GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA
ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., DIRECTOR.

REPORT

ON A GEOLOGIAL EXAMINATION OF THE

NORTHERN PART OF

VANCOUVER ISLAND

AND ADJACENT COASTS.

BY

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

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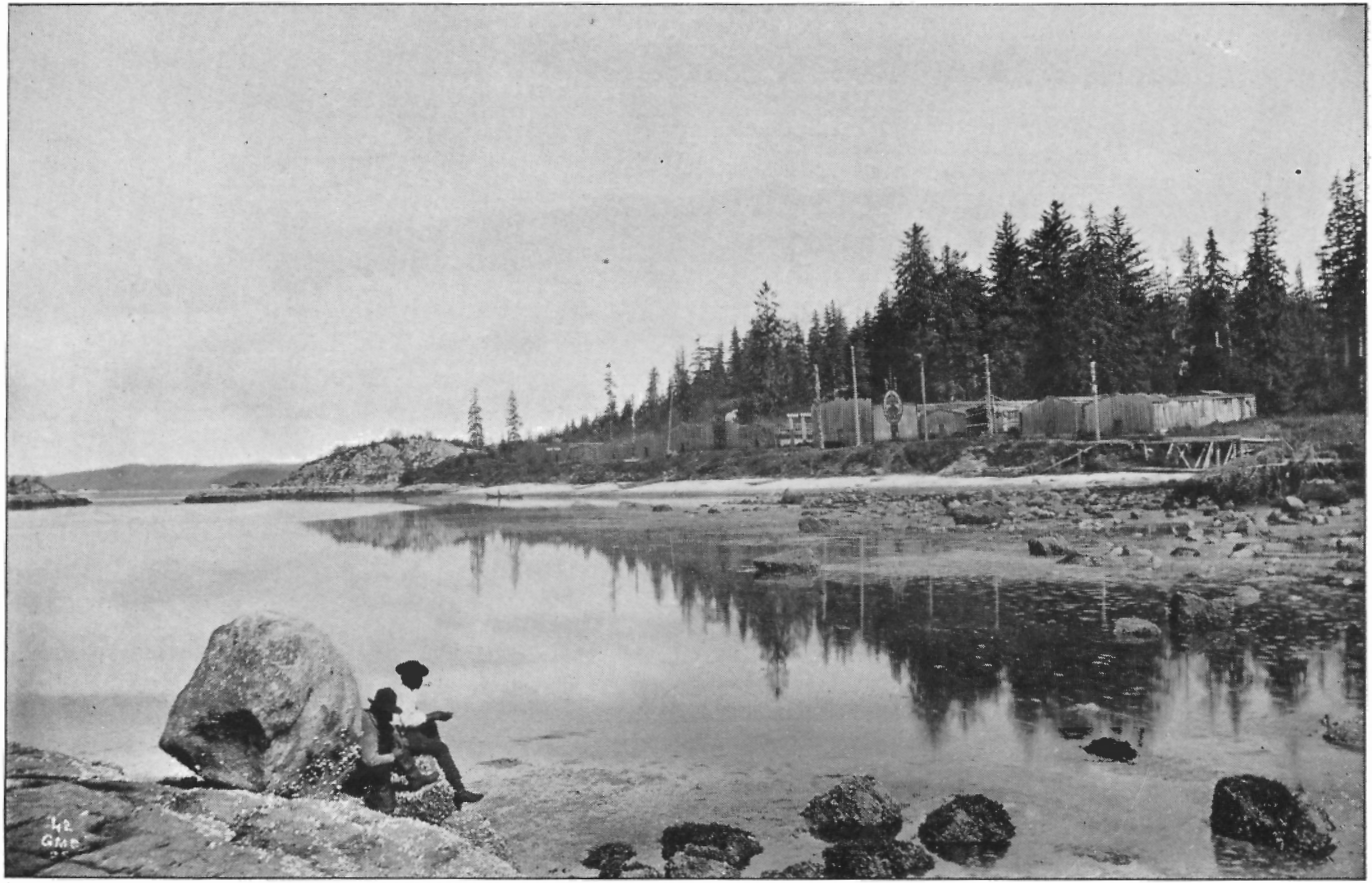

G. M. DAWSON, PHOTO., 10 SEPT., 1885. IVES-PROCESS; G. E. DESBARATS & SON, MONTREAL.

MĀMĒLILIAKA VILLAGE, VILLAGE ISLAND,

NEAR ENTRANCE TO KNIGHT'S INLET, BRITISH COLUMBIA.

To Alfred R. C. Selwyn, C.M.G., LL.D., F.R.S.

Director of the Geological and Natural History Survey of Canada.

Sir,—I have the honor to present herewith a report on the northern part of Vancouver Island, from Comox to Quatsino Sound, with the coasts of adjacent islands and portions of the mainland. This report embodies the results of work done in 1885, together with that of some examinations carried out in 1878, which were at the time regarded as incomplete. This report is of a preliminary character, the explorations to which it relates having been for the most part confined to the shores, and directed specially toward ascertaining the character and extent of the areas of Cretaceous coal-bearing rocks.

I have the honour to be, sir,

Your obedient servant,

GEORGE M. DAWSON.

Ottawa, March 1, 1887.

NOTE.—The bearings throughout this report are given with reference to the true meridian, unless otherwise specially noted.

Distances are stated in nautical miles, as measured on the Admiralty charts.

The native names of places which are divided into syllables, have been correctly ascertained, and in these the vowels are uniformily employed with their 'continental' values. The pronunciation of other Indian names has either not been accurately ascertained, or their orthography has already become so fixed in previous publications, as to render it inadvisable to change them.

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Nature of Report and map.

The field-work upon which the present report is based, occupied the greater part of the season of 1885, the party leaving Victoria on the 21st of June, and returning to the same point on the 22nd of October. It was intended to continue the exploration in the following summer, and to supplement the information gained by an examination of the shores, in 1885, by a number of selected traverses into the interior of Vancouver Island, but this having proved impossible, the report on the work of 1885 is here presented, together with a first edition of a geological map of the northern portion of Vancouver Island, which it is to be hoped may ere long be republished in a more complete form. In the following synopsis of results, special prominence is given to the facts bearing on the Cretaceous coal-bearing rocks of the region.

A short preliminary account of the work of 1885 has already been given in the Summary Report for that year, forming Part III. of the Report of the Department of the Interior, and reprinted in the first part of the Annual Report of the Geological Survey for 1885 (p. 39 A, *et seq*).

Previous geological work on the coast.

The portion of the seaboard of British Columbia, heretofore geologically investigated, has been comparatively limited. The late Mr. James Richardson cursorily examined a number of points, and has furnished valuable notes on these in his various reports, but his detailed work on the coast was practically confined to the coal-bearing Cretaceous areas of the south-eastern part of Vancouver Island, including, more particularly, those of Nanaimo and Comox. His final report on

the Nanaimo and Comox regions, with other less important areas of coal- or lignite-bearing rocks, is published, with a geological map on a scale of four miles to an inch, in the Report of Progress for 1876–77. In 1878, the writer explored and surveyed the greater part of the coast-line of the Queen Charlotte Islands, details respecting which are given in the Report of Progress for 1878–79. In the same year, some reconnaisance work was effected in the northern part of Vancouver Island, including parts of Quatsino Sound, but this was not judged to be sufficiently complete for publication. The increasing interest in the resources of the province of British Columbia, and the fact that efforts were actually in progress to develop coal-fields north of those of Comox, rendered it desirable to ascertain more precisely the extent and probable value of these northern coal-fields, and the work undertaken in 1885 was, in consequence, largely devoted to this end.

Mode of prosecuting work.

A small schooner was chartered in Victoria to serve as a means of locomotion and basis for operations, and surveys were conducted along the shores, generally by means of boats and canoes. The best and most instructive sections occur along the coast-line, and attention was consequently restricted chiefly to these, though some bush traverses were also made for the purpose of ascertaining the width of the areas of Cretaceous coal-bearing rocks met with. It was endeavoured to make the examination of such parts of the coast as were gone over, so complete as to obviate the necessity of its revision, but where extended inland work appeared necessary to complete the geological outlines, it was thought better to postpone this till all the information possible had been gained by examinations of the coast sections. While therefore, the result of the work of the season must be regarded as strictly preliminary, in so far as the country in general is concerned, the outlines of formations on the coast are proximately exact. With the information now gained, the work of another season would, it is believed, suffice to complete the delineation of the Cretaceous rocks of the northern part of Vancouver Island and its vicinity, much of the information gained in 1885 possessing a negative value, in showing in which parts of the region the Cretaceous rocks need not be looked for.

General results.

The geological result of the season's work may therefore be described in general terms as an examination of the shores of Queen Charlotte Sound (exclusive of those of the long inlets which penetrate the mainland), of those of the northern extremity of Vancouver and adjacent islands, and of Quatsino Sound, together with all the main shore of the Strait of Georgia which had not previously been geologically mapped by Mr. Richardson, with the exception of a stretch of about forty-two miles, between Jarvis and Burrard inlets. With this exception, and that of the upper portions of the long inlets, the shores of the waters sepa-

rating Vancouver Island from the mainland, have now been examined geologically, the length of coast-line gone over in 1885 being, exclusive of minor indentations, about 958 miles.

A survey was also made of the shores of Nimpkish or Karmutzen Lake, in the interior of Vancouver Island, and much information of a general character as to possible routes and the nature of the country, was obtained, such as to render it possible to lay out future work for the completion of the survey of any given portion of the region.

Specimens collected.

The geological and other specimens collected have already been referred to in my preliminary report. The invertebrates obtained by dredging and otherwise, have since been worked up by Mr. J. F. Whiteaves, whose report on them is published in the Transactions of the Royal Society of Canada (Vol. IV., Sec. IV., p. 111), rendering it unnecessary to include a list of them in the present report. The total number of species enumerated by Mr. Whiteaves, is 185. Notes and descriptions also by Mr. Whiteaves, of the fossils collected, form Appendix I. to this report. A list of the plants, by Professor Macoun, forms Appendix II., the meteorological observations constituting Appendix III. A considerable amount of information was also incidentally obtained on the Kwakiool Indians of the northern part of Vancouver Island and its vicinity, but with the exception of a few remarks bearing on particular localities, and the Indian names of a number of places, given on the map, this is not included in the present report.

Appendices.

The existence of trustworthy charts of the shores examined, together with the published account of the coast in the Vancouver Pilot, render it unnecessary, in most cases, to describe its general features at length. Such short notes, as it has been deemed advisable to give, are therefore incorporated with those on the geological features of the same localities.

General Geology.

Geological resemblance of Vancouver and Queen Charlotte Islands.

The geological resemblance between the part of Vancouver Island which is here described, and the southern half of the Queen Charlotte Islands, is extremely close. This resemblance had previously been referred to by me in general terms, and was indeed to be expected, as the Queen Charlotte Islands and Vancouver Island form portions of a single axis of elevation, which here constitutes the western member of the Cordillera. The work now reported on has, however, shown that the similarity of the rock formations is so close as almost to amount to identity, and the general geological description given in my report on the Queen Charlotte Islands, of 1878–79, might be adopted, with little change, for the northern part of Vancouver Island. The greatest point of difference as between the two islands, is the consider-

able development of Tertiary rocks in the northern part of the Queen Charlotte group, while rocks of this age are, so far as known, very scantily represented on Vancouver Island, and scarcely seen in the northern half of the island which is now under review.

Great abundance of volcanic materials.

By far the greater part of the area of the northern portion of Vancouver Island is occupied by rocks of volcanic origin, which at first sight, and as judged by Eastern American analogies, might often be supposed to represent formations occupying a very low stage in the geological scale. These volcanic rocks, originally composed of minerals already crystalline, have since been subjected to metamorphism more or less intense, to which, in consequence of their composition, they have easily yielded, and now form, for the most part, rocks which might be spoken of as "traps" and "greenstones." These frequently show, locally, little or no evidence of their bedded character. Such rocks, however, when closely examined, and followed from point to point, are found to form portions of a stratified series of great thickness, which includes, besides the preponderant volcanic materials, certain argillites and limestones, holding Triassic fossils.

Their original character.

The greater part of this old volcanic series appears to have been built up of basaltic and trachytic lava flows, alternating with rough volcanic breccias and tuffs, largely composed of fragments derived from such flows. These rocks are now represented by hard amygdaloids and agglomerates of general dark greenish colours, though often greyish and sometimes purplish or reddish; by felsites, more or less porphyritic, and by hard, regularly stratified ash-beds, which, where the alteration has been most pronounced, are locally changed to hornblendic or micaceous schists.

Subsequent alterations.

A microscopical examination of a limited number of specimens of these volcanic rocks, selected as characteristic, shows that they may now be classed generally as diabases and felsites, with occasional examples of diorite. These have, however, been subjected to so much alteration subsequent to the first mineralogical changes, that the felspars are almost invariably much decomposed, and few of the other crystalline minerals are unaffected. It is to the development of various green minerals as alteration-products during this secondary change, that the characteristic tint of these altered volcanic rocks is largely due.

Lava flows.

It is worthy of remark, that in several somewhat widely separated localities, a few of which are specially noted in the sequel, the original 'ropy' structure, frequently found on the surface of modern lava beds, has been well preserved in these old volcanic rocks, notwithstanding their great alteration. This structure is, of course, now only clearly apparent where the surface of an old lava has been covered by

some ashy or calcareous material, which has subsequently been removed by weathering.

Irregular quartz masses.

The rather frequent occurrence of disconnected flattened or lenticular masses of crystalline quartz, or quartz and felspar, in massive green diabase rocks, giving them a blotched appearance, was at first a somewhat puzzling phenomenon. These are not of the character of segregations from the enclosing rock, but would seem to represent the position of former cavities and interspaces in breccias, or the brecciated surfaces of lava-flows which have become filled with zeolitic or chalcedonic materials, which have subsequently passed into their present state during the metamorphism of the formation.

Associated limestones and argillites.

In association with these volcanic rocks, limestones, argillites and quartzites occur, possibly at several different horizons, but one of these, which is of considerable thickness and great persistency, and possesses very distinctive characters, has now been recognized at a number of places, from the northern part of the Strait of Georgia round the north end of the island, and in Quatsino Sound. This intercalated zone is of considerable thickness, having been estimated at 2500 at one place on the north coast of the island, where it appeared to be fully displayed.* Massive limestones, which, when the strata are considerably altered, pass into marble, form its lower portion. The upper part of the limestone becomes interbedded with argillites in regular flaggy layers, and black, flaggy argillites, interbedded with quartzites, overlie these. Where the top of this argillite series is seen, it often holds tufaceous and fine agglomeritic beds, and is followed, in ascending order, by a great thickness of the altered volcanic rocks. In other localities, the limestone is found to become interbedded with volcanic materials beneath, and though no complete section of the entire series can be offered, it is quite clear, from observations made in a great number of places, that these sedimentary materials form an intercalation in the great volcanic series.

Evidence of age of these rocks.

The importance of this fact is apparent, when it is stated that the only means of fixing the age of the entire series is afforded by the fossils obtained from the limestone and argillite intercalation. These occur chiefly in the argillites and in passage beds between these and the more massive limestones, and are referable to the so-called Alpine Trias. No fossils, except these of this age, have yet been found in association with this sub-Cretaceous series in the northern part of Vancouver Island, while the Triassic forms have been recognized in numerous localities. The evidence on which these rocks are, there-

* A partial section of the same belt of rocks in Section Cove, Queen Charlotte Islands, showed a thickness of 1733 feet. Report of Progress Geol. Surv. Can., 1878-79, p. 55 B.

fore, coloured as Triassic on the map, is identical with that on which the reference of the precisely similar series of the Queen Charlotte Islands is based. It is quite possible, in both cases, that the lower portion of the series may include rocks of greater age than Triassic, and the association of Triassic and Carboniferous volcanic rocks in the southern part of the interior of British Columbia, lends a degree of probability to the conjecture that rocks of the Carboniferous period may form a portion of those here described. There is, however, no direct evidence of this, either in the northern part of Vancouver Island or in the Queen Charlotte Islands.

Rocks of southern Vancouver Island.

The rocks beneath those of Cretaceous age in the southern portion of Vancouver Island are likewise, in great part, altered volcanic materials, which are interbedded with limestones, and in some places with argillites. The conjecture that beds of Carboniferous age may occur together with those referable to the Trias, in the Queen Charlotte Islands and the northern part of Vancouver Island, is strengthened by the fact that the late Mr. J. Richardson obtained a few poorly preserved fossils from limestones interbedded with the altered volcanic rocks of the Ballinac Islands, between Nanaimo and Comox, and at Mount Mark, in the centre of Vancouver Island, between Qualicum and Alberni, which were supposed by Mr. Billings to be either Carboniferous or Permian, and probably the former.*

Rocks of interior of British Columbia.

Though an unconformity has been proved to exist in at least one place between the Triassic and Carboniferous volcanic rocks of the southern interior of the province,† no such break has yet been found in any part of the sub-Cretaceous series of Vancouver Island, and if rocks of both these periods actually occur there, they cannot at present be separated.

The series as a whole, indicates throughout a continuance or recurrence of volcanic phenomena on an enormous scale, and must be at least several thousand feet in thickness.

The Vancouver series.

As a convenient distinctive name for the whole, I shall employ the term *Vancouver Series*, including for the present under this name, not only the entire mass of volcanic materials which unconformably underlie the Cretaceous, but also the interbedded limestones and flaggy argillites and quartzites. This name may also be understood to include the similar beds of the Queen Charlotte Islands, as well as those of the southern part of Vancouver Island, to which it was originally applied by Dr. Selwyn in 1871. If this great mass of rocks should eventually prove separable into Triassic and Carboniferous portions, I would suggest the retention of the name Vancouver series for the former.

* Reports of Progress Geol. Surv. Can., 1872-73, p. 54, and 1873-74, p. 98.

† Report of Progress Geol. Surv. Can, 1877-78, p. 171 B.

Subjacent granites.

The beds of the Vancouver series are the oldest known to occur in the district here described and in the Queen Charlotte Islands, and are frequently found in contact with or resting upon granitic rocks. They have not, however, been deposited upon a granitic floor, as the granites are evidently later in date than the rocks of the Vancouver series, and nothing whatever is known of the character of the surface upon which its volcanic and other associated beds were originally formed.

Relation of granites to Vancouver series.

The relations of the granites to the rocks of the Vancouver series is peculiar, and appears at first sight to be of a very anomalous character. The position of the exposed areas of granite, so far as determined, is shown upon the map, and it may be added that the granites there indicated, with the exception of certain isolated patches, form merely the south-western border of the great granitic region of the Coast Ranges of the mainland, which, wherever examined by myself or by Mr. Richardson, has been found to be almost entirely composed of granites or granitic rocks. The circumstances attending the line of junction of the granites with the rocks of the Vancouver series have been carefully examined at a great number of points. The granites near this line are usually charged with innumerable darker fragments of the Vancouver series, which, when in the immediate vicinity of the parent rocks, are angular and clearly marked, but at a greater distance become rounded and blurred in outline, and might then be mistaken for concretionary masses in the granite, into the substance of which they have been in process of being absorbed. The width of the belt characterized by these fragments is very variable, and where the plane of the present surface cuts that of the junction of the two classes of rock at an acute angle—as is often the case—it is considerable, frequently exceeding half a mile. In other cases, the fragments are scattered out into the granite for a few hundred feet only. It was in several instances found impossible to draw a distinct line between the granites and the Vancouver rocks, except on the assumption that this line should run where the two materials are blended in nearly equal proportions. The edge of the Vancouver series is also, for some distance from the contact, very generally shattered and penetrated by granitic spurs, or by felsite dykes, which probably represent the granites in a fine-grained state.

Character of junction.

Included fragments.

Cause of peculiar relations observed.

If the granite merely formed limited intrusive masses in the Vancouver rocks, no difficulty would be found in accounting for the above facts, but the circumstance that it appears everywhere to be the material upon which these rocks rest, and that it is, nevertheless, evidently of later date than these rocks, appears to call for some special explanation. The only explanation which

appears satisfactorily to account for the appearances met with, is, that in consequence of upheaval and denudation we now have at the surface a plane which was at one time so deeply buried in the earth's crust that the rocks beneath it had become subject to granitic fusion or alteration. The present surface must, therefore, have been either covered to a very great depth by beds accumulated in regularly superposed layers, or the strata must have been heaped together by folding to such a depth that the lower parts of the whole were affected by such granitic fusion, which was gradually progressing upwards through the mass, incorporating the rocks of the Vancouver series as it went. It is clear that the granitic rocks beneath were in a plastic condition, not alone from the fact that they are found to penetrate the older series, but also from the evidence everywhere met with of the scattering out of fragments of the stratified rocks into the granites.

Upward progress of isothermal planes.

Heaping together of stratified rocks by folding.

It is further probable that it was rather by excessive folding together of the rocks than by the superposition of a great mass of horizontal deposits, that the thickness of the Vancouver series became so great as to bring its lower portions down below the plane of fusion. This is shown by the fact that in some places—notably in the vicinity of Blunden Harbour and Seymour Narrows—both the granites and the rocks of the Vancouver series have been subjected to great pressure in a horizontal direction, causing the fragments in the agglomerates to assume lenticular forms, and impressing a more or less distinctly schistose character upon them, while the dark included fragments in the granites have been squeezed out into sheets, giving the portions of these rocks which are characterized by an abundance of such fragments an almost gneissic lamination. At the time at which this effect was produced, the granites must still have been in a plastic state.

Much altered masses.

Isolated masses of the volcanic rocks which have been included in the granites, are occasionally found in a highly crystalline schistose state. In a few places within the granite area, distinctly gneissic rocks were noted. These may either be still more highly altered portions of the Vancouver series, or may be the result of a foliation superinduced in the granite itself. There is little or nothing to indicate that they represent remnants of any older distinctively gneissic formation.

Nature of granite.

As is fully stated in following pages, the granites are almost always hornblendic and generally grey in colour. They, however, in many places, hold so little quartz and so large a proportion of hornblende, that they become quite dark in colour and resemble diorites, with which indeed they may at times be classed. Though granitoid rocks, differing somewhat in composition, occasionally meet along pretty definite lines, they more frequently blend imperceptibly. It appears

highly probable that the locally character of the beds, passing into a state of granitic fusion, may account for such differences.*

Argillite zone

On the inner side of Vancouver Island, it may further be remarked that for a long stretch the flaggy argillites and quartzites are frequently directly in contact with the granitic rocks, rendering it probable that the refractory character of their materials has proved a sufficient barrier to the progress of the granitic change, which may, locally, have nearly reached its possible limit. On the same side of the island, in proximity to the granitic mass, the volcanic materials are much more highly altered than on the outer or west coast, where granitic rocks are rarely seen.

Bearing of facts on production of gneissic foliation elsewhere.

The relations here well exemplified by the contact of the Vancouver series with the subjacent, though newer, granites, precisely repeat those fully detailed by Mr. A. C. Lawson, in his report on the Huronian (Keewatin) and so-called Laurentian rocks of the Lake of the Woods. (Annual Report, Geological Survey of Canada, 1885, p. 61 cc, *et seq.*) I have myself described the subjacent granitoid gneisses of that particular region as Laurentian (Geology and Resources of the Forty-ninth parallel, 1875), but in view of the facts now brought to light there, and those here detailed, I am disposed to regard them as not properly referable to the Laurentian, but as foliated granites which have been produced by circumstances nearly identical with those which have affected the Vancouver series. In the Lake of the Woods region, such effects had ceased before the earliest Palæozoic sedi ments were laid down, while in the west, they occurred at some date between the close of the Triassic and the inauguration of the Cretaceous periods.

Cretaceous rocks.

The northward continuation of the Comox Cretaceous rocks, when fully worked out, will probably be found to correspond with the series already determined by Mr. Richardson in the southern part of the same field. Of the precise relationship of the presumably Cretaceous area on the north-east side of Malaspina Strait, in the absence of determinable fossils, nothing can at present be said. It is possible that these rocks may prove to be Tertiary, like those of Burrard Inlet.

Cretaceous of Vancouver and Queen Charlotte Islands.

In the northern part of Vancouver Island, the Cretaceous which still remains, appears to consist of outliers of a distinct and older basin, and may probably be regarded as having been originally continuous with that developed in the Queen Charlotte Islands. The Cretaceous rocks of Quatsino Sound, have so far afforded the best sections, and in these we appear to find represented the three higher members of the Cretaceous section of the Queen Charlotte Islands, as it exists in the vicin-

* Compare remarks by Dr. Selwyn on granites of Eastern Townships, Quebec. Report of Progress Geol. Sur. Can., 1880-82, p. 7A.

ity of Skidegate Inlet. Remarks as to the character and possible thickness of the beds of Quatsino, are given at length on a later page. In comparing these with the corresponding rocks of the Queen Charlotte Islands, it is probable that the thickness of the Quatsino beds is somewhat less, and that the conditions met with in the lower or coal-bearing portion of the series, are more distinctly littoral at Quatsino, sandstones and conglomeritic layers being relatively more important. The Cretaceous rocks which extend along the north-east shore of Vancouver Island, from Port McNeill to Beaver Harbor, may in part represent the lowest, or coal-bearing portion of the Quatsino section. A few fossil plants obtained from Beaver Harbour, are Middle Cretaceous, and possibly referable to a horizon near that of the lowest beds at Quatsino, but much larger collections since made at Port McNeill, which have not yet been worked up in detail, are regarded by Sir Wm. Dawson as distinctly newer than these, though possibly older than the Nanaimo and Comox Cretaceous floras. It is thus evident that we have not merely a single horizon to deal with along this part of the north-east coast. No trace of the lower subdivisions represented at Skidegate (D. and E.), has yet been found on Vancouver Island.

The relations of the Cretaceous rocks of the Queen Charlotte Islands and those of thenorthern part of Vancouver Island, as now understood, may be expressed as below, in tabular form:—

Table of Cretaceous series.

	QUEEN CHARLOTTE ISLANDS.	NORTHERN PART OF VANCOUVER ISLAND.
Upper Cretaceous	A. Upper shales and sandstones, 1500 feet.	A. { Port McNeill beds (?) / Upper shales.
Middle Cretaceous	B. Coarse conglomerates, 200 feet. C. Lower shales and sandstones, with coal, 5000 ft. D. Agglomerates, 3500 feet. E. Lower sandstones, 1000 feet?	B. { Coarse conglomerates. C. { Lower sandstones & shales, with coal. D. wanting. E. "

Character of deposits.

In the course of the examination of the Cretaceous rocks of the northern part on Vancouver Island, it has been found that these rest unconformably on a rough and irregular denudation-surface of the older rocks, and that they have filled pre-existing hollows and valleys in this surface during a prolonged period of more or less uniform progressive depression. Owing to this circumstance, the higher Cretaceous beds successively overlap the older rocks, and as the areas of these beds which have escaped subsequent denudation, are pro-

bably to a great extent those which have filled the deeper portions of the hollows, it follows that the actually outcropping edges of the beds rarely give a complete section of the entire thickness of the formation. Under such circumstances, the Cretaceous beds in contact with the older rocks can be expected to represent merely a succession of shore deposits, which may be very different from those of the central portions of the same basin, in which, other things being equal, there is a greater probability of finding thick and workable deposits of coal. It is thus of importance to keep this condition in view in any explorations which may be carried out in search of coal.

Tertiary.

Of distinctively Tertiary rocks, the only recognized occurrence within the area here described, is the small volcanic patch of Eel Reef, in Port McNeill.

Conditions of formation of rock-series.

The conditions of deposit and periods of disturbance and mountain formation indicated by the rocks of the northern part of Vancouver Island, and probably also by those of its southern portion, are very similar to those already outlined in a former report for the Queen Charlotte Islands. In the Triassic, and possibly also in the earlier Carboniferous period, enormous quantities of volcanic materials were ejected and accumulated along this part of the Pacific border, the inclusion in which of limestones and argillaceous deposits represent quiescent intervals, some of which must have been of long duration. This was closed or followed by a period of flexure and disturbance, which must have affected principally a line nearly coincident with that of the actual Coast Range of the adjacent mainland of British Columbia, during which the granitic rocks of that range and its vicinity were either locally produced or forced up into their present relations with the stratified series. More evidence of disturbance and of marked unconformity at this epoch, is found in Vancouver Island than was observed in the Queen Charlotte Islands. A prolonged period, resulting in very extensive denudation, must next have supervened, and either in consequence of this alone or as the result of the combined effect of denudation and depression, the mountains produced along the line of the Coast Range of the mainland, must have been broken through or greatly reduced, since the Middle Cretaceous beds occur not only on the coast, but to the east of the axis of the ranges now bordering it. A movement in the sense of depression progressed during the entire Cretaceous period, but Vancouver Island may have remained a land area during the earlier part of this period, as no representatives of the earlier beds of the Cretaceous have yet been found on it. These, in the Queen Charlotte Islands, again indicate great volcanic activity. Subsequent to the Cretaceous period a second era of folding and moun-

tain making occurred, which probably resulted in the re-elevation of the Coast Range, but acted even more violently along a line running through the western portions of Queen Charlotte and Vancouver Islands—a fact rendered evident by the crumpling and contortion of the Cretaceous strata in the vicinity of this line, while the same beds are relatively undisturbed both along the eastern shores of the Queen Charlotte Islands and the north-eastern coast of Vancouver Island. For the Tertiary period, the region here specially described gives no information, except such as is afforded by the denudation and planing down of the older deposits.

Glaciation

The main facts bearing on the glaciation of the region and on the character of its superficial deposits are given in a summarized form at the end of the present report.

Useful minerals.

Throughout the descriptive portion of the report, details are given respecting the minerals of economic importance; consisting chiefly of coal, iron-ore and copper, with marble, granite and other building stones. It is unnecessary separately to enumerate the various localities, as these are sufficiently indicated by the marginal notes.

Descriptive Geology.

Northern Part of the Strait of Georgia.

Cretaceous rocks of Nanaimo and Comox.

The Cretaceous coal-bearing rocks of Nanaimo and Comox, border the south-western shore of the Strait of Georgia, forming a belt of comparatively low rolling or hilly country, between the mountainous region of the interior of Vancouver Island and the coast. Though locally much disturbed and affected by folds and faults parallel to a general north-west and south-east direction, these Cretaceous rocks still preserve, to a great degree, their original relation to the wide depression now occupied by the Strait of Georgia, being largely of the character of littoral formations, such as conglomerates and sandstones, to which category, in a certain sense, the coals also may be added. Series of shaly strata, intercalated with these, and holding truly marine fossils, indicate periods of greater depression, but the fact remains that many of the beds were laid down, along a sea-margin nearly at the level of the present coast. There is thus every reason for the belief that the Cretaceous strata underlie a great part of the actual Strait of Georgia, a belief which is strengthened by Mr. Richardson's observations of certain small patches of these rocks on the shores of Texada and Lasqueti Islands, on the north-east side of the strait. It is probable, however, that the rocks maintain their coal-bearing character, with greater regularity, in a direction parallel to the present and former coast-line,

than they would be found to do, if it were possible to follow them far beneath the waters of the strait, where more exclusively marine conditions might be expected to obtain. The somewhat variable character of the Cretaceous from point to point, is shown by the fact that Mr. Richardson found it necessary to adopt a different series of subdivisions for the measures of the Nanaimo and Comox regions, though these occupy the same general strike, and only fail in being continuous by the existence of a few miles of coast near Nanoose Harbour, on which the older underlying rocks occur. Coal-bearing character.

From reports received, and also from the flat appearance of the southern extremity of Valdez Island, and of Cortez, Mary, Savary, Hernando and Harwood islands, it was supposed that the Cretaceous coal-bearing series might have an important development in the northern and north-eastern part of the Strait of Georgia, or on the shore of the mainland in the vicinity. To determine this point, and also to learn something of the north-westward continuation of the Cretaceous rocks of Comox district, and the character, and bearing on this question of the outlying Cretaceous patches, of Texada and Lasqueti islands, already referred to, a systematic examination of the coast was begun at Comox. This was carried northward to Seymour Narrows, eastward by Cortez and the Redonda Islands to Malaspina Inlet and Strait, and included the whole of the shores of Texada and Lasqueti Islands. The results of this examinaton will now be given in such detail as appears necessary, in the order just stated. Variability of section.

From Comox wharf, the shore, turning eastward, forms a remarkable headland at a distance of about four miles,* which is named Cape Lazo on the chart, or in Mr. Richardson's reports, Point Holmes.† Mr. Richardson's detailed examination of the coast extended for some miles to the north-west of Cape Lazo. The coast sections at Comox wharf, and to Cape Lazo, show only boulder-clay and other drift deposits, and these, forming scarped bluffs, constitute conspicuous landmarks. From Cape Lazo north-westward, the coast was carefully examined, but for about eighteen miles, not a single exposure of solid rock was found; low bluffs of the drift deposits only diversifying the otherwise wooded banks which rise above high-tide mark. The shore itself is low and sandy, or gravelly, with wide flats bare at low-tide, and is strewn with numerous and large boulders. The first rock in place was seen at the distance above stated from Cape Lazo, in the middle of a wide shallow sinuosity of the coast known as Oyster Bay. Exposures here North-east border of basin. Comox to Oyster Bay.

* Nautical miles, measured on the Admiralty charts, are used in expressing distances throughout this report.

† The first-mentioned name undoubtedly has the priority. It occurs on Elsa's map (1791) as Pta. de Lazo de la Vega, though on the map accompanying Grant's paper (Jour. Royal Geog. Soc. 1857) and on other maps, it is shown as Point Holmes.

Oyster Bay.

occur frequently, for about four miles, or to Willow Point, nearly opposite Cape Mudge, and extensive surfaces and reefs of rock are laid bare at low-tide. The rocks are Cretaceous sandstones, of yellowish- and greenish-grey colours, sometimes soft and becoming rather shaly, and often nodularly hardened by calcareous matter, pale in colour and very compact, but weathering to pitted surfaces. No conglomerates were seen, though occasional layers holding a few pebbles occur in the sandstones. At the place first mentioned, in the centre of Oyster Bay, the sandstones form a low rocky cliff above the beach, but they generally appear only between tide-marks. A short distance further northward, about a mile south of Shelter Point, which forms the northern point of Oyster Bay, the sandstones were observed to dip S. 31° W. $< 25°$,* but this dip is probably exceptionally high, as elsewhere the inclination does not exceed ten degrees, and is generally less than five degrees in amount. The beds lie in low, wide undulations, with no well-marked or persistent direction of strike, and the total thickness of strata shown along this part of the shore, must be quite inconsiderable.

North-western limit of basin on coast.

Some miles further to the north-west, nearly opposite the Yaculta village of the chart, (Tsa-kwa-loo'-in) is a low bluff, partly overgrown with grass, and bearing traces of having been formerly inhabited by the Indians. This, at first sight, appeared to be composed of conglomerate, but on examination proved to be merely drift or raised beach-gravel, cemented by calcareous matter. With this exception, the shore from the vicinity of Willow Point to Orange Point (a distance of over six miles) is low, and no rock exposures occur. At Orange Point, the old trappean rocks, which are known to underlie the Cretaceous unconformably, appear, consisting here of a massive looking, greyish-green diabase with epidotic veins, in which no stratification was clearly observable.

Extent of Comox basin.

The information afforded by the sections along the coast from Comox to Orange Point is, therefore, very meagre, but the exposures seen, together with the relatively low and uniform character of the country for several miles inland, leave it scarcely doubtful that the Cretaceous rocks here form a continuous belt, and confirm Mr. Richardson's conjecture that these rocks extend from Comox as far as Cape Mudge. Between the Comox River and the Campbell River (two miles south of Orange Point) the streams reaching the coast are very inconsiderable in size, the greater part of the region draining southward by the Comox (Courtenay) River. I was, however, informed that some miles up a small stream, which debouches about half a mile southward from Kuhushan Point of the chart, coal has been found. A coal

* This, with other bearings throughout the report, is given with reference to the astronomical meridian. The magnetic variation is here 23° 15′ East.

seam is also reported by Mr. Drabble about a day's journey up the Campbell River, while sandstones are seen in the banks of the river, from near its mouth, a long way up.

The Cretaceous rocks seen along the coast south of Orange Point rather resemble those of Mr. Richardson's lowest division, the "Productive measures," than those of the overlying "Lower shales," to one of which divisions they are probably referable.* Horizon.

Beyond Seymour Narrows, the coast of Vancouver Island makes a projection to the north-eastward, and from the occurrence of sandstone and coal on the Campbell River, together with the general strike of the Cretaceous rocks, I have little doubt that these continue inland in a north-westward direction, leaving the coast near Orange Point and running behind the promontory just alluded to, possibly as far as the Salmon River, about thirty-five miles distant. On this stream, Mr. King, who has prospected the region for timber, reports that at about four miles above the forks of the river, or nine miles from its mouth, sandstones appear, and characterize a considerable tract of country of a lumpy or hilly character. The same gentleman informed me that sandstone again appears not far up the course of a considerable stream which empties into Menzies Bay, near Seymour Narrows. Probable inland continuation.

To properly explore and map out the Cretaceous, coal-bearing rocks forming the north-western extension of those seen in the vicinity of Comox, it would be necessary to traverse all the larger streams, and though this is a work requiring some time and labour, on account of the generally thickly wooded and impassable nature of the country, it is one of importance, and should be undertaken, if possible, at an early date. In Mr. Richardson's opinion, the Comox coal-basin, though at present at a disadvantage owing to its somewhat greater distance from markets, is relatively more important than that of Nanaimo. The last section of the coal-bearing rocks examined by him to the north-westward, was that on Brown's River, nearly abreast of Cape Lazo. He there found the lower member of the Cretaceous series, designated by him the Productive Measures, to have a thickness of 739 feet, and to contain nine seams of coal, varying in thickness from six inches to seven feet. There is every reason to hope that the measures may continue equally rich in coal in their extension to the north-westward. If this should prove to be the case, even as far only as the Campbell River, a length of twenty-five miles will be added to the known portion of the Comox coal-basin, and this without taking into consideration the probable extension inland toward the Salmon River, above referred to. It is, however, to be anticipated, that boring operations, Value of Comox coal-field.

* See Mr. Richardson's observations in Reports of Progress Geol. Surv., Can., 1872-73 and 1876-77.

Exploration by boring necessary.

on a somewhat extensive scale will be necessary, before this north-western part of the basin is fully proved, as the covering of drift materials is almost everywhere deep.

Vancouver series on Discovery Passage.

From Orange Point, above mentioned, the altered volcanic or trappean rocks (referred in a general way, as elsewhere stated, to the Triassic and provisionally designated the Vancouver series) are almost continuously exposed along the west side of Discovery Passage to Seymour Narrows, and along the east side from the Narrows southward to within two miles of the extremity of Cape Mudge. In this part of Discovery Passage, these rocks are generally amygdaloidal in character, but have, in many places, been so much changed by subsequent action, that this character has almost disappeared, together with all traces of the original bedding. Wherever the dip may still be distinguished, however, it appears to be at rather low angles. Most of these rocks show spots and veinlets of epidote of secondary formation, and they are generally greenish or greenish-grey in colour, though occasionally purplish. Copper Cliffs, of the chart, are composed of greenish and blackish altered amygdaloid, and show copper staining along jointage planes in some places. Steep Island, at the mouth of Gowland Harbour, is composed of massive beds of coarse agglomerate, many of the fragments in which are of amygdaloid. Copper stains also appear here. The dip is apparently N. 63° E. $< 30°$.

Lithological character of rocks.

A few typical specimens of the altered volcanic rocks of the Vancouver series, from the vicinity of Discovery Passage, have been subjected to a preliminary microscopic examination, with the following results:—

No. 6. Orange Point, Discovery Passage.—Dark grey-green diabase, considerably decomposed, but appears to have been originally an amygdaloid.

No. 7. Discovery Passage.—Amygdaloidal diabase, of which the cavities are generally filled by quartz. Reddish in colour as the result of the peroxidation of contained iron during decomposition. Contains little chlorite.

No. 8. Steep Island, Discovery Passage.—Greenish-grey amygdaloidal diorite, considerably decomposed, and amygdules filled by quartz.

No. 127. Discovery Passage, near Elk Bay.—Blackish-green glossy schistose rock, collected near line of junction of Vancouver series and granite. This is evidently a fragmental rock, and may be classed as a volcanic ash, being chiefly composed of felspar, much decomposed, and with abundance of chloritic matter.

No. 128. Discovery Passage.—Coarse greenish-grey agglomerate, a much decomposed diabase in which a minute concretionary structure is developed.

The southern extremity of Cape Mudge resembles Point Lazo in general appearance, and is like that point entirely composed of drift materials, including boulder-clay, which overlies stratified sandy deposits. The water shoals gradually, and wide flats covered with boulders are laid bare at low tide, a circumstance almost always, in this region, found to characterize a coast-line formed of boulder-clay or other drift materials. The same character is continued along the east side of the Cape Mudge promontory, northward as far as Drew Harbour. It is possible that Cretaceous rocks may underlie the southern extremity of the Cape Mudge promontory, but there is no evidence of this, and the older volcanic rocks have now been traced southward so far along the west side, that but two miles of the extremity of the cape remains, under which they might occur. Cape Mudge.

Drew Harbor is an excellent anchorage, sheltered on the east side by a low sandy and gravelly spit over a mile in length. It has been utilized lately as a logging camp, and considerable quantities of timber have been cut in parts of Valdez Island, adjacent to it. Drew Harbour.

The Strait of Georgia may be described as terminated to the northward by Valdez, Read and Cortez islands, which are separated by comparatively narrow passages, the first-named consisting, however, in reality of several islands separated by subsidiary channels, which have not been surveyed, and are scarcely navigable, on account of their rocky character and the very strong tides which run through them. North end of Strait of Georgia.

Forming a disconnected fringe of comparatively low, flat land to the southward of these islands, is the promontory of Cape Mudge, Mary Island, Reef Point of Cortez Island, with Hernando, Savary and Harwood islands, the three last-named lying close to the shore of the mainland to the eastward. With the exception of the low land thus designated, the islands closing the Strait of Georgia to the north, are almost uniformily rocky, with rough, irregular surfaces, the average height of the elevations on which increase eastward toward the base of the Coast Range, and become high mountains along the sides of the fiords which penetrate far into the mainland. The fundamental and most prevalent rock is granitic, and is usually a hornblendic granite, rich in triclinic felspar, varying much in texture, but usually greyish in tint; one variety merging by imperceptible gradations with another. Included in these granites, or resting upon them, are areas more or less considerable, of altered volcanic rocks, associated with occasional argillites and limetones, the whole referable to the Vancouver series. Low islands. Higher rocky islands.

Having premised these general facts, such local details as seem important, will now be given for the region, the actual boundaries of the rock-series being indicated on the accompanying map. The stratified materials of volcanic origin, are, in the following pages, generally

designated as the altered volcanic rocks, the question of their geological age having been already discussed. (See p. 9 B.)

Vicinity of Drew Harbour.

The rocks of the shore west and north-west of Drew Harbour have the same appearance and character with those of Discovery Passage, already described, and are altered volcanic materials. To the north of Drew Harbour, however, just east of Open Bay, crystalline limestone appears in association with these rocks, and is cut off to the eastward by granitic rocks which show in places more or less gneissic foliation. What is probably a continuation of the same limestone band appears again, at less than a mile to the south-eastward, in the little rocky islets named the Breton Islands on the chart. The limestone is here, however, interstratified with grey and blackish thin-bedded argillites and quartzites, the strike of the whole being S. 47° E., with dips at very high angles, but generally south-westward. These beds are cut by dykes of highly quartzose, slightly hornblendic, granite, and are all much shattered, with rusty joints.

Hoskyn Inlet.

Hoskyn Inlet, which separates the Valdez Islands from Read Island, running north-north-eastward for nearly nine miles, was examined by my assistant, Mr. D. B. Dowling. It is narrow, and is bounded throughout by rough, rocky shores, composed of granitic rocks of the usual character. An opening, known as Surge Narrows, occurs on the west side of the inlet, and runs toward Discovery Passage through the Valdez group, with, possibly, a branch opening toward the north-east. Surge Narrows is partly blocked by several small, rocky islands, between which the tide runs with great velocity, resembling the rapids on some large river. The only spots which might be used as land for settlement are at the head of Village Bay and at the old Indian camp at the Narrows.

Read Island.

The highest land on Read Island is near its north end, and has an elevation, according to the chart, of 1608 feet. The south-east side of the island is throughout composed of massive, hornblendic granite, which varies from a fine-grained, dark-grey material to a pale whitish rock regularly spotted by rather large black crystals of mica and hornblende. Dark greyish-green dykes, probably diabase, intersect these rocks in all directions, and in some cases are so numerous as to form nearly one-third of the entire mass. The northern part of the east end of the island was not particularly examined, but appeared, from a distance, to be composed of similar crystalline rocks.

Cortez Island.

Cortez Island is, in the main, a tract of rough, rocky land, resembling Read Island in its general character. It is very irregular in form, and has a length of about fourteen miles from north to south, with a maximum breadth of about eight miles. The north-eastern portion of the island, which is nearly separated from the rest by a

long, narrow lagoon, appears to be throughout composed of hornblendic granites, the hornblende in some parts of which is rather of a greenish than a black colour. On Lewis Arm, some portions of this rock scarcely contain any visible quartz, while others hold numerous fine-grained, dark and more highly hornblendic masses, which may be fragmental or concretionary. Dark-colored dykes, resembling those already described on Read Island, are numerous locally. The north-east side of the main part of Cortez Island is everywhere formed of similar granitic rocks, with, in some places, numerous dark-coloured intrusions. At the point just east of Carrington Bay, an obscure appearance of stratification occurs, with a strike of about N. 27° W., and small quantities of molybdenite were found in quartz veins. On the small islands named Camp Islands, the granitic rocks were observed to be much broken up and silicified by action subsequent to their formation, which has produced numerous little masses of crystalline, iron pyrites and of epidote, which, however, do not occupy true veins. Molybdenite.

With the exception of Reef Point, which is composed of drift deposits, the entire south-west shore of Cortez Island, with Gorge Harbour, is composed of similar granitic rocks, containing more or less hornblende, and offering no peculiarities worthy of special note. On the east side, a mile from the south point, is a rather fine-grained greenish rock, which is much shattered and traversed by epidotic veins, and has an apparent dip of N. 55° E. $< 60°$, and is probably a highly altered remnant of the Vancouver series. North of this, the granitic rocks resume, but continue to hold numerous fragments of a similar material. For about two miles south from the entrance to Squirrel Cove, the shore is bordered by a low terrace, composed of sand and gravel deposits, and heavily wooded. The flat land thus formed, however, appears to be quite limited in width. Near the entrance to Squirrel Cove, on the west side, are extensive exposures of coarse-grained, pale-coloured hornblendic granite, suitable for building-stone, and moderately well situated for quarrying. Squirrel Cove is a good, though small harbour, with an old Indian village site at its northern extremity, and a narrow, stony passage opening to the lagoon previously mentioned, which might be passable for small boats at very high tides. Just west of Squirrel Cove, on the outer shore, the granite was observed to assume reddish tints, though without otherwise changing its general character. Deer were moderately abundant on Cortez Island, and a limited number of sheep might be pastured on it. South-west shore of Cortez Island. Building stone.

The Twins, two small islands to the south of Cortez Island, are chiefly composed of the usual hornblendic granite, which is, however, Twin Islands.

in part reddish in colour. The east shore of the southern island, three quarters of a mile in length, is interesting, as displaying stratified rocks, consisting of dark slaty argillites, quartzite and limestone. These are all much broken and contorted, but in one place were observed to strike N. 57° W. They may be considered, with little doubt, as representing the continuation of similar stratified rocks met with on the north part of Hernando Island, and described on a subsequent page.

Redonda Islands.

The Redonda Islands, two in number, are very irregular in form. They are high and mountainous for the most part, a point on the inner or eastern island attaining 5140 feet, and several summits on the western island rising about 3000 feet. These islands may in fact be considered as a portion cut out of the general outline of the coast, by the two passages which converge and unite to form the fiord known as Toba Inlet, and as such, represent a part of the outer portion of the Coast Range. The western island is twelve and a half, the eastern, nine miles in length. The north side of West Redonda Island, is entirely composed of grey, hornblendic granite, generally notably coarse in grain, and occasionally porphyritic, and in some places, holding dark, highly hornblendic portions, a foot or more in diameter. The shore is uniformily bold and composed of solid rock, the only beach being in Deceit Bay, of the chart. Raza Island and the part of the mainland which forms the north shore of Pryce Passage, though not touched on, are evidently composed of rocks similar to these just described. Dean Point, the extreme north-eastern termination of the island, is peculiar in showing a rather highly quartzose granite, which contains very little hornblende. At Welsh Cove, a mile south of the last, on the east side of the island, the granite becomes distinctly pinkish in tint, and consists of two felspars, one probably orthoclase, the other triclinic, of pink and white colours respectively, with black mica, a little hornblende and abundance of quartz. This stone is well adapted for building purposes, and in Welsh Cove is favourably situated for quarrying, as it is traversed by nearly horizontal jointage-planes and rises in a low cliff from the water's edge. Near Dean Point and Welsh Cove, dark dykes, which were scarcely seen along the north shore, again become somewhat abundant. Further south, on the east shore, the rocks are in some places much darker in colour and more hornblendic, though still coarsely crystalline. In such rocks, quartz is almost or entirely absent, and they are either syenites or diorites. It is impossible, however, to separate the rocks of this character from the paler coloured and more quartzose varieties, with which they frequently blend by insensible degrees.

West Redonda Island.

Building stone.

At Marylebone Point, the south-eastern corner of West Redonda

Island, is a small inlet, shown on the chart in dotted lines. It is about half a mile in length only, and receives a stream at its head which, at a distance of about two hundred yards, was found to issue from a lake which is a mile or more in length and about twenty feet only above high-water mark. Marylebone Point.

In the inlet just referred to, and about Marylebone Point, a greenish dioritic material is so irregularly mingled with paler granite of the usual character, that it is impossible to say which should be regarded as an intrusion in the other, each constituting about half the mass.

The south-east shore of West Redonda Island, on Desolation Sound, presents no features worthy of special mention, being composed of similar hornblendic granites. At one place, a considerable number of blackish diabase dykes were observed with a north-westward run. At another, near 'White Patch' of the chart, distinct traces of copper occur, forming green stains on weathered joints. Martin Island and Kinghorn Island, show only the same rocks. The west side of East Redonda Island was landed on at one point only, but is also evidently composed of similar rocks. East Redonda Island, as seen along Waddington Channel, and doubtless throughout its extent, is composed of granitoid rocks. It was not, however, particularly examined. East Redonda Island.

Cape Mudge, Mary Island and Reef Point, with Hernando, Savary, and Harwood islands, have already been described as differing altogether in character from most of the land to the north and north-east of the Strait of Georgia. They may originally have formed a connected border of low terrace-land, with a maximum elevation of about 200 feet above the present sea-level. With small exceptions, they are entirely composed of drift deposits, consisting of boulder-clay, with bedded sands and gravels, some points in connection with which are more fully described under the head of surface geology. Though in general wooded, there are on these islands patches of meadow-land, which is often covered with bracken, and the woods are not so dense and impenetrable as elsewhere. The soil is usually, if not in all cases, rather light and sandy, but a considerable portion of these low lands might be utilized for purposes of agriculture. Border of low lands and islands.

Mary Island has an area of about 2200 acres, and no exposures of rock in place occur on it. Its southern extremity is prolonged by a long bouldery reef, while its northern is formed by a sand spit, which nearly reaches to Cortez Island. The area of the flat land which forms Reef Point is about 2300 acres, and it terminates similarly, southward, in a wide, bouldery flat, partly bare at low tide. Mary Island.

The area of Hernando Island is about 2200 acres. Stag Bay, on its north side, affords a good anchorage, and its north-eastern shore, for about a mile in length, is composed of rock. The south-eastern Hernando Island.

exposures consist of massive crystalline rocks, probably dioritic, and differing from the more abundant hornblendic granites. Hidalgo Point, adjoining the last, is formed of stratified materials, much indurated and shattered by pale felspathic dykes, but consisting of rather thin-bedded, blackish argillites and quartzites, in some of which impressions of ammonitoid shells were found. These Mr. Whiteaves, in the Appendix, provisionally describes under the name *Belonites Vancouverensis*. The prevalent dip is about N. 55° E. < 40°.

Fossils.

Savary Island.

Savary Island, lies nearly east and west, and is about four miles long, but quite narrow. Its south side is formed by cliffs, and steep scarped banks of boulder-clay and stratified sands, the opposite or northern side being lower. Its total area is about 1200 acres, the soil being very light and sandy. Like the islands previously described, it presents wide, flat, boulder-strewn beaches, many of the boulders reaching a diameter of ten or even twenty feet. The extreme east end of the island, is formed by a steep but rounded mass of coarse, spotted, hornblendic granite, cut by dark dykes of diabase or diorite.

Harwood Island.

Harwood Island, with an area of about 1900 acres, scarcely differs from those above described. It is composed, for the most part, of well stratified sands and hard silty deposits, resembling those met with below the boulder-clay on Savary Island. The southern point of the island is composed of a rather fine-grained, grey, hornblendic granite, very much jointed. The lowest side of this island is toward the south, where there is some open land, covered with bracken. Elsewhere, the shore is generally bordered by bold, high banks, which are, however, as a rule, grass-grown, and do not present the same striking appearance as those of Savary Island.

Mitlenatch Island.

Mitlenatch Island, an isolated rock, 200 feet in height and half a mile in diameter, which lies in the middle of the strait, three miles east of Hernando Island, is composed of altered volcanic rocks, chiefly a grey-green massive amygdaloid, in which the cavities have been filled by quartz. These rocks are much jointed, and assume rugged forms where exposed to the action of the sea. The direction of their dip could scarcely be ascertained, though it appeared to be about S. 12° E. < 10°. The island has been heavily glaciated in a direction from north-west to south-east.

No Cretaceous rocks observed.

From the above notes, it will be apparent that no rocks of the Cretaceous, coal-bearing series occur in the islands bordering the north and north-east part of the Strait of Georgia, though these were specially looked for. Should such rocks occur there, they must occupy hollows between the projecting masses of the old crystalline rocks, and are now either covered by the waters of the strait or concealed by the drift deposits.

Malaspina Inlet and Vicinity.

The observations made in Malaspina Inlet, and along the shore of the mainland from Desolation Sound to Jarvis Inlet, may now be summarized, after which, those referring to Texada and Lasqueti islands will be given.

Malaspina Inlet. Malaspina Inlet runs about eight miles south-eastward, parallel to the shore of the Strait of Georgia, but separated from it by a promontory about two miles wide. The inlet itself is about half a mile in average width, and throws off an irregular branch to the eastward—Lancelot Arm—about three and a half miles in length. The rocks forming the shores of the main inlet belong entirely to the granitic series, but are rather peculiar in the paucity of quartz, which in some places is almost entirely absent, causing the rock to be more properly named a syenite or diorite than a hornblendic granite. The rocks are usually grey in general colour, but in some places dark greenish-grey. They hold often many darker masses of a fragmental appearance, and it was also here observed that they were frequently reticulated by pale lines, dependent on the bleaching of the rock by some subsequent action along the planes of jointage.

Marble with serpentine. On the eastern extension of the inlet, the shores are generally formed of rocks similar to those above described, which, though probably in some places diorite in composition, preserve a granitic appearance, and by the addition of quartz and mica pass into true granites. In Theodosia Arm, which is entered from Lancelot Arm by a narrow passage, these rocks were observed to possess a slight appearance of bedding or foliation, and between Martin and Ellen Points of the chart, on the north side (just west of the entrance to Theodosia Arm), a small mass of stratified rocks appears, surrounded on all sides by those of a granitoid character. These consist of a grey and white spotted marble, in which kernels and veinlets of pale green serpentine have been developed, with some blackish, hard argillites with rutsy joints. The dip and strike are very irregular, but the former appeared to average N. 8° E. $< 70°$. These rocks occupy the shore for about 200 feet only. They show traces of copper, and similar traces were again seen nearly opposite Thynne Island of the chart, on the west side of Lancelot Arm.

Character of shores. Though generally low, the shores of Malaspina Inlet are almost everywhere of solid rock, with small beaches showing only here and there in sheltered angles. The main inlet is continued southward by a low valley, and Theodosia Arm ends westward in a shallow flat, beyond which, low country extends for some distance. There is a

considerable quantity of very fair timber in the vicinity of the inlet generally, and probably a large area in the flat land beyond the head of Theodosia Arm. As coal had been reported to occur on this inlet, it was closely examined, but no trace of Cretaceous or Tertiary rocks was found. Though it is still possible that coal-bearing rocks may occur in the low tract just referred to, no drift material was observed which might indicate their existence.

Report of coal.

Entrance of Malaspina Inlet.

About the entrance to Malaspina Inlet, there is a considerable area of greenish granitoid rocks, some of which may be diorites, and, by their fine grain and much fractured appearance, suggest the possibility that they may represent the last stage in alteration of stratified rocks belonging to the volcanic series. They are occasionally associated with crumbling red syenite. The shores of the large bay east of the entrance of Malaspina Inlet, together with the south shore of Mink Island, lying off it, are characterized by granitic rocks which present no unusual characters.

Reddened granites.

Georgina and Sarah Points, to the west of the entrance, are composed of red syenite or hornblendic granite, while the intervening shore is generally occupied by the usual grey variety. The red rock appears here, and elsewhere in this vicinity, to be merely an altered variety of the grey, in which, in consequence of some action subsequent to its formation, the iron has become peroxidized. The texture and grain of both rocks is the same, and they are similarly blotched by darker included masses, which in the red variety are at times still blackish, but have also occasionally become reddened. The red rock is always much shattered and jointed, a circumstance probably connected with the change it has suffered. Its broken character renders it quite unfit for use, as a building stone.

Coast from Sarah Point to Jarvis Inlet.

Sarah Point to Ragged Islands.

From Sarah Point, to a point opposite the south end of the Ragged Islands, the rocks are partly reddish, like these last described, but chiefly grey in colour, and hornblendic granites, which in some places appear, from the absence of quartz, to become diorites. They are much shattered, and cut by numerous dark-coloured dykes, and some pale syenitic ones, and include very numerous irregular or lenticular fragments of a darker colour, such as are almost always found when the granitoid rocks approach the borders of stratified masses. The fragments are in some places so abundant, that from their arrangement, they cause the rock to assume a gneissic appearance, the strike being in general nearly parallel to the shore. On the inner side, and near the south end of the Ragged Islands, a small area of distinctly

stratified hornblendic gneiss, with fine-grained mica-schist, occurs. These rocks are much broken and very irregular, but the general dip is about N. 47° E. $<$ 60°. Powell Islets and White Island, further off shore, are composed of the usual grey granitoid rocks, and scarcely any soil is found upon them.

Coast south of Ragged Islands.

From the Ragged Islands southward, for a distance of five miles, or to a point nearly abreast of the southern termination of Malaspina Inlet, the coast continues very bold, and is composed everywhere of solid rock. The prevalent materials are grey hornblendic granites, of the usual massive character, which in some places have assumed a red tint, in the manner previously explained. Distinctly stratified rocks were observed in two places. The first of these is just south of Hirtuda Point, and opposite the east end of Savary Island. The rocks seem to be diorites and felsites, but are so much shattered and rust stained as to be almost past recognition. The strike appears to be nearly north and south, but the shore is characterized by these rocks for about 300 feet only. The second occurrence is two miles further southward and is much more important, occupying the shore for three-quarters of a mile. It includes a bed of grey marble, about fifty feet in thickness, and nearly vertical, with a strike of about N. 20° W. The marble is associated and interstratified with dark greyish and greenish speckled rocks, which are so completely shattered, that but for the marble, their stratified character could scarcely be recognised. These rocks have not been specially examined, but their mineral constituents are much decomposed. They are either diorites or diabases, and appear to represent the last stage in metamorphism of stratified volcanic rocks, like those of Discovery Passage.

Included stratified masses.

Marble.

Low shores.

South of this point, to the Klahoos Indian village in the bay abreast of Harwood Island, the shore is much less bold, and the rock appears in isolated low exposures only. It is either hornblendic granite or diorite, of granitoid texture, wherever seen. The long low gravelly beaches, which characterize this part of the coast, are not indicated on the chart, and indeed the representation of the smaller features of the coast, from Sarah Point southward to Jarvis Inlet, is very imperfect. Notably wide tide-flats, strewn with large boulders, occur along the coast about half way between Savary and Harwood islands.

Vicinity of Klahoos village.

The south point of the shallow, open bay, in which the Indian village above referred to is situated, is formed of a boss of rather coarse granitoid rock, containing much hornblende and little or no quartz, which is cut by dark diabase dykes of the usual character. Half a mile southward, in the next bay, is the mouth of a small river, which flows from a lake at a distance of about a mile and a half from the shore. This lake is reported to be very large and to run a long way

Powell Lake and River.

to the northward. Its form is conjecturally indicated, and it is named Powell Lake on the map published by the Chief Commissioner of Lands and Works of British Columbia (1884), and the river may be designated by the same name. From views of the country in this vicinity, obtained from the strait, the lake would appear to occupy a rather narrow valley between high hills, and it is doubtless orographically identical with many of the salt-water inlets. Three-quarters of a mile from the mouth of the river is a rapid and fall, the stream here being confined between high, rocky banks, and well adapted for use as a water-power. The stream averages 150 feet in width by three feet deep. Its valley is nearly impassable from fallen timber and a stiff, intervening growth of sal-lal bushes, and, finding the rocks all of the usual granitic character, I did not take time to penetrate as far as the lake. The height of the river above the fall and rapid is about fifty feet above sea-level.

Water-power.

Powell River to Grief Point.

Southward, to within a couple of miles of Scotch-fir Point, at the entrance of Jarvis Inlet, the coast is low, and a low and apparently everywhere densely wooded country stretches some miles inland, and will, doubtless, afford a large quantity of valuable timber. From the mouth of Powell River to Grief Point, due east from the north end of Texada Island, there are no rock exposures along the shore. Grief Point itself is low and flat, but half a mile to the south-east of it, a bluff about eighty feet in height affords a section of the drift deposits, by which a considerable part of the low country is probably underlain. These resemble those of Savary and other neighbouring islands, being composed of finely stratified hard sands, overlain by about fifteen feet of stony clay, which probably represents the boulder-clay.

Grief Point to Sandstone River.

Six miles eastward along the north shore of Malaspina Strait from Grief Point, is the mouth of Sandstone River, of which some particulars are given below. On the intervening coast, rock *in situ* appears in three places only, as follows:—Two miles east of Grief Point, forming a low bluff; blackish, spotted hornblende-schist with some grey felsite, both cut by numerous veinlets of epidote and quartz. Strike, S. 87° E., nearly vertical. Islets, in the same little bay, of similar rocks, with fine and coarse-grained diorite. Point just west of mouth of Sandstone River, with low exposures of grey hornblendic granite. East of the river, low exposures of rather coarse hornblendic granite are more frequent, and before Scotch-fir Point is reached they become almost continuous, but offer nothing worthy of special note.

Sandstone River.

The Sandstone River is a small stream, and at the date of my visit (July 1885) was about twenty feet wide only, with an average depth of about nine inches. Its bed presents almost continuous exposures of sandstones and shales, for about a mile and a half up from its mouth.

The sandstones are soft, of yellowish and brownish colours, often coarse, and in places slightly conglomeritic; the shales are blackish or greenish-grey. The beds are almost horizontal, the highest dip probably not exceeding 5°, and the total thickness of beds exposed cannot be more than about 200 feet. Flattened stems and logs, included in the sandstones, are in the form of lignite, but no true bed of coal or lignite is exposed. A few fossil plants which were obtained are very imperfectly preserved, and insufficient to show whether these beds should be classed as Cretaceous or Tertiary. Further up the river, the banks become quite low, and show only occasional small exposures of drift materials, the current is slack, and there appeared to be no prospect of obtaining further information as to the width of the sandstone series. It may, however, underlie a considerable part of the low country of this part of the coast.

Coal or lignite.

In a small stream about a mile east of Sandstone River, the Indians report the existence of similar rocks at a short distance from its mouth. No exposures of sandstone, however, appear along the coast, and it would seem that the low bosses of granite there occurring have served to protect the sandstone rocks in an inland basin. Before the exact limits of this sandstone basin can be mapped, it will be necessary to traverse the whole of the thickly wooded, low country near the coast from Jarvis Inlet to the Klahoos Indian village, the Indians inhabiting which were quite averse to giving any information or assistance respecting the region at the date of our visit.

Area of sandstones.

The rocks of Jarvis Inlet, for a distance of about six miles up, were examined by Mr. Dowling, who reports them to consist of hornblendic granite, but in general, of paler tints than usual. Near the south-east point of Hardy Island, is a small area of included schistose rocks, and in the vicinity of the small bay on the south side of the island, near its west end, it was observed that the granite is favourably situated for quarrying, and well adapted for building-stone.

Jarvis Inlet.

Building-stone.

From the mouth of Jarvis Inlet to Burrard Inlet, the coast has not yet been examined geologically. As seen from the sea, it is evidently for the most part granitic, but there are low wooded areas in some places, and Cretaceous and Tertiary rocks may not improbably be found in these, particularly in the vicinity of Trail Islands, and about Thormanby Island.

Coast south of Jarvis Inlet.

Texada Island.

Texada Island, so named by Elsa, in 1791, is nearly twenty-seven miles in length, with an extreme breadth of but five and a half miles. The island is high and mountainous throughout, and very rocky, offering scarcely any land suitable for agriculture. The shores are very

Geological character of the island.

bold, beaches of gravel or sand being quite exceptional, though narrow boulder-beaches are more common. The island may, in fact, be regarded as a partially submerged mountain range or ridge, and by reason of its narrow form, when seen from the Strait of Georgia to the south-eastward, resembles a single high mountain mass. It is in general, wooded, and some very fair timber is to be found in the valleys, but bare rocky hill-sides are everywhere frequent. The forest is, however, generally not dense, particularly on the south-eastern side of the island, where the climate must be relatively dry. Deer are generally abundant on the island, and it will doubtless eventually be utilized for the pasturage of sheep. It is singularly deficient in harbours, in comparison with other parts of the coast—Gillies Bay, on the south-west side, and a second bay at the northern extremity, being the only two of any value, and both somewhat exposed to certain winds.

Mr. James Richardson's explanations.

The geological features of a portion of the island were examined by the late Mr. Jas. Richardson, and are described by him in the Reports of Progress of the Geological Survey, for 1873–74 and 1876–77. My own examination of the island, in 1885, was confined almost exclusively to the shores, but included a careful inspection of every part of the coast-line, it being specially desirable to ascertain the existence or otherwise of any rocks of the Cretaceous coal-bearing series which might there occur. With the exception of the Cretaceous area of Gillies Bay, discovered by Mr. Richardson, it may now be affirmed, that no rocks of this age appear on the island.

General geological character.

Texada Island is composed, for the most part, of the rocks of the Vancouver series, and chiefly of altered volcanic materials. These are, however, traversed by somewhat important granitic masses, particularly on the north-east shore; while the northern extremity of the island, for a length of about five miles, is largely composed of more or less crystalline limestone, which is frequently a true marble. Deposits of copper, marble and magnetic iron-ore have been located on the island, and work undertaken on them, though the last mentioned mineral is the only one of which the exploration has attained any considerable importance. So far as the stratigraphical features go, there is no reason to believe that the altered volcanic rocks, and the massive limestones, represent distinct formations, and the palæontological evidence is almost nil, consisting of a few obscure molluscs obtained from the less altered parts of the limestone about a mile south of Point Marshall, at the north end of the island. The association and interbedding of volcanic rocks with the marbles of the northern part of the island, and the intercalation of these limestone beds with those of the southern portion, indicate the close relationship in time of the two classes of rock, which—even apart from the facts afforded by similar

association elsewhere—renders it necessary for the present, at least, to regard the whole as forming one great series.

Bed of marble.

At the base of Mount Dick of the chart, on the east shore, near the southern extreme of the island, is a small broken and shattered anticlinal, including a bed of purplish, pinkish and variegated marble, with a maximum thickness of about twenty feet. This is interbedded with greenish, rubbly, felspathic rocks, in association with which are some dark-coloured, earthy, calcareous shales. The marble is too much affected by joints to be of any value.

Coast from Point Upwood to North-east Point.

Point Upwood, and the southern end of the island in its vicinity, is composed of hard, massive, greyish and greenish-grey rocks, many of which, though much altered, are still evident agglomerates, and show their fragmental character on weathered surfaces.

On rounding the south-east point of the island, well stratified greenish and grey felspathic and hornblendic schistose rocks are met with, presenting a ribboned appearance on weathered surfaces. They are not far from vertical in attitude, and the strike, which is fairly regular, nearly coincides with the coast, causing the same rocks to characterize it for several miles northwards. These rocks are closely associated with agglomerate and ash rocks, which sometimes replace them on the shore, and eventually preponderate, and occupy the coast to the exclusion of other materials, to a point nine miles north of the south point. Thence, for three miles, the only rocks seen along the shore are grey hornblendic granites of coarse or medium grain. Beyond these, greenish, bluish and grey rocks, composed of altered volcanic materials, again appear, and occupy the shore to a place abreast of Scotch-fir Point. These rocks are here even more completely altered and hardened than usual, being traversed by numerous dykes of dark greenstone and some of granite, while small segregated granite masses also occur in them. They are extremely shattered, and jointage-planes coloured by copper, were observed in several places. The appearance of these rocks is such as to lead to the belief that they form but a narrow border on the coast, and are backed by and in contact with granite on the landward side. At North-east Point of the chart, and for nearly two miles southward from it, the shore is again occupied by granitic rocks, which, near their junction with the volcanic series, hold numerous dark fragments, as is usual at such junctions.

Ash-rock.

A specimen of a dark grey, rather fine-grained, massive rock, from a point a mile and a half north of the south end of the island, proved on microscopical examination to be an evident altered ash rock. It is chiefly composed of broken felspar grains, with a few of quartz, and much chloritic matter subsequently developed. Rocks of identical

appearance to this one, macroscopically, are very abundant both on Texada and Lasqueti islands.

Iron ore beyond North-east Point.

For four miles north-westward from North-east Point, there are alternations of granite with volcanic rocks, as shown on the accompanying map, but no new features are presented. At the place thus defined, a little cove, with a small, abandoned frame house, occurs. The granites here again indicate their approach to the stratified rocks by the number of included dark fragments, and are replaced by them beyond the north point of the cove. The Vancouver rocks are here made up of dark green hornblendic and epidotic materials, and include a bed of marble, in association with which is a considerable deposit of magnetic iron-ore, details of which are given on a later page, in connection with those of other similar deposits of the island.

Marbles.

Beyond the above occurrence of iron ore, the shore is occupied for about a mile by marble, associated with some greenish amygdaloidal rocks. The marble varies from nearly white to grey and blotched varieties, and forms cliffs of from fifty to eighty feet in height. The dip averages about south-south-west, or inland, at high angles. Granite next appears for about half a mile, but near the entrance to Marble Cove, it is again replaced by marble. Near the northern edge of the granite, where that rock is in contact with the marble, it assumes a somewhat unusual appearance, being almost entirely composed of

Copper ore.

quartz and white felspar. It is here traversed by a vein of copper ore, on which some work has been done, a drift of about sixty feet having been run in on the vein in a direction of S. 38° W. The vein, as seen at the mouth of the drift, is about eighteen inches wide, and is still visible in the roof where the work stopped, though turning off a little in a southerly direction. Several tons of ore, remaining on the dump, appear to be of fairly good quality, consisting of mixed copper and iron pyrites (the latter often in large crystalline cubes) in a gangue of calcite and quartz, with andradite, tremolite, chlorite and molybdenite as accessory minerals. The work has not been carried sufficiently far to warrant any definite opinion on the character or continuity of the deposit. Endeavours should be made to trace it by uncovering the surface, rather than by further drifting. A small building has been erected near the drift, which is situated about 200 yards from the shore, near the base of a steeply sloping hill.

Assay.

On assay by Mr. Hoffmann, the ore from this locality proved to contain, in addition to copper, 10·20 ounces of silver to the ton. The specimen submitted to analysis consisted of about 55 per cent. metallic sulphides, the remainder gangue.

Marble quarry at Marble Cove.

Marble forms the shores of Marble Cove, with the exception of the north point, where granite occurs, apparently as a dyke running

inland in a westward direction. From this cove, with unimportant local exceptions, marble is found continuously along the shore to the north end of the island. A small marble quarry has been opened at the north side of the cove, this place having probably been selected as affording a shelter to small vessels. Trial shipments of the marble have been made to Victoria, and several large and good looking blocks still remain at the quarry. It would appear, however, that the site chosen for the quarry is not a very good one, as the stone is there more affected than usual by jointage-cracks, and is not so well coloured as at some other points. Attention might with advantage be directed to the marble cliffs previously described, about a mile and a half south-eastward from the cove, or to the exposures north of the cove. These places, though not affording harbours, are only rarely exposed to any heavy sea, and the water is generally so bold that barges or schooners might be laid up almost to the shore while loading.

Marble Cove and north end of island.

From Marble Cove to the north point, the marble, though often much disturbed and traversed by dykes, generally dips southward at rather low angles. At the north point it is vertical, with a strike of S. 10° E. The shores of the bay, at the north end of the island, with Marshall Point west of it, are also chiefly composed of marble or limestone, more or less distinctly crystalline. The dip is very irregular in direction and amount. The rock is much jointed, and traversed by numerous greenish felspathic and blackish diabase dykes. Similar conditions continue, for about a mile and a half south, along the west shore, till the exposures are interrupted in a wide bay, beyond which the limestones are not again seen. Rebecca Island, a small rocky patch lying off Point Marshall, is composed of greenish felspathic rocks and highly crystalline marble, and evidently constitutes a detached portion of the Texada Island mass. The general form assumed by the marbles and associated rocks of the northern part of Texada Island, is that of a synclinal.

Rebecca Island.

Marshall Point to Gillies Bay.

Southward, from the last limestone exposures, to within ten miles of Gillies Bay, hard greenish and grey much altered amygdaloids occupy the shore, till replaced near the point above defined (at which the houses of the Texada Iron Mine are situated) by agglomerates. These volcanic rocks evidently underlie the limestones, and at the mine are abruptly cut off by a granitic mass, half a mile in width on the shore. This rock closely resembles that seen near the copper deposit, on the opposite side of the island. The wharf of the Texada Iron Mine, is situated about a quarter of a mile south-east of the houses, at the foot of the slope. The line of junction of the granitic with the volcanic series, presents the characters commonly found under such circumstances, the volcanic rocks being not only much hardened, but

shattered and penetrated by granitic dykes, while both rocks show scattered segregations of iron pyrites.

Texada iron mine.

The principal deposit of ore, from which a considerable quantity has been shipped, but on which operations were practically suspended at the time of my visit, in 1885, is situated about quarter of a mile inland from the wharf, and at a height of probably about 250 feet from the sea, on the brow of a steep rocky hill. The arrangements for mining and shipping the ore are complete. Shoots at the head of the wharf, receive the ore from trucks, at the bottom of the slope, which is substantially laid and well ironed, and is provided with a double track, the full trucks in descending drawing up the empties. From the level of the drum at the head of the slope, the track runs a short distance round the eastern flank of the hill, to the place at which the ore is at present being quarried. A drift, which has been run into the side of the hill, was closed and could not be examined. A very large quantity of ore is at present in sight above the level of the track, and in advantageous positions for work.*

Mr. Richardson on Texada iron ore.

Mr. Richardson, who examined this deposit with some care before working had been attempted, describes it as follows:†—"On the south side of Texada Island, about three miles north-westerly 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 about 150 feet down, and extending from 200 to 250 feet in length, is an exposure of rich magnetic iron-ore. On the outcrops, facing to the north-west, the ore-bed, which dips from S. 58° E. to $< 25°$–30°, is 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 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 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 rocks beneath it to the

* Work was again resumed in the autumn of 1876, and during the winter about 5500 tons of ore was mined and shipped by the Puget Sound Iron Company to their works at Irondale, W.T. The Texada ore is generally mixed from 1-9 to 3-10 bog ore, found near Irondale, and produces thus, or when smelted alone, an excellent foundry pig.

† Report of Progress, Geol. Surv. Can., 1873-4, p 99.

south-west. Where the ore bed is exposed in this part of the hill, a similar arrangement of the beds is observed, and what 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 overturned 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 to 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."

Nature of the ore-deposit.

I would modify the above description by Mr. Richardson in one main point only, namely, in respect to the nature of the ore-deposit. This appears to me to be neither a bed nor a true vein, but a contact-deposit which has been produced at or near the junction of the granitic mass with the stratified rocks, and more particularly with the limestone. Near the head of the slope, where the ore has been worked, the granitic rocks are replaced by grey crystalline limestone, which occasionally becomes a nearly white marble, and at this contact, the large bodies of ore are found, and appear to occupy irregular 'chimneys' or interspaces of very variable dimensions. The ore penetrates, to some extent, not only the granitic rocks, but also the altered volcanic rocks and the limestone. It frequently includes large or small epidotic kernels, together with detached fragments of the volcanic rocks, and, in some places, reticulated veins of ore are seen in the granite, forming a species of ore-breccia. The appearances are such as to indicate that the formation of the deposit occurred contemporaneously with the intrusion of the granitic mass, and has been dependent on the effects produced by that intrusion. Specimens of mixed ore and limestone, which may be collected, closely simulate interbedding, but the appearances developed since work has been carried on are such as, in my opinion, to prove that the ore cannot be considered a bedded deposit.

Ore bodies.

The first ore exposure mentioned by Mr. Richardson is probably one which has been cut through on the slope, between the wharf and its head. This is thirty feet or more in thickness, but is of inferior quality, and contains a considerable proportion of iron pyrites. The second exposure described is doubtless that at the head of the present slope. Portions of the ore in the actual workings are also found to

contain more or less pyrites, and these are at present rejected as unfit for shipment. Traces of copper are also not infrequently seen on weathered jointage-planes in the mass of the iron ore.

Analyses of ore.

The quality of the greater part of the ore is excellent. A partial analysis by Dr. Harrington, in the laboratory of the Survey, showed 68·40 per cent. of iron, with only ·003 per cent. of phosphorus. In Volume XV. (Mining Industries) of the Tenth Census of the United States, p. 580, a partial analysis by Whitfield is given of a sample of this ore, selected as representing a lot of 600 tons at the Puget Sound Iron Company's furnaces. This shows—Iron, 65·71; phosphorus, ·013. A more detailed analysis, carried out by Messrs. P. C. Gilchrist and E. Riley, of specimens sent to the Colonial and Indian Exhibition in 1886, and published by these gentlemen in the Journal of the Iron and Steel Institute, 1886, p. 561, gave the following result:—

Iron	69·85
Manganese	trace.
Siliceous matter	2·75
Sulphur	·06
Phosphoric acid	trace.
Moisture	trace.

Further tracing and working of the ore.

The character of this ore, as a contact-deposit on the borders of the granite, indicates the importance of tracing out the junction of this rock with the stratified series, and particularly the advisability of closely examining and uncovering such contacts as occur between the granite and the limestone. So long as such deposits can be found in convenient proximity to the shipping point, it will be unnecessary to sink on them to any great depth, and the quantity of ore already known is not likely to be exhausted for many years. The deposit of similar ore, noted on the opposite side of the island, occurs under nearly identical circumstances. The same may be said respecting the copper ore previously described, and traces of either copper- or iron-pyrites were observed in several additional localities near such contacts in different parts of Texada, in which island indications of metalliferous deposits of this character are unusually abundant. It should be stated here that the outlines of the granite as shown on the map, are exact only where they come out on the shores; they are scarcely more than hypothetical in the interior, having been traced inland for an inconsiderable distance only in a few places. The information gained with respect to the position of the metalliferous deposits, should, however, serve as an important guide to further discoveries, the characters of the granitic and other rocks being sufficiently distinct for easy recognition.

A few words may now be added respecting the deposit of magnetite at the north-east side of the island. This, as has already been indicated, is situated on the shore of a shallow bay or cove, almost directly across the island from that last described and about five miles from the north point of the island. A bed of grey to white crystalline limestone or marble here occurs in association with hard, greenish, altered volcanic rocks of the usual character. The calcareous rock appears to form a bed of which the greatest observed thickness was about fifteen feet. It is, however, so much shattered and twisted as to render its thickness very irregular, but runs along the shore with a general strike of about S. 55° E. for 200 feet or further, generally maintaining a dip at an angle of 40° or more to the southward. That the calcareous material is a bed, is rendered evident by its blending and becoming interstratified with the greenish felspathic rocks, and also by the entire absence of any characteristic crystalline vein stuff. It is in some places quite free from magnetite, but is generally highly charged with that material, which, though forming in it very irregular masses of pure ore, has generally more or less of a stratiform arrangement, and is occasionally found minutely interlaminated with calcareous matter. The most important solid stratiform mass of magnetite seen is about four feet in thickness. Epidote, and in some places small quantities of quartz, occur in association with the ore, which, when the limestone is removed by weathering, generally forms black masses of pure magnetite of a scoriaceous appearance and very irregular in form. The beach is strewn with loose blocks derived, by this process of weathering, from the limestone, and the deposit has the appearance of being an important one, deserving attention so soon as the price of ore may justify mining operations. The contact of the limestones and volcanic rocks with the granite is close by to the south on the shore, and it appears probable that granite also occurs at the back of these rocks, not far inland.

Iron ore of east side of Texada Island.

Peculiar relations of magnetite and limestone.

A short distance southward from the wharf of the Texada iron mine, the shore loses its bold character. With the exception of the sandstones to be noticed immediately, no rock exposures are seen, and the beach is low and boulder-strewn to Shelter Point or Island, a distance of three and a half miles. The sandstones just alluded to are evidently of Cretaceous age, and indicate the existence of an outlier of that formation, representing a portion of the north-eastern edge of the Comox coal-basin, the greater part of which is concealed by the waters of the Strait of Georgia. This outlier was discovered by Mr. Richardson, and is noticed by him in the Report of Progress for 1876–77, p 169. Though the shores of the bay were examined by me at low tide, I could find but a single small outcrop of the sandstone in place, and this

Cretaceous outlier of Gillies Bay.

partly covered by boulders and gravel. The sandstone is grey in colour, but weathers brown, and forms rough honeycombed surfaces. It has a dip of about 5° in a direction S. 48° W., or directly seaward. It does not resemble the Cretaceous beds, subsequently described as having being found actually in contact with the older rocks on Lasqueti Island, but may nevertheless be not far from the local base of the Cretaceous series.

Extent and character of the outlier.

It is impossible to determine the actual extent of the Cretaceous outlier thus indicated, but as represented on the accompanying map, it is given its probable maximum size, and is somewhat larger than shown on Mr. Richardson's map. The low, level character of the land about Gillies Bay, appears to indicate that its area may be as great as shown. Mr. Richardson supposed the rocks to represent the lowest division or Productive measures of the Comox section, and though this must remain for the present uncertain, in consequence of the possible progressive overlap of the upper parts of the Cretaceous on the older rocks in this vicinity, it may eventually be desirable to set the question at rest by boring, as it is possible that a workable area of coal may occur in the outlier. The extremity of the point north of Gillies Bay, would be the most suitable place for such boring, but it should be stated that the surface of the older rocks is here evidently a very rough one, and that after having passed through the drift deposits at this point, these old rocks might be found directly to underlie them.

Coast south-east of Gillies Bay.

Shelter Island consists of grey-green altered volcanic rocks, chiefly a rather rough agglomerate, which is overlain by an amygdaloid. The dip is about S. 45° E. $< 25°$. The remaining portion of the shore of Texada Island, to the south-eastward, is composed of greyish greenish, and bluish-grey, hard, altered volcanic rocks, chiefly or entirely agglomerates or amygdaloids, but in many places so much altered, as to be scarcely recognizable as such. They form, for the most part, a bold rocky shore, and a few small rocky islets lying off, are of the same materials. The strike is generally nearly parallel to the shore, with south-westward dips at angles of 15° to 30°. The only feature requiring special note, is the occurrence of a small bed of limestone, a few feet in thickness, about half a mile southward from the most prominent south-western point. This includes obscure traces of fossils. It rests upon the surface of a greyish amygdaloid, and is overlain by 'ropy' felspathic trap, which, as it resembles the upper surface of an old lava-flow, may indicate an inversion of the strata. The occurrence of the limestone in this accociation, may at least be accepted as an evidence of the submarine character of some of the eruptions which have produced this great series of volcanic rocks.

Interbedded limestone.

Lasqueti Island.

Lasqueti Island, separated from the southern part of Texada Island by Sabine Channel, contrasts markedly with that island in the much indented outline of its shores. Its surface is generally characterized by irregularly rounded, rocky hills, the highest of which attains an altitude, according to the chart, of 1056 feet. There are, however, some limited tracts susceptible of cultivation, near the shore, and two or three settlers have established themselves upon these, and have stocked the island with sheep. General character.

The island is composed, for the most part, of altered volcanic rocks, which are probably a repetition of those met with on the adjacent portion of the shore of Texada Island, Sabine Channel occupying an intervening synclinal. The strikes of the beds, on the sides of the channel, diverge to the north-westward, coinciding approximately in direction with the opposite shore lines. The northern portion of the island is chiefly composed of amygdaloids, while the southern is formed principally of agglomerates, which have, however, in many places, been so much altered as to require very close examination to detect their true character. Some compact trappean beds occur in association with the agglomerates, which have evidently been lava-flows, one of these, near Point Young, shows a fairly well marked columnar structure, and another, three-quarters of a mile north from the south-east point, on Bull Passage, affords an excellent example of the 'ropy' structure above alluded to. This peculiar structure was not infrequently observed in other places in connexion with the altered volcanic rocks, and is pretty evidently that of the surface of a lava-flow, resembling those found on Vesuvius and other recent volcanoes. The flow of the viscous or partly consolidated mass, has produced a confused aggregate of knotted, rounded and irregularly cylindrical forms of an involved character, and without distinct interspaces. The structure is not merely superficial, but affects a considerable mass of material, which in this instance, is now a bluish felspathic rock, not evidently amygdaloidal. The lithological characters of the other rocks of the altered volcanic series on Lasqueti, are so similar to those of the rocks of Texada as not to require special description. Rocks of Vancouver series. Ropy structure.

The head of False Bay, at the west end of the island, is occupied by a mass of granitic or syenitic rocks, of pale greyish tints, which shatter and penetrate the Vancouver rocks near the line of junction. The extension inland of this mass is not accurately known. Granite.

The most interesting geological point connected with Lasqueti Island, is the occurrence, on its shores, of small outliers of rocks of the Cretaceous outliers.

Cretaceous system. The more important of these were observed by Mr. Richardson, and are noticed by him, in general terms, in the Report of Progress for 1876–77 (p. 169.) The places at which the outliers occur are as follows:—1. Tucker Bay, small island in south-east angle; 2. Tucker Bay, south-west angle, behind a small point or peninsula (this outlier has an area of a few yards only); 3. Extremity of west point of Tucker Bay; 4. Island in bay west of Tucker Bay; 5. North point of Lasqueti Island, with two small islands to the east of it (this outlier has an aggregate area of about 250 acres, and is the largest); 6. West end of Lasqueti Island (a narrow border, along the shore opposite Flat Island, half a mile in length); 7. Inner side of Flat Island; 8. South shore of Lasqueti Island, half a mile east of Boat Cove; 9. Sangster Island, to the south of Lasqueti.

Jenkins Island, Bare Islands, and the Sisters, though surrounding Lasqueti to the west and south-west, are composed of altered volcanic rocks, the latter consisting of bluish-grey agglomerate, dip N. 45° E. $< 15°$. The positions of the small Cretaceous outliers surrounding Lasqueti Island are shown on a special plan in the corner of the map which accompanies this report.

Character of lowest beds.

With the exception of places in which the lowest beds of the Cretaceous outliers follow undulations of the subjacent surface, these rocks dip uniformly off shore at low angles. varying from 0° to 15°, being in no case much greater than might be accounted for by the slope of the old shore-line on which they have been deposited. Where well exposed, the lowest beds of the Cretaceous are rough conglomerates, with coarse sandstones, the fragments consisting of the altered volcanic rocks, which give a greenish colour to the whole. The surface of the older rocks is often extremely rough and irregular, resembling portions of the present coast-line which has been much broken up by the waves, and the Cretaceous deposits are often found filling nearly vertical crevices in the older rocks with the appearance of a rough concrete which has been cemented by calcareous matter. These appearances are well seen at the small outlier numbered 3, at the west end of No. 5, the north end of No. 6, and at No. 7.

Large boulders.

The last mentioned locality is notable on account of the numerous large partly rounded blocks of the Vancouver rocks, which appear irregularly imbedded in the basal Cretaceous conglomerate. These seem to have been derived from neighbouring cliffs of the altered volcanic materials, and some of them are as much as fifteen feet in greatest diameter. At this place also, calcareous, serpula-like tubes, with portions of shells, were found still actually attached to the old rocks, and the whole appearance is that of a rough shore-line. Spines of an

Echinoid, and partially rounded fragments of thick-shelled molluscs, are moderately abundant in parts of these green basal Cretaceous conglomerates. These include a *Terebratella*, apparently an undescribed species; an *Ostrea*, a *Pecten*, and a cast of an *Opis* like *O. Vancouverensis* of the Productive measures. The most common and characteristic fossil is, however, a species of nullipore, which frequently forms a considerable portion of the mass. A second form, with coarser structure, may also be a nullipore, but much resembles a fine-grained coral-like *Solenopora*. These are found, not only in detached pieces, but in small encrusting masses, on stones included in the conglomerate. Calcareous Polyzoa and other organic fragments are also seen to be abundant under the microscope. Fossils.

Overlying the conglomerates above described, or in some places resting without their intervention on the surface of the older rocks, are grey, brown-weathering sandstones, with conglomeritic layers, holding well-rounded pebbles, quite different from the sub-angular material of the basal beds. The greatest thickness of Cretaceous rocks appears in the outlier at the north end of Lasqueti Island, and is about 260 feet, the higher beds much resembling those previously described at Gillies Bay, Texada Island. Sandstones.

The questions raised by the occurrence of these littoral Cretaceous beds are very interesting, but can here only be touched on. They are identical with the basal beds described by Mr. Richardson, and afterwards examined by me, on the north shore of Departure Bay, east of the coal wharves.* They also resemble those noticed by Mr. Richardson, but which I have not seen, on North-west Bay.† The amount of disturbance which the Cretaceous rocks have suffered in both the Nanaimo and Comox areas, is too great to allow us to assume that these littoral deposits—thus rather widely spread, but in the cases above mentioned, always at the present sea-level—represent portions of a single contemporaneous Cretaceous shore. It must rather be assumed that they constitute parts of a shore deposit which has progressively overlapped the older rocks during a period of subsidence, and that the coal deposits of the Cretaceous rocks have been formed at times during which the deposition was in excess of the subsidence, or when the subsidence had temporarily ceased, allowing the formation and continued existence of land areas. This being the case, the littoral deposits in question need be accepted as marking any precise stage in the Cretaceous or as holding a definite relation in stratigraphical position to the coal-bearing horizons. Conditions of deposit.

Sangster Island, to the south of Lasqueti, was not visited by me. Sangster Island.

* Report of Progress Geol. Surv. Can., 1871-72, p. 81.
† Report of Progress, Geol. Surv. Can. 1876-77, p. 167.

It is described by Mr. Richardson as "wholly composed of sandstones and conglomerates, the latter being largely made up of rounded pebbles of white, yellow and greenish quartzite, ranging from half an inch to fifteen inches in diameter, together with other rounded pebbles of dioritic rocks. The pebbles are held in a matrix of greenish-brown sandstone."* It would appear from this description that the horizon of the rocks of Sangster Island may be nearly the same with that of the highest beds of the north point of Lasqueti Island. Should it ever be determined to test these outlying Cretaceous rocks by boring, with the view of determining the possible existence of coal, this island seems to be the most promising place for the attempt, though but little encouragement can be offered to such an experiment, as the total thickness of the measures would probably be found to be small, and the surface on which they rest is likely a very rough and irregular one.

Possible occurrence of coal.

Northern Part of Discovery Passage.

Distribution of granites and Vancouver series.

Discovery Passage, of which Seymour Narrows forms the most constricted portion, runs north beyond the Narrows, with a few degrees of westing, for twelve miles. The west shore for ten miles northward, the east for six miles,—or to the southern point of the wide inlet which penetrates Valdez Island—are formed of the rocks of the Vancouver series; the northern parts of both shores being of granitic rocks. The line separating the two classes of rocks runs south-eastward, crossing the strait very obliquely, and continuing toward the eastern shore of Valdez Island, where it has already been noted north of Drew Harbour (p. 22 B). The general strike of the Vancouver rocks is about north-north-west by south-south-east, or nearly parallel to the direction of the line separating these rocks from the granites. The strike is, however, irregular in detail, and in many places the rocks are so massive as to afford no information as to their attitude. For about three miles along the west shore, near Elk Bay, the rocks are greenish schists, passing into schistose agglomerates, in which the fragments have been squeezed into lenticular forms, and in a few places approaching ordinary argillites in appearance, and probably in composition. The southern part of the west shore is chiefly occupied by greenish, altered agglomerates, in which the constituent fragments can sometimes be made out only on weathered surfaces. Three and two-third miles south of Otter Point, a quartz vein about two feet wide, holding a little copper pyrites, was observed cutting these rocks.

Copper ore.

* Report of Progress 1876-77, p. 169.

On the east side of the passage, the rocks about Plumper and Deep-water bays, and those of Separation Head, are amygdaloids of green and pale greyish-green colours, very distinctly stratified in massive beds, and dipping at rather low variable angles. These rocks, in some places, show the peculiar 'ropy' structure which has already been noticed (p. 41 B). Paler, apparently concretionary, and more highly epidotic portions produce an irregular blotching on some surfaces, and in certain layers, very irregular, flattened ma ses, chiefly composed of crystalline quartz, are plentifully distributed. These were frequently seen in certain beds of the altered volcanic rocks. They appear, as already explained, to represent original cavities or interspaces in the slaggy surfaces of lava-flows which have been filled by subsequent percolation with chalcedony or zeolitic minerals, and finally altered to their present state during the metamorphism of the rocks.

Amygdaloids.

Quartz blotches.

The granitic rocks appear on the west side of the passage, a mile and a quarter south of Otter Cove. A small isolated area of the altered volcanic rocks then occurs on the shore. It is shattered, and penetrated in all directions by granitic and felspathic dykes. The granite near the junction of the two classes of rocks, is characterized by the usual abundance of dark included fragments. It presents exactly the same appearance at its contact with the altered volcanic rocks further south, on the east side of the passage. The granite is of the usual grey colour, and contains hornblende in greater or less abundance. It varies slightly in texture and composition, and dark greenish-grey diabase dykes are found cutting it in some places. In Otter Cove, the granite has a pale pinkish tinge, and contains a white triclinic felspar, with a pink orthoclase. The grain is uniform and the stone free from injurious jointage-planes. It is moderately easy to dress and work, and takes a a good polish, and might be quarried to advantage on the island in the mouth of the cove, or elsewhere around its shores. Chatham Point, to the north of the cove, shows a highly hornblendic and darker coloured variety of granite.

Margin of granite.

Building-stone.

Some notes on the microscopic character of the altered volcanic rocks of Discovery Passage are given on page 20 B.

Johnstone Strait, and Islands and Channels to the Northward.

Johnstone Strait runs, from Chatham Point, with a remarkably direct course of about west-north-west, for fifty-four miles, the western extremity of the strait being assumed to be at Beaver Cove. The strait has an average width of about a mile at its eastern end, but gradually widens, till it averages nearly two miles in width at its western extremity. The south shore is, throughout, formed by Van-

Johnstone Strait.

couver Island, and is singularly bold and even in outline. Beaches of any kind are quite rare, the only ones of any importance being at the mouths of Salmon and Adams rivers of the chart. This bold shore is backed by abrupt mountains, which generally rise with steep wooded slopes from the water's edge and form an almost connected chain, which, on the charts, is named in different parts of its length from east to west, Halifax Range, Prince of Wales Range, Newcastle Range and Franklin Range. The northern side of the strait is formed by the Thurlow Islands, Hardwicke Island, two projecting promontaries of the mainland, and Cracroft Island, between which open channels and passages, leading to Phillips Arm, Loughborough Inlet and Knight Inlet. Though nearly in all cases rocky and bold, the northern shores of the strait do not exhibit mountains so high as these bordering the south or Vancouver Island shore, though farther north, toward the heads of the larger fiords, mountains of equal and greater height are found, the altitudes of the higher peaks increasing with considerable regularity as the axis of the Coast Range is approached.

Depth and origin.

Johnstone Strait has not been fully examined as to depth, but like most of the fiords in this region, it is very deep, many soundings given on the chart at depths greater than one hundred fathoms, not having reached bottom. It is probable that a median channel at least one hundred fathoms in depth, could be traced throughout the greater part of its length. Its whole appearance suggests that it may have originated as an old river-valley, which has received at one time the drainage of the mainland to the north, by a number of streams, of which it carried the united waters toward the hollow now occupied by Queen Charlotte Sound.

Nature of examination.

Following the plan adopted in the Strait of Georgia, both shores of Johnstone Strait were geologically examined, together with the adjacent islands and water-ways, but the longer fiords, which penetrate the coast of the mainland, and a number of connecting passages, in which there appeared to be no reasonable probability of the occurrence of the Cretaceous coal-bearing rocks, were left for subsequent investigation.

Having in the preceding pages described at some length the character, appearance and relations of the fundamental granitic rocks of the region, with those of the superposed Vancouver group, it may now be sufficient, without entering into detail except in special cases, to summarize the facts observed, the distribution of the two series being shown on the accompanying map.

South shore. Granitic areas.

The examination of the Vancouver shore of Johnstone Strait, was carried out by my assistant, Mr. Dowling, from whose notes it appears that granitic rocks characterize it from Chatham Point westward, for nine and a half miles. These rocks here present no unusual character,

and where they meet with the altered volcanic rocks of the Vancouver series, become spotted by dark, included fragments, in the manner commonly observed near such junctions. A second area of similar rocks appears on the south shore of the strait, opposite the entrance of Port Neville, and occupies the coast to and beyond Adams River, a distance of eight miles. From the appearance of the mountains inland, and the abundance of included fragments (which are not usually observed in the granite very far from its edge) it is probable that this granitic area constitutes a rather narrow border along the coast. The granites here contain, as a rule, about the usual proportion of hornblende, but in some cases pass into a rock which might be classed as a granitoid diorite.

South shore. Vancouver series.

With the above exceptions, the entire south coast of Johnstone Strait is formed of rocks of the volcanic portion of the Vancouver series. The strike of these is, in general not far from parallel to the shore, with prevalent dips in a southward or south-westward direction. This fact is evidenced, not alone by the observed attitude of beds, but also by the recurrence of rocks in different places along the shore which exhibit peculiarities so well marked, that there is every reason to infer the repetition at several points of a single bed. The altered volcanic rocks present the usual dark greenish and greenish-black colours in most places, and consist of agglomerates and amygdaloids, closely resembling those of Discovery Passage, which, it is to be observed, are in nearly the same line of strike. The resemblance of these rocks is so close to those of Discovery Passage, as to suggest identity of horizon with that of the rocks of that place, which have been noted already in some detail. Concretionary beds, or beds showing the 'ropy' flow structure, are marked features in some places.

North shore. Thurlow Island.

The south side of East Thurlow Island, forming the north shore of Johnstone Strait at its east end, together with the western shores of Nodales Channel and the Pendar Islands are formed of granitic rocks of the usual character, but here, and on the opposite side of Johnstone Strait, west of Chatham Point, there is a marked abundance of a highly hornblendic, dark coloured granite, which in some cases appears to blend with a pinkish granite like that of Otter Cove (p. 45 B), in other cases meets it along jointage- or fault-planes, and in a few instances appeared to be distinctly penetrated by dykes of the paler granite, both being, in turn, cut by dark, diabase dykes.

Building-stone.

On the inner side of the small island nearly opposite Chatham Point to the north, a quarry might advantageously be opened, the stone resembling that of Otter Cove, and being favourably situated to work.

West Thurlow Island.

Of West Thurlow Island, eleven and a half miles in length, the whole

shore was examined. It is composed almost entirely of grey, granitic rocks, which however, in places, become unusually dark in colour, and approach diorite in appearance, quartz being almost entirely absent. Mica was rarely observed as an important constituent. Included dark fragments, with their edges more or less distinctly angular, are abundant in many places, and at one locality, on the north shore, just south of Tucker Point, there are considerable exposures of granite, so regularly spotted by dark inclusions of this kind, as apparently to possess some value as an ornamental stone. Some of these inclusions still preserve angular outlines, and show adjacent faces of complimentary form, between which the granite has penetrated, while others are undefined in outline, and appear to be melting away in the granitic magma. A large specimen of the rock brought away from this locality, proved susceptible of a good polish, and the circumstances are such that a quarry might here be opened, if desired. The north side of Chancellor Channel, opposite to West Thurlow Island, is everywhere granitic, though it was not so closely examined.

Blotched granite.

Agglomerates and argillites.

At its west end, this island terminates in two points, the northern of these being named Eden Point. The end of this point, together with that to the south of it, and the south shore of the island for two and a half miles eastward, is composed of altered rocks of the Vancouver series, some of which are brecciated, and apparently altered agglomerates, but include also some well-bedded and much hardened dark argillites of a flaggy character. These rocks are all not only highly altered, but much disturbed and thrown about, and evidently form but a narrow border resting on the granites.

Hardwicke Island.

Further west, the rocks last described fringe the south shore of Hardwicke Island. About midway, between Eden Point and Helmcken Island, a small detached area of fine-grained dark rocks of dioritic aspect first appears, and is presumed to represent a much altered part of the stratified series. North of Helmcken Island, similar rocks, but here distinctly bedded, and striking about west-north-west, occupy the shore for about three-quarters of a mile. They are cut in all directions, by small, pale, felspathic dykes, which are doubtless connected with the granite, and may be regarded as a compact form of that material. Beyond a small interruption of grey granite, similar bedded rocks resume, and form the south-eastern shore for three and a half miles, together with York Island and a second small islet lying beyond it. The series here includes a considerable thickness of hard, flinty, flaggy argillites and quartzites, much fractured and jointed, and weathering rusty, with interbedded quartzites and materials of dioritic appearance. There are also thick masses of altered amygdaloid of the usual dark greenish colours. The angles of dip are high and irregular, but the strike runs

nearly parallel to the shore. The argillites and quartzites precisely reproduce the appearance of those of Hernando Island, in the Strait of Georgia (p. 26 B). Helmcken Island is composed of similar rocks, but was not closely examined.

Gneissic rocks.

The remainder, and greater part of Hardwicke Island, is occupied by granitic rocks, which in a few places assume an appearance of gneissic lamination, possibly indicating the bedding of rocks from which the granites themselves have been formed, but more probably referable to some species of superinduced foliation. The strike of the gneissic structure is very irregular, but where best developed, at the east end of the island, near the middle of Wellbore Channel, it is about N. 68° E., and nearly vertical. Traces of gneissic structure were found in a few other places in the region here described, but are quite rare and exceptional, a fact leading to the belief that they may be explicable in the manner above suggested.

Absence of drift deposits.

The almost complete absence of drift deposits or terraces, among these rocky, though wooded islands, cannot be better illustrated than by referring to the fact that traces of such deposits were found in two places only on the whole shores of Thurlow Islands and Hardwicke Island. One of these is at the east end of East Thurlow Island, near the entrance to Mayne Passage, where a small low terrace with scarped front was seen. The second locality is on Hardwicke Island, due north of the west end of Helmcken Island, where a terrace about fifty feet high occurs, formed of stratified sands, capped by gravels.

Coast west of Hardwicke Island.

Further to the west, the rocks of the Vancouver series form the southern part of the promontory which separates Blenkinsop Bay from Port Harvey, and with the exception of one small interruption of granite, occupy the coast for five and a quarter miles west of the entrance to Port Harvey. The relatively low and flat character of the promontory just referred to, led to the belief that it might be occupied by Cretaceous or newer rocks, but such did not prove to be the case. The line of junction between the stratified rocks and granites, beginning just within the western entrance point of Blenkinsop Bay, turns north-north-westward, and runs across to Port Neville. The southern shore of the promontory is occupied by greenish altered volcanic rocks, chiefly amygdaloids, while between these and the granites to the north-westward, is an extensive display of hard, flaggy argillites, of the usual character, which, so far as observed, dip north-north-eastward, at very high angles. The argillites are attached to the volcanic rocks, and interbedded with them about the junction, and both are much disturbed and cut by numerous grey felspathic dykes. On the west side of the entrance to Port Neville, similar rocks are again found, their strike turning to the south of west. They terminate in

Vancouver rocks.

a feather edge on the shore, at the distance above given west of the entrance, and where in immediate proximity to the granites, are much shattered and traversed by granitic dykes, and by segregation veins filled with the constituent minerals of the granites.

Granites. The north shore of Sunderland Channel and shores of Blenkinsop Bay are formed of the usual grey hornblendic granite, cut by numerous greenstone dykes. Similar massive rocks form both shores of the entire upper portion of Port Neville, but in a few places on the north side, they become dioritic, and show the same appearances of gneissic foliation previously alluded to. The strike of the foliation is not discordant with the bedding of the altered volcanic rocks, the margin of which is found about a mile and a half south-westward. Similar rocks form the point which separates Johnstone Strait from Havannah Channel, and the Broken Islands lying off this point. At a place nearly a mile west of the point, on the south side of Havannah Channel, hornblendic and felspathic schists were observed to form a small area in the granite, with a strike of S. 30° W., and nearly vertical. These may represent an included mass of the Vancouver series, but are more highly altered and crystalline than usual.

Gneissic rocks.

Cracroft Island. Cracroft Island, nineteen miles in length, forms the north shore of Johnstone Strait west of Havannah Channel. It decreases gradually in width westward, terminating in a long, narrow point. The south shore of the island, to the west side of Forward Bay, is composed of granitic rocks, with the exception of one place, nearly due west of Domville Point, where blackish and greenish dioritic schists appear for about one hundred yards, with a strike of N. 26° W. These are probably a continuation of the foliated or stratified crystalline rocks last described. On the west shore of Port Harvey, and elsewhere in this vicinity, grey hornblendic granite of good quality might easily be quarried in large blocks.

Building-stone.

The northern shore of the eastern half of Cracroft Island was not examined. The whole western part of the island, from a line beginning just within the west entrance point of Forward Bay and running north-westward across it, is composed of rocks of the Vancouver series, and very largely of amygdaloidal rocks in heavy beds, which dip at rather low angles of inclination.

Hanson and Plumper Islands. Hanson Island and the group of small islands at its west end, known as the Plumper Islands, are also entirely composed of rocks of the Vancouver series, comprising both amygdaloids and agglomerates, the whole with greenish, blackish, grey, and occasionally purplish tints. The strike of the rocks in these islands shows a distinct tendency to a general south-westward direction, with north-westward dips, often at low angles. In the bay at the east end of Hanson Island,

south of Burnt Point, a small, low reef was found to be composed of fine-grained grey limestone, of which the attitude could not be determined.

General distribution of rocks, etc. Johnstone Strait.

From the foregoing description of the rocks of the vicinity of Johnstone Strait, it will have been observed that this fine channel follows in a general way the line of junction of the Vancouver series with the underlying granitic rocks; the granites, nevertheless, forming two portions of the southern shore, and the stratified rocks occurring in a number of places with a greater or less width on its northern side, and entirely composing both shores for a length of about fifteen miles at its western extremity. The strait probably owes its existence to this geological feature, and there is a tendency, generally observable, to the formation of a hollow in the granites near their line of junction with the stratified rocks, giving evidence of a greater facility of erosion or decay in the granites at or near this line. A further important fact, brought out by the examination of this part of the coast, is the frequent recurrence and general continuity of the zone characterized by the flaggy argillites, in that part of the Vancouver series near the edge of the granites, and the independently observed parallelism, in a broad way, of the strikes of the bedded rocks with the line of junction. There is little room for doubt that the argillites hold a position well down in the generally volcanic series, and characterize a definite horizon, which can thus be traced from point to point, from Hernando Island in the Strait of Georgia to Queen Charlotte Sound, a total distance of about eighty-three miles.

Argillite zone.

West end of Johnstone Strait.

On reaching the eastern end of Queen Charlotte Sound, the northern border of the rocks of the Vancouver series sweeps round to the north, with an irregular edge, touching here and there upon the islands which fringe the sound. Before reaching the north side of the sound, however, their border again probably becomes coincident in direction with the general strike, and continues north-eastward, rarely infringing upon the granitic shore of the mainland. The greater part of the wide hollow now occupied by the waters of the sound is, doubtless, excavated in beds of the Vancouver series.

Eastern Extremity and Northern Shore of Queen Charlotte Sound.

Before proceeding to note the character of the north-western part of Vancouver and adjacent islands, the observations made along the eastern and northern shores of Queen Charlotte Sound may be briefly summarized. The existence of the wide hollow occupied by the sound and the presence of Cretaceous, coal-bearing rocks on its southern shore, appeared to render it not improbable that these rocks might

extend in places to the east or north shores, but the most careful examination has failed to discover any trace of them on these shores.

Swanson and Harbledown Islands.

The southern and south-western parts of Swanson and Harbledown islands, with several smaller islands of the same group, are composed of rocks of the Vancouver series, while the northern parts of the two large islands, above named, with almost the whole of Lewis Island, and a number of smaller islets and rocks fringing them on the north, are granitic. The line between the two series is somewhat irregular, as shown on the map. The stratified rocks are here all extremely disturbed and irregular in attitude, being traversed by intrusive masses and dykes. This is particularly the case at the west end of Harbledown Island, the south-west point of which, and its south shore eastward for about two miles, is chiefly composed of dark, coarsely crystalline rocks,

Flaggy argillites.

of dioritic appearance and evidently intrusive. Notwithstanding this irregularity, however, a wide belt of splintery, flaggy argillites, with interbedded quartzites, can be traced from the north-west extremity of Swanson Island, in a south-eastward direction, across the two intervening small islands, to Harbledown Island, around the shores of Parson Bay, and again on the south shore of the island, where it includes beds of fine-grained, grey limestone. The argillites are associated with a considerable mass of greenish, altered volcanic rocks, in most places, and where the stratified rocks approach the granites, they become distinctly crystalline, often forming dark, blackish-green, hornblendic schists, as on the south-east part of the shore of Harbledown Island. On this shore, half a mile west of the extreme east point, is a some-

Marble.

what extensive exposure of grey and variegated white-and-grey marble, which in places has apparently been broken up and re-cemented, having in the process included numerous fragments of the adjacent green, felspathic and hornblendic rocks. The relations of the bedded rocks to the granites, and the extreme alteration which they have suffered in this region, seem to show that they may be regarded as forming a thin overlapping edge on a general granitic substratum. The north-

Smaller islands.

east shore of Harbledown Island, with the south-west of Turnour Island (forming the opposite side of Beware Passage), together with Village Island, Indian Islands and the Cary Group, are composed of grey hornblendic granites, charged with numerous dark fragments, and intersected by dykes of intrusive rocks of several kinds. With the exception of a narrow tongue of flaggy argillites, which penetrates its southern side, Lewis Island is formed of the same granitic rocks.

Archipelago of Queen Charlotte Sound.

The west end of Gilford Island, also Midsummer, Bonwick, Mars, Hudson, Crib, Tracy, Eden, Insect and Baker islands, and the Benjamin Group, with innumerable small islets and rocks constituting the archipelago, are, with few and small exceptional points, composed of

rocks of the granitic series. The eastern parts of Turnour and Gilford islands were not examined. The exceptions above referred to, are found in a few small islands and rocks to the west of Midsummer and Bonwick islands, forming part of the outer edge of the archipelago, and are as follows :—

Remnants of Vancouver series, east end of sound.

The south-west side of the outer small islet of the Sedge Islands, is composed of much altered quartzites and limestones, in thin, alternating beds. These are in contact with the granite, and traversed by granitic veins. Though much twisted, their average strike is about N. 50° W.

House Island, half a mile due south of the last, is formed of quartzites, hard, flaggy argillites, and thin beds of limestone, the whole having a ribboned aspect, and the beds averaging from one to six inches thick. These beds also are much disturbed, but have a general south-westerly strike, and are vertical.

Canoe Islands, a short distance east-south-east of the last, are composed entirely of dark-coloured diorite or syenite, with much hornblende, and netted with granitic veins.

A little islet, without a name, at the north-west extremity of Midsummer Island, again shows a small mass of stratified rocks, like those first described, with a south-westerly strike. The neighbouring granitic rocks are charged with innumerable fragments of those of the stratified series.

In addition to the above localities, a small, much altered mass of the stratified rocks, was seen on Bush Island, north of Lewis Island, and the adjacent granites are full of regularly disposed dark fragments, like those of Tucker Point (p. 48 B). Another small mass of the same rocks was seen on an islet off the north extreme of Bonwick Island, and it is probable that still others may yet be found in this archipelago, as it would appear that the general line of separation between the granites and the overlying stratified rocks, slopes westward at a very low angle, in consequence of which small folds or faults have resulted in letting in little areas of the overlying rocks, here and there, even in the region generally characterized by granitic materials.

Character of junction with granites.

On the channel north of Insect Island, the granitic rocks were observed to be more or less gneissic in appearance, and the north-west point of Lewis Island is composed of a pinkish granite, differing from the usual grey variety, and with two felspars. Dark, highly hornblendic rocks, of granitoid texture, also appear in several places, and some of these might appropriately be classed as diorite, from their external appearance. On one of the small islets, west of the end of Midsummer Island, a dark rock of this character assumes a beautiful spheroidal concretionary structure, which is well shown on glaciated

Spheroidal diorite.

surfaces. The spheroidal masses are closely crowded together, their diameters being from two to four inches.

Superficial deposits and terraces are almost entirely absent from the whole of the islands of the archipelago which closes Queen Charlotte Sound to the east, the smaller islands being, as a rule, little else than solid masses of rock.

Foster and Numas Islands.

Foster Island, in the centre of the eastern part of Queen Charlotte Sound, is composed of stratified rocks, which from their appearance and relative situation, may be regarded as the continuation of those of Sedge and House Islands, previously described. Some of the rocks are quite schistose in aspect, with much hornblende and mica, but these are interbedded with quartzites and limestones in thin layers. The strike is about S. 52° E., and the beds are nearly vertical. Numas Island, ten miles further westward, and also in the centre of the sound, appears to be entirely composed of a dark, highly crystalline, dioritic rock, in which no bedding could be distinguished. It may be regarded as probably an intrusive mass.

North Shore of Queen Charlotte Sound.

Broughton Island.

Of Broughton Island—sixteen miles in length—the whole coast was examined, with the exception only of the upper part of Greenway Sound, which penetrates it on the north, and the heads of some of the deeper bays. The island is in general densely wooded, and several of the hills on its northern part surpass 1000 feet in height, though all are much inferior in altitude to many of those on the adjacent mainland, and occasional glimpses are caught of high, rugged mountains of the central parts of the Coast Range, still further to the north. Booker Lagoon, which opens from Cullen Harbour, on the south shore of the island, has bold, rocky shores, and, in addition to the usual grey hornblendic granites, considerable areas of dark crystalline rocks of dioritic aspect were here found. These are frequently cut by dykes and veins of the pale granite, and a gneissic lamination was seen in them in some places, though it is very doubtful whether this represents true stratification.

Cullen Harbour.

Shore west of Cullen Harbour.

The south side of the island, west of Cullen Harbour, shows a similar association of dark, highly crystalline, hornblendic rocks with the grey granites, and it is not improbable that these dark rocks here represent a final stage in the alteration of massive volcanic materials in contact with the granites. Fragments of the dark rocks are scattered through the granites in a number of places. On the east end of the inner of the Polkinghorne Islands (off the west point of Broughton Island) a dark dioritic rock of greenish appearance is interlami-

nated with grey granite, the lamination being vertical, with a strike of N. 45° W. Other parts of these small islands consist, so far as examined, of dark rocks of dioritic aspect, cut by pale granite veins or dykes. The northern half of Vincent Island, midway between the Polkinghorne Islands and Broughton Island, is composed of much altered flaggy argillites and quartzites, which, near their junction with the granites, become micaceous and hornblendic, and assume a gneissic appearance. Strike N. 57° W, with northerly dips at angles of 70° to vertical. The same rocks were afterwards again found, in the line of the strike just given, on the opposite side of Wells Passage, three miles to the westward. Flaggy argillites.

The west end of Broughton Island is composed of rocks so similar to those of the south shore that it is unnecessary separately to describe them, and the opposite side of Wells Passage, as seen across, appears also to be entirely of granitic rocks. The Kun-sta-mish Indian village, a favourite summer resort of the Indians, is situated just east of the entrance of Claydon Bay of the chart. Salmon are caught in considerable numbers at the mouth of a rapid river of some size which enters the west end of the Embley Lagoon, two miles north. This stream is not shown on the chart, and the outline of the lagoon itself is very imperfectly given. All the adjacent shores, examined or seen from a distance, are granitic. Near the mouth of the river above mentioned, hard Pleistocene clays, containing fossils, are exposed on the beach. These are again referred to in the sequel. Kun-sta-mish.

Grey granitic rocks characterize almost the entire north shore of Broughton Island, and as far as could be seen across Sutlej Channel, also that of the adjacent mainland. The only exceptions observed were:—Near the east end of Sir Edmund Head, where a small patch of hornblendic and micaceous schists occurs. Dip S. 10° E. $< 45°$; and near the east end of the island, opposite a small islet named Birmingham Island, where similar rocks were again noted. The west end of Pearse Peninsula, for a length of about a mile along the shore, is composed of similar hornblendic and micaceous stratified rocks, with an average strike of about N. 35° E. These probably run along the south shore of Deep Harbour, and possibly connect eastward with the last mentioned. The granites in the vicinity are full of dark fragments, which have sometimes been squeezed into lenticular forms, producing a laminated appearance. The strike of this superinduced structure was at one place, west of Pearce Peninsula, observed to be N. 38° E. With the exception of the above defined portion of Pearce Peninsula, the entire south shore of Broughton Island to the east of Cullen Harbour is granitic. North shore of Broughton Island. Shore east of Cullen Harbour.

Having at several times heard rumours to the effect that Indians Reported coal.

had found coal in the vicinity of Drury Inlet, I made enquiries on the subject while at Kun-sta-mish, but succeeded in learning merely that, many years ago, an Indian had gone about two days' journey up a small river which runs into Rocky Bay (Wells Passage), and had there found some material which was subsequently, from his description, conjectured to be coal. No trace of the Cretaceous sandstones was found in the whole region examined in this vicinity, and it is probable that the above mentioned report is entirely baseless.

Coast from Wells Passage to Blunden Harbour.

From Wells Passage to Blunden Harbour (eleven miles) the coast was examined by Mr. Dowling, who found it to consist chiefly of rocks of the granitic series, but to show in some places evident gneissic lamination of the kind previously described, and at many points to be filled with dark fragments. At one place, four miles west of Wells Passage, dark hornblende-schists appear, with a north-westward strike, and nearly vertical.

Blunden Harbour.

The shores of Blunden Harbour and Bradley Lagoon, opening off it, are likewise composed of granitic rocks, with some areas of the darker and more hornblendic variety already several times alluded to. A large part of the granite is closely packed with dark, fine-grained fragments, which have frequently been squeezed into lenticular forms, and even pass into sheets, which preserve their continuity for several yards. A laminated structure thus produced is often seen, the lamination running about N. 50° E., with a dip at a very high angle northward.

Our examination of the north shore of Queen Charlotte Sound terminated to the west at Blunden Harbour, the weather having become extremely unfavourable for further work on this open coast.

Malcolm, Haddington, Cormorant and Pearse Islands, and the adjacent Shore of Vancouver Island from Beaver Cove to Port McNeill.

Pearse Islands and the portion of the shore of Vancouver Island above defined, are composed, probably throughout, of rocks of the Vancouver series, with granites, while the remaining islands included under this heading are either formed of drift deposits or of Cretaceous rocks.

Pearse Islands.

The Pearse Islands are entirely formed of altered volcanic rocks, with light southward dips wherever their attitude could be ascertained. The rocks are generally greenish or grey and frequently epidotic, but in some places have a purplish-grey colour. While in a few localities, evidently altered amygdaloids and agglomerates, they are mostly compact. The whole group is very heavily glaciated, and shows no vestige of superficial deposits.

Beaver Cove.

For a distance of a mile on its east shore, and on the west shore for

about half a mile, Beaver Cove is occupied by grey and reddish granite, while the remainder of its coast-line is formed of compact, greenish-grey felspathic rocks, which were at one place observed to have a probable strike of about S. 30° W. At a point about half a mile up the valley of the stream which empties into the cove, an attempt has been made to open a marble quarry. A number of good blocks have been got out, and some have been taken to Victoria. The marble is grey, often very prettily marked, and the situation is favourable for shipment. The felspathic rocks and associated marble much resemble those seen inland on Nimpkish Lake (subsequently described), and may probably be regarded as a continuation of the same beds. Rocks are exposed along the shore westward from Beaver Cove to a point opposite the east end of Cormorant Island. They consist of greenish hornblendic and greyish felspathic materials of volcanic origin. About the mouth of Nimpkish River, and thence westward to Port McNeill, no rocks are seen along the shore, which is presumably, though not certainly, underlain by the Vancouver series.

Marble quarry.

Cormorant Island differs remarkably from the adjacent Pearse Islands, in being entirely composed of drift deposits, consisting for the most part of hard stratified silts. No rock in place is seen anywhere along the shores, and the island is flat-topped, with an average height probably slightly in excess of one hundred feet. The soil is rather sandy in character, and the surface densely wooded. At Alert Bay, on the south side of the island, is a large Indian village (I-lis), a salmon cannery, and a church and houses belonging to the mission.

Cormorant Island.

Haddington Island is formed of grey Cretaceous sandstones, with a low northward or north-eastward dip, but considerably broken by a more noticeable vertical jointing. The sandstone is rather remarkable in character, being very fine-grained. It is well situated for quarrying, in blocks of moderate size, and would be very easily dressed.

Haddington Island.

Malcolm Island resembles Haddington Island, but is much larger, being thirteen miles in extreme length. Its whole shore was closely examined; but rock in place occurs at a single point only, on the south side, due north of the centre of Cormorant Island. The rock is here a conglomerate, containing rounded pebbles of granite, and of the altered volcanic rocks, up to six inches in diameter, with occasional thin layers of sandstone. It is horizontal, or nearly so. This isolated exposure possibly represents a portion of the conglomerate subdivision (B.) of Quatsino. (See p. 87 B.) The remainder of the shores of Malcolm Island show only drift deposits, consisting of silts, sands and gravels, similar to those of Cormorant Island.

Malcolm Island.

Conglomerate.

Like Cormorant Island, Malcolm Island is densely wooded, but with an even surface, and a general elevation, according to the chart, of 300

to 400 feet. The soil, wherever observed, is sandy and light, but nevertheless susceptible of cultivation, and the island will doubtless eventually be utilized for farming purposes.

Area of the Cretaceous rocks.

The occurrence of the conglomerate above noted, is of importance, as indicating the eastward continuation of the area of Cretaceous rocks which is seen along the shore of Vancouver Island from Port McNeill to Beaver Harbour, and as rendering it probable that rocks of this age may underlie a considerable part of the area of Malcolm Island. Boring operations, to determine the possible existence of coals which may underlie Malcolm Island, will doubtless eventually be carried out as the coast becomes more fully occupied by settlers. The southern edge of this portion of the Cretaceous is probably a faulted boundary. It must run nearly due east from Port McNeill, including Haddington Island, and possibly part of the north end of Cormorant Island, and then turning to the north or north-east, and pass to the west of Stubbs Island, which is composed of the older rocks.

Nimpkish River and Lake.

Nimpkish River.

Before describing the character of the coast of Vancouver Island, further west, a few notes may be given on Nimpkish River and Lake. The lake is named Karmutsen, on many maps, but is generally known as Nimpkish Lake. It is laid down on the map accompanying this report, from the results of a survey of its shores, made with a patent boat-log, its form, as thus ascertained, differing widely from that previously given. The Nimpkish (Kwā-ne) is a small, rapid, crooked stream, full of boulders, difficult of ascent at high water, on account of the strength of the current, and at low stages with scarcely sufficient water on the rapids to float a canoe. The distance, in a straight line, from the mouth of the river to the lake, is about four miles, and the total fall about one hundred feet. Some remains of an old Indian village are at its mouth, and a short distance below the lake, on the left bank, are a few houses, which are still inhabited by the Indians at certain seasons. The banks are densely wooded, and the land bordering the stream rather low. The salmon used in the cannery at Alert Bay, are caught in seines at the mouth of the river, while the Indians annually take a large number of these fish by means of traps and spearing.

Nimpkish Lake.

Nimpkish Lake is fifteen miles in length, with an average width of rather less than a mile. It occupies a portion of an important structural valley, which can be seen, continuing in a southward direction, for a considerable distance beyond its head. At the north or lower end of the lake, this valley bifurcates, one branch being now occupied

by the Nimpkish River, the other diverging in a north-westward direction. From this north-west valley, a stream about twenty feet wide enters the lake, and the valley is reported by the Indians to run through to the Klik-sī-we River, and to contain one or more small lakes. From the south-west angle, at the head of Nimpkish Lake, a wide, sluggish stream, about a mile in length, leads to a second small lake, about three-quarters of a mile long, called Anutz Lake on Trutch's map, but known to the Indians as Hē-lo-tzō. From this small lake, a trail leads across to a stream which flows into the head of one of the arms of Nootka Sound on the west coast, and was formerly used as a means of communication between the Indians of the east and west sides of the island. The only stream of any importance which flows into Nimpkish Lake, is the Nē-nil-gish, which enters about a mile from the head, on the east side. This river, which is from 150 to 200 feet in width at high stages, comes from the southern valley already mentioned, and according to Mr. H. Moffat, who explored it in 1852, drains a second large body of water, which is named Conuma Lake on later maps, but by Mr. Moffat, Lake Kanus.*

Character of shores.

The west shore of Nimpkish Lake is everywhere bold and rough, rising, at a short distance, to steep hills and mountains of considerable height, the highest being Mount Karmutzen, with an approximate altitude of 5500 feet. The east shore, though often rough and rocky, seldom rises to a height of more than two or three hundred feet near the lake, and to the east end of the northern half of the lake, a relatively low country extends toward Beaver Cove. There are a few small rocky islets in the lake, the only ones of any importance being too near the middle of its length, which can be seen from almost all parts of the lake, and are known to the Indians as Sē-ko-youē, or Half-way Islands. Very little good timber was seen along the shores of the lake, but it is probable that better grown forests occur in the valleys opening from it, while cultivable land may also be found in the low country between the lake and Beaver Cove.

Rocks of Nimpkish River and Lake.

With the exception of a single area of granite, the rocks of the river and lake belong entirely to the Vancouver series. The granite occupies the west shore for a length of about two-thirds of a mile, opposite the Half-way Islands. Though generally grey, it is locally reddened and otherwise variegated in colour, and much fractured, and appears to come in contact with the altered volcanic rocks to the north along the line of a fault. The felspathic and diabase rocks of the river and lake offer no points worthy of special mention, being of the usual greenish

* For Mr. Moffat's notes see Facts and Figures relating to Vancouver Island and British Columbia, by T. D. Pemberton, London, 1860, p. 143. Mr. Moffat calls Nimpkish Lake, T'sselth Lake, the Ne-nil-gish River, the Oakseey.

and bluish-grey colours, and often very compact and massive, though occasionally evidently altered amygdaloids. These rocks of igneous origin are, however, associated and interbedded with limestones and flaggy argillites and quartzites, the former here assuming unusual prominence, and being in most places converted into marble. The marbles occur in extensive exposures at points one and three-quarters, six and a half and nine miles, from the lower end of the lake, on its east side. From a point a mile and a half from the head of the lake, on the west shore, a grey crystalline limestone, still showing obscure traces of fossils, occupies the shore for over a mile. Opposite the limestones, on the east shore, are extensive exposures of hard, dark, flaggy argillites and quartzites, the latter paler in tint and often rusty. These beds here have an exposed thickness of from 300 to 400 feet. Fragments of somewhat similar argillaceous rocks, of a very dark colour, and showing obscure traces probably referable to *Monotis* or *Halobia*, are found in the gravel of the Klē-shum-e stream and its neighbourhood, and have served to give rise to baseless reports of the existence of coal. Some undeterminable impressions of bivalve shells were also found in beds of grey, rusty quartzite or felsite, on the Nimpkish River, but nothing can be made of them from a palæontological point of view. On the river, the average strike of the beds is nearly east and west, with dips at high angles, both to the north and south. On the shores of the lake and in the vicinity, the beds generally lie at comparatively low angles, with dips which vary much in direction, and no connected section of the rocks was obtained. In limestone on the river, and in the grey limestone, previously mentioned, on the lake, cherty beds are common. The marble is generally fine-grained, and of various grey and mottled colours, and might be quarried with ease along low cliffs on the shore. These cliffs are frequently excavated into grottoes and small caves along the water's edge, and afford evidence of a rise of about ten feet above the summer level of the lake. The annexed cut gives a diagramatic representation of the mode of erosion of the low limestone and marble cliffs round the lake, and shows the peculiar uniform slope of the rock-surface below the water-line :—

Marble and flaggy argillites.

Reported coal.

Character of marble.

FIG. 1. DIAGRAMATIC SECTION OF ERODED MARBLE CLIFFS ON NIMPKISH LAKE.

On the river, a few small, sandy and gravely terraces, identical in character with those of Cormorant Island, were noted.

Coast from Port McNeill to Beaver Harbour.

This coast, fourteen miles in length, is occupied by Cretaceous rocks, chiefly sandstones. It was examined by me when on my return from the Queen Charlotte Islands in 1878, but the results of this and other unconnected examinations made at the same time, were not included in my report of that year. In 1885 it was re-examined by Mr. Dowling and in part by myself.

Small Tertiary area.

Eel Reef, in Port McNeill, a small rocky patch, covered at high-water, is composed chiefly of brownish, blackish and reddish basalt, compact or vesicular in texture. The whole is much broken, and appears to represent a bed of agglomerate or breccia, made up almost altogether of basaltic material, but including also fragments of the green altered volcanic rocks and of Cretaceous sandstone. It is scarcely possible to determine whether any of the basalt forms part of a solid bed of that material, or whether it occurs merely as large fragments in the agglomerate. The mass is, however, undoubtedly post-Cretaceous, and probably synchronous with the Miocene volcanic rocks of the Queen Charlotte Islands, and is of interest as the only instance of undoubted Tertiary rocks met with in the whole area here reported on.

Cretaceous rocks of Port McNeill.

Fossil plants.

On the south shore of Port McNeill, and round the head of the harbour, no rock is seen, but the north shore and Ledge Point afford almost continuous exposures of Cretaceous sandstones, either massive or nodular, and often shaly. At a point on this shore from which Eel Reef bears S. 65° W. (mag.), a large collection of fossil plants was made. The rocks here dip N. 25° W. $< 10°$. The plants occur in beds of shales and shaly sandstones about five feet above a small seam of coal from one to two inches thick. These fossils include, according to Sir Wm. Dawson, a number of dicotyledonous leaves of different genera, together with a *Salisburia* and a *Taxodium*. Some of the species seem to be identical with those of the Productive measures of Comox and Nanaimo, but many are distinct. They are either referable to the same horizon with these or to a slightly older one.

Ledge Point is formed of a coarse, nodular sandstone which weathers brownish. From Ledge Point all along the shore to within half a mile of Thomas Point (the south entrance point of Beaver Harbour), low exposures, chiefly of sandstones, with occasional beds of shale, are frequent on the beach. At one place, three miles west of Ledge Point, the sandstone becomes conglomeritic, holding pebbles up to six inches

Former coal mining at Suquash.

in diameter. The angles of dip of these beds are invariably low, seldom exceeding ten degrees, and the direction somewhat inconstant. Thin seams of coal, which appears to be of good quality, are seen in several places along the shore. At Suquash or Sa-kwash, coal was at one time mined by the Hudson's Bay Company, on a limited scale, and I am informed that in all from 9000 to 11,000 tons was obtained. A short tunnel was driven and other exploratory work carried out, which is subsequently referred to. The seams as now visible on the beach at this place, are two in number, the upper being at least one foot, and in places probably two feet in thickness. It is separated by about a foot of soft shale from a lower seam with a maximum thickness of about six inches.

Other local outcrops of coal.

A quarter of a mile south-eastward from the old wharf, two seams, each about an inch in thickness, are seen on the shore. Westward, half a mile beyond False Head, is a seam of five inches thick; and three-quarters of a mile still further west, a coal outcrop of four inches in thickness occurs. Again, near the mouth of the Kī-uk River, two miles from Point Thomas, two seams of six and three inches respectively were found. Thomas Point is composed of the underlying volcanic rocks, but to the west of it, opposite Fort Rupert, on the shore of Beaver Harbour, small areas of sandstones and shales are found dipping off the older rocks. Some plants were collected in these shales in 1878, among which Sir William Dawson has found a *Neuropteris* and a *Salisburia*,* which appear to be of Middle Cretaceous age.

Klik-si-wi River and vicinity.

The Klik-sī-wi River reaches the coast at a point directly opposite the west end of Malcolm Island, and was found by Mr. Dowling, when on an excursion inland from the head of Port McNeill, to occupy a valley to the east of two conspicuous hills marked on the chart. No rock exposures were, however, found till the summit of the southern of the hills above mentioned was reached, and the rocks there seen (trachytes) are probably intrusive. The Klik-sī-wi River was afterwards ascended for about two and a quarter miles from its mouth,

Coal seams.

for the purpose of examining a reported coal seam, which, however, proved to be from two to three inches in thickness only, though overlain by about three feet of coaly shale. The beds were found to be practically horizontal. On another small stream which reaches the sea west of the Klik-sī-wi, at a point about three-quarters of a mile due south of the mouth of the Klik-sī-wi, a prospecting hole was made many years ago. The seam is here about sixteen inches thick, and dips eastward at an angle of about 5°, though the beds else-

* See Trans. Royal Soc. Can., Vol. I., Sect. IV., p. 15.

where in the brook are nearly horizontal. From its appearance and that of the associated beds, the coal here exposed is probably the same with that last alluded to. It further appears quite probable that the coals at Suquash represent a further continuation of the same bed. A short traverse was made by Mr. Dowling up the bed of the stream at Suquash, but without developing any facts of importance or reaching the western edge of the coal-bearing rocks. Like nearly all the streams in the northern part of the island, this is extremely difficult to examine or follow, owing to the thick growth of forest and underbrush and tangled masses of fallen timber.

Rocks on trail toward Quatsino.

A traverse was subsequently made by Mr. Dowling, of a part of the trail from Fort Rupert toward the head of Quatsino Sound. A small stream was reached at about four and a half miles nearly due south from the fort, which flows into the Kī-uk River, and the latter was followed down to the coast. On this small stream and on the river, sandstones occur, and are either horizontal or show very light, irregular eastward dips. Thin streaks of coal were seen at one point on the river, and a new species of *Placenticeras* (described in the appendix) together with casts of a small *Mactra* or *Cymbophora*, were found.

General arrangement of Cretaceous rocks in this vicinity.

The low undulating character of the dips along the coast between Port McNeill and Beaver Harbour, and the existence of several rather considerable intervals in which the rocks are concealed, precludes the possibility of arriving at any accurate estimate of the thickness of the Cretaceous rocks there exposed, or of presenting a complete section of them. It appeared at first probable that the entire thickness was very inconsiderable, but the existence of fossils, which are probably referable to the lowest beds of the Quatsino region, (See p. 84 B, 91 B) in the rocks of one end of this shore-line, (at Fort Rupert), while those at the other extremity, (at Port McNeill), evidently belong to a much higher stage in the Cretaceous, appeared to call for some explanation. On carefully plotting the observed attitudes of the rocks, it became evident, that notwithstanding local irregularities, there is a general tendency to north-west by south-east strikes, while dips in a south-easterly direction also greatly preponderate. A section based on these dips, shows that a total thickness of about 6000 feet of beds may easily occur between Beaver Harbour and Port McNeill, the beds at the latter place being the highest. This would be amply sufficient to account for the difference of horizons indicated by the fossils.

Against this explanation it must, however, be urged, that the thickness of the lowest sub-division at Quatsino (A. see p. 84 B) is probably not greater than 3000 or 4000 feet. There is every reason to think that the section in this contiguous area is similar, and in this case the massive conglomerates of Quatsino (B. p. 86 B) should appear about

midway between the extreme points, or near Suquash, where the Cretaceous beds should be, according to the dips, about 4000 feet thick. No such massive conglomerates are, however, seen, and it is improbable that beds of this character are concealed beneath low parts of the shore. There is, however, at Suquash, a decided appearance of faulting, and on consideration of the facts, so far as known, I am inclined to believe that an extensive down-throw here occurs to the southward along an easterly and westerly line. On the hypothesis, the beds along the shore south of Suquash, are much newer than those to the north, being entirely above the conglomerates (B.) and nearly equivalent to the lowest beds of the Nanaimo and Comox basins, as their contained fossils would indicate. The close lithological resemblance of these beds to those seen near Oyster Bay (p. 17 B) lends countenance to this view, according to which the massive conglomerates seen at one place on Malcolm Island (p. 57 B) may represent a portion of subdivision B., of Quatsino, which here appears at the surface owing to a less throw in the fault to the eastward.

Probable fault at Suquash.

Fault bounding measures to south.

The line of the main fault which bounds the Koskeemo coal-basin to the south, if continued eastward, passes nearly through Port McNeill, and it appears probable that this fault does actually so continue, with a similar extensive downthrow to the north, bounding the Cretaceous rocks in this direction, and accounting for the non-appearance of the conglomerates (B.) and lower beds (A.) at the southern edge of the basin. The occurrence of the small Tertiary volcanic patch of Eel Reef may be in connection with this important fault.

Other conditions.

The facts in evidence are not sufficient to prove the hypothesis above stated, which may, nevertheless, be of use as a guide in the future exploration of the field. The rock met with at the bottom of boring No. 2, at Suquash, (p. 67 B) might be assumed to belong to the Vancouver series, at the base of the Cretaceous, which must, in this case, be quite thin. It is quite as likely, however, that the rock here reached was in reality the top of the massive conglomerate subdivision.

Composition of coals.

As further confirming the view that the beds at Suquash and southwards represent a horizon lower than those to the north, the analyses of coals from the southern and northern parts of this shore-line given on a subsequent page, may be referred to. A fuel from the Kī-uk is a true coal with strong coke, resembling the Coal Harbour specimen, while fuels from Suquash and Klik-sī-wi closely approach lignite-coals in character.

From the above notes, it will be apparent that the extension inland of the Cretaceous coal-bearing rocks, which occupy the shore from Port McNeill to Beaver Harbour, has not been determined. This

must be ascertained by the laborious process of tracing their boundary in the wooded interior. The continuously low character of the country between Klik-sī-wi and Rupert Arm of Quatsino Sound, appears, however, to indicate the probability of a wide area of Cretaceous rocks. Here, as elsewhere in the northern part of Vancouver Island, it appears that the present surface of the country nearly coincides with the old denuded surface of the Vancouver rocks upon which the Cretaceous was laid down. Whether the Cretaceous was originally deposited only in hollows and valleys among these older rocks, or formed a nearly continuous sheet, of which portions still remain only in these hollows, is as yet uncertain. In either case, however, the result is the same, leading to the appearance of the Cretaceous in isolated patches of irregular form, and sometimes in the most unexpected places—so much so, that till every square mile of the country has been systematically examined, it will be impossible to affirm that all existing outliers are known. Those outliers, however, which have the greatest area, and are on or near the shore, are naturally the most important, and these, fortunately, are not so difficult of discovery and definition. It is probable that about four weeks of work inland will be necessary to fix, with approximate certainty, the outlines of the Cretaceous region here specially described.

General features of Cretaceous outliers.

Respecting the probability of the discovery of really important coal seams in this area, little can as yet be said with certainty. Those so far found, are all quite thin. The regularity of the beds, the low angles at which they lie, and the long stretch of coast characterised by them, are all in favour of mining operations, should thicker seams be developed. When it shall become important to determine the coal-bearing character of the rocks, boring operations of a systematic character will have to be resorted to.

Coal deposits.

Through the kindness of Mr. G. Blenkinsop, formerly of the Hudson Bay Company, I have been put in possession of some records of borings already made by that company, in 1852, near Suquash, and at the mouth of the Kī-uk River. These records are signed by Boyd Gilmour, a miner employed by the company to search for coal. They appear to have been kept with some care, but the nomenclature applied to the various rocks is such, as in some instances to leave it in doubt what the beds penetrated actually were. In such cases, the names used in the original logs are retained.

Borings for coal by Hudson's Bay Company.

No. 1. Boring at Kī-uk River, on the beach, about two and a half miles from Fort Rupert.

Boring at Ki-uk River.

	FEET.	INCHES.
Gravel and shingle	7	6
Hard confused sandstone	16	7
Dark grey freestone	12	6
Dark scaly tile coal	1	6
Grey freestone	11	0
Freestone, flakes dark coloured	5	6
Grey, hard sandstone	29	4
Dark coloured clayey stuff	1	3
Grey flagstone, "with dougars and kingle plays"	23	4
Dark coloured stuff with coaly streaks	1	3
Dark freestone	10	6
Dark sandstone	60	2
Whin	..	2
Total	180	7

Boring at Suquash.

Boring No. 2 was made at Suquash, on the beach, below a "cliff or scar." It is stated that the section in the cliff should be added to that obtained in the hole. The cliff section is as follows, according to Gilmour's notes:—

	FEET.	INCHES.
Brownish freestone	10	0
Grey shaly stuff	13	5
Good coal	0	5
Brownish freestone	18	0
Good coal	0	4
Freestone, in which the boring commences	10	0

Boring No. 2, is then given as follows:—

	FEET.	INCHES.
Freestone	6	0
Grey, soft sandstone	21	5½
Hard freestone	1	4
Soft freestone	0	10
Coal parting	..	..
Coarse fire-clay	0	5
Grey shaly or clayey stuff	7	3
Hard freestone	3	4
Hard freestone, confused	1	3
Soft clayey stuff, with white balls	6	3½
Soft, grey flakey stuff	2	11
White, soft stone, with soapy feel	2	11
A coaly stone	1	11
Grey flaky material	5	10½

	FEET.	INCHES.
Flaky freestone	6	0
Dark grey freestone	12	0
Very hard confused rock	0	8½
Very hard stone	1	8
Dark grey freestone	0	10
Hard, bluish-green stuff	2	6½
Very hard stone	0	7½
Very hard confused rock	1	10½
Grey freestone	2	9
Dark clayey sandstone, without partings	6	1½
Grey freestone	3	2½
Very hard confused rock	2	3
Grey freestone	2	9
Dark grey clayey sandstone	2	4
Dark grey stuff	5	8
Hard grey freestone	3	10
Hard grey freestone	12	4
Hard white stuff	6	5½
Dark clayey stuff	0	1½
Whitish hard stone	3	8
Hard freestone	3	1
Hard, dark freestone	3	9
Dark clayey stuff	4	2
Dark grey clayey stuff, without partings	3	9
Dark and a little more clayey	1	7
Hard freestone	0	4
Light grey clayey stuff	1	0
"Dougar plays"	2	6
Greenish-blue clayey stuff	2	5½
Dark clayey stuff	1	5
Very dark stuff	2	1
White, soft freestone	5	9
Very hard freestone	3	0½
Soft freestone	8	6
Grey clayey stuff	6	10
Grey clayey stuff, without partings	3	5
Sandstone full of boulders (nodules?)	4	6½
Similar, but darker coloured	1	9
Dark coloured stuff, some coaly streaks	4	11
Dark rock, "Dougar plays"	10	0
A dead grey coloured sandstone. The only change in this stuff is from a lighter to a darker colour	60	9
Very hard, green whinstone, much mixed with white spar	2	0
Total	329	4½

Boring No. 3. This boring was, according to Mr. Blenkinsop, about two miles inland from Suquash, and, on the hypothesis previously Boring near Suquash.

stated, must be to the north of the Suquash fault and in beds equivalent to subdivision A., at Quatsino.

	FEET.	INCHES.
Whitish clay, sand and shingle, alternating	31	6
Grey flakes	25	6
Soapstone	1	0
Dark grey stuff	3	0
Light-coloured soft freestone	3	0
Confused soft sandstone	0	10
Hard, greenish stone	3	6
Dark, sandy stuff, with coaly streaks	2	6
Light-coloured freestone	5	5
Confused sandstone	5	5
Confused sandstone, not so hard, and darker	8	0
Dark freestone	19	8
Dark slaty stuff	21	6
Dark clayey stuff	1	10
Clean coal	0	4
Coarse fire-clay	2	8
Greyish freestone	9	10
Light-coloured freestone	15	0
Greenish sandstone	16	9
Dark-coloured stuff, with coaly streaks	1	3
Clayey stuff	5	11
Spotted or mixed freestone	2	8
Dark clayey stuff	2	5
Dark scaly stuff, with coaly streaks	5	6
Dark grey sandstone	18	1½
Dark clayey stuff	2	5
Dark greyish sandstone	27	8½
Dark clayey stuff	3	6
Dark grey sandstone	2	3½
Dark clayey stuff, slight coaly streaks	5	4½
Light-coloured sandstone	1	0
Grey shaly clay	16	3
Dark grey sandstone	10	10
Dark grey dead stuff	1	11
Hard, grey sandstone	0	11
Total	285	4

Remarks on borings.

Of Boring No. 1., it is remarked that an open "cutter" was struck in the whin, which yielded a great quantity of salt water, though the bole was begun a six or eight feet above high-water mark. This hole was abandoned owing to the loss of the boring rods. As no description of the "whin" in which it terminated is given, it remains uncertain whether the Cretaceous rocks were completely passed through, though from the proximity of the older rocks to the Kī-uk River, it is not improbable that this was here the case.

Boring No. 2., at Suquash, has already been referred to on page 64 B. It may have ended in the massive conglomerates, of subdivision B., of Quatsino.

The result of these borings must certainly be considered as unfavourable to the view that the Cretaceous, in this part of its extent, includes coal-seams of importance. There is, however, it may be added, a persistent rumour that a coal-seam, six feet in thickness, was reached at Suquash, but not reported, owing to the wish of the men engaged to discontinue operations at this place. Under the circumstances, little weight can be given to such a report. If further work should be contemplated in this region, I should be inclined to advise an experimental boring on the south shore of Malcolm Island, at the locality of the occurrence of the conglomerate. This would test an entirely new portion of the field.*

The following assays of coals from three points on the coast between Port McNeill and Beaver Harbour have been made by Mr. G. C. Hoffmann in the laboratory of the Survey.

Assays of coals.

From small seam of coal on stream about three-quarters of a mile south of mouth of Klik-sī-wi River. This coal produces a coherent but tender coke, and is considerably acted on by a solution of caustic potash.

Hygroscopic water	3·65
Volatile combustible matter	42·23
Fixed carbon	39·84
Ash	14·28
	100·00

From Suquash. This coal yields a moderately firm coke, and is considerably affected by a solution of caustic potash, yielding a brownish-yellow colour, like the last.

* Dr. W. F. Tolmie, in 1835, was the first to make known the occurrence of coal on this part of the coast, this being also the first discovery of coal on Vancouver Island. See Bancroft, History of British Columbia (1887), p. 186, and Tolmie's statement, given as a foot note in the same volume (p. 189). Bancroft closely follows Grant in his account of the early exploration of the coal, but falls into error with respect to Port McNeill and Beaver Harbour, which he regards as alternative names for a single place. This is clearly shown by the latitudes quoted by him on p. 189, which are correct and not erroneous, as he assumes. The original coal mine was at Suquash, to which Port McNeill was the nearest convenient and safe anchorage. Fort Rupert was afterwards (1849) founded at Beaver Harbour, which then became the chief point of call. Ellenborough Promontory (p. 191) is evidently Ledge Point, and Bailie Hamilton's Bay is near the position of Suquash. There is also some confusion as to the dates between which systematic exploration of the coal was carried on by miners imported by the Hudson's Bay Company. The work occurred between 1849 and 1851, according to Bancroft; but that it was continued till 1853, is shown by the fact that the original record of boring No. 2 at Suquash (communicated to me by Mr. G. Blenkinsop) states the progress of each day's work, beginning on Monday, October 30, 1852, and ending July 8 (1853?). Though it is impossible now to locate the places described by Grant as those at which work was done, it is evident from the details which he gives, that several trial shafts and borings, besides those of which I have been able to obtain records, were made.—See Description of Vancouver Island, by W. C. Grant, Journ. Royal Geog. Soc., Vol. XXVII. (1857), p. 275.

Hygroscopic water	5·03
Volatile combustible matter	41·51
Fixed carbon	46·52
Ash	6·94
	100·00

From a thin seam at Kī-uk River. This coal yields a firm coherent coke, and is scarcely affected by a solution of caustic potash.

Hygroscopic water	3·68
Volatile combustible matter	39·29
Fixed carbon	47·03
Ash	10·00
	100·00

Beaver Harbour to Shushartie Bay.

Rocks of Hardy Bay.

With the exception of the Cretaceous outlier on the beach opposite Fort Rupert, the rocks seen along the shores of Beaver Harbour, and on the islands off it, belong exclusively to the Vancouver series, being generally dark greenish, altered volcanic materials, and occasionally evident altered amygdaloids. The general dip appears to be south-eastward, at angles of 40° to 45°.

Rocks of Beaver Harbour.

Hardy Bay, which is separated by a narrow hilly promontory from Beaver Harbor, is also chiefly bordered by the volcanic rocks of the Vancouver series. These rocks show dips to the south or south-east in a few places, at somewhat lower angles than the last, from which they also differ in the notable prevalence of reddish and purplish beds.

Cretaceous outlier.

At the bottom of Hardy Bay, on the west side, the shore is occupied, for about a mile and a half, by Cretaceous rocks, forming an outlier on the older series. These rocks are chiefly soft, greyish sandstones, which sometimes become pebbly, and pass into true conglomerates. They form flat exposures along the beach, chiefly between high- and low-water marks, the total thickness seen being very small. A small

Wa-ki-law River.

stream, known to the Indians as the Wa-kī-law, was followed up for a distance of over a mile, for the purpose of ascertaining the inland extension of this outlier. The beds are at first flat, or dip seaward at nearly the slope of the bed of the stream. Again, further on, they undulate at various low angles, and were eventually found dipping seaward off the surface of the older rocks. The appearance is, however, that of an unconformity by overlap, the bottom beds of the Cretaceous being probably not seen, even at the line of junction with the crystalline series. The same thing doubtless occurs at Fort Rupert, the Cretaceous sandstones having filled hollows on an irregular surface,

and having been since largely removed by denudation. The older altered volcanic rocks, where seen below the Cretaceous, are somewhat decomposed and soft, easily broken with the hammer, and shaling off along jointage planes, etc. They are very different in appearance from those exposed along the present shore, which are usually hard, and often quite smoothed by glacial action.

Several years ago, Mr. John McAlister carried out some small prospecting operations, for coal, on this Cretaceous outlier. Some holes were sunk on the beach, but to an inconsiderable depth, and without finding any coal.

The Wa-kī-law River, according to Indian report, rises in a lake nearly a mile in length, at a distance of about three miles from the shore.

Kowat-se River.

The Kowat-se (or "West-side") River, which enters Hardy Bay, at the head, in the south-west angle of the shore, is a larger stream than the last, having a flood-water channel of 100 to 150 feet in width. It is reported, also, to rise in a lake, which is said to be of considerable size. For about a mile and a half from its mouth, which was the extent of my examination of it, it is blocked with heavy masses of fallen and drift timber, and the land bordering it is all low. The Cretaceous rocks forming the edge of the outlier last described, probably underlie the mouth of this river, but are concealed, and must be quite narrow, as a short way up stream, the rocks of the older series are seen. Three-quarters of a mile from the shore, a small detached outlier of coarse Cretaceous conglomerates appears, with a width of about quarter of a mile. The altered volcanic rocks are seen both above and below this patch, the existence of which shows how probable it is that numerous outliers, as yet unknown, may occur at a distance from the shore in this part of Vancouver Island.

Grass land.

At the head of Hardy Bay is a salt marsh, with an area of about eighty acres, covered with good grass. In the vicinity of this bay, and southward from Beaver Harbour, there are considerable tracts of low, level land, all now heavily timbered, but which may eventually be reclaimed for agriculture.

South shore of Goletas Channel.

From Duval Point, at the west side of Hardy Bay, to Shushartie Bay, a distance of fifteen miles, the coast of Vancouver Island was examined by Mr. Dowling. This shore, which forms the south side of Goletas Channel, is almost perfectly straight, and is throughout very bold and rocky, with small sandy beaches at a few places. It is bordered by a series of hills and low mountains, which exhibit remarkably uniform conical forms. The channel evidently follows an important structural break of some kind, which is parallel in direction to the northern part of Quatsino Sound, and nearly coincides with the general

strike of the beds, so far as this could be ascertained. The rocks belong entirely to the Vancouver series, and present no features worthy of special note. They consist, for the most part, of dark green, altered amygdaloids and agglomerates, which look nearly black at a distance.

Hope and Galiano Islands, and the Gordon Group.

Hope Island. With the exception of the shores of Bull Harbour, which were examined by me while detained there by gales in the autumn of 1878, the following notes on Hope Island, are due to Mr. Dowling. The north-eastern shore is bordered by dark-coloured rocks which appear to be much altered felsites, and probably form a continuation of the altered volcanic materials of the north part of Galiano Island. The greater part of the eastern portion of Hope Island, together with the western extremity of the western portion, is composed of rocks of the granitic series, which seem, however, often to be darker in colour than usual.

Bull Harbour. With the exception of granitic dykes, the shores of Bull Harbour and the south coast on both sides of it, for some distance, are composed of rocks of the Vancouver series, amongst which flaggy argillites are largely represented, of which the felspathic beds at times become almost gneissic on approaching the granites. The general strike of these rocks is about north-west. In my notes of 1878, the rocks of Bull Harbour itself, are said to consist of hard felspathic materials, probably altered ash-beds or felsites, pale in colour, but weathering to a bronzed surface. These are generally pretty well bedded, though sometimes brecciated, and pass into hard, blackish, much fractured argillites, in which no fossils could be found. In a few places, the rocks are nearly horizontal, but they are generally much disturbed, turning up suddenly at all angles, and also violently flexed and crumpled. There are many small faults, some of which are parallel to the direction of the harbour, which is probably due to the weathering out of the rocks described along one or more of these lines of fracture. Bull Harbour, has evidently at one time been a passage, separating Hope Island into two parts. It is now closed at the north end merely by gravel deposits, which have been banked up by the action of the outer surf.

Outlier of sandstone. In the wide bay at the east end of Hope Island, directly opposite Vansittart Island, there is on the beach, overlying the granitic rocks, a small outlying patch of grey and yellowish soft sandstones, nearly horizontally bedded, and probably referable to the Cretaceous, though no fossils more characteristic than broken shells of *Ostrea* were found in them.

North-west shore of Galiano Island. The greater part of the north-west shore of Galiano Island is composed of granitic rocks, which generally show two varieties of felspar,

one being of a pinkish colour. They are charged with numerous dark fragments, which, in some places, form about half of the entire mass. Opposite the north-east end of Vansittart Island, there is a small connected area of fine-grained, blackish, hornblendic rock, in character precisely resembling that of the fragments above alluded to. No bedding could be made out, but I feel little doubt that this represents a much altered included portion of the Vancouver series. At the same place, is a small stream, which, according to Indian report, drains a long lake, occupying a valley which runs toward the head of Port Alexander. Vansittart Island is low, and formed of dark rocks, evidently, of the stratified series, but was not visited.

The island in the centre of the bay at the north end of Galiano Island, is composed of granite, but the bottom and east shore of the bay, together with the north extremity of Galiano Island, is composed of dark, flaggy argillites and quartzites of the character already frequently described, but here interbedded with thin grey-blue limestones. The whole forms a series of compressed folds, with a strike of about S. 35° E. On the north-east shore of the island are similar flaggy argillites, interbedded with volcanic materials, some of which are evidently altered amygdaloids, and generally dip north-eastward at high angles. At the extremity of the point which forms the east side of Port Alexander, similar argillites are found interbedded with hard grey sandstones, which pass into quartzites. The shores of Port Alexander are chiefly of argillites, which, in some places, become quite thin and slaty, and yielded a couple of obscure fossils, one of which is, however, probably referable to *Belonites Vancouverensis*. The rocks are either vertical, or have a very high north-eastward dip, with a persistent strike of N. 35° W. They evidently run through on this strike from the north end of Galiano Island.

North-east shore.

Port Alexander.

For over a mile west of Port Alexander, on the south shore of the island, are greenish and grey altered volcanic materials, which must underlie the argillites. Further west, the granitic rocks form the greater part of the shore, though two much altered and disturbed patches of flaggy argillites and quarzites also occur. These, at one place, a mile and a half from the west end of the island, include a rather thick bed of bluish impure limestone, which is interbedded with quartzite, and dips inland from the shore, or northward, at an angle of about 30°.

South shore.

Balaklava Island, which adjoins Galiano Island on the east, appears to be almost entirely composed of the flaggy argillites and associated rocks, with probably some altered volcanic materials. The strike is in general parallel to the longer axis of the island, but this, together with the angle of dip, is somewhat variable. Large exposures of greyish limestone, dipping S. 87° E. $< 60°$, appear on its west side, near the north point. The south point is composed of sandstone, like that of the east

Balaklava Island.

point of Port Alexander. The limestone above mentioned, probably conformably overlies the argillites of the west part of Galiano Island.

Hurst Island. The whole southern part of Hurst Island is composed of grey granite, which is usually of the ordinary hornblendic character, but in some places contains a considerable proportion of black mica. Its northern side is formed of flaggy argillites, which are often altered to true lydian-stone. These are interbedded with calcareous layers, and occasionally hold calcareous concretions. Felsites of grey tints also occur, and are apparently interbedded. The dip of these beds is from S. 28° E. to S. 43° E. at an angle of about 40°, and they appear to form the north-east side of a synclinal, repeating the beds of the north-east shore of Galiano Island.

Bell and Heard Islands. Bell and Heard Islands are in the line of strike of the rocks last described, and are similar in character, with dips in the same south-westward direction. Duncan Island was not visited, but appeared also to be formed of similar dark-coloured rocks.

Miles Cone. The small islands between Heard Island and Miles Cone, are masses of altered volcanic rocks, which in some places are evidently agglomeritic or amygdaloidal. On the west side of Miles Cone, which forms a remarkable land-mark, rising steeply to a height of 380 feet, bluish-grey, fine-grained felsitic rocks are interbedded with flaggy argillites, with a dip of S. 25° W. $< 45°$. No granite was seen in these small eastern Islands of the Gordon Group.

Walker Islands. The Walker Islands, lying in the middle of Queen Charlotte Sound, were not visited. From a small island, near the north-west end of this group, a very rich specimen of magnetic iron ore was given to the late Mr. James Richardson. Owing to their exposed position, these islands can be visited only in fine weather, and the time at my disposal did not suffice to enable me to examine them.

General note on islands north of Goletas Channel. The islands to the north of Goletas Channel, of which the geological features have just been noted, are in general densely wooded, wherever the surface is not composed of bare rock. Owing, however, to their exposed situation, the trees are of inferior size and quality. The most prominent hill is Mount Lemon, on Galiano Island, with a height, according to the chart, of 1200 feet. Drift deposits occur here and there in sheltered places, forming small, low terraces. The only permanently inhabited Indian village is that known to the whites as the Nawitti village (Mēl-oo-pa of the Indians), and is on the south-east shore of Hope Island. At this place there is a good anchorage for small vessels, in Nawitti Cove, which is outlined on the charts but not surveyed. The strong tidal currents running past its mouth render it, however, rather difficult of entrance.

In reviewing the general geological features of these islands, we cannot but be struck with the fact that the granitic rocks of this vicinity are confined to them, and do not occur on the opposite shore of Vancouver Island. In the occurence near the line of junction of these rocks and those of the Vancouver series, of the flaggy argillites and associated limestones, and in the existence, along the same line, of a straight and deep channel (here Goletas Channel), the conditions observed further south, about Johnstone Strait, are repeated.

Shushartie Bay to Cape Scott.

Shushartie Bay to North-west Nipple.

From Shushartie Bay, the coast-line runs westward twenty-two and a half miles, to Cape Scott, the north-western point of Vancouver Island. It is in general low, with rocky points, which separate wide, sandy beaches. No hills of great height exist in the northern extremity of the island, and the bottom shoals gradually for several miles off shore. Many parts of this shore are laid down very imperfectly on the charts. From Shushastie Bay, to a bay three miles beyond Cape Commerell, the rocks of the coast are entirely altered volcanic materials, which repeat the characters of those observed to the east of Shushartie Bay. They are generally greenish in colour, and often evident altered amygdaloids, with southward dips at angles of 30° to 50°, wherever the attitnde could be ascertained. Near North-west Nipple, and elsewhere, whitish, felspathic dykes, which weather red from contained pyrite grains, are seen cutting the rocks.

The rock at North-west Nipple is dark greenish-grey in colour, and very compact, and probably represents an altered lava. In composition it was found, on microscopical examination, to be a decomposed diabase.

Coast west of North-west Nipple.

Between North-west Nipple and the bay just referred to (for which no name appears on the chart), the strike of the beds gradually changes to a north-westward direction, the dip being to the south-west. On the east and west sides of the bay, inside the entrance points, granite appears, and it probably continues round the bottom of the bay also, though no exposures are here seen on the beach. The granite here differs somewhat from that usually found, and resembles in appearance and mode of occurrence that described on Nimpkish Lake. It may in both cases be regarded as probably of intrusive origin, and lies to the west of the general line of junction of the granitic and Vancouver series, the phenomena connected with which are elsewhere discussed.

Two streams, known to the Indians as the Ya-kwan and Kao-sa-a, respectively enter this bay. The first mentioned is the more important and is esteemed a good salmon river. The Indians occasionally travel across from here to the West Arm of Quatsino Sound, and as the

distance of thirteen miles in a direct line is said to be made in one day, the trail must be an exceptionally good one for Vancouver Island.

Synclinal.

West of the granitic intrusion above described, the green, altered volcanic rocks resume, and about a mile further on, in the second of two small, shallow bays, there is a regular ascending section, with south-westward dips, at angles of 20° to 40°, showing a great thickness of limestone, argillites, sandstones, etc., overlying the volcanic rocks. From smaller exposures seen in the next long sandy bay, it is probable that this forms one half of a synclinal, the greenish, volcanic rocks again coming to the surface near the position of Nahwitti Cone of the chart. I was unable to give this part of the coast as detailed an examination as its geological interest seems to merit, in consequence of the heavy sea, which was at the time rolling in upon it, but the main features appear to be as follows.

Probable sequence of rocks.

The greenish and greenish-grey, hard, felspathic, volcanic rocks are followed, apparently in regular ascending order, by massive greyish-blue, cryptocrystalline limestone, which occasionally becomes almost a marble, and is often cherty. This is cut by pale-grey, red-weathering, felsite dykes, and must be several hundred if not a thousand feet in thickness. Above this is a considerable thickness of hard, bluish, flaggy limestones, interbedded with calcareous argillites, black, flinty argillites and felsites, and holding in some layers a few fossils, amongst which *Halobia Lommeli*, and *Arcestes Gabbi*, have been recognised by Mr. Whiteaves. These rocks are followed by very hard, greenish, calcareous sandstones, with some softer, yellowish layers, the whole closely resembling the sandstones of the east side of Port Alexander, before noticed. Above these is a considerable thickness of rocks, apparently for the most part very hard, grey sandstones, passing into quartzites, and weathering red, from contained dolomitic matter.

Thickness of limestones and argillites.

The thickness of the entire mass of ordinary sedimentary rocks here overlying the altered volcanic materials must be in the vicinity of 2500 feet. The series, as a whole closely resembles that seen, but less perfectly, on Nimpkish Lake, and almost exactly reproduces the section measured in 1878, in Section Cove, Queen Charlotte Islands. The age of the upper portion at least of the limestones is definitely shown to be that of the Alpine Trias by its contained fossils.

Coast from Nahwitti Cone to Cape Scott.

From Nawitti Cone to Cape Scott the coast is chiefly composed of altered volcanic rocks, which are often distinctly amygdaloidal, and not infrequently show reddish tints. The dips are rather irregular, and no well-marked sequence could be made out. Four and three-quarter miles east of Cape Scott, a well-stratified band of grey limestone, about thirty feet thick, runs across a low point. It is interbedded with the volcanic rocks, being underlain by amygdaloids and agglomerates, and

overlain by an amygdaloid. An amygdaloid, holding thin layers of limestone is again seen on the west side of a bay, two and three-quarter miles east of the cape. Further east, in the same bay, (which, as shown on the chart, is very much too deep) isolated exposures occur on the beach near low-water mark, of hard, greenish-grey, calcareous sandstone, which in some layers contains fragments of *Inoceramus*, or some similar shell, with a pronounced prismatic structure. Similar exposures of sandstone again occur in the next shallow bay, a mile and a half east of the cape. The lowest thin bed of the sandstones at this place, is an arkose-like rock, largely made up of crystalline grains of red felspar. It is highly calcareous, and rests upon a very rough brecciated surface of the greenish volcanic rocks, into the fissures and crevices in which crystalline calcite has penetrated. The exposures are again on the beach, near low-water mark. The sandstones of this and the last mentioned place are believed to represent outliers of the Cretaceous, though it may be to some extent doubtful whether they should not rather be classed with those above described as conformably overlying the limestones of the Vancouver series.

Calcareous ash-rock with fossils.

A rock having a somewhat unusual appearance was collected at a point on the coast one and a half miles east of Cape Scott. Macroscopically, it had a granular character, and showed some evidence of stratification. It is of a dark greenish-grey colour and is blotched with leek-green patches of some chloritic mineral. This rock proved, on microscopic examination, to be an evident volcanic ash, containing angular fragments of orthoclase and triclinic felspars, not much decomcomposed, together with calcite and chloritic matter. Organic remains are further distinctly visible in it, consisting of pieces of crinoidal columns and one fragment which is apparently part of the spine of some echinoderm. Taken in connection with the interbedding of limestones and volcanic material previously described, this more intimate mingling of the same classes of materials is a point of interest, which could not have been determined by any superficial examination of the rock, and was not even suspected till it was placed beneath the microscope.

Terraces.

In some of the bays along the shore of Vancouver Island, between Shusharte and Cape Scott, there are terraces of sand and gravel deposits about fifty feet in height, but no true boulder-clay was seen in these. Iron ore, and iron sands containing gold, have been reported on this part of the coast, but on insufficient evidence. On the sandy beach of the bay east of Cape Commerell, and elsewhere, magnetite sand occurs in the form of layers a few inches thick, on the beach, but is not in sufficient quantity to be of economic value. The gold which has been reported doubtless occurs in this, as 'colours' can be

Reported iron and gold.

found in almost any magnetic sand along the shores of the island, though in washing a small quantity of the sand from this place, none were actually met with. In the Vancouver Island Pilot* p. 175. Nahwitti or Nawitti Bar is is said to be a ledge of "sandstone formation," but as no part of the bar is exposed at low water and no sandstone is seen on the adjacent shore, I am at a loss to know how the facts as to its composition have been obtained.

Low land.

The low character of the country, for a long way back from this part of the coast, affords reason for the belief that there is here a considerable body of land which may eventually be utilized for agriculture. There is also probably a considerable quantity of good timber in this low tract, though that seen near the shore was wind-shaken and inferior. Having heard reports of a lagoon with open grass lands running across to the east of Cape Scott, I delayed long enough to visit it. It is reached by a trail, from the bottom of the bay five miles east of Cape Scott, and also by a second trail, three miles east of the same point. By the last mentioned trail, it is distant from the shore about half a mile, the intervening country being low and thickly wooded. The lagoon opens in a bay, three and a half miles south of Cape Scott, on the west coast, and when afraid to pass round the cape—which in bad weather is much dreaded—the Indians occasionally portage their canoes to the lagoon for the purpose of reaching this coast. The lagoon, which is narrow, is bordered by muddy flats, a quarter of a mile or more in width and all subject to overflow at exceptionally high tides. They are well covered with coarse grass, and a considerable area might be reclaimed for agriculture by dyking the mouth of the lagoon, which would not be a very difficult operation. Further inland, on streams flowing to the lagoon, the Indians report somewhat extensive open, grassy flats, which are resorted to by the elk or wapiti. The Indian name of the lagoon is Kī-kī-tlum or the "grassy place."

Lagoon.

Scott Islands.

Cox, Lanz, East and West Hay-cock, and Triangle islands, which together with several smaller rocks from a chain running in a westward direction from Cape Scott, for about thirty miles, were not visited. It is indeed only under the most favourable circumstances that they can be reached by canoe or boat on account of their extremely exposed position.

Cape Scott to Quatsino Sound.

Cape Scott.

The rocks of Cape Scott and of the west coast southward to the western mouth of the lagoon (Na-kum-kilis of the Indians), essentially resemble these of other parts of the Vancouver series, being chiefly amygdaloids, with quartz filling, well bedded ash rocks, and compact felsites, but differ in the prevalence of reddish tints and in

* Admiralty, London, 1864.

their often less highly altered appearance. The general dip is about W. $< 30°$, and the whole series is much shattered by jointage-planes and cut by innumerable little dolomitic veins, which weather to bright yellow tints. The appearances tend to show that the volcanic rocks have here been changed and reddened by hydrothermal or solfataric action.

From the last locality southward to Sea-otter Cove, the rocks are generally similar in character, and have at first a similar attitude. The strike, however, before reaching Cape Russell, turns more to the east, and the rather massive beds are affected by flexures, dipping sometimes to the northward and sometimes southward. Near Cape Russell, reddish tints are not so prominent, and reddened portions of the formation were here observed to be irregular and not conformable with the strike, thus affording evidence that the reddening is often, if not in all cases, due to subsequent action. Dolomitic veins are uniformly abundant in the reddened rocks. Cape Russell.

On the east side of Sea-otter Cove are blackish Monotis shales, containing intercalated thin beds of amygdaloid, and becoming interbedded at one end of the section with tufaceous layers, some of which resemble ordinary sandstone in appearance, and are associated with beds of fine agglomerate and lenticular limestones—the whole proving, in the most conclusive way, the inter-relationship of the volcanic rocks and the argillites. Tufaceous rocks, like these here described, were seen in the bay north of Sea-otter Cove, and the associated argillites are doubtless there concealed beneath a low beach. From Sea-otter Cove southward, the argillites and tufaceous rocks run across the narrow neck which separates the cove from San Josef Bay and are again seen on the continuation of the same line of strike in the middle of the south shore of the bay, where they appear to run out in a series of shallow folds on the volcanic rocks. This outcrop of the argillites may thus be said to be traceable continuously for about four miles, but the observed dips were so conflicting that it was impossible to determine their position relatively to the volcanic rocks flanking them on both sides. It appeared most probable, however, that they form an irregular anticlinal, which runs to the southward, the small cove just inside the south entrance of San Josef Bay being again occupied by the argillites, with westward dips. In this case, a rough-weathering agglomerate, which occupies the intermediate portion of the shore of the bay, would underlie the argillites, while the reddish felspathic rocks of the south entrance point and of the vicinity of Cape Russell would overlie them. Sea-otter Cove. San Josef Bay.

From San Josef Bay to Cape Palmerston, and thence to Raft Cove, the shore is continuously occupied by altered volcanic rocks, partly Cape Palmerston.

reddened and in part of the usual greenish and blackish colours. Some of these are evident agglomerates, while others are massive felspathic materials of uncertain origin. All the rocks along this part of the coast are terribly shattered by pointage-planes—so much so, indeed, that it is often almost impossible to break out a shapely hand specimen.

Raft Cove.

On the north side of Raft Cove, near the entrance point, flaggy argillites, rather greyer than usual in colour, and associated with agglomerates and other volcanic materials, again appear, with a very regular strike S. 30° E. and north-eastward dip at angle of 60°. Resting upon these, just at the north entrance point, is a small isolated patch of greenish sandstones, unconformably superposed and full of rounded pebbles of the volcanic rocks of the Vancouver series. Some layers contain masses of *Aucella Piochii*, proving the identity of horizon with the Aucella sandstones of Quatsino Sound, subsequently mentioned.

Cretaceous outlier.

Raft Cove to Quatsino Sound.

From Raft Cove southward to Quatsino Sound, a distance of eleven miles, the rocks of the coast, though closely examined, presented no new features requiring special mention. Though considerably flexed and with rather irregular dips, the shore appears in the main to follow the strike. The materials are entirely volcanic in origin, with greenish, greyish, blackish and reddish tints, and vary in texture from agglomerates to fine-grained felsites, some of which are reddish and slightly porphyritic. Considerable beds of amygdaloid are also included in the series. The shore is almost uninterruptedly compsed of solid rock, forming a rough, iron-bound coast-line, which only at rare intervals shows a little creek or cove capable of affording shelter to boats or canoes.

Lithological characters of specimens.

A few typical rocks of the Vancouver series, selected from those collected on the west coast between Cape Scott and Quatsino, were subjected to a preliminary miscroscopical examination, with the following result:—

No. 360. Three and a half miles south of Cape Scott. A dark brownish-red, minutely porphyritic, compact rock. Proved to be a felsite, the porphyritic felspar being orthoclase.

No. 360 *b*. Same locality as above. A purplish-grey, rather slaty rock, with minute green spots. This is a fragmental, felspathic rock, much decomposed, and containing a quantity of some green chloritic mineral.

No. 362. Coast five miles south of Cape Scott. A dark reddish-brown, compact rock. This is a finely porphyritic diabase, considerably decomposed, and might be classed as a melaphyre.

No. 387. Coast one mile north of Top-knot Point. A dark brownish-grey, distinctly porphyritic rock. This is a felsite, the porphyritic felspar being orthoclase in Carlsbad twins.

No. 390. Coast two miles south-east of Top-knot Point. A greenish-grey, speckled rock, of rather pale tint, is too much decomposed for recognition, but is chiefly formed of decomposed felspar, with chloritic matter.

General character of coast.

The distance from Cape Scott to Quatsino Sound is twenty-six miles, the general direction of the coast being nearly straight, and running north-north-west by south-south-east. It is indented by a number of bays and coves, but the only one of these which constitutes a passable harbour is Sea Otter Cove, and this, in consequence of its narrow opening with a number of rocks near it, and the strong tidal currents running past it, would be difficult of entry by a vessel without steam-power. This whole coast is much bolder in character than that to the east of Cape Scott, and in most places rises steeply from the water's edge, into hills, many of which exceed 1000 feet in height. These are generally densely wooded, but bare, dead trees are seen in great abundance almost everywhere, standing among those which are still living. This is not the result of forest fires, but is probably caused by the very heavy storms to which this unprotected coast is subject, in consequence of which, also, most of the timber is stunted and crooked. Further inland, and particularly in the valleys which must exist there, timber of a much better character is doubtless to be found. The coast is, in some places, fringed with low, rocky reefs, which extend far seaward, and upon which the long swell of the Pacific never ceases to break with fury. Behind these are generally sheltered nooks, known to the Indians, into which canoes can be run safely, even in heavy weather. Other parts of the shore, not protected by such fringing reefs, are cut into pillars and 'stacks,' or the cliffs are arched out by the sea into caves and grottoes. A shore of this character generally presents numerous little sandy or gravelly beaches, most of which are, however, exposed to the full force of the sea. Larger stretches of sandy or gravelly beach, are found in San Josef Bay, Raft Cove, Open Bay, and elsewhere. No permanently occupied Indian villages are now to be found on this part of the coast, though several old village sites were observed, and there are rude huts at one or two places, to which the natives resort for halibut fishing.

Quatsino Sound.

General description.

This inlet, which is the north-westernmost of those by which the outer Coast of Vancouver Island is dissected, is also one of the longest, and most complicated in outline. It penetrates the island in an easterly direction for over twenty-five miles. The description of its dimensions and form, given in the Vancouver Pilot, 1864, p. 242, can scarcely be

improved on for brevity, and is as follows:—"The breadth at the entrance is nearly six miles, narrowing to less than a mile at five miles within; the sound then runs in a north-easterly direction, (mag.) nearly straight for thirteen miles, when it branches off in two arms, one extending to the south-east for twelve miles, and terminating in low land; the other arm lies to the northward of, and is connected with the Sound by a straight, narrow pass, [Quatsino Narrows] about two miles long; its length is twenty-two miles in an east and west direction, and the eastern extreme, Rupert Arm, is only six miles distant from Hardy Bay on the north-east side of Vancouver Island; the western part terminates within twelve miles of San Josef Bay on the outer coast. Just within the entrance of the sound, on the north side, is Forward Inlet, about six miles long in a northerly direction, in which are the best anchorages of the sound."

Character of shores.

The shores of Quatsino Sound are in general rocky and bold, with mountains or high rocky hills, rising steeply from them. There is, however, a somewhat greater extent of sandy and gravelly beach than occurs in most of the inlets of the coast, and the mountains are not so closely crowded together as in many parts of Vancouver Island, there being considerable intervening tracts of lower land, and wide valleys of which the terminations are not known, running back from its shores. Somewhat extensive areas of low country border the shores of Winter Harbour, at the head of Forward Inlet, and a wide tract of country characterized by low rounded hills, exists on the south shore of the main inlet west of Limestone Island, while other important low areas are found near Hecate Cove, Coal Harbour and Rupert Arm. The quantity of good timber on these must be very considerable, and toward the upper part of the sound, the Douglas fir—which is not seen along the outer coast of Vancouver Island—re-appears.

Indian villages.

Forward Inlet is the particular territory of the Quatsino or Kwatsi-no tribe, whose village is on the east side, opposite Robson Island. A second village which these people inhabit at certain seasons, is near the head of Winter Harbour, and is named Tē-nā-ate. The present Koprino or Keaw-pēno village is on the east side of the harbour of the same name. It is known as Ten-as-kuh ("plenty cedar-bark,") and is the old summer village of this tribe. The site of their old winter village, now abandoned, is five and a half miles further east, and is named Bēce. These people have, however, now almost ceased to maintain their existence as a separate tribe. The main village of the Koskeemo or Kōs-kīmo tribe, known as Whatē-ēs is at Turn Point, at the entrance to Quatsino Narrows. These people have also a summer village opposite Koprino Harbour, where indicated on the charts, which is named Mā-ātē. There are, besides these, several other abandoned village sites in different parts of Quatsino Inlet.

Forward Inlet.

The shores of Forward Inlet are chiefly composed of rocks of the Vancouver series, but in part also of Cretaceous sandstones. On the east side of Robson Island, and on the shores of the point to the north, which separates the main inlet from Browning Creek, there are extensive exposures of the flaggy argillites, which, though much crumpled and confused, and penetrated by a number of grey felspathic dykes, appear in the main to assume an anticlinal form, overlying a greenish-grey compact volcanic rock, and being overlaid by agglomerates, which are often well bedded, and sometimes have a rather tufaceous appearance. The argillites themselves present their usual black flinty appearance with regular and thin bedding where undisturbed, and are frequently more or less calcareous. The general strike of these and the associated altered volcanic rocks, is about north-west by south-east, but there are, doubtless, several folds and possibly other complications, as the argillites recur at two places on the shore to the east of, and opposite, the point above mentioned, and also at two places on opposite sides of Winter Harbour, further up the inlet. The exposures of these argillites in Forward Inlet afforded a considerable number of specimens of the *Belonites*, for which Mr. Whiteaves, in the appendix, proposes the name *A. Vancouverensis*.

Triassic argillites.

Cretaceous rocks of Browning Creek.

The altered volcanic rocks here present no unusual characters and do not require special description. One of the Cretaceous outliers above referred to, occurs at the head of Browning Creek, at the middle of the west shore of the expansion in which this branch of the inlet terminates. It is a very small patch of greenish-grey sandstones, not more than fifty yards wide. The beds dip N. 75° E. $< 25°$ at the south-east, and about N. 20° W. $< 30°$ at the north-east of the exposure. The sandstones rest on reddish-weathering hard felspathic rocks of the Vancouver series, of which they include rounded pebbles. Some layers contain great numbers of shells of *Aucella Piochii*, together with a few other fossils. Specimens collected at this place by me in 1878, have been figured and described by Mr. J. F. Whiteaves. (Trans. Royal Soc. Can. Vol. I., sect. iv., p. 81.)

Cretaceous rocks of Winter Harbour.

A second, and much more important Cretaceous outlier, is that which surrounds the upper part of Forward Inlet, known as Winter Harbour and appears, on both shores, to the exclusion of other rocks, for a mile and a half from its head. The rocks are here again chiefly greenish-grey sandstones, but also include layers of conglomerate, and hard, fine-grained, calcareous beds, more or less nodular in character. The dips are generally northward, at angles of 60° to 5°, and the beds appear to form an ascending series of considerable thickness, of which layers characterized by a great abundance of *Aucella* and other fossils form the lowest visible member. Local irregularities in dip and other cir-

cumstances lead to the belief that the beds have not alone been affected by folding, but that faults also exist, and as the land is rather low and densely wooded on both sides of the inlet, the form and dimensions of the Cretaceous area of this place have not been determined. To the north-eastward, it extends to the lower end of the lagoon, which opens from the head by Winter Harbour, but on the channel connecting the lagoon and the harbour, there is a projecting mass of the older volcanic rocks. The lagoon itself (known as Huh-nish by the Indians), was examined by me in 1878, in consequence of the reported existence of coal upon it. So far as the small rock-exposures show, its shores are chiefly composed of altered volcanic rocks. The coal was found to occur upon a small creek or stream at the upper south-west angle of the lagoon, the exposures being at about forty yards from high-water mark. The beds are nearly vertical, and a couple of small holes had been sunk upon them, the first showing—coal, apparently of good quality, 1 foot; shale 1 foot 6 inches; coal, partly impure, 1 foot; shale and coal, 2 feet 6 inches; carbonaceous shale, 2 feet. The second hole, at a distance of thirty feet across the measures, shows about 3 feet of coal and shale intermixed, followed by carbonaceous shale and this again by a pale clayey material. The area of the coal-bearing rocks is here, apparently, quite small, and they are so much disturbed, that even if the seams were of a more promising character, this would not be a suitable place for work.

Lagoon.

Coal outcrops.

Position of coal

With the exception of the place just described, no coal was seen in the Cretaceous rocks of any part of Forward Inlet. There is reason to believe that the coals seen at the head of the lagoon occupy a horizon near the base of the Cretaceous series, and that they might be found by boring through the less disturbed Cretaceous rocks of the vicinity of Winter Harbour, possibly in greater thickness.

Thickness and composition of Cretaceous.

In addition to the Cretaceous outliers seen in Forward Inlet, there are probably numerous others of the same kind yet to be found inland from it, and the extension of the Winter Harbour area to the northward may he considerable. Mr. Dowling examined a small stream known as the Zenaad River for about a mile from the shore in a northward direction, without reaching the limit of the Cretaceous. A number of circumstances appear to establish a probability of the existence of an important fault, with downthrow to south-west, which may run nearly parallel in direction to the lagoon, passing near the head of Winter Harbour. The probable thickness of the Cretaceous series from the southern outcrop to the head of the harbour, is about 3600 feet, the highest rocks seen, at the head of the harbour, being rather massive conglomerates. Similar conglomerates are again seen a short distance up the Zenaad River, these rocks probably being in both cases to the

south-west of the fault. These conglomerates are supposed to be identical with those forming the upper number of the series in the Koprino area, subsequently described, and as sandstones resume further up the Zenaad River, with regular low dips to the northward, or north-eastward, it is quite probable that the upper part of the range of high hills, rising above this part of the river, which is continued in a south-eastward direction to the east of the lagoon, may prove to be composed of the same massive conglomerates, coming in again at a higher level in consequence of the fault. In this case the Carbonaceous area may extend some miles to the north. The whole question of the inland extent of the Winter Harbour and Koprino Cretaceous areas deserves examination, but would require two or three weeks of work in the bush.

Fossils.

In addition to *Aucella Piochii*, which has already been referred to as filling entire beds, both on Browning Creek and Winter Harbour, *Scaphites Quatsinoensis* is found in both the above localities. On the south side of Winter Harbour, in addition to the *Scaphites*, the fossiliferous nodules have yielded a *Cinulia*, a *Dentalium*, fragments of an *Alaria*, the cast of a small *Protocardium*, an *Astarte*, like the supposed *A. Packardi* of the Queen Charlotte Islands, a *Yoldia*, an *Arca*, and a few scattered bones of some teleostean fish.

Forward Inlet to Koprino Harbour.

The north shore of Quatsino Sound, from Forward Inlet to Koprino Harbour, exhibits a great series of the altered volcanic rocks of the Vancouver series. These show persistent south-westward dips, at angles of from 35° to 60°, but are probably repeated either by folding or faulting, as the thickness indicated would otherwise be enormous. The materials are principally agglomerates, of greenish or grey tints, but occasionally, conspicuously red in colour. Amygdaloids also occur, but do not form so important a part of the whole. These rocks have been subjected to somewhat less alteration than usual, and the agglomerates frequently weather out into rough surfaces, with a scoriaceous appearance. The rocks of the south shore of the inlet, from Bold Bluff to the west side of Koskeemo Bay, of the chart, are similar, with similar dips. The west side of Koprino Harbour is composed of similar greenish rocks, probably agglomerate, but on the east side of the north-west cove, a massive grey limestone, with a minimum thickness of about forty feet, appears, and is associated with hard sandstones and flaggy argillites of the same series, considerably disturbed and irregular. Beyond the next little cove, or creek, to the east, the rocks of the shores and Islands of Koprino Harbour, belong entirely to the Cretaceous series, of which some details are given below. The abutting of the strike of the Cretaceous rocks of Plumper Island, in the centre of the harbour, on the green rocks of its west side, with other circumstances, give evidence of the probable existence of an important fault,

with a course of about N. 15° E., and downthrow to the eastward. The same fault appears to run across the inlet, and to cut into the south shore, just east of the end of the larger island in Koskeemo Bay, of the chart. There is here a small tongue of Cretaceous sandstone, with irregular dips, which is presumed to be in contact with the fault to the east.

North shore of inlet east of Koprino.

From the east side of Koprino Harbour, for a distance of some miles, or to a point opposite the middle of Limestone Island, Cretaceous sandstones and conglomerates occupy the shore, forming a part of what may be called the Koprino Cretaceous area. Thence to Hecate Cove, the altered volcanic rocks are again met with, with westward dips, at angles of 30° to 45°. These rocks run across to Limestone Island to the south, of which they form the greater part. Bluish and grey limestones, however, which conformably underlie these volcanic materials, outcrop along the east shore of the island, and in a small islet off it, were found to contain silicified corals in considerable abundance. Of these, Mr. Whiteaves states that one form resembles *Thamnastræa*, while a second is probably an *Astrocenia*. They are probably not older than the Trias, and might be newer.

Fossil corals.

South shore of inlet.

Similar agglomerates and amygdaloids compose the south shore of the inlet, south of Limestone Island, with the exception of the east side of Banter Point of the chart, where a small outcrop of limestone again occurs. Altered volcanic rocks, of the same general character, and with similar persistent westward dips, form the greater part of the entire south shore of the inlet eastward to Village Islands, opposite Koprino Harbour, together with Brockton Island. On the east side of Village Islands, the flaggy argillites re-appear, overlying well-bedded, fine-grained, felspathic rocks. The exceptional points on this shore consist of small outliers of Cretaceous sandstones, which may be regarded as portions of the southern edge of the Koprino Cretaceous area previously alluded to. The largest area of these rocks extends along the coast between Limestone and Brockton islands, for nearly two miles, with low dips generally off shore. The rocks are greenish-grey sandstones, and may extend for some distance to the south, as the land in that direction is all low. The exposures at the east end of this area show the sandstones passing into conglomerates, and in actual contact with the older volcanic rocks, filling hollows and crevices in their surface, which has been very irregular.

Cretaceous outliers.

In these outlying patches of Cretaceous, on the south shore, obscure impressions of plants were frequently seen, together with casts of a small *Lima* and of ammonitoid shells. The small islands in the deep bay between Brockton and Village islands, represent a second outlier of similar sandstones, some of which contain fragments of *Inoceramus*.

They dip regularly off shore, at angles of 10° to 20°, the strike running round parallel to the shore of the bay.

Koprino Cretaceous area

The shores of Koprino Harbour, and the islands in it, afford a number of excellent exposures of the Cretaceous sandstones and conglomerates, but the dips and strikes of these are so extremely varied and irregular, that a minute survey of the whole would be required before any definite conclusions could be drawn as to their exact relations. It is highly probable, however, that the section is here complicated by one or two faults, one of which may possibly be continuous with that previously referred to, as probably running parallel with the lagoon of Winter Harbour, on Forward Inlet. A coal-seam was reported to exist in the vicinity of Koprino, but on obtaining an Indian to guide me to it, I found that it was the same coal occurrence which has already been described at the head of the Winter Harbour lagoon. This is reached by a trail from Koprino, in less than two miles.

Cretaceous on north shore of inlet.

The Cretaceous rocks, of that part of the Koprino area which extends from the east entrance point of the harbour, for at least seven, and probably, for eight miles, along the north shore of the main inlet, are throughout, pretty regular and not much disturbed. They consist chiefly of conglomerate and sandstones, the former frequently producing bold bluffs and hills along the coast, which in the main, very closely follows the strike. The beds dip inland, the direction varying generally but a few degrees on either side of north, though one or two rather sudden changes of strike were observed locally. The angle of inclination varies, as a rule, between 10° and 20°. Beneath the massive conglomerates, which must have a thicknsss of at least several hundred and possibly of 1000 feet or more, are softer sandstones, which often occupy the beach. Near the last exposures to the east, (opposite the west end of Limestone Island) the beds take on a light eastward dip, but probably dip westward, at pretty high angles, further east, as, after a concealed interval of about a mile, the underlying altered volcanic rocks appear, terminating the possible extent of the Cretaceous basin in this direction.

Ten-o-suh River.

As affording a means of examining the inland extension of this Cretaceous area, the Tēn-o-suh River, which flows into the north-east angle of Koprino Harbour, was followed up for about three miles. This stream is quite a small one in the autumn, but from the size of its bed, and the inextricable log-jams with which it is filled, must be a formidable torrent at some seasons. The exposures seen along it were rather few, but appeared to indicate an anticlinal, followed by a light synclinal. The rocks are sandstones and conglomerates, without distinctive features, and no trace of coal was observed, nor was the northern edge of the Cretaceous basin reached. The Indians, by fol-

lowing this river to its head, and then descending the valley by a second small stream, reach the West Arm, at a place nearly opposite the Nookneemish River.

Composition of series.

It may, I think, be assumed with considerable certainty that the massive conglomerates so largely developed in the Koprino area, are equivalent to those of which the base is seen forming the highest beds in the Koskeemo Cretaceous area, subsequently described. They are probably also identical with those seen at the head of Winter Harbour, forming the highest member of the Forward Inlet Cretaceous. The greater part of the comparatively soft sandstones shown in the lower parts of the sections in both these areas is doubtless now covered by the water of the main inlet east of Koprino Harbour, thin selvage edges only appearing in a few places on the south shore, as before noticed. By assuming an average angle of dip for the measures, the thickness of the beds underlying the conglomerates, and for the most part beneath the inlet, would appear to be at least 2,000 feet, and it may be much greater. This is somewhat less than the estimated thickness of the same part of the section of Forward Inlet, and greater than that taken as a minimum for the same beds in the Coal Harbour area.

Beds overlying conglomerates.

The only locality in which beds pretty certainly overlying the conglomerate portion of the series were seen, was in a small island in Koprino Harbour, opposite the East Cove. These are grey, finely fissile, rather hard and very regularly bedded shales, quite different in appearance from any other rock seen about Quatsino Sound. These are at angles of 60° to 80° in the centre of a small synclinal and conformably overlie massive conglomerates to the south, though in contact with an intrusive rock to the north. The exposed thickness is probably over a hundred feet. No fossils were obtained from these beds, but they closely resemble the Upper Shales, which are found overlying the conglomerate member of the Queen Charlotte Island Cretaceous series. (See Report of Progress, Geol. Surv. Can., 1878-79.)

Probable importance of Koprino area.

It appears quite probable that the Cretaceous basin, here spoken of as the Koprino area, may prove to be the most important, from an economic point of view, of those of Quatsino Sound. It is much larger than any of the others; the regularity of its beds to the east and north of Koprino Harbour is great, and it is more easy of access than the Coal Harbour area, to reach which, the Quatsino Narrows must be passed, which can only be done at favourable stages of the tide. The circumstances being such, it would seem to be a quite legitimate (though it must be admitted, in the present state of our knowledge, a purely speculative) enterprise to test this area for coal, by

boring at some favourable point or points near the shore to the eastward of Koprino Harbour. Such an enterprise, should, as a matter of course, be preceded by a thorough examination of all parts of the surface of the area, which would be somewhat laborious, on account of the thick and tangled character of the forest growth.

In all attempts to determine the character of this and other Cretaceous basins of the vicinity by an examination of the natural outcrops, it must be borne in mind that, as before stated, they probably fill pre-existing hollows in the surface of the older rocks, upon which they progressively overlap. The circumstances requiring consideration in this connection are more fully stated in the preliminary pages of the report.

South-east arm.

The south-east arm of Quatsino Inlet, clearly follows the general strike of the rocks of the Vancouver series, and occupies a depression which has been worn out along the outcrop of the same bed of limestone, which is noted in connection with Quatsino Narrows and the east end of Limestone Island. The beds dip in general south-westward at high angles all along the arm. Limestone is frequently seen along the east shore, and appears to rest on a green amygdaloid. At Long Island, near the southern extremity of the arm, there are large exposures of flaggy argillites, which follow the limestones in ascending order and are often more or less calcareous. Obscure casts of *Monotis* or *Halobia* were seen in them in a few places. Further exposures of these argillites are found skirting the west shore of the arm nearly to its north end. The argillites are overlain by dark greenish agglomerates. Copper-stained greenish rocks were observed in several places on this arm, but appeared to result merely from the weathering of small quantities of copper pyrites, in or near felspathic dykes, which cut the other rocks, and are of no importance. No Cretaceous rocks were seen on this arm.

Limestones.

The existence of the transverse hollow now occupied by Quatsino Narrows, is pretty evidently due to the softer character of a thick bed of limestone, which nearly follows the course of the narrows. A second bed, or possibly a repetition of the same bed, runs across a low country from Hecate Cove to the south shore of the West Arm, parallel to the first. The same limestone appears on the opposite side of the West Arm, in large exposures to the west of Hankin Point. The Cretaceous rocks of the vicinity of Coal Harbour, which may be designated the Koskeemo area, occupy the northern shores of the West and Rupert arms, for some miles on each side of the promontory of which Hankin Point forms the apex. This coal-bearing area is treated separately below, in some detail. The shores of the West Arm were examined by me in 1878, to within three miles of its extremity. Two very small selvages of Cretaceous sandstone were found on the

Cretaceous areas.

north shore, beyond the main Koskeemo area,—the first five, the second six and a half miles west of Coal Harbour. The rocks had rather high dips off shore, or to the southward, but whether they represent small portions of the Koskeemo area which come in to the north of a continuation of the main fault, subsequently described, or indicate the position of Cretaceous rocks which may have filled a pre-existing hollow now occupied by the West Arm, I was unable to decide. The remaining rocks seen along the West Arm, belong to the Vancouver series, and are largely of the usual altered volcanic materials. A persistent bed of limestone, however, which is associated with these rocks, runs along the south shore for several miles, with a general southward dip.

Rupert Arm.

The rocks of Rupert Arm, with the exeeption of the Cretaceous previously alluded to, are generally reddish or grey felspathic materials, of somewhat doubtful origin, but referable to the Vancouver series. Limestones again outcrop at the points to the east of the entrance to Quatsino Narrows. All the western part of the south shore of this arm shows no rock exposures, and from the low character of the country, it is possible that the Cretaceous rocks of the Coal Harbour area are continued in this direction.

Koskeemo Cretaceous area.

The area of Cretaceous rocks on the north side of the West and Rupert arms of Quatsino Sound has attracted considerable attention, and several praiseworthy attempts have been made to prove and develop its coal-bearing character. The latest of these has been carried out by the West Vancouver Commercial Company, who executed various borings and other operations, at intervals from November, 1883, to May, 1885. Having been supplied with copies of the drill records obtained, through the kindness of Mr. J. Preston Moore, a somewhat detailed investigation of that part of the district in the vicinity of Coal Harbour and the Nookneemish River was undertaken, including paced surveys along the shores and between the several points at which borings had been made, and extending inland on the Nookneenish and tributaries of the Natzinughtum to the northern edge of the Cretaceous area. A general examination of the shores had already been made by me in 1878, but the somewhat fragmentary information then gained had not been published.

Limits of the area.

Though the northern edge of the Cretaceous basin has not been continuously traced, it has been defined at four points, viz., at its two extremities on the shore, and at two intermediate places where it crosses the streams above named or their tributaries. By joining these, with due regard to the observed dips and strikes of the rocks, it may be assumed that a fairly correct outline of the basin on this side is obtained, the Cretaceous rocks there resting unconformably on, and dipping re-

gularly southward from, those of the Vancouver series. To the south, the basin is cut off by a fault, with an extensive downthrow to the north, and a course of about N. 89° W. The throw of this fault must exceed the entire exposed thickness of the Cretaceous of this basin, which is at least 1500 feet. To the westward, it runs past the mouth of Coal Harbour, cutting into the shore near a small cove, a mile and a third beyond the west entrance point of the harbour. It then crosses the bay at the mouth of the Nookneemish River, again cutting the shore a mile beyond the mouth of that stream. Eastward, it must cut the west shore of Rupert Arm, about two miles from its head, and as the shore in the intervening stretch is all low, it is possible that the rocks of the Cretaceous series here re-appear, and continue for some distance eastward. Still further in this direction, the fault appears to run completely across the island to Port McNeill and beyond, as explained on p. 64 B. The rocks to the south of the fault, which form Hankin Point, are massive, greenish amygdaloids, overlain by a thick bed of limestone, which forms low cliffs near the east entrance point of Coal Harbour, and re-appears in the cove at the east side of Hankin Point. On both sides of the bay into which the Nooknemish flows, the older rocks to the south of the fault are hard, shattered, rusty quartzites, and greenish and purplish felspathic materials, sometimes evidently altered agglomerates. Great fault.

The total length of the Cretaceous area thus outlined, from east to west, is seven miles; its greatest probable width about two miles, and its approximate probable area—without including under-water extensions—about 5630 acres. So far as I have been able to ascertain, its rocks comprise a series of sandstones, shales and conglomerates with general southward dips, generally at angles of from 10° to 30°, complicated only by one slight synclinal flexure, which runs nearly east-and-west across the northern part of Coal Harbour. When immediately in contact with the great fault, near the east entrance point of the harbour, the beds are much disturbed, and for a few yards assume a very steep northward dip. It must be stated, however, that in consequence of the thickly wooded, and drift-covered character of the land and the want of continuous sections on shore, numerous minor dislocations might occur without affording any evidence of their existence. General character of rocks.

The nearest approach to a complete section of the basin, is obtained on the west side of Coal Harbour, and in the vicinity of the road or trail which has been cut in a northward direction from the harbour, and by which the sites of the more important borings and prospecting openings are reached. An examination of this section leads to the belief, previously alluded to, that the entire thickness of the Cretaceous series here shown, is from 1300 to 1500 feet. An attempt has been made to General section.

formulate a general vertical section of the measures by bringing together all the facts afforded by the natural exposures, and those obtained in the borings, in the vicinity of the line of section above defined. It has been found, however, impossible satisfactorily to accomplish this, in consequence of the almost complete absence of well marked zones or beds with distinctive characters which might serve as planes of reference. Shales, sandstones, and more or less, conglomeritic beds, together with numerous thin seams of coal and coaly streaks, are met with in comparatively thin alternating layers throughout all parts of the series, and the character of individual beds appears to vary from point to point in different parts of their extent, to a perplexing degree. It seems pretty certain, however, that the highest exposed part of the formation is largely composed of massive conglomerate, of which only the lowest beds probably remain, and which are exposed in the light synclinal which crosses Coal Harbour, and again on the east side of the harbour, to the north of the fault.

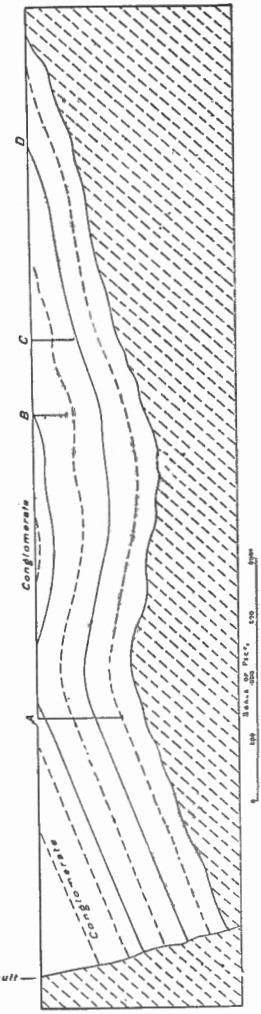

FIG. 2. DIAGRAMATIC SECTION OF COAL-BASIN. WEST SIDE OF COAL HARBOUR. DIRECTION, SOUTH TO NORTH.

Coal-bearing horizons.

At a probable depth of from 200 to 300 feet below these, is a coal-bearing zone, of which the outcrop appears on the shore of the west side of the harbour, to the south of the axis of the light synclinal, with a north-westward dip at an angle of 25°. There is here about two feet of coal of fair quality. The westward extension of this light synclinal is not known, but its northern edge, not far from the horizon of the coal, should pass near the position of boring B, on the plan, and the coal which is reported to outcrop near the mouth of the Natzinughtum, (but of which I saw only detached fragments), is probably the continuation of the northern outcrop of the seam just mentioned. It is, doubtless, also the same seam which was reached in boring E, near the mouth of the Natzinugtum, at a depth of twenty-eight feet, and reported to be 5 feet 4 inches in thickness, but of poor

quality. The same seam is again supposed to be represented by the outcrop on the shore two and a quarter miles north-eastward from Hankin Point. It is here separated into three parts, the two lower of 6 inches each, the upper of 1 inch, separated by several feet of clayey shales, and dipping S. 5° E. and 30°.

Lower coal-bearing zone.

The second coal-bearing zone is probably from 400 to 500 feet lower in the series. It occurs, furthest west, a mile and a quarter beyond the mouth of the Nookneemish River, near the beach, where a small shaft has been sunk, and a few tons of coal extracted. The outcrop could not be seen, but was reported to show about 3 feet 6 inches of coal, of which, however, about a foot was of inferior quality. There are no exposures on the Nookneemish where this seam should cross, but it is probably the same which was struck in boring F, near the mouth of that river, at a depth of 217 feet. It is pretty evidently again the same which has been opened further east by a small slope about a mile due north of the west entrance point of Coal Harbour, at the point marked D. The seam is here reported to be from 2 to 3 feet in thickness, and is of good quality. No outcrop of this seam was found on the shore east of Hankin Point, but if my view of the structure of the basin is correct, it is probably that which was reached in the deep boring at A, at a depth of 456 feet, with a thickness of 6 inches only. The position of this coal-bearing horizon must be about 300 feet above the base of the Cretaceous rocks.

North edge of basin.

North of the opening last mentioned, a coal-seam of about 3 inches in thickness was observed. It is associated with hard flaggy sandstones and hard dark shales, which form the lower part of the formation, and appear to have been penetrated to some depth in the bottom of boring A. At the eastern extremity of the field, about three miles north-eastward from Hankin Point, on the shore, a considerable thickness of conglomerates occur in what here must be the lowest part of the series. These were not seen elsewhere in the same position, and this occurrence is somewhat anomalous.

No thick coal seams yet developed.

The particulars above given, in conjunction with the record of borings, will show that no coal-seams of satisfactory workable dimensions have yet been found in this area, notwithstanding the exploration of it, which has been carried out by boring and otherwise. While, therefore, not ignoring the fact that more important seams may yet be found here, I cannot concur with Mr. Robert Brown, in his exceptionally high estimate of the value of this field.* It must be admitted that the enterprise of the gentlemen who have attempted the development of this area, has so far met with results of

*See his Paper on Coal-fields of the North Pacific Coast. Trans. Edinburgh Geol. Soc., 1868-69.

a somewhat discouraging character. In opposition to these, however, it may be stated that the explorations have not been sufficient to exhaust the possibilities of the field. As I am aware that some test borings were made before those of which I have been able to obtain the records were executed, and of which no detailed logs appear to have been kept, I feel some hesitancy in advising as to further explorations by boring, should such be decided on. Judging merely from the facts at my disposal, and from the observed attitude of the strata, I should be inclined, however, to recommend the continuation of boring C,—the furthest inland boring to the west of Coal Harbour,—to a further depth of 350 to 400 feet, or to the bottom of the Cretaceous rocks. Should it, however, prove impracticable to resume boring in this hole, or difficult to do so, a new hole might be begun at about a quarter of a mile to the north, which would be expected to reach the bottom of the Cretaceous series at a depth of about 400 feet. My reason for particularly advising the further prosecution of boring C, is, that so far as can be made out, this hole terminated but a short distance above the probable position of the underground continuation of the seam opened at D, and work done there would serve, in the first instance, to prove the character of this seam at a point some distance from its outcrop. Should this additional work be carried out, the character of the rocks as a coal-bearing series, might be assumed to be pretty well tested.

Best mode of testing the area.

Analyses given in Mr. Robert Brown's paper, already quoted, show that the quality of the Koskeemo coals is often very good. An analysis by Mr. G. C. Hoffman of the coal from the opening marked D., on the accompanying plan, shows the following result:—

Analysis of coal.

Hygroscopic water	1·05
Volatile combustible matter	34·38
Fixed carbon	54·01
Ash	10·56
	100·00

This fuel produces a fine compact coke, and is scarcely acted on by a solution of caustic potash.

Few fossils were obtained from the Cretaceous rocks of this area, but so far as they go, they bear out the view expressed in the preliminary pages of this report, as to the position of the beds in the Cretaceous series. On the Nookneemish River, some casts of molluscs were found not far above the lowest of the Cretaceous beds. These represent a small *Trigonia*, and the shell named *Pleuromya lævigata*, by Mr. Whiteaves, in his report on the fossils from the Queen Charlotte Islands. Among some fossil plants collected near the west entrance point of Coal Harbour, Sir Wm. Dawson has recognized *Sequoia Reichenbachi*,

Fossils.

Heer, and a form near to, if not identical with, *Thinnfeldia arctica*, Heer. These two forms are found similarly associated in Spitzbergen, in beds which are supposed to be Cretaceous, but must be low down in that formation.

The detailed records of borings in the vicinity of Coal Harbour, and on the Nookneemish, are as follows, the letters by which they are denoted, referring to those placed on the accompanying plan and section:— Boring A: Coal Harbour.

Deep boring near "The Settlement" (A.)

	FEET.	INCHES.
Coarse grained sandstone	29	10
Seams of coal shale and clay	2	10
Hard sandstone, ending in black shale	14	0
Pipe-clay	8	9
Coarse-grained sandstone	15	8
Seams of shale and coal	3	6
Fire-clay	5	10
Seams of shale, slate and coal (all mixed)	15	9
Fire-clay, with small pieces of coal intermixed	6	10
Seams of shale and coal (all mixed)	6	0
Dark, smooth, greenish slate	12	9
Reddish shale and sandstone, mixed with coal	8	0
Sandstone, with occasional spots of coal	20	11
Hard, smooth, grey shale	11	10
Same shale, with seams of shale and coal	38	8
Bluish sandstone, with hard, black grains and occasional pebbles	28	6
Hard, grey slate, showing pyrites	4	0
Sandstone	9	4
Hard, blue clay	2	11
Bony coal and shale	5	5
Mixed clay and shale	3	7
Hard sandstone, with hard, black grains and occasional pebbles	34	9
Seams of slate, shale and coal	14	6
Same black-grained sandstone as above	5	0
Grey slate, with occasional spots of coal	31	0
Seams of slate, coal and sandstone	13	0
Hard, fine conglomerate	13	4
Hard, grey sandstone, with spots of conglomerate	12	0
Hard, fine conglomerate, same as above	18	6
Soft, coarse, yellow, sandstone	4	8
Bony coal and shale	3	6
Fire-clay, mixed with shale	5	4
Coal, same as above	0	6
Hard sandstone, with black grains	5	0
Hard, black pebble conglomerate	7	8
Mixed seams of shale and bony coal	9	3

	FEET.	INCHES.
Hard sandstone	3	11
Fine quartzite conglomerate (very hard)	13	5
Hard, fine-grained sandstone	5	6
Coal	0	6
Same sandstone as just above	10	0
Very hard, fine, black pebble conglomerate (same as above)	15	7
Black slate and shale, with streaks of coal	5	11
Same black pebble conglomerate	2	8
Dark sandstone, with occasional spots of conglomerate	32	5
Dark slate	6	8
Dark sandstone, with spots of conglomerate	3	8
Very hard, fine conglomerate	12	3
Reddish sandstone	5	0
Hard, black and white pebble conglomerate	15	7
Black, sandy shale, with occasional streaks of coal and abundance of gas	28	10
Hard, fine-grained sandstone	21	8
Hard, black and white pebble conglomerate	21	11
Sandy shale	14	9
Grey sandstone, hard and uniform	80	0
Hard, compact black slate	8	6
Conglomerate	2	0
Total	739	8

Boring B. Coal Harbour.

Boring, about two-thirds of a mile to the northward of the last (B.)

	FEET.	INCHES.
Fine, white and blue clay	26	4
Pebbly conglomerate	12	8
Coarse sand (like beach sand)	2	3
Mixed sandy shale and coal	1	9
Sandstone	6	9
Slate	3	0
Sandstone	7	0
Sandy shale and slate, and dark sandstone	21	4
Coal, of good quality, and fire-clay	4	6
Fine-grained sandstone	14	9
Sandy shale and slate	1	3
Sandstone, with occasional spots of conglomerate	89	11
Black, sandy shale and black slate	11	9
Sandstone	18	3
Mixed shale, slate, clay and coal	4	3
Sandstone 6′ 1″ and black, compact slate 5′ 1″	11	2
Dark sandstone 10′ 1″ and same black compact slate 6′ 8″	16	9
Hard, fine-grained, black sandstone	5	2
Same hard, black, compact slate	6	7
Hard, dark, brittle sandstone	9	7
Hard, black slate	0	4
Total	280	10

Boring about three quarters of a mile northward from first hole. (C.) Boring C, Coal Harbour.

	FEET.	INCHES.
Coarse sandstone	3	8
Shale and coal	0	4
Coarse sandstone, same as above	5	4
Slate	3	4
Very fine grained sandstone	10	0
Black, mucky clay, with pieces of coal	1	1
Mixed slate	9	8
Black sand	0	3
Same fine-grained sandstone as above	3	3
Black, sandy shale	3	0
Sandstone	4	0
Black slate	0	10
Soft coal	0	9
Dark shale mixed with coal	1	7
Very fine grained sandstone	1	1
Black, flinty sandstone, like chert	0	3
Silicious limestone	3	8
Same black, flinty substance	0	2
Black, sandy shale	3	2
Same silicious limestone	1	0
Hard, black slate	9	8
Hard, grey slate, in places sandy	26	5
Coarse-grained sandstone	18	2
Hard, black slate	8	0
Sandstone	15	9
Grey slat	3	0
Hard, grey sandstone	7	9
Coal, good quality	0	8
Shale	0	4
Sandstone	31	10
Slate	3	9
Same sandstone	6	10
Hard slate, with shell impressions	5	1
Sandstone, with two small streaks of coal	9	0
Same slate as above, with shell impressions	1	6
Hard, dark, brittle slate	42	9
Shale and coal	0	3
Some hard, brittle slate, as before	11	2
Layers of slate, sandstone and conglomerate	9	2
Mixed seams of coal, slate and clay	1	4
Bands of shale, coal, sandstone and conglomerate	5	1
Sandstone and sandy shale	10	3
Brittle, dark sandstone	10	2
Fine, brittle conglomerate	8	3
Hard, coarse-grained sandstone	3	0
Hard slate with white seams of flint and lime	4	1
Hard, black, sulphurous sandstone	5	0

	FEET.	INCHES.
Soft, grey slate	5	0
Fine conglomerate, slaty matrix	17	5
Reddish sandstone	4	0
Different coloured, sulphurous slates	22	6
Hard, flinty slate (white seams)	4	5
Total	368	0

Boring E, Coal Harbour.

Boring on the Wagstee, at bottom of Coal Harbour, east of mouth of Natzinughtum. (E.)

	FEET.	INCHES.
Coarse conglomerate	24	10
Coarse sandstone	3	0
Coal seam (poor quality)	5	4
Fire-clay	4	0
Sandstone, same as above	30	0
Dark conglomerate	24	4
Sandstone, with spots of conglomerate	49	8
Fine conglomerate	7	0
Hard sandstone	40	0
Total	188	2

Boring F, Coal Harbour.

Near this place, on the Natzinughtum, a hole was put down 709 feet, but no record has been obtained of it. It ended in conglomerate, and it is to be presumed that it did not cut any coal-seams of importance. The probable position of this hole is marked (F).

Boring G. Nookneemish.

Boring near the mouth of the Nookneemish River. (G.)

	FEET.	INCHES
Soft shale	5	7
Sandstone	149	2
Tough, white clay	9	6
Sandstone with occasional streaks of coal	43	7
Conglomerate	4	6
Dark, sandy shale	5	2
Good coal	1	0
Soft, sandy shale	4	0
Hard, dark, smooth shale	1	6
Soft coal	0	6
Pipe-clay	0	3
Hard, blue slate	0	6
Soft, dark sandstone	20	10
Sandstone, with streaks of slate and shale	43	8
Smooth, black slate	3	3
Very hard conglomerate	43	7
Light, bluish clay, with quartz chips	12	3

	FEET.	INCHES.
Hard, dark sandstone	14	5
Soft, sticky, dark-blue clay	2	0
Hard, light-coloured sandstone	5	1
Total	370	4

GLACIATION AND SUPERFICIAL DEPOSITS.

Previous reports and papers.

In previous reports of the Geological Survey on different parts of the province of British Columbia, numerous observations on the phenomena connected with the glaciation of the country are recorded, and the importance of this epoch in its geological history is illustrated. In several papers, published elsewhere,* I have treated the same subject in a more general way, and advanced such hypothesis as appeared to be warranted by the facts. Though not previously examined in detail, the glacial phenomena and surface deposits of the region covered by the present report, have already been described in general terms, in the papers above referred to. To these former general statements, the work of 1885 has added much in the way of detail, but it has not in any important way, modified the main conclusions there stated.

Strait of Georgia glacier.

Evidence was advanced, in my paper published in the Quarterly Journal of the Geological Society for 1878, to show that the whole Strait of Georgia was at one time occupied by a great glacier, which had, in some places, a width of fifty miles, and attained a minimum thickness of 3000 feet in its northern part, and of about 700 feet at the south-east extremity of Vancouver Island, near Victoria. In a subsequent paper, I was able to state, as a result of observations made in 1878, that a second glacier, of equal magnitude, and discharging to the north-westward, had occupied Queen Charlotte Sound. These two great glaciers filled the wide orographic valley which separates the mountain systems of Vancouver Island from those of the coast ranges. They were supplied by tributary glaciers arising in these ranges, but particularly by those of the last named range, and probably received in addition, a great quantity of ice from the confluent glacier-mass of the interior plateau, which was forced seaward through the low gaps in the coast ranges. Evidence was found in the vicinity of Victoria and Nanaimo, to prove that when the Strait of Georgia glacier decreased and shrank back, the land was at a relatively lower level than at present, and that the deposits found in these localities to contain marine shells, were formed at or near the wasting edge of the glacier†

Queen Charlotte Sound glacier.

* See particularly, On the Superficial Geology of British Columbia. Quart. Journ. Geol. Soc., Vol. XXXIV. Additional Observations on the Superficial Geology of British Columbia and Adjacent Regions. Ibid. Vol. XXXVII. Notes on the Glaciation of British Columbia. Canadian Naturalist, Vol. IX.

† Quart. Journ. Geol. Soc. Vols. XXXIV., p. 96, XXXVII. p. 297.

Observations on direction of ice-movement.

No reasonable doubt can, I believe, be entertained respecting the existence and general features of the two great glaciers, as above outlined. During the geological examination of the coast here reported on, the direction of glacial striation and grooving was recorded at a great number of points. As, however, the separate enumeration of these could serve no useful purpose, it is proposed merely to note the main directions of ice movement indicated by them. In this connection, it should be observed, that in a region possessing such marked physical features as this, single observations do not possess the same value as those made in a more nearly level country. The glacier-mass, which has buried the great valley to the north-east of Vancouver Island, while flowing out in a general way to the north-west and south-east, from a median point situated in the vicinity of Seymour Narrows, has often swerved locally through many degrees, in consequence of the bold character of the surface over which it passed. Whether such deflections affected the whole thickness of the glaciers, when at their maximum, or whether only the lower parts of the mass conformed in direction to that of the hollows and valleys previously worn out, while the upper moved steadily in a single direction, can scarcely yet be affirmed. From examples seen on a small scale, however, (some of which, in the vicinity of Victoria, have previously been described) the latter supposition would appear the more probable, and by comparing directions obtained near the sea-level, with those to be found on the summits of the higher hills in the same vicinity, this point might be definitely settled.

Local deflections.

General direction.

In general, it is found that the striation and grooving in the various channels and narrow water-ways, shows that the ice has moved through these parallel to their length, the course of the motion being in each case that most nearly conforming to the movement of the mass as a whole. This remark must not, however, be taken as referring merely to hollows now flooded, the same effect having been produced, to a greater or less extent, by all irregularities of the surface. Even in the channels and fiords, only those instances of striation which occur crossing flat points or islands, can be accepted as showing the true course of the ice; as on inclined surfaces, or where bold points or cliffs occur, the direction of striation varies through a number of degrees in the same channel. Vertical surfaces are often well glaciated, and give evidence of great lateral as well as downward pressure. Under-cutting of such surfaces is sometimes seen, and heavy grooving not infrequently runs upward or downward at considerable angles from the horizontal, where channels are markedly widened or constricted.

Glaciated vertical surfaces.

Strait of Georgia glacier.

As stated in a previous paper, the general direction of motion of the

ice which has over-ridden the low south-eastern end of Vancouver Island, near Victoria, as derived from a large number of observations, is S. 11° W. At Nanaimo, heavy glacial grooving was observed running in a south-eastward direction, parallel to the coast and to the main direction of the strait, and glaciation similarly parallel to the shore, was seen on the mainland side of the strait, to the east and north of Texada Island.

Texada Island.

At the south end of Texada Island, the glaciation has been nearly parallel to both shores, showing a certain amount of convergence. Across Mitlenatch Island—which may be accepted as a crucial instance, on account of its isolated situation in the centre of the northern part of the strait—the glacial grooving runs about S. 17° E.

Discovery Passage.

In the southern part of Discovery Passage, opening from the northern end of the Strait of Georgia, the glaciation is south-eastward, in conformity with the general trend of the passage. On the opposite or east side of the northern end of the Strait, the ice has moved south-westward down Desolation Sound, and in the numerous intervening passages and channels, it has pursued in each case a southward course as nearly as the main direction of the channel would permit.

Desolation Sound.

Bute Inlet.

About the mouth of Bute Inlet, which has formed one of the main feeders of the Strait-of-Georgia glacier, the mountain sides were found to be ice-smoothed to a height of 3000 feet or more, and similar evidence has been obtained by myself and Mr. Richardson, in several of the fiords both to the north and south of this place.

Neutral point.

The point from which the glacier-mass has moved in opposite directions toward the Strait of Georgia and Queen Charlotte Sound respectively, has been in Discovery Passage, about midway between the position of Seymour Narrows, and Chatham Point at the north end of the passage. At a place five miles south of Chatham Point, on the west side of the passage, the glaciation was observed to run S. 36° W., almost directly athwart the trend of the passage and towards rather high hills situated not far inland, on Vancouver Island.

Queen Charlotte Sound glacier.

Beyond Chatham Point, the ice has moved westward and north-westward along Johnstone and Broughton straits, and specially heavy glaciation was noted about the islands and channels near the opening of Knight Inlet to Queen Charlotte Sound. The valleys and channels on the north side of Johnstone Strait, have brought in tributary ice at considerable angles to the general westward direction of flow, while in the eastern part of Broughton Strait, about Pearce Islands and Hanson Island, there is ample evidence of a change in direction to the north-westward, the ice moving out toward the larger hollow now occupied by the east end of Queen Charlotte Sound.

Results of heavy ice pressure.

In this vicinity, and elsewhere, where the pressure of the ice has been very heavy, it was observed that projecting bosses on horizontal surfaces (due either to original inequalities of the surface, or to the greater resistance offered by the harder parts to erosion) were often bordered on the side against which the ice impinged, by one or two concentric furrows, which, in some cases, are several inches in width. Somewhat similar effects were seen on vertical surfaces where the ice has been squeezed through narrow rocky passes. A remarkable instance of this kind, sketched near the north-east point of the Pearce Islands, is here illustrated. It appears probable that the grooves shown in the engraving, and others like them, have been formed on the exposed side of bosses, which, when the lateral pressure became less, were ground off flat, leaving only the curved hollows on a plane striated surface. It must, however, be admitted that sculpturing of this kind is somewhat difficult of explanation, where the surfaces affected, as in this instance, are composed of a homogeneous hard rock.

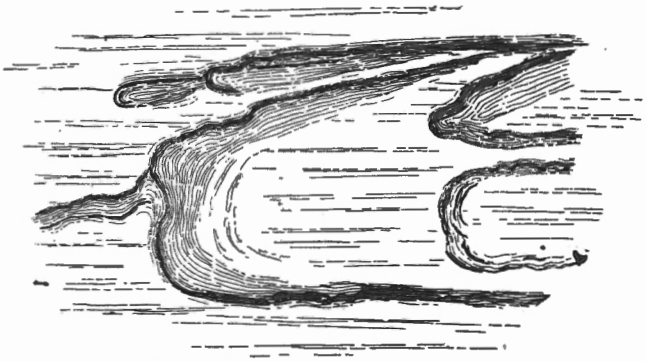

FIG. 3. VERTICAL ROCK-SURFACE, GLACIALLY GROOVED. PEARSE ISLANDS, QUEEN CHARLOTTE SOUND.

Direction of ice-movement, from left to right. Area of rock-surface 12 feet by 24 feet.

Nimpkish Valley.

On Nimpkish Lake and River, the striation shows a northward direction of movement, from the mountainous region of the centre of Vancouver Island toward Queen Charlotte Sound. The Cretaceous rocks bordering the coast from this place north-westward to Beaver Harbour, owing to their soft character, afford little clue to the direction of glaciation, but some facts observed on the upper part of Quatsino Scund, shows it to be not improbable that a portion of the Queen-Charlotte-Sound glacier crossed this low portion of Vancouver Island. About Beaver Harbour, and on the little islands of the Masterman Group, lying off the coast between Beaver Harbour and Hardy Bay,

North-west extremity of Vancouver Island.

very heavy glaciation occurs in bearings varying from N. 49°, W. to N. 62° W. On the north-east side of Queen Charlotte Sound, the glaciation is again nearly parallel to the shore, in a west-north-westward bearing, though local glaciation was seen following the valley of the lagoon which opens from Blunden Harbour, with a southward course, or nearly at right angles to this. On Numas and Foster islands, which lie in the centre of the wide sound, where the direction of the glacier's motion cannot have been affected by local irregularities, the striation and grooving runs N. 89° W. North-east side of sound.

At the north end of Vancouver Island, a portion of the Queen-Charlotte-Sound glacier has occupied Goletas Channel, and a part of the ice has been forced northward past Galiano Island and between the islands of the Gordon Group. It also appears to have crossed Hope Island in a northward direction by the hollow now occupied by Bull Harbour. Limit of glaciation westward.

In following the north coast westward, moderately heavy glaciation continues to appear, parallel in direction to the shore, to North-west Nipple, a few miles beyond Cape Commerell. The traces of glaciation are here, however, less marked, and usually confined to the rounding, more or less perfect, of pre-existing irregularities, repeating the appearances seen at the higher levels near Victoria, and indicating, very probably, the approximate position of the end of the Queen Charlotte Sound glacier in this direction.

With the exception of some rather dubious traces which appeared to show a seaward movement of ice in San Josef Bay, no signs of glacial action were noted about the north-western extremity of Vancouver Island, or on its exposed west coast. Such traces may, very probably, have been obliterated along these shores by the action of the waves, the whole of this coast being, as previously mentioned, much exposed, and showing abundant evidence of great sea erosion still actively in progress. It is probable, however, that the glaciation has here not been very heavy, as otherwise some remnants of it might have been observed. West Coast.

The small number and limited areas of terrace deposits along the entire coast of British Columbia has been referred to in the papers previously quoted. The region embraced by the present report offers no exception in this respect to the general rule, and no instances were observed of terraces at a greater height above the present sea-level than about 200 feet. Some of the lower tracts of land—particularly those characterized by the Cretaceous sandstones—are covered to a considerable depth by detrital deposits, and the same remark applies to a number of sheltered valleys in the higher regions. Boulder-clay was noted in some such localities, but, in general, only the more superficial stratified sands and gravels were found to be exposed. Superficial deposits not abundant.

Notable exceptions.

To this general statement, the most notable exceptions are found in the low islands and points of low land which fringe the northern extremity of the Strait of Georgia, and in Malcolm and Cormorant Islands, which occupy a relatively similar position at the eastern end of Queen Charlotte Sound. It has previously been suggested* that the islands and adjacent low tracts of land composed of detrital materials, and forming the projecting portions of a comparatively shoal bank at the north-east of the Strait of Georgia, may be assumed to represent the position of a moraine, formed during a period of arrest in the decrease of the great glacier, when its length had been reduced by at least one hundred miles. A closer examination has thrown additional light on this point.

Two boulder-clays.

At one place, on the Vancouver shore, about four miles north of Cape Lazo, a section in a bank about forty feet high, shows at the base a hard, bluish boulder-clay, with some traces of stratification, overlain by ten to fifteen feet of hard, well-bedded, fine sands, which in turn are followed by a hard, yellowish, rather sandy boulder-clay, the whole being capped by a few feet of yellow sand and gravel. In Cape Lazo, hard, bedded, silty or sandy deposits are overlain by boulder-clay. A similar succession was observed in a small patch of drift in a cove in Discovery Passage, a short distance south of Seymour Narrows, on the east side, and again on a larger scale in Cape Mudge, where the underlying silty deposit joins the boulder-clay above, along an irregularly undulating line. Mary, Hernando, Savary and Harwood islands, are chiefly composed of hard, well bedded, horizontally stratified sands and silts of pale colours, but in the cliffs on the south side of Savary Island, these are clearly seen to be overlain by boulder-clay, which rests upon them in irregular

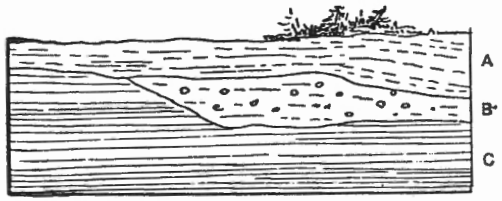

FIG. 4. DIAGRAMATIC SECTION OF DRIFT DEPOSITS. SAVARY ISLAND.

A. Stratified sands and gravels.
B. Boulder-clay.
C. Hard, well bedded silts and sands.

hollows, and is in turn overlain by rather incoherent yellowish, irregularly bedded sands and gravels, as represented diagramatically in

* Quart. Journ. Geol. Soc. Vol. XXXVII, p. 278.

the annexed figure. At the west end of this island, pretty good proof was found that the stratified silts rest directly on glaciated rock-surfaces.

With the exception of the first-noted section, no direct evidence of the superposition of the stratified silts on a lower boulder-clay was discovered, but the large and very numerous boulders which are strewn over the wide tidal flats and beaches of the islands last enumerated, may reasonably be assumed to have been derived from such an underlying boulder-clay, as the deposits which have been worn back in the cliffs, seem incapable of having afforded them.

Mode of formation of deposits.

It would thus appear, that there are in the vicinity of the northern part of the Strait of Georgia, two distinct boulder-clays, of which the lower is in all probability equivalent to that which immediately overlies the glaciated rock-surfaces in the southern part of the strait and near Victoria. Water action, as shown by bedding, is more or less apparent throughout the whole of the deposits, but in the important intercalation of bedded silts—essentially a loess deposit—we find evidence of a period during which the great glacier had shrunk back so far as not to have reached to the open water of the strait. This period must have been of considerable length, and during it, the turbid waters derived from glaciers in the narrower inlets, were quietly depositing their fine, suspended material. The sea must have been at this time, at an elevation of from 100 to 200 feet greater than at present. At a later date, the glacier either again pushed forward to a limited distance over the bedded silts, leaving the upper boulder-clay along its front during its final retreat, or subsidence being continued, the water became sufficiently deep to allow detached floating ice from the smaller glaciers to transport and lay down this upper boulder-clay.

Two maxima of glaciation.

Notwithstanding difficulties which occur in connection with the first hypothesis, the now compacted character of the silts, together with the sharpness of their plane of junction with the overlying boulder-clay, appear to be in its favour, and if correct, this explanation will accord well with the fact of the occurrence of a second and less intense period of glaciation. Of this good proof has now been found both in the interior of British Columbia and on the Great Plains to the east of the mountains.

Cormorant and Malcolm Islands.

The stratified silts and sands of Cormorant and Malcolm islands, are identical with those above described, but neither the upper nor the lower boulder-clay was clearly seen in association with them here. The islands and coasts within the line of these important remnants of drift deposits of the upper ends of the Strait of Georgia and Queen Charlotte Sound, are almost absolutely destitute of superficial deposits, and may be supposed to have been swept bare during the second advance of the ice.

Fossils.

The only locality within the region here specially described in which the deposits referable to the glacial period were found to contain fossils is that already referred to on p. 55 B, on the shore of the Embley Lagoon, on the north-east side of Queen Charlotte Sound. Hard sandy clays, exposed on the beach at this place, afforded a few casts of molluscs, from which the whole of the calcareous matter had been removed. Among these Mr. Whiteaves recognizes *Saxicava rugosa* var. *arctica*, and *Leda minuta* var. (?)

Changes in level.

Having on a former occasion discussed the evidences of changes in level of the coast of British Columbia as a whole,* this question need not here be entered into. It may be stated, however, that the rather frequent occurrence in this district of a low terrace, or of beach deposits, at about ten or fifteen feet above the present high-tide mark, indicates a comparatively recent elevation to that extent, further evidence of which may be afforded by the very fresh and unworn character of the glaciated rock-surfaces now exposed to the action of the sea along the shores.

Note on Distribution of Trees.

Value of forests.

The great extent and value of the timber of the coast of British Columbia and Vancouver Island is now being more fully discovered. Along the actual shore-lines and on the rocky and mountainous tracts, the timber is usually of a somewhat inferior quality, but in the more level inland regions, and in valleys which are sheltered from the violence of the winds, there are everywhere great quantities of fine trees, capable of supplying an almost unlimited amount of timber when the necessary facilities are provided for bringing out the logs to the shore. The greatest present need is the protection of the forests against fires. The islands and coasts of the Strait of Georgia constitute a region to a considerable extent climatically diverse from that of Queen Charlotte Sound, and from the west coast of Vancouver Island, being less humid than either of these, and a number of plants are found in this special region which do not occur elsewhere in the province. Of trees, the arbutus (*Arbutus Menziesii*) and the oak (*Quercus Garryana*) are altogether confined to it within the limits of British Columbia. The oak is last seen to the north-westward in prairie lands along the Comox River. The arbutus, which never in this region exists far from the shore, was observed, to the northward, in a shrubby form a few miles northward of Seymour Narrows, or to Elk Bay in Discovery Passage.

Restricted limits of some plants.

* Note on some of the More Recent Changes in Level of the Coast of British Columbia and Adjacent Regions. Canadian Naturalist, Vol. VIII., p. 241. See also Report of Progress Geological Survey of Canada, 1878-79, p. 94 B, and papers previously quoted.

To the north-eastward it extends to the Redonda Islands, in the mouth of Toba Inlet.

Douglas fir and yellow cypress.

The Douglas fir (*Pseudotsuga Douglasii*), the most important timber tree of the region, is abundant on the inner shores of Vancouver Island and on the adjacent mainland, but does not occur on the northern extremity of the island or on the west coast, though it reappears in considerable abundance on the upper part of Quatsino Sound. The yellow cypress (*Thuya excelsa* = *Chamæcyparis Nutkaensis*), found at a considerable elevation on the hills near Burrard Inlet and elsewhere near the coast of the southern part of the Strait of Georgia, was observed near the water-level on the Nimpkish Lake, but comes down first to the sea-shore in the vicinity of Blunden Harbour, on Queen Charlotte Sound. In the northern part of Vancouver Island, it is most abundant on the higher hills and plateaus, to which the Indians are in the habit of resorting when they require a supply of the bark. The white pine (*Pinus monticola*) was observed in a number of places both in the Strait of Georgia and Queen Charlotte Sound, but never in large groves.

Other trees.

The following species were noted in greater or less abundance over the entire area covered by this report:—Western hemlock (*Tsuga Mertensiana*), western cedar (*Thuja gigantea*), Menzie's spruce (*Picea Sitchensis*), western scrub pine (*Pinus contorta*), yew (*Taxus brevifolia*), alder (*Alnus rubra*).

The juniper (*Juniperus Virginiana*) was found assuming an arboreal form only on the shores of the Strait of Georgia.

APPENDIX I.

NOTES ON SOME MESOZOIC FOSSILS FROM VARIOUS LOCALITIES ON THE COAST OF BRITISH COLUMBIA, FOR THE MOST PART COLLECTED BY DR. G. M. DAWSON IN THE SUMMER OF 1885.

By J. F. Whiteaves.

(1.) TRIASSIC SPECIES.

Monotis subcircularis, Gabb.

Monotis subcircularis, Gabb.—1864. Palæont. Californ., Vol. 1, p. 31, pl. 6, figs. 29, 29a.

A few miles above Fossil Point, on the Peace River, lat. 56° 10′ long. 122° 10′, A. R. C. Selwyn, 1875. Fossil Ridge, Upper Pine River, lat. 55° 30′ long 122°, J. Hunter, 1877. South side of Houston Stewart Channel, Queen Charlotte Islands, nearly opposite Rose Harbour; Section Cove, north end of Barnaby Island, Q.C.I.; and south side of Skidegate Channel, Q.C.I., a mile and a half west of Log Point; G. M. Dawson, 1878.

Halobia (Daonella) Lommeli, Wissmann.

Halobia Lommeli, Wissmann.—1841. Beitr. Petref., IV. Heft, 22, tab. 6, fig. 11.
" " Horness.—1855. Densk. Kais. Akad. Wissench. IX, 52, taf. 2, fig. 17.
" " Zittel.—Fossile Moll. und Echinodermen aus Neu-Seeland, 27, taf. 6, figs. 1*a*, *b*, *c*.
" " Stoliczka.—1866. Mem. Geol. Surv. Ind., V, 44.
Avicula pectiniformis, Catullo.—1847. Prodr. Pal. Alpi. Ven., 73, pl. 1, figs. 1, 2, 3.
Posidonomya Lommeli, d'Orbigny.—1849. Prodr. du Paleont. Stratigr. Univ., I, 201.
? Halobia dubia, Gabb.—1864. Palæont. Californ., Vol. I, p. 30, pl. 5, figs. 28*a*, *b*.
Daonella dubia, Mojsisovics.—1874. Ueber der Triasch. Pelecyp. Gatt. Daonella und Halobia, p. 22.
Halobia (*Daonella*) *Lommeli*, Meek.—1877. U. S. Geol. Expl. 40th Par., Vol. IV, p. 100, pl. 10, fig. 5.

South side of Houston Stewart Channel, Q.C.I., nearly opposite Rose Harbour; and Section Cove, north end of Barnaby Island, Q.C.I., G. M. Dawson, 1878. Bay five miles west of Cape Commerel, north end of Vancouver Island, G. M. Dawson, 1885.

Aulacoceras Carlottense. (N. Sp.)*

Guard elongated, in the more perfect though smaller of the only two specimens collected, which may therefore be regarded as the type of the species, narrowly conical and increasing very slowly in thickness from the acutely pointed posterior end, whose apex is slightly excentric; in the larger but less perfect example comparatively thick, somewhat fusiform and bluntly pointed posteriorly, with the apex distinctly excentric. Alveolus and phragmocone unknown. Outer surface marked by close-set, rounded, longitudinal ribs, which are separated from each other by narrow but deep linear furrows.

In 1878 six badly preserved specimens of the guards of one or more species of Belemnites were collected by Dr. G. M. Dawson at Houston Stewart Channel, in the Queen Charlotte Islands. Of these, the two described above are both longitudinally ribbed on the outside, and apparently belong to the genus *Aulacoceras* of Hauer. The smaller of the two is a natural longitudinal section of the guard, about two inches in length and not quite half an inch broad at the thickest end, while the larger, which is only a badly-preserved natural mould or impression of one side of a large specimen of the guard with part of the test preserved at the posterior end, but which shows clearly one of the lateral grooves that are said to be characteristic of the genus, is nearly five inches in length and fully an inch and a half broad in the thickest part. Of the other four specimens two are mere fragments which cannot be determined either generically or specifically, one being a very slender guard about two inches and a half long and not quite a quarter of an inch broad at the thicker end, whose surface markings are not preserved, while the other is a piece of the posterior or pointed end of the guard of a small individual, about an inch and a quarter long and a quarter of an inch broad at the thicker end, whose surface appears to be perfectly smooth.

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* Illustrations of all the new species proposed in this paper are in preparation. These will be issued in one of the parts of the "Contributions to Canadian Palæontology," as soon as practicable.

ARCESTES GABBI, Meek.

Arcestes Ausseanus, Gabb.—1864. Palæont. Californ., Vol. I, p. 25, pl. 3, figs. 26 and 17 (not of Hauer, teste Meek).
Arcestes Gabbi, Meek. —1877. U. S. Geol. Expl. 40th Parallel, Vol. IV, pt. I, p. 121, pl. 10, figs. 6, 6*a* and 6*b*.

Bay five miles and a half west of Cape Commerell, north end of Vancouver Island, G. M. Dawson, 1885; one tolerably perfect specimen and a few fragments of others.

CELTITES (?) VANCOUVERENSIS. (N. Sp.)

Shell discoidal, compressed, whorls four to five, slender, gently convex at the sides, increasing very slowly in size and very slightly involute, so that the whole of the sides of the inner ones are exposed to view: umbilicus wide and extremely shallow: outer volution distinctly keeled at the periphery: exterior of the whole test strongly ribbed, the ribs simple, transverse, generally straight, broadening outwards and interrupted on the keeled periphery of the outer volution. Siphuncle and septum unknown.

North entrance point of Houston Stewart Channel, Queen Charlotte Islands, at east end of channel; Crescent Inlet, Moresby Island, Q.C.I., and north shore of Kun-ga Island, Q.C.I.; also Browning Creek, Forward Inlet, Quatsino Sound, Vancouver Island, and Forward Inlet, near Observatory Rock; G. M. Dawson, 1878.

Robson Island, Forward Inlet, and east side of Winter Harbour, Forward Inlet, a mile and a half north of Log Point; Alexander Harbour, Galiano Island, north end of Vancouver Island, and Hernandez Island, Strait of Georgia; G. M. Dawson, 1885.

With the exception of a few crushed fragments, all the specimens from these localities are mere natural moulds or impressions in shale of one side only of each shell, in which not a vestige of any part of the sutural line can be detected. Gutta-percha casts made from the most perfect of these moulds are very similar in shape and sculpture to the Nevada fossil which Meek has identified with the *Clydonites lævidorsatus* of Hauer, but in the former the periphery is distinctly keeled, while in the latter the same part of the shell is described as being "more or less narrowly rounded." In the specimens collected by Dr. Dawson, so little of the external keel is preserved, and its characters are so imperfectly exhibited, that, although it is quite clear that it is neither crenate nor serrated, it is quite impossible to tell whether it was originally simple or divided by a longitudinal median groove as in *Arpadites*.

Some of the best specimens were sent to Professor Hyatt, who makes the following remarks upon the species in a recent letter to the present writer: "It is remarkably *Arietes*-like in aspect, and if it were from the Lower Lias the exact genus could be pointed out without difficulty as *Arnioceras*. If a Triassic species, as you suggest, I should think it might belong either to *Arpadites*, *Celtites* or *Balatonites*. The ribs, straight, undivided, and the aspect of the umbilicus are very like either of the last two, but which it is most like I find myself unable to decide. *Arpadites* is more apt to have curved ribs, tuberculated near the umbilicus, and wider in the abdomino-dorsal diameter. Having no sutures, we are of course necessarily groping in the dark, since almost any of the three Ceratitic genera mentioned above might have discoidal radical forms like these specimens."

The species is so characteristic of a definite horizon in the Triassic rocks at several localities in the Queen Charlotte and Vancouver groups of islands that, although its generic position is so uncertain that it is doubtful even whether it should be referred to the *Tropitidæ* or *Ceratitidæ*, it nevertheless seems desirable, as a matter of convenience, to propose for it a local and purely provisional name.

(2.) CRETACEOUS SPECIES.

AUCELLA PIOCHII, Gabb.

Inoceramus Piochii, Gabb.—1864. Pal. Californ., Vol. I, p. 187, pl. 25, fig. 173 (exclus. fig. 174).

Aucella Piochii, Gabb. —1869. Pal. Californ., Vol. II., p. 194, pl. 131, figs. 92, *a-c*.

Tatlayoco Lake, B.C., G. M. Dawson, 1875. Banks of the Upper Skagit River, B.C., G. M. Dawson, 1877, and Browning Creek, Forward Inlet, Quatsino Sound, north-west coast of Vancouver Island, G. M. D., 1878.

Long Island, Harrison Lake, B.C., also west shore and peninsula on the south-east shore of the same lake, and Chilliwack River, near Tamiahai Creek, B.C., A. Bowman, 1882.

Browning Creek, Forward Inlet and west side of Winter Harbour in Forward Inlet, also Raft Cove on the west coast of Vancouver Island, north of Quatsino Sound, G. M. Dawson, 1885.

West of Fraser River, B.C., a little to the north of sources of Bridge River, B.C., from a mountain six or seven thousand feet high above sea level, Mr. Soues (per Mr. T. Elwyn), 1886. South Fork of Quesnel River, near the foot of Quesnel Lake, A. Bowman, 1886.

In an article "On the Lower Cretaceous Rocks of British Columbia,"* the writer has already expressed the opinion "that the *Aucella Piochii* of Gabb cannot be distinguished from the *A. Mosquensis* of Von Buch, even as a local variety," and the only reason why the former name is provisionally retained in this and in previous papers is to show that the specimens from British Columbia are precisely similar to those which are so characteristic of a well-marked horizon in the Shasta Group of California.

YOLDIA ARATA, Whiteaves.

Yoldia arata, Whiteaves.—1884. Geol. and Nat. Hist. Surv. Can., Mesoz. Foss., Vol. I., p. 233, pl. 31, figs. 4 and 4*a*.

East side of Winter Harbour, Forward Inlet, G. M. Dawson, 1885; a few casts of the interior of the shell of a small *Yoldia* which are somewhat doubtfully referred to this species.

ASTARTE PACKARDI.

Astarte Packardi, Whiteaves (as of White).—1884. Geol. and Nat. Hist. Surv. Can., Mesoz. Foss., Vol. I, p. 229, pl. 30, figs. 6, 6*a* and 6*b*; but possibly not *A. Packardi*, White, 1880, U. S. Geol. Surv., Contr. to Pal., Nos. 2-8, p. 149, pl. 37, figs. 6*a* and *b*.

Same locality, collector and date as the preceding. A few imperfect and badly preserved valves of an *Astarte* which can scarcely be distinguished from a species from the "Lower Shales" of the Queen Charlotte Islands, which the writer has identified with the *A. Packardi* of White, although in the former the surface seems to have been coarsely and irregularly striated or finely plicated, while in the latter it is regularly and distinctly ribbed.

It is only proper to add, also, that Dr. White regards the Queen Charlotte Island species as distinct from his *A. Packardi*.

OPIS VANCOUVERENSIS, Whiteaves.

Opis Vancouverensis, Whiteaves.—1879. Geol. and Nat. Hist. Surv. Can., Mesoz. Foss., Vol. I, p. 158, pl. 18, figs. 4 and 4*a*.

West end of Lasqueti Island (in the Strait of Georgia) near False Bay; a cast of the interior of the right valve of a shell which almost certainly belongs to this genus, and most probably to this species.

* Trans. Royal Soc. Can., Vol. I., Section IV., pp. 81-86.

PLEUROMYA LÆVIGATA, Whiteaves.

Pleuromya lævigata, Whiteaves.—1884. Geol. and Nat. Hist. Surv. Can., Mesoz. Foss., Vol. I, p. 224, pl. 30, figs. 1, 1*a*, 1*b* and 1*c*.

Nookneamish River, north-west end of Vancouver Island, G. M. Dawson, 1885, six badly preserved but nearly perfect and eight imperfect casts of the interior of the shell. These specimens are very variable in shape, no two being alike.

PLACENTICERAS OCCIDENTALE. (N. Sp.)

Perhaps a variety of *Ammonites bicurvatus*, Michelin, which Zittel (Handbuch der Palæontologie, vol. 2, p. 452) says is a *Placenticeras*.

Cfr. *Ammonites bicurvatus*, Mich., d'Orbigny.—1840-42. Pal. Franc., Terr. Cret., tome I, p. 286, pl. 84, figs. 3 and 4, but not (teste Pictet) figs. 1 and 2.

Shell strongly compressed at the sides, periphery rather sharply angulated but not distinctly keeled: outer whorl very closely embracing, umbilicus rather narrow, a little less than one-fourth of the greatest diameter: aperture narrowly sagittate, its base deeply emarginate by the encroachment of the preceding volution.

Surface of the sides of the outer whorl marked by broad and rather distant, radiating, bifurcating and doubly flexuous raised plications, which commence at the umbilical margin, curve at first gently forwards, then as gently backwards, and are finally bent very abruptly forwards next to the periphery, upon which they form narrow, elongated and acute tongue-like processes. In addition to these plications the surface is marked by fine, simple and comparatively close-set, radiating raised lines, which are also doubly flexuous on each side. These raised lines are most strongly marked on the outer half of the sides, and are as well defined on the summits of the plications as in the smaller spaces between them. Septation unknown.

K-uk River, coast of British Columbia, G. M. Dawson, 1885; one tolerably well preserved but somewhat imperfect cast of the interior of the shell, whose greatest diameter is a little less than five inches.

The species seems to differ from *P. bicurvatus*, not only in its much greater size, but also in the presence of numerous, fine-set and doubly flexuous raised lines, in addition to the radiating plications or rib-like folds which are common to both.

SCAPHITES QUATSINOENSIS.

Olcostephanus Quatsinoensis, Whiteaves.—1882. Trans. Roy. Soc. Can., Vol. I., Section IV., p. 82, woodcut fig. 1.

East side of Winter Harbour, Forward Inlet, Quatsino Sound, V.I., G. M. Dawson, 1885, two well preserved and nearly perfect but not quite adult specimens, and a few fragments.

These show clearly that the species is not an *Olcostephanus* of the type of *O. bidichotomus*, as was at first supposed, but a finely-ribbed small Scaphite very nearly related to the *Scaphites æqualis* of Sowerby. Its ribs too are not invariably bidichotomous, for in some of the specimens collected in 1885 they are trifurcated, while in others, in closely contiguous portions of the same specimen, they are bidichotomous, trifurcated, or simple with shorter ones intercalated between, though they are apparently never tuberculated nor nodose.

The type of *O. Quatsinoensis* is a well preserved but very imperfect and immature specimen, collected by Dr. Dawson in 1878 at Browning Creek, Forward Inlet, where it is associated with an abundance of *Aucella Piochii*. The occurrence of a small Scaphite associated with these *Aucellæ* suggests the idea that the rocks which contain so many of the latter may be much newer geologically than has as yet been supposed.

In addition to the foregoing, a few Cretaceous fossils whose specific relations are at present obscure, were collected by Dr. Dawson in 1885 at the following localities. From the west end of Lasqueti Island, near False Bay, a single specimen of a finely ribbed *Terebratella*, apparently undescribed but too imperfectly preserved to show its characters satisfactorily; two small valves of an *Ostræa*, and a fragment of a valve of a *Pecten*. From Nookneamish River, coast of British Columbia, numerous casts of the interior of the shell of a small *Trigonia*; and from the east side of Winter Harbour, Forward Inlet, casts of an undetermined species each of the genera *Dentalium*, *Cinulia*, *Protocardium* and *Arca*.

APPENDIX II.

LIST OF PLANTS OBTAINED

BY DR. G. M. DAWSON

ON

VANCOUVER ISLAND AND ADJACENT COASTS, IN 1885.

BY PROF. J. MACOUN.

NOTE.—The shores of the Strait of Georgia constitute a distinct region climatically from that of Queen Charlotte Sound and the northern and western parts of Vancouver Island, being characterized by a relatively less copious rainfall and greater summer heat. The flowering plants and ferns of the two districts are therefore separately enumerated. The *Mosses*, *Liverworts* and *Lichens* are, however, given in a single list. Most of the species enumerated from Sooke were collected by Mr. James Fletcher.

COASTS AND ISLANDS ADJACENT TO THE STRAIT OF GEORGIA.

Arabis perfoliata, (Lam.) Drew Harbor.
Lepidium intermedium, (Gray.) Drew Harbor.
Arenaria peploides, (Lam.) var. *oblongifolia*, (Watson.) Between Cape Lazo and Shelter Point.
Sagina occidentalis, (Watson.) Malaspina Inlet.
Silene antirrhina, (L.) Drew Harbor.
Geranium pusillum, (L.) Drew Harbor.
Trifolium microcephalum, (Pursh.) Drew Harbor.
Vicia gigantea, (Hook.) Sooke.
Rosa Nutkana, (Presl,) Hernando Island.
Heuchera micrantha, (Dougl.) North end of Texada Island.
Tiarella trifoliata, (Hook.) Comox.
Godetia amœna, (Lilja.) Sooke.
Opuntia fragilis, (Haw.) Hernando Island.

Daucus pusillus, (Mx.) Drew Harbor and Mary Harbor.
Peucedanum leiocarpum, (Nutt.) Drew Harbor.
Archangelica Gmelini, (DC.) Sooke.
Osmorrhiza nuda, (Torr.) Sooke.
Lonicera hispidula, (Dougl.) Sooke.
Galium triflorum, (Mx.) Sooke.
Galium aparine, (L.) Sooke.
Grindelia integrifolia, (DC.) A glabrate form. North end of Texada Island.
Gnaphalium purpureum, (L.) Sooke.
Adenocaulon bicolor, (Hook.) North end of Texada Island.
Balsamorrhiza deltoidea, Nutt. Drew Harbor.
Franseria bipinnatifida, (Nutt.) Between Cape Lazo and Shelter Point.
Madia dissitiflora, (T. and G.) North end of Texada Island.
Eriophyllum cæspitosum, (Dougl.) Between Cape Lazo and Shelter Point.
Cnicus edulis, (Gray) North Point of Texada Island.
Senecio aureus, (L.) var. *Balsamitæ*, (T. & G.) North Point of Texada Island.
Hieracium albiflorum, (Hook.) North end of Texada Island.
Campanula Scouleri, (Hook.) Sooke.
Specularia perfoliata, (A. DC.) Drew Harbor.
Vaccinium ovatum, (Pursh.) North end of Texada Island.
Arctostaphylus Uva-ursi, (Spreng.) Sooke.
Trientalis Europæa, (L.) var. *latifolia* (Torr.) Comox.
Amsinckia lycopsoides, (Lehm.) Mary Island.
Convolvulus Soldanella, (L.) Savary Island.
Cuscuta salina, (Engelm.) Hernando Island.
Plantago maritima, (L.) Hernando Island.
Castilleia miniata, (Dougl.) (Leaves three-cleft, uncommon.) Sooke.
Micromeria Douglasii, (Benth.) North end of Texada Island.
Atriplex patula, (L.) var. *littoralis*, (Gray.) Drew Harbor.
Salicornia ambigua, (Mx.) Drew Harbor.
Brunella vulgaris, (L.) North end of Texada Island.
Quercus Garryana, (Dougl.) Comox.
Juniperus Virginiana, (L.) Lasqueti Island.
Tsuga Mertensiana, (Carr.) Sooke.
Pinus monticola, (Dougl.) North end of Texada Island and Sooke.
Pinus contorta, (Dougl.) Sooke.
Pseudotsuga Douglasii, (Carr.) Sooke.
Corallorhiza striata, (Lindl.) Sooke.
Allium acuminatum, (Dougl.) Mary Island.
Zygadenus venenosus, (Watson) North end of Texada Island.

Agrostis exarata, (Trin.) N. end of Texada Island and Blunden Harbor.
Agrostis vulgaris, (With.) Drew Harbor.
Trisetum canescens, (Buckley.) Sooke.
Danthonia Californica, (Bolander.) North end of Texada Island.
Poa Bolanderi, (Thurber.) Sooke.
Glyceria maritima, (Wahl.) North end of Texada Island.
Festuca ovina, (L.) Sooke.
Festuca ovina, (L.) var. Malaspina Inlet, North end of Texada Island.
Festuca microstachya, (Nutt.) Sooke.
Deschampsia elongata, (Munro.) Sooke.
Bromus ciliatus, (L.) Sooke.
Triticum divergens, (Nees.) North end of Texada Island.
Hordeum pusillum, (Nutt.) North end of Texada Island.
Elymus arenarius, (L.) North end of Texada Island.

Northern part of Vancouver Island and Coasts of Queen Charlotte Sound and vicinity.

Stellaria uliginosa, (Murr.) Blenkinsop Bay.
Stellaria borealis, (Bigel.) Blenkinsop Bay.
Hypericum Scouleri, (Hook.) Nimpkish Lake.
Neillia opulifolia, (Benth & Hook.) Nimpkish Lake.
Spiræa discolor, (Pursh) var. *ariæfolia*, (Wat.) Nimpkish Lake.
Solidago elongata, (Nutt.) Nimpkish Lake.
Aster foliaceus, (Lindl.) Nimpkish Lake.
Menziesia ferruginea, (Smith) Nimpkish Lake.
Myrica Gale, (L.) Nimpkish Lake.
Chamæcyparis Nutkœnsis, (Spach.) Nimpkish Lake.
Thuya excelsa, (Bong.)
Juncus Balticus, (Deth.) Blenkinsop Bay.
Juncus alpinus, (Vill.) var. *insignis*, (Fries) Nimpkish Lake.
Juncus Mertensianus, (Meyer) Nimpkish Lake.
Juncus falcatus, (Meyer) Nimpkish Lake.
Carex Sitchensis, (Prescott) Blenkinsop Bay.
Carex lenticularis, (Mx.) Nimpkish Lake.
Deyeuxia crassiglumis, (Vasey) Nimpkish Lake.
Deschampsia cæspitosa, (Beauv.) Knox Bay.
Glyceria distans, (Wahl.) Blunden Harbor.
Polypodium Scouleri, (Hook. & Grev.) Cape Scott, north-west point of Vancouver Island.
Lomaria Spicant, (Desv.) Alert Bay.
Asplenium Trichomanes, (L.) Strait of Georgia.
Aspidium spinulosum, (Swz.) var. *dilatatum*, (Hornm.) Alert Bay.

VANCOUVER ISLAND AND ADJACENT COASTS.

MUSCI.

Sphagnum rigidum, (L.) Cape Scott.
Dicranoweisia cirrhata, (Lindb.) Knox Bay.
Dicranum scoparium, (Hedw.) Texada Island and other points.
Dicranum majus, (Turner) Knox Bay.
Ceratodon purpureus, (Brid.) var. *xanthopus*, (Sulliv.) Pearse Island.
Barbula Mulleri, (Bruch and Schimp.) Drew Harbor.
Grimmia apocarpa, (Bruch and Schimp.) Texada Island.
Racomitrium heterostichum, (Brid.) Pearse Island.
Racomitrium varium, (James & Lesq.) Blenkinsop Bay.
Racomitrium lanuginosum, (Brid.) Malaspina Inlet.
Ulota phyllantha, (Brid.) Vancouver Island.
Ulota Barclayi, (Mitt.) Malaspina Inlet.
Mnium spinulosum, (Bruch & Schimp.) Forward Inlet, Malaspina Inlet.
Mnium punctatum, (Hedw.) Johnston Strait, Harbledown Island, and Comox.
Mnium Menziesii, (Muell.) Malaspina Inlet.
Mnium affine, (Bland) Malaspina Inlet.
Aulacomnion androgynum, (Schw.) Malaspina Inlet.
Pogonatum alpinum, (Roehl.) Comox.
Polytrichum piliferum, (Schreb.) Texada Island.
Neckera Douglasii, (Hook.) Johnston Strait.
Antitrichia curtipendula, (Brid.) Harbledown Island.
Hypnum (*Heterocladium*) *heteropterum*, (Bruch) Comox.
Hypnum (*Claopodium*) *ramulosum*, (Hampe.) Texada Island.
Hypnum (*Eurhynchium*) *Stokesii*, (Turn.) Alert Bay.
Hypnum (*Eurhynchium*) *Oreganum*, (Sulliv.) Texada Island.
Hypnum (*Isothecium*) *myosuroides*, (Mitt.) Texada Island, Johnston Strait, Redonda Islands and Forward Inlet.
Hypnum (*Brachythecium*) *asperrimum*, (Mitt.) Comox.
Hypnum (*Isothecium*) *stoloniferum*, (Hook.) Texada Island, Harbledown Island.
Hypnum (*Thamnium*) *neckeroides* (Hook.) Comox.
Hypnum (*Hypnum*) *Sequoieti*, (Muell.) Malaspina Inlet, Texada Island and Thurlow Islands.
Hypnum (*Hypnum*) *subimponens*, (Lesq.) Comox.
Hypnum (*Pleurozium*) *splendens*, (Hedw.) Johnston Strait, Alert Bay.
Hypnum (*Hylocomnium*) *loreum*, (Linn.) Forward Inlet, Johnston Strait.
Hypnum (*Plagiothecium*) *undulatum*, (L.) Harbledown Islands and vicinity.

HEPATICEÆ.

Anthoceros stomatifer, (Aust.) Redonda Islands.
Metzgeria conjugata, (Aust.) Blenkinsop Bay.
Frullania Grayana, var. *Californica*, (Aust.) Redonda Islands.
Frullania Bolanderi, (Aust.) Hanson Island and Alert Bay.
Lepidozia Californica, (Aust.) Alert Bay.
Radula Hallii, (Aust.) Alert Bay.
Jungermannia Schraderi, (Mart.) Alert Bay.
Jungermannia, Sp. Forward Inlet.
Jungermannia, Sp. Harbledown Islands.
Scapania nemorosa, (Nees.) Hanson Island.
Scapania Bolanderi, (Aust.) Alert Bay.

LICHENES.

Ramalina reticulata, (Noehd.) Common in woods.
Ramalina calicaris, var. *farinacea*, (Fr.) Alert Bay.
Ramalina calicaris, Var. On trees, Thurlow Island. Only one small specimen.
Cetaria sæpincola, Ach.) var. (b) *chlorophylla*, (Wahl.) Thurlow Islands and Pearse Islands.
Cetaria lacunosa, (Ach.) Hernando and Hanson islands.
Cetaria lacunosa, (Ach.) var. (b) *stenophylla*, (Tuck.) Hanson Island.
Cetaria glauca, (Ach.) Hernando Island and Pearse Island.
Alectoria ochroleuca, var. *sarmentosa*, (Nyl.) Pearse Island and Thurlow Islands.
Parmelia physodes, (Ach.) Hanson Island.
Parmelia physodes, var. *enteromorpha*, (Tuck.) Thurlow Island, Redonda Island, Alert Bay and Harbledown Island.
Parmelia saxatilis, (Fries) Redonda Island, Harbledown Island and Thurlow Island.
Umbilicaria angulata, (Tuckerm.) Harbledown Islands.
Sticta pulmonaria, (Ach.) Alert Bay, Forward Inlet and Johnston Strait.
Sticta Oregana, (Tucker) Comox and Alert Bay.
Sticta scorbiculata, (Ach.) Comox, Pearse Islands and Redonda Island.
Sticta, Sp. Redonda Island.
Nephroma Lusitanicum, (Schœr.) Comox and Thurlow Island.
Peltigera aphthosa, (Hoffm.) Harbledown Island and Comox.
Peltigera polydactyla, (Hoffm.)
Peltigera scutata, (Leight) Harbledown Island.
Peltigera canina, (Hoffm.) Pearse Island and Comox.

Leptogium palmatum, (Mont.) Forward Inlet.
Placodium elegans, (C.) Harbledown Island.
Placodium aurantiacum, (N. & H.) Blenkinsop Bay.
Lecanora subfusca, (Ach.) Hanson Island, Blenkinsop Bay and Pearse Island.
Lecanora pallescens, (Schœr.) Comox and Alert Bay.
Lecanora, (Sp.) Thurlow Islands.
Pertusaria ambigens, (Tuck.) Pearse Island.
Stereocaulon tomentosum, (Fr.) Thurlow Islands and Hanson Island.
Cladonia pyxidata, (Fr.) Thurlow Islands.
Cladonia fimbriata, var. *tubæformis*, (Fr.) Alert Bay, Thurlow Island, and Redonda Islands.
Cladonia gracilis, var. *verticillata*, (Fr.) Forward Inlet and Knox Bay,
Cladonia gracilis, var. *hybrida*, (Fr.) Redonda Islands.
Cladonia squamosa, (Hoffm.) Redonda Islands, Knox Bay, and Thurlow Island.
Cladonia furcata, var. *crispata*, (Fl.) Alert Bay and Hanson Island.
Cladonia furcata, var. *racemosa*, (Fl.) Thurlow Island and Hanson Island.
Cladonia furcata, var. *subulata*, (Fl.) Hansom Island and Comox.
Cladonia furcata, (Fr.) Harbledown Island.
Cladonia rangiferina, var. *alpestris*, (Hoffm.) Hanson Island and Knox Bay.
Cladonia cornucopioides, (Fr.) Hanson Island and Johnston Strait.
Cladonia bellidiflora, (Ach.) Thurlow, Hanson, and Pearse islands and Johnston Strait.
Boemyces æruginosus, (Scop.) Thurlow Island and Comox.
Sphærophorus globiferus, (C.) Thurlow Island, Hanson Island, Alert Bay and Harbledown Island.
Biatora, Sp. On moss at Knox Bay.
Biatora, Sp. On bark of trees, Hanson Island and Comox.
Endocarpon, Sp. On rocks at Comox.

APPENDIX III.

METEOROLOGICAL OBSERVATIONS ON THE COAST OF BRITISH COLUMBIA, JUNE 21ST TO OCTOBER 22ND, 1885.

The barometer readings are those of a small aneroid, but have been corrected for instrumental error and are believed to be nearly exact.

The temperature is stated in degrees Farenheit.

The force of the wind is estimated according to Beaufort's scale. The proportion of the sky covered by clouds is estimated on a scale of 0 to 10, 0 being a cloudless sky, 10 a completely clouded sky. The character of the clouds is denoted by the usual letter or combination of letters referring to Howard's classification.

PLACE.	Date.	Hour.	Barometer corrected.	Ther. corrected.			Direction of wind.	Force of wind.	Amt. of cloud.	Kind of cloud	Temp. of surface water.	Weather at time.	Weather during last interval.
				Air.	Max.	Min.							
VICTORIA TO SEYMOUR NARROWS.				°	°	°							
Off Victoria	June 21	8.15 a.m.	30.27	59.	....	....	S.S.E.	I	2	C & K.	51.	Fog bank in Strs,	
Swanson Channel	" 21	7.00 p.m.	30.126	57.	....	....	E.	II	1	K& CK.	51.5	.....	Light S.S.E. wind changing to E.fair.
" "	" 22	7.00 a.m.	30.22	59.	....	45.	S.	I	2	C K.	52.5	.....	Light airs and calm. Fair.
Str. of Georgia off Fraser R.	" 22	7.00 p.m.	30.13	64.	69.	....	S.S.W.	I	4	C. & K.	64.5	Fair.	E. & S.E. lt. winds. Fair.
" " " Dep. Bay	" 23	7.00 a.m.	30.22	63.	....	....	W.	IV	7	K S.	63.5	.....	Str'g W.w'd. Sea rough w'd III to IV.
" " " "	" 23	7.00 p.m.	29.97	66.	76.	....	S.W.	I	1	K.	66.5	Fair.	Calm from 9 a.m.
" " " Ballinac I.	" 24	7.00 a.m	30.01	61.	....	....	N.W.	II	½	K.	63.	Fair.	Lt. E. air 9.12 p.m. Calm 12.30. N.W. breeze from 12.30.
" " " Hornby I.	" 24	7.00 p.m.	29.87	68.	76.5	....	Variable.	0	3	C.	62.5	Fair.	Lt. N.W. wind falling calm and var.
Baynes Sound, S. end	" 25	7.00 a.m.	30.01	68.	....	59.	Calm.	....	7	C K.	64.5	.....	Lt. puffs from S. followed by calm.
Comox Harb	" 25	7.40 p.m.	29.99	67.	73.	....	S.E.	II	7	K.	65.	....	Str. S.E. wind from 10 a.m.
" "	" 26	7.00 a.m.	30.13	58.	....	52.	N.W.	I	5	K.	64.5	.....	Calm nearly all night,
North end Texada I.	" 26	7.00 p.m.	30.19	64.5	....	....	E.S.E.	II	9	K S.	64.5	Shrs. Clearing.	Strong breeze since 9 a.m.
North end Texada I.	" 27	7 00 a.m.	30.24	64.	....	55.	S.E.	1	9	K. & S.	62.5	.....	Lt. air S. S.E. Calm with showers.
1½ mile N, Cape Lazo	" 27	7.00 p.m.	30.09	65.	74.	....	E.	0	10	K S.	57.5	.....	Lt. variable airs.
" " "	" 28	7.00 a.m.	30.07	61.	....	....	E. variab.	I II	10	K S.	57.0	....	Calm all night. Breeze in morning changing S. and E.
Oyster bay	" 28	7.00 p.m.	30.09	65.	74.	....	Variable.	0	10	K S.	62.	.....	Rain till noon. Calm since 1 p.m.
Discovery Passage	" 29	7.00 a.m.	30.21	60.	....	....	N.W.	II	1	K.	60.	.....	Calm all night.
Disc. Passage off Yucalta village	" 29	7.40 p.m.	30.02	74.	77.	....	Calm.	....	....	.....	51.	Clear.	Very light air N.W. all day.
" " "	" 30	7.00 a.m.	.....	52.	....	....	"	....	10	N.	51.5	Rn'g. very hard.	Calm & lt. S. wind. Rain began 5 a.m.
Off Cape Mudge	" 30	7.30 p.m.	30.02	60.	....	....	"	....	7	K.	63.	.....	Calm and light S. E. air,
" "	July 1	7.00 a.m.	30,04	58.	....	52.	N.W.	II	7	K S &C.	62.5	.....	Lt. N.W. wind,

Drew Harbor	July	1	7.00 p.m.	30.00	66·5	76.	....	N.	II	1	K S.	66.	....	Lt. N.W. changing to S. wind.
" "	"	2	7.00 a.m.	30.10	59.	....	51.	N.	I	2	C.	64.	Fair.	Lt. N. wind.
" "	"	3	7.00 p.m.	30.20	73.	90.	...	N.	I	....	Clear.	66.	....	Strong N. wind in afternoon.
" "	"	4	7.00 a.m.	30.34	66.	....	52.	N. by E.	II	....	Clear.	66.	....	Continued strong wind chang. to S.E.
" "	"	4	7.00 p.m.	30 27	67.	89.	...	N.	I	....	Clear.	67.	.....	Str. breeze in afternoon from N. fair.
" "	"	5	7.00 a.m.	30.29	70.	....	61.	N.	II	....	.....	67.	.....	Fair continued. Strong wind.
" "	"	5	7.00 p.m.	30.13	77.	88.	....	N.	II	....	.....	67.	.....	" " " " squally.
Mary Island anchorage	"	6	7.00 p.m.	29.97	73.	....	....	N.	IV	1	C.	52.	.....	Light wind and fair, forenoon, heavy during afternoon.
" " "	"	7	7.00 a.m.	29.94	62.	....	57.	N.W.	II	8	C & K.	50 5	....	Blowing all night.
Stag Harbor	"	7	7.00 p.m.	29.94	72.	76.	....	N.	II	1	K	63.	Very smoky.	Heavy N. wind part of afternoon.
" "	"	8	7.00 a.m.	29.99	67.	...	62.	N.	I	....	K& Sm.	53.	" "	Fresh breeze all night.
" "	"	8	7.00 p.m.	29.94	69.	77.	..	N.	I	8	K.	62.	" "	
" "	"	9	7.30 a.m.	30.07	61.	....	60.	Calm.	....	....	Smoke.	57·5	" "	6 a.m. lt. S.E. breeze foll. by calm.
Malaspina Inlet, Georgina Pt.	"	9	7.00 p.m.	30.04	68.	75.	....	"	....	....	"	65.	" "	Slight S.W. changing to west breeze.
" "	"	10	7.00 a.m.	30.13	62.	....	58.	"	....	....	.....	56.	" "	
" " "	"	10	7.00 p.m.	30.06	68.	78.	....	"	....	....	.....	64.	" "	Light W. wind in afternoon.
" " "	"	11	7.00 a.m.	30.14	60.	....	56.	"	....	....	.....	59.	....	Calm all night.
Savary Island	"	11	7.00 p.m.	30.11	71.	90.	....	"	....	....	Clear.	60	Little smoky.	Light west S.W. and S.E. variable breeze. Fair.
N. Savary Island	"	12	7.00 a.m.	30.16	62.	....	58.	N.W.	I	...	"	58.	Clear.	Calm all night.
W Ragged I.	"	12	7 00 p.m.	30.07	72.	87.	....	Variable.	0	....	"	60.	.....	Calm and clear.
Stag Harbor	"	13	7.00 a.m.	30.12	69.	...	61.	W.	0	....	"	60.	.....	Slight breeze at midnight.
" "	"	13	7.00 p.m.	30.005	72.	78.	....	S.E.	III	8	K.	57.	A few d'ps of rain	Wind changed at 3 p.m.
Off Dinner Rock	"	14	7.00 a.m.	30.135	61.	...	....	N.	I	....	.....	62.	.....	Made sail 3 a.m. wind then N.W.,I.
Off Indian Village, Klahoos	"	14	7.00 p.m.	30.125	61.	76.	....	S.W.	I	9	K.	63.	....	Little rain at noon.
" " "	"	15	7.00 a.m.	30.155	62.	....	60.	N.	II	4	K.	62.5	....	Started at about 9 a.m. blowing fresh N. to N.W.
Thunder Bay, Jarvis Inlet	"	15	7.00 p.m.	30.135	66.	80.	...	Variable.	I	1	K.	66.	Fair.	Wind gradually fell chang. S.E. & S.
" " "	"	16	7.00 a.m.	30.105	70.	..	60.	Calm.	....	1	K.	63.	.....	
" " "	"	16	7.00 p.m.	30.085	65.	76.	....	S. by W.	I	10	K.	67.	.....	Blowing hard S. 11 a.m. till 3 p.m.
" " "	"	17	7.00 a.m.	30.045	63.	....	55.	Calm.	....	7	K.	63.	.....	
N. End Texada I.	"	17	8.00 p.m.	29.985	62.	75.	....	S.	I	2	K S.	62.	.....	Wind var. all afternoon.
" "	"	18	7.00 a.m.	29.985	63.	....	60.	N.W.	I	2	S.	62.5	... .	Blowing hard 5 a.m. N.W.
Comox Harb.	"	18	7.00 p.m.	30.015	62.	74.	....	S.E. by S.	IV	5	K S.	62.	.....	Fresh breeze during afternoon.
" "	"	19	7.00 a.m.	30.135	62.	....	55.	S.	0	9	K S.	62.	.....	Rained a little about 8 p.m.
" "	"	19	7.30 p.m.	30.135	61.	74.	....	S.E.	III	7	C K S.	61.5	.....	
" "	"	20	7.00 a.m.	30.165	61.	..	56.	S.E.	I	8	K S.	62.5	....	
Duncan Bay	"	20	7.00 p.m.	30.155	62.	70.	....	Calm.	....	10	K S.	52.	Rain'g moder't'ly	Brisk S.E. wind all afternoon.
" "	"	21	7.30 a.m.	30.235	61.	....	58.	"	....	2	C K S.	53.	.....	

PLACE.	Date.	Hour.	Barometer corrected.	Ther. corrected. Air.	Ther. corrected. Max.	Ther. corrected. Min.	Direction of wind.	Force of wind.	Amt. of cloud	Kind of cloud	Temp. of surface water.	Weather at time.	Weather during last interval.
FROM SEYMOUR NARROWS TO NORTH END VANCOUVER I. AND QUEEN CHARLOTTE SOUND.				°	°	°							
6 miles N. Seymour Narrows	July 21	7.00 p.m.	30.27	64.	69.	....	Variable.	0	9	K S.	50.5	.....	Little rain, 2 p.m.
Elk Bay	" 22	7.00 a.m.	30.32	57.	....	53.	.....	.....	9	K S.	50.	.....	
" "	" 22	7 15 p.m.	30.27	60.	70.	....	Calm.	.....	10	K S.	50.5	.....	Showers light 6, 6.30 p.m.
" "	" 23	7.00 a.m.	30.234	56.	....	54.5	"	.....	10	K S.	50.5	Foggy in Straits.	
" "	" 23	7.00 p.m.	30.164	64.	66.	....	N.W.	I	3	K S.	51.	Wind squally.	Wind rose at 1 p.m. to II squally.
Knox Harbour	" 24	7.00 a.m.	30.214	56.	....	56.	W.	II & IV	9	K& KS.	51.	" "	Continued high wind, clouds mv'g. E.
" "	" 24	7.00 p.m.	30.174	62.5	70.	....	S.W.	II		Clear.	51.5	.....	" " "
" "	" 25	7.00 a.m.	30.234	58.	....	52.	S.W.	0		"	50.	.....	
" "	" 25	7.00 p.m.	30.114	68.	76.	....	S.W.	III		"	52.	.....	Strong wind in straits, rose at noon.
" "	" 26	7.00 a.m.	30.144	59.	....	54.	S.W.	0	4	K.	50.	.....	Clouds morning east.
" "	" 26	7.00 p.m.	30.054	64.	73.	....	S.W.	IV	3	C & S.	52.	.....	Wind strong since 2 p.m. fair.
" "	" 27	7.00 a.m.	30.114	56.	....	55.	S.	0	8	K.	50.5	.....	Wind very strong early part of night
" "	" 27	7.00 p.m.	30 064	62 5	....	....	S.W.	V	1	S.	52.	.....	Blowing hard all day S.W. V. to VI.
Blenkinsop Bay	" 28	7.00 p.m.	30 051	60.	....	....	S.W.	IV		Clear.	50.5	.....	" " " " " " night W. VI.
" "	" 29	7.00 a.m.	30.134	56.	....	54.	S.	0	7	K.	53.5	Nearly calm, fair	
Forward Bay	" 29	7.00 p.m.	30.114	69.	79.	....	W.	0	3	K.	50.5	.....	Wind average IV. during day.
" "	" 30	7.00 a.m.	30.164	54.	....	52.	S.W.	0	10	K.	49.	.....	
" "	" 30	7.00 p.m.	30.214	54.	78.	....	W.	1	10	K.	49.	.....	Lt. S. W. breeze in strait.
" "	" 31	7.00 a.m.	30.284	54.	....	53.	Calm.	.....	10	K.	49.5	Misty.	Rained ¼ inch commenced 10 p.m.
" "	" 31	7.00 p.m.	30.374	57.	59.5	....	"	.....	10	CK&S&K.	51.	Fair.	Cleared at about 3 p.m.
" "	Aug. 1	7.00 a.m.	30.364	53.	....	54.	E.	1	7	KS & K		.....	Lt. variable all day.
Off Hanson I.	" 1	7.00 p.m.	30.263	59.	69.	....	W.	III	7	K S.	54.	.....	Clouds morning N.
Alert Bay	" 2	8.00 a.m.	30.323	58.	....	56.	Calm.	.....	4	K.	52.	.....	
" "	" 2	7.00 p.m.	30.273	61.	66.	....	S.W.	0	1	K.	49.5	.....	
" "	" 3	7.00 a.m.	30.253	53.	....	....	Calm.	.....	10	K S.	48.5	Raining hard.	
" "	" 4	7.00 a.m.	30.253	55.	....	54.	"	.....			49.	Thick fog.	
East end Malcolm I	" 4	7.00 p.m.	30.253	65.	....	....	S.W.	III	10	K S.		Raining hard.	Heavy storm came up from SW 5 pm
" "	" 5	7.00 a.m.	30.233	53.	....	52.	S.W.	(?)	10	K S.		Calm in Bay.	
Alert Bay	" 5	7.00 p.m.	30.203	57.	78.	....	S.W.	IV	6	K S.	50.	.....	
" "	" 6	7.00 a.m.	30.213	55.	....	55.	S.W.	0	10	K S.	49.5	.....	
" "	" 6	7.00 p.m.	30.153	61.	83.	....	Calm.	.....		Clear.	51.5	.....	Lt. S.W. wind all day.
" "	" 7	7.00 a.m.	30.212	54.	....	50.	"	.....	10	K S.	48.5	Raining a little.	Calm all night.
Port McNeill	" 7	7.00 p.m.	30.202	58.	....	....	W.	1	10	K S.	54.	.....	Lt. W. wind in afternoon.
" "	" 8	7.00 a.m.	30.262	58.	....	53.	W.	II	8	K S.	53.5	Clouds moving E.	Strong breeze during night.
" "	" 8	7.00 p.m.	30.222	59.	....	....	W.	IV	2	C & K.	53.	.....	Strong breeze all day.

Port McNeill	Aug.	9	7.00 a.m.	30.252	56.	....	54.	W.	I	10	K S.	53.	.....	Lt. to moderate W & NW wind, fair.
Off Suquash	"	9	7.00 a.m.	30.272	56.5	66.	....	N.W.	III	1	C & S.	54.	Fair.	Lt. var. winds, clear, clouding up NW
Off Beaver Harbor	"	10	7.30 a.m.	30.312	57.	....	....	E.	I	10	S.	53.5	Misty.	
Fort Rupert	"	10	7.00 p.m.	30.272	58.	66.	....	W.	I	1	K.	57.	.....	Lt. wind since noon.
" "	"	11	7.00 a.m.	30.242	54.	....	53.	E.	0	....	.....	56.5	Misty.	
" "	"	11	7.00 p.m.	30.122	62.	73.	....	E.	1	....	Clear.	57.	.....	
" "	"	12	7.00 a.m.	30.062	57.	....	49.	Calm.	.....	....	"	55.	.....	
" "	"	12	7.00 p.m.	29.922	66.	75.	....	N.E.	.....	....	"	60.	.....	
" "	"	13	7.00 a.m.	30.031	55.	....	53.	E.	0	....	Mist.	55.	Misty.	N.W. wind falling calm and changing to S.E.
Goletas Channel	"	13	7.00 p.m.	30.221	56.5	63.5	....	E.S.E.	II	2	C & CS.	51.	Fair.	Lt. var. calm, misty till near noon.
Nawitti Village	"	14	7.00 a.m.	30.346	55.5	....	....	.....	.....	9	C K.	47.5	Fair. Some mist.	Lt. wind in forenoon, died away towards sunset.
" "	"	15	7.00 a.m.	30.321	56.	....	50.	S.	I	7	C& CK.	49.	" Cl'ds mv'g N.	
" "	"	15	7.00 p.m.	30.231	60.	68.	....	W.	I	1	C K.	50.	"	Fine and clear, very little wind out in Sound.
" "	"	16	7.00 a.m.	30.221	56.	....	52.	W.	I	....	Misty.	48.5	.....	
" "	"	16	7.00 p.m.	30.231	59.	71.	....	W.	I	....	"	50.	Misty.	Cleared about 11 a.m., few clouds, misty at 6 p.m.
" "	"	17	7.00 a.m.	30.300	54.	....	53.	Calm.	.....	....	"	50.5	"	Cleared about 10 a.m
Bull Harbor, Hope Island	"	17	7.00 p.m.	30.299	62.	70.	....	W.	I	....	"	53.5	.....	Cleared about 10 a.m., fog from W. at 5.30 p.m.
" " " "	"	18	7.30 a.m.	30.199	54.	....	53.	W.	1	....	"	51.	.....	
" " " "	"	18	7.00 p.m.	30.299	60.	73.	....	W.	1	1	S.	55.	.....	Very foggy and damp till 1.30 p.m., cleared and wind IV.
" " " "	"	19	7.00 a.m.	30.409	56.	....	54.	Calm.	.....	10	K S.	51.	.....	
Off N. W. Nipple, N. 20° E. Nahwitti Cove	"	19	7.00 p.m.	30.409	62.	72.	....	"	.....	1	K S. Clear.	52.	.....	Slight W. wind 10 a.m. till 3.30 p.m.
" " " "	"	20	7.00 a.m.	30.209	....	....	....	"	.....	....	"	56.5	.....	Calm and clear all day.
" " " "	"	20	7.00 p.m.	30.099	60.	....	....	"	.....	....	Misty.	51.5	.....	Clear till 4 p.m., slight puff of wind made 3 miles and anchored, fog.
N. Cape Scott	"	21	7.00 p.m.	30.029	57.	....	....	"	.....	....	"	50.5	Little rain.	Clear and calm during night.
Off " "	"	22	7.00 a.m.	30.099	56.	....	....	W. by N.	0	....	K S.	50.5	.....	Commencing to blow.
" " "	"	22	7.00 p m	30.108	57.	....	....	W.	1	8	C.	51.5	Mist on hills.	Clear and calm during night, lt. mist.
Hecate Cove, Quatsino Sound	"	24	7.30 a.m.	30.158	54.5	....	48.	Calm.	.....	2	K S.	56.	.....	
" " " "	"	24	8.00 p.m.	30.098	58.	70.	....	"	.....	1	K S.	54.	Clouds moving E.	
" " " "	"	25	7.00 a.m.	30.118	57.	....	....	"	.....	8	K S.	57.	.....	
" " " "	"	26	7.00 p.m.	30 298	67.	....	....	W.	1	8	K S.	56.	.....	
" " " "	"	27	7.00 a.m.	30.328	57.	....	....	Calm.	.....	5	S.	54.	.....	Light E. wind in morn. chn'g. to W.
" " " "	"	28	7.00 p.m.	30.097	64.	....	....	"	.....	....	Clear.	52.5	Lt. mist in Sound	
" " " "	"	29	7.30 a.m.	30.097	52.	....	50.	"	.....	....	"	55.	.....	Lt. S.W. wind since 10 a.m.
Off Limestone Island	"	29	7.00 p.m.	30.047	62.	71.	....	W to S W	0	5	K & S.	53.	.....	11 to 11.30 p.m. strong breeze west.
" " "	"	30	7.00 a.m.	30.117	54.	....	53.	Calm.	.....	5	K.	55.	Clouds mv'g N.E.	
Quatsino Inlet	"	30	7.00 p.m.	30.167	58.	66.	....	W.	I	4	K C&S.	55.5	.....	
North Harbor	"	31	7.30 a.m.	30.297	56.	....	54.	Calm.	.....	6	K S.	57.	Clouds mv'g N.E.	S.W. wind outside, light.
" "	"	31	7.00 p.m.	30.317	62.	....	....	E.	I	5	K.	56.	" " N.	
" "	Sept.	1	7.00 a.m.	30.337	58.	....	56.	Calm.	.....	7	K S.	56.	.....	Wind rose in harbor 11 a.m.
4 miles off Raft Cove	"	1	7.00 p.m.	30.3:6	63.	70.	....	S.	I	10	S.	54.	.....	" S.S.E. all night, N. of Cape Scott E., land covered by fog.
Off Cape Scott	"	2	7.00 a.m.	30.236	60.	....	59.	E.S.E.	I	10	S & K.			

PLACE.	Date.	Hour.	Barometer corrected.	Ther. corrected. Air.	Max.	Min.	Direction of wind.	Force of wind.	Amt of cloud.	Kind of cloud	Temp. of surface water.	Weather at time.	Weather during last interval.
				°	°	°							
Goletas Channel	Sept. 2	7.00 p.m.	30.206	62.	69.	....	W.	I	8	K S.	50.	.....	S.E. breeze sprang up at noon from S., heavy.
Beaver Harbor	" 3	8.00 a.m.	30.136	55.	....	52.	S. W.	I	....	Misty.	51.	.....	
" "	" 3	7.00 p.m.	30.076	63.	67.	....	W.	1	5	C & K.	53.	.....	Mist coming from W outside in chn'l.
" "	" 4	7.00 a.m.	30.076	54.	....	53.	Calm.	.....	....	Misty.	52.	.....	
Off Kliksewi R., near Suquash	" 4	7.00 p.m.	30.105	54.	63.5	....	S. E.	0	4	K & K S.	52.	....	N.E. wind I. changed at 2.15 p.m. to N.W. Calm 6.30 p.m.
S. Malcolm I., near Rough B.	" 5	7.00 a.m.	30.125	54.	....	....	Calm.	.....	....	Misty.	48.5	.....	
Alert Bay	" 5	7.00 p.m.	30.126	54.	65.	....	S. W.	1	10	K S.	48.	.....	
" "	" 6	7.00 a.m.	30.086	54.	....	53.	Calm.	.....	10	K S.	48.5	.....	Calm during night. No rain.
" "	" 6	7.00 p.m.	30.055	57.	69.	....	S.W.	0	8	K S.	48.5	.....	
" "	" 7	7.00 a.m.	30.055	52.	....	51.	Calm.	.....	4	C S.	48.	Fog bank in Str.	
Fresh Water Bay	" 7	7.00 p.m.	29.925	58.	64.	....	S.E. to E.	0	8	K.	48.	Clouds moving N.	Slight E. wind veering N.E. and E.
" " "	" 8	7.00 a.m.	29.715	53.	....	53.	Calm.	.....	6	K.	51.	Misty in Straits.	S.E. breeze and rain about midnight.
" " "	" 8	7.00 p.m.	29.635	59.	....	....	S. E.	0	10	K.	48.5	Raining heavy.	Lt. showers, 11 a.m. heavy 12 noon 1 p.m. light all afternoon.
" " "	" 9	7.00 a.m.	29.695	51.	....	50.	N.W.	1	8	K S.	48.	Clouds moving E.	
Farewell Harbor	" 9	7.00 p.m.	29.865	50.	61.5	....	N.W.	0	1	K S.	48.	Clr'd about 8 p.m.	Few shrs. forenoon. Afternoon fine.
" "	" 10	7.00 a.m.	29.995	50.	....	46.	Calm.	.....	6	CS KS.	48.5	.....	
" "	" 10	7.00 p.m.	29.955	58.	71.	....	N.W.	0	6	K S.	49.	Fog in Straits.	
" "	" 11	7.00 a.m.	29.865	51.	....	51.	S. E.	0	10	K S.	48.	Few dp's. of rain.	Rained heavily early in morning and during night.
" "	" 11	7.00 p.m.	29.955	51.	63.5	....	N.W.	0	4	K & S.	48.	Clouds moving E.	Cl'd during forenoon. Wind lt. N.W.
" "	" 12	7.00 a.m.	29.725	51.	....	50.	S. E.	1	10	K S.	48.	Raining.	
" "	" 12	7.00 p.m.	29.614	53.	57.5	....	N.W.	1	10	K S.	48.5	"	Rn'd nearly all day, very heavy shrs.
" "	" 13	7.00 a.m.	29.964	50.	....	48.	Calm.	.....	5	K S.	48.	....	" all night, cleared about 5 a.m.
" "	" 13	7.00 p.m.	30.044	53.	62.5	....	N. E.	1	10	S.	48.5	Raining mod'tly.	Quite clear all forenoon. Clouded during afternoon.
" "	" 14	7.00 a.m.	29.794	51.	....	48.5	S. E.	II	8	C&K S.	49.	.....	Bar. fell till midnight. S.E. wind and rain, heavy 12.5 p.m.
Cullen Harbor	" 14	7.00 p.m.	29.674	58.	....	....	N.W.	II	8	K S.	51.	A few drops rain.	Wind in Sound. S.W. clouds coming from S.W.
" "	" 15	7.00 a.m.	29.893	48.	....	48.	W.	I	6	K S.	49.	Clearing.	Several showers during night.
" "	" 15	7.00 p.m.	29.983	55.	....	....	S. E.	0	2	K S.	51.5	.....	Rained, moderate 11.30 a.m. till 3 pm.
" "	" 16	7.00 a.m.	30.213	50.	....	48.	Calm.	.....	2	K S.	51.	.....	No rain during night.
Monday Harbor	" 16	7.00 p.m.	30 073	....	....	....	.....	.....	...	.....	.....	Stm coming S.W.	Storm passed N. Rn'd at Cullen Hr.
Cullen Harbor	" 17	7.00 p.m.	30.093	56.	....	....	Calm.	.....	4	K S.	49.	A few sprinkles.	A few showers during afternoon.
" "	" 18	7.00 a.m.	29.953	51.	....	51.	S. E.	0	10	K S.	49.	" "	Rained hard at 5 a.m.
" "	" 18	7.00 p.m.	30.093	54.	....	....	Calm.	.....	9	K S.	50.5	.....	Heavy showers in afternoon. Lt. rain all day.

Cullen Harbor	Sept.	19	7.00 a.m.	30.133	49.	....	49.	S. E.	I	9	K S.	50.	.....		
Blunden Harbor	"	19	7.00 p.m.	29.733	53.	54.	....	E.S.E.	VI	10	K S.	53.	Occasional lt shrs	Lt. wind freshn'g up and blowing in st'g squalls. Heavy shrs till 2 pm.	
" "	"	20	7.00 a.m.	29.798	51.5	...	....	S.W.	V	7	K S.	52.	Showery.	Lt. rain till midnight. Wind mod'rg. Heavy thunder shower 6 a.m.	
" "	"	20	7.00 p.m.	30.223	52.	59.5	....	S.W.	I	9	C S & K.	55.	Clearing.	Showery.	
" "	"	21	7.00 a.m.	30.222	50.	....	49.	S. E.	II +	10	K S.	53.	Sq'ly with lt rain.		
" "	"	21	7.00 p.m.	30.123	53.	...	....	S. E.	II	10	K S.	52.	Dropping rain.	Rain'g steadily all day. Wind SE stg.	
" "	"	22	7.00 a.m.	29.972	52.	....	52.	S. E.	I	10	K S.	52.	Lt. rain.	Showery.	
" "	"	22	7.00 p.m.	29.742	61.	64.	....	S. E.	II	10	S & K S.	53.	.....	Showers all day. Light.	
" "	"	23	7.00 a.m.	29.717	54.	....	53.	S. W.	II	10	CK& KS.	53.5	.....	Showers during night.	
Between Foster I. & Malcolm I	"	23	7.00 p.m.	29.902	53.	63.5	....	Calm.	.....	2	K	48.5	.....		
Near Mitchel Bay	"	24	7.00 a.m.	30.012	45.	....	44.	E.	0	8	K S.	48.	.....		
Alert Bay	"	24	7.00 p.m.	30.152	50.	62.5	....	Calm.	.....	6	K S.	52.	Clearing.	Showers light.	
" "	"	25	7.00 a.m.	30.142	49.	....	47.	S. E.	II +	7	K S & S.	48.5	Squally.		
" "	"	25	7.00 p.m.	30.007	53.	56.5	....	S. E.	V	10	K S.	48.5	Lt. rain.		
" "	"	26	7.00 a.m.	29.902	50.	....	50.	E.	V	10	K S.	48.	Clouds mv'g. W.		
" "	"	26	7.00 p.m.	29 811	52.	53.5	...	S. E.	III +	10	K S.	49.	Raining modr'ly.	Showery all day. Wind strong S.E.	
" "	"	27	7.00 a.m.	30.101	50.	....	49.	S. W.	I	2	K S.	49.	.....		
Beaver Cove	"	27	7.00 p.m.	30.151	51.5	63.5	....	S. in Bay.	I	3	CS& CK } K S. }	53.	Fair. Cld'g from S	Lit. westerly wind falling calm in evening. Scattered clouds.	
" "	"	28	7.00 a.m.	30.061	43.5	..	42.	" "	I	8	CS. CK. } K. S. }	50.	Fair.	Lt. S. wind, partly clouded, no rain.	
Broughton Straits	"	28	7.00 p.m.	30.071	52.5	65.	....	E.S.E.	II	8	C S & S.	49.	Fair. Clouding.	Nearly calm till 11 a.m. Lt. E. wind all p.m. Partly clouded.	
Growler Cove	"	29	7.00 a.m.	30.151	52.	..	43.5	E.S.E.	V	10	K S & S.	49.	Showery.	Strong S. E. wind, freshening to gale, with rain. Becomes clouded.	
" "	"	29	7.00 p.m.	30.216	55.	59.5	...	E.S.E.	V	....	.....	49.	Squally, showery	Blowing half gale S. E. all day. Shrs in p.m. Generally clouded.	
" "	"	30	7.00 a.m.	30.161	55.	...	54.5	E.S.E.	0	7	K S.	48.5	"	Blowing strong SE all day. Showers.	
Broughton Straits	"	30	7.00 p.m.	30.356	52.5	57.5	....	Calm.	.....	8	K S&S. } CK&CS }	48.5	Calm and fair.	S.E. followed by lt. W. wind. Shr'y clearing 3 p.m.	
" "	Oct.	1	7.00 a.m.	30.510	51.5	...	50.	"	.....	9	S & mist.	49.	Mist low on hills.	Lt. var. nearly calm. Generally clouded, banks of mist, no rain.	
Johnstone Straits	"	1	7.00 p.m.	30.505	51.	61.5	....	W.	II	4	C&CK S.	50.	Fair. lwr.cld. "	Calm till 3 p.m. then light W. gradually freshening. Generally clear.	
" "	"	2	7.00 a.m.	30.50	48.	....	47.	S.S.W.	II	....	CK mist.	47.5	Mist low on hills.	Lt W wind dying away at 4 a.m, fol. by lt. S.E. Fair, generally clear.	
" "	"	2	7.00 p.m.	30.41	53.	70.	....	Var.	0 I	8	C K.	49.	Fair.	Lt. S.E. wind falling calm 10 a.m. Lt var. and calm till evg. Clear, fair.	
Otter Cove	"	3	7.00 a.m.	30.36	52.	....	49.	N. W.	IV	2	K S.	49.5	"	Lt. var. Heavy squall from W. 2 p.m fol. by str. N.W. Partly clouded.	
Seymour Narrows	"	3	7.00 p.m.	30.23	58.	64.	....	N. W.	III	1	C S.	.....	"	N.W. strong all day. Light clouds moving east.	

PLACE.	Date.	Hour.	Barometer corrected.	Ther. corrected. Air.	Max.	Min.	Direction of wind.	Force of wind	Amt. of cloud	Kind of cloud.	Temp. of surface water.	Weather at time.	Weather during last interval.
SEYMORE NARROWS TO VICTORIA C.B.				°	°	°							
Duncan Bay	Oct. 4	7.00 a.m.	30.24	48.	....	48.	W.	II	1	C.	49½.	.....	Clear all night, a few clouds. Wind W. II to III.
Str. of Georgia W. of Savary I.	" 4	7.00 p.m.	30.22	57.	65.	....	W.	0	....	Clear.	54.	.....	Lt. N.W. changing to N.E., E. and S.W. to W., dying away.
Off Cape Lazo	" 5	7.00 a.m.	30.30	49.	....	48.	N.W.	0-I	6	C.	53.	Fog E. edge of str	Lt. W. changing to N.W.
Comox Harbor	" 5	7.00 p.m.	30.25	52.	64.	....	W.	0	2	C.S.	53.5	Fair.	Lt. N. " " N. E. in strs. Baynes Sound wind S.E. to S.
" "	" 6	7.00 a.m.	30.26	46.	....	46.	W.	I-II	1	C.S.	52.5	Fair.	
" "	" 6	7.00 p.m.	30.17	55.	64.5	.. .	W.	0	....	Clear.	56.	.....	West wind died away 10 a.m. S.E. to S., lt, 10 a.m. 5 p.m. clear.
" "	" 7	7.00 a.m.	30.17	46.	....	45.	W.	1	....	"	53½.	Mist at mouth of Coventry R.	
" "	" 7	7.00 p.m.	29.99	56.	66.	....	W.	0	....	"	56.	.....	Wind W., died away 10 a.m., S. lt. 10 a.m.
" "	" 8	7.00 a.m.	29.91	45.	....	45.	W.	0	4	C. K.	54.	.....	
" "	" 8	7.00 p.m.	29.89	54	....	....	S. W.	1	10	K. S.	55.	.....	On mts. and strs. shrs. Str. SE in pm. Heavy K.S. clouds on mts. to W.
" "	" 9	7.00 a.m.	29.96	45.	....	42.	W.	1	4	K. S.	53.	.....	
" "	" 9	7.00 p.m.	30.10	47.5	....	....	W.	1	1	K. S.	53.5	.....	Westerly wind all day. KS clouds on mts. Few shrs. in p.m.
" "	" 10	7.00 a.m.	30.305	40.	....	38.	W.	1	1	K. S.	52.5	Mist in harbor.	
Between Texada and Hornby I.	" 10	7.00 p.m.	30.37	53.	....	....	S. E.	1	4	K. S.	53.	Clouds moving E.	Very light wind, variable.
Off False Bay	" 11	7.00 a.m.	30.31	48.	....	47.	E. to S	1-1	5	KS CS K.	52.	.....	Calm 7-10. S.E. II ½ hour. Calm till 4.30, clear till 5 pm, clds from SE.
" " "	" 11	7.00 p.m.	30.21	50.	....	....	N.W.	I	6	K. S.	53.	.....	Calm and lt. var. N. W. lt., commenced at 4 p.m.
False Bay	" 12	7.00 a.m.	30.11	49.5	....	48.	Var.	0	7	K. S.	53.5	A few sprinkles.	No wind noticed during night.
" "	" 12	7.00 p.m.	30.05	52.	....	....	Calm.	.....	10	S & K. S.	53.	.....	Lt. N.W. and W. wind. Heavy clds. mv'g. NE and N all day. No rain.
" "	" 13	7.00 a.m.	30.06	50.	....	50.	"	.....	10	K S.	53.5	Clouds mv'g. NE.	Lt. rain during night. Lt. wind NW.
" "	" 13	7.00 p.m.	30.085	52.	62.5	....	"	.....	...	Clear.	54.	.....	Clearing. Lt. wind N.W. Clouds KS moving N.E. and E.

" "	Oct.	14	7.00 a.m.	30.085	50.	....	47.	S. E.	II	8	K.& K.S	54.	Mist in strs.		
" "	"	14	7.00 p.m.	30.065	52.	56.5	....	SWin strs N.W.	I	9	K. S.	53½.	Rn'g. Clouds NE.	Heavy S.E. wind till 5 p.m. Ch'd. to SW 6 pm. KS clds. mvg. NW&NE	
" "	"	15	7.00 a.m.	30.195	45.	..	42.	N.W.	I	2	K. S.	52½.	.....	.....	Cleared 9 p.m., wind S.W. 3 a.m. wind N.W. Sky clear.
" "	"	15	7.00 p.m.	30.265	48.	....	....	N.W.	I	1	K. S.	53.	.....	.....	Clear nearly all day. KS clds. N.W. to S.E. Wind III, fell at sunset.
" "	"	16	7.00 a.m.	30.245	43.	....	43.	N.W.	I	7	K. & K.S.	53.	Clouds mv'g.S.E.		
" "	"	16	7.00 p.m.	30.150	48.	66.	....	N.W.	0	10	S. & K.S.	52.5	.....	.....	KS clouds moving E. all day. Wind III N.W., dying away 5 p.m.
" "	"	17	7.00 a.m.	30.295	42.	....	40.	W.	0	6	K. & fog.	51.	.....	.....	
" "	"	17	7.00 p.m.	30.375	50	60.5	...	Calm.	.....	9	K.	52.	.....	.....	Few sprinkles 9 a.m. Lt. W. to N.W. wind all day. Clouds from S & W.
" "	"	18	7.00 a.m.	30.415	49.	...	47.	N.W.	0	9	K. S.	52.	Clouds moving E.		
Strs of Georgia near Ballidrac I.	"	18	7.00 p.m.	30.285	52.	68.	....	S.W.	0	1	S.	52.	.....	.....	Lt NW wind all day, dying away 5 pm clds KS dn'g a.m. Sky clear in pm.
Off Nanaimo	"	19	7.00 a.m.	30.215	48.	....	47.	N.W.	0	2	K. S.	52.	.....	.....	Lt. N.W. and W. wind, sky clear, wind dying away at 5 a m.
" Gabriola Reefs	"	19	7.00 p.m.	30.11	53.	....	....	Calm.	.....	4	K. S.	53.	.....	.....	Lt. S. and S.E. wind 8.30 a.m. to 6 p.m. K.S. clouds moving E.
" Portier Passage	"	20	7.00 a.m.	30.13	49.	....	48.	E. to S.	1	8	K. S.	51.5	.....	.....	Calm and lt var. S. and W. wind.
4 miles S.E. Portier Passage	"	20	7.00 p.m.	30.015	52.	64.	....	S.	0	6	C.S&K.S.	53.	.....	.....	Lt. S.E. 2 hrs. Calm nearly all day. Clouds from W. and S.W.
N.E. Saturna I	"	21	7.00 a.m.	30.045	51.	....	50.	Calm.	.....	8	K.	51.5	Clouds from W.		Lt. wind 11 p.m. to 5 a.m. KS clds. at 11 p.m. moving N.E.
Off Discovery Island	"	21	7.00 p.m.	30.05	53.	...	....	E.S.E.	0	3	K. S.	50.	Clouds from S.W.		Breeze N.W. 10 a.m.–4 p.m.
" Beacon Hill	"	22	7.00 a.m.	30.065	50.	....	....	Calm.	.....	....	Fog.	.....	.....	.....	Lt. N. wind 10 p.m.–1 a.m.