different levels, afforded by a fall of about 200 feet in a mile, are features which render it pre-eminently valuable as a water-power. The last fall is a little more than four miles from the coast, at the mouth of the

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river, but the shallowness of the water and the exposed position render it an indifferent harbour. Deep Bay, however, further west, although small, is one of the best harbours on the coast, and is only eight miles north-west from the lower falls. Deep Bay.

At the north-west end of Texada Island limestones are well exposed on the coast from one mile south of Point Marshall, around the north-west end, and thence along the north-east shore for about four miles south-east, or altogether for a distance of about seven miles. These limestones are similar to those of Mount Mark, being of white, whitish dove-grey, and bluish colours. Some of the white variety is, however, finer grained, and in this respect, as well as in colour, more nearly approaches in character to fine statuary marble, but the beds are here traversed by numerous joints running in different and irregular directions, so that it would seldom be possible to obtain sound blocks of large dimensions, though there are a few places where blocks might be obtained sufficiently large for ordinary building purposes.

Timber, etc.—On the Donaldson River, which rises in the Beaufort Mountains and falls into the Gulf of Georgia about three miles west to Deep Bay, white pine, *P. strobus*, is more abundant at 800–1,400 feet above the sea than it is at lower levels. The soil on and near the Donaldson River at the above elevation is of a mixed clayey and sandy character, and here white pine is very abundant and of large size. The following are the dimensions of one tree of average size which was measured as it lay on the ground. Diameter, three feet from the root, two feet, and at 105 feet, eighteen inches. Total length 175 feet—105 feet without a branch. Many of the trees are considerably larger, and more than 200 feet in height. White pine timber is worth nearly double the value of Douglas pine, *Abies Douglassii*, on account of its superiority for finishing purposes, and it may be useful to persons seeking for it to know that it will probably be found in greater abundance and of better quality at the above elevation than at lower levels. Timber.

With regard to the agricultural capabilities of the country examined, I have nothing to add to the information given in the reports of 1871-72 and 1872-73. On all of the islands explored during the season the rocky character of the surface renders them wholly unfit for cultivation.

I have the honour to be, Sir,

Your obedient servant,

JAMES RICHARDSON.

GEOLOGICAL SURVEY OFFICE,
Montreal, May 1st, 1874.

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