Appendix D

Transactions of the Manchester Geological & Mining Society, 1903-1904 volume 28: Mr. W. J. Sutton F.G.S. (America), read the following paper on "The Geology and Mining of Vancouver Island:

Comparatively little is yet known regarding the Geology of Vancouver Island, owing to the mountainous character of the interior, and the dense growth of vegetation, making it almost impenetrable.

It is interesting to note, its geographical position on the north-west coast of America being so very similar to that of the British Isles on the north-west of Europe. The climate is identical, owing to similar meteorological conditions. We have the influence of the Pacific Ocean, with its Japan current, striking our coast line, as you have the Atlantic, with its Gulf Stream, so materially affecting your climate.

"We have a large portion of the population, of English birth, who have brought their manners and customs with them, and it may be truly said that there is no place outside of England to-day more characteristically English than the City of Victoria at the present time. So that we might with good reason, like Max O'Rell, speak of Vancouver Island and its people as "John Bull, Jr., and his Island."

Vancouver Island is about three hundred miles in length, with an average width of about seventy miles. Its mountains, with the Queen Charlotte group of islands to the north, form a partially submerged range of mountains, which have been called by the Geological Survey of Canada the Vancouver Range. It forms the extreme western portion of the great Cordilleran system of Western America, comprising four great mountain ranges, *i.e.,* the Rocky Mountains, the Gold Range, the Coast Range, and the Vancouver Range.

The Rocky Mountains are composed principally of stratified rocks (largely carboniferous).

The Gold Range of mountains is composed principally of gneisses, schists and gold bearing slates, and comprise the archean axis of that portion of North America.

The Coast Range of mountains is composed almost entirely of granite with small included areas of gneiss and mica schist (usually highly garnetiferous).

The Vancouver Range is very variable in character, being composed of slates, quartzites, and schists, with local areas of crystalline limestone, and large areas of volcanic rocks comprising diabases, gabbros, and large quantities of clastic volcanic material.

The Vancouver range does not form a continuous range, but is very much broken up into detached ranges and isolated peaks with very deep intervening valleys, making it very rugged over the greater portion of the interior of Vancouver Island. Standing on one of these elevated snowcapped peaks the scenery is grand beyond description. The higher ranges run from four to eight thousand feet in elevation, and on the northerly slopes are covered with perpetual snow.

The mountains are heavily clothed with timber up to an elevation of about four thousand feet, above which the timber becomes very small and scrubby.

The timber is almost entirely coniferous, the most abundant tree being the Douglas fir. We have also red cedar, spruce, and hemlock of commercial importance; with alder, maple, oak, yellow cedar, balsam, arbutus, and white pine over small areas.

The oldest rocks on Vancouver Island have been tentatively placed in the carboniferous period, although I am inclined to think that we shall yet find some strata lower down in the geological scale. The oldest fossil bearing strata so far found have been the detached areas of limestone, which is almost invariably highly crystalline with all vestiges of organic life destroyed. Along with this absence of fossils we have the sedimentary rocks of the earlier period very much broken up and penetrated by volcanic intrusions, thus making the determination of the geological succession a very difficult problem indeed.

Bearing this in mind, the following is given as a broad generalization of the geological succession on Vancouver Island:—

Tertiary period,
Cretaceous period,
Jurassic period,
Triassic period,
Carboniferous period.

Commencing with the oldest formation, we have a series of slates, argillites, quartzites, and schists, with small local areas of highly crystalline limestone, which are placed in the carboniferous period.

Before the close of this period of sedimentation there appears to have been some extrusion of volcanic material along the sea coast, thus making no sharp line of separation with the following period of active vulcanism which has been placed in the Jura-Triassic. This comprises an immense quantity of volcanic material, making a total of many thousands of feet in thickness. This volcanic scries extends from one end of Vancouver Island to the other, and must have been one of the most terrific outbursts of explosive vulcanism in geological times, as the amount of ash and agglomerate extruded during this period amounts to thousands of feet in thickness. I have found it extremely difficult to ascertain the thickness of this elastic volcanic material, as it is intimately incorporated with contemporaneous volcanic flows. The bulk of this eruptive series is composed of diabase, and is very similar in composition and character to the basic volcanic flows of the copper-bearing series of Northern Michigan and Wisconsin, which has been definitely determined as pre-cambrian. Under the microscope one would take them to belong to the same petrographical province. During the Cretaceous period there was a gradual subsidence with the deposition of a large thickness of sediment, principally sandstone, with interbedded coal seams. Sometime after the close of the Cretaceous period, probably during the early miocene, we had another volcanic disturbance on Vancouver Island.

Along the Beaufort Range, near Union, the Cretaceous strata have a vertical displacement of about two thousand feet. During this disturbance comparatively little volcanic material was ejected. It was of a trachytic character, and of limited extent. One of these flows is of special interest in the neighbourhood of the coal mines at Union, where a seam of bituminous coal has been converted by it into a fair grade of anthracite. This flow covers an area of about 1,000 acres, and is about 100 feet thick. It is a quartz andesite or dacite.

The focus of disturbance during this period appears to have been to the north of Vancouver Island as we find a much greater eruption in the Queen Charlotte Islands, where a large flow of basalt quickly followed the outflow of trachyte and trachytic breccia.

During the middle Tertiary we had a small off shore deposit formed, along the west coast of Vancouver Island. It now forms a narrow fringe of friable sandstone extending from Sooke Harbour to Cape Beale. In the neighbourhood of Victoria we have beautiful evidences of glacial action owing to the tough durable eruptive rocks having retained the grooving remarkably well, with numerous exposures all over the city.

Considerable boulder clay has been deposited over different portions of the Island during the Glacial period. More particularly in Comox district.

The whole of what is now the Gulf of Georgia and Straits of Fuca must have been filled by an immense glacier which wrapped Vancouver Island with its icy mantle, and having its outflow to the north and south of the Island.

I can thus only briefly sketch the geology of the Island. "With regard to mining I may say that coal mining is at present the principal mining industry on Vancouver Island.

The output per annum is in the neighbourhood of one million tons. This is mined by two colliery companies—The Wellington Colliery Company, with head-office at Victoria, and The Western Fuel Company (formerly The Vancouver Coal Company), with head-office at Nanaimo. The coal is a first-class bituminous coal, having about the following composition:—

	Per cent.
Volatile matter	30 to 40
Fixed carbon	55 „ 65
Ash	6 „ 8

There are two workable seams of coal, separated by about 300 ft. of intervening strata, principally sandstone. The seams vary from 3 ft. to 7 ft. in thickness. The lower seam lies near the base of the coal formation (Cretaceous), in fact it is sometimes found resting on the underlying basic igneous rocks, showing that the coal began to be deposited soon after a level surface had been formed along the coast. The lower seam is, as a rule, the thickest bed and cleanest coal, and usually a free burning coal, only coking slightly.

The upper seam is a strong coking coal. The Wellington Colliery Company have a large coking plant at Union Wharf. The coke is mostly made from washed screenings. The coal is washed by an elaborate system of jigs, and coked in bee-hive ovens.

The mining has been done principally by means of inclines on the dip of the bed, which is frequently exposed along the rim of the coal basin.

The usual dip of the coalbeds is about fifteen degrees, but they are frequently faulted and disturbed. In the neighbourhood of Nanaimo the coal mines extend for a considerable distance under the sea.

The principal market for the coal is the San Francisco market, although the local consumption has greatly increased during recent years. A local demand for coke has been created by the erection of two smelters on the island.

These smelters have been built to handle the product of the copper ores of the North-west coast. The mining of copper and gold ores comes next in importance to coal mining.

The most important output at present is from the mines on Mount Sicker, about fifty miles from Victoria. I may especially mention the Tyhee and Lenora mines. The ore is principally chalcopyrite, carrying a little gold and silver in a compact barite gangue. It occurs in the form of lenses along a highly schistose zone formed by dynamic metamorphism.

The country rock was originally granitic in character, cut by intrusive basic eruptives. These have been converted into sericitic end chloritic schists, along a zone about half-a-mile in width, with a vertical schistosity and strike of about North 75° West. This belt appears to cut across Vancouver Island, but has not yet been thoroughly explored.

The ore from the Tybee mine is taken by an aerial tramway to the Esquimalt and Nanaimo railway, and thence by rail a short distance to the Company's Smelter at Ladysmith, which is also the shipping port for the Wellington Collieries from their mines at Extension.

The Ladysmith smelter handles about 125 tons of ore per day, converting it into a high grade copper matte, which is shipped to an American converter and refining plant.

The ore from the Tybee mine is taken by a narrow guago railway to the Crofton smelter, a distance of about ten miles. The Crofton smelter is capable of handling about 300 tons daily. They have also a converter, and the product consists of *981* blister copper. There are a large number of occurrences of copper ore throughout the extent of Vancouver Island, which may be said to be only in the prospect stage.

Most of these prospects are contact deposits formed near the contact of limestone and acid eruptives.

The ore of these contact deposits is principally chalcopyrite and bornite, associated with pyrite, pyrrhotite, and magnetite. The associated gangue minerals are garnet, epidote, chlorite, ilvaite, and clinochlore.

Some of these contact deposits are almost entirely phyrrhotite, others entirely compact magnetite, containing over 60 per cent, of metallic iron, and sufficiently free from sulphur to be suitable for the manufacture of iron and steel Some of this ore has been mined at Texada Island, and shipped to a

small blast furnace at Port Townsend, in the State of Washington, where a good pig-iron has been made from it. The possibilities in favour of iron manufacture may be said to be very promising, owing to the fact that all the materials required in the process can be obtained close to the seaboard.

Considerable placer gold was found on Leech Kiver some years ago, and most of the mountain streams show "colours," but at present very little is being taken out. Beyond the copper and iron ores, no other mineral of economic importance is being mined at present.

Quite a number of minerals have been found in small quantities. I may mention cinnabar, native arsenic, stibnite, realgar, galena, sphalerite, and native copper.

I look forward to considerable development in the way of copper and gold mining on the Island, as the numerous prospects indicate a field of great possibilities

The PRESIDENT: I think we are very much indebted to Mr. Sutton for his very interesting paper, and following the usual course, I will thank someone to move a vote of thanks to Mr. Sutton.

Mr. DICKINSON: I have much pleasure in moving a vote of thanks to Mr. Sutton for his interesting description of the geology and mining of Vancouver Island. I have not myself had an opportunity of being there, but I have heard something about it, and I should like, after the vote has been passed, Mr. Sutton to tell us whether any of the basaltic rocks are inter-stratified, or imperfectly stratified, with any of the coal measures similar to what we have found in Scotland. He spoke of one of the mining operations extending to where the coal was changed into anthracite. It is quite common in Scotland, where the coal comes near to one of these basaltic rocks, to find it deprived of its volatile matter and formed into anthracite. I should like to know, therefore, whether any of the basaltic beds do override the coal measures.

Mr. J. TONGE: I have pleasure in seconding the motion. I wish Mr. Sutton would tell us what the relative value of the coal found in the Cretaceous beds and the semianthracite coal was. He has given us an idea by stating the amount of carbon in each. To what extent has anthracite coal been found?

The resolution was adopted.

Mr. SUTTON: I thank you for your vote of thanks. In regard to the questions, I may say the area covered by this anthracite is about 1000 acres. It is merely a local flow, about 100 feet in thickness, and there is about 50 feet of sandstone between the flow and the coal. We have not mined any of the coal yet. An incline is being run into the Anthracite seam, and we expect to be mining coal from it next summer. The difference in value will be, I think, about two dollars a ton—that is if it retains the character which is expected from the borings that have been made.

Mr. ASHWORTH: I have been very much interested in listening to what Mr. Sutton has said about Vancouver Inland. I wish he would tell us how the coal in one place which he has described compares with that which is found further west.

Mr. SUTTON: You are treading on tender ground, because I am an employee of the Wellington Colliery Company. Comparisons are said to be odious, but I may say that the coal further west, to which Mr. Ashworth refers, has up to date been a little better than our coal; but before I came away I learned that its quality was declining, in that it was becoming more mixed with other substances, so that before long I think they will have to wash their coal. The coke we make is made out of the washed coal. We do not make any with coal taken direct from the mine. But taking it all in all there is not a great difference in the qualities.

The PRESIDENT: Will you tell us the thickness of your coal seams?

Mr. SUTTON: They vary from three feet to seven feet. Our best seams run about five feet, and we work them down to about *2* feet. That is the thinnest we can work to a profit at the present time. We pay the highest wages out there, I believe, of any colliery in the world—averaging about four dollars for a working day of eight hours.

Mr. ASHWORTH: Are the coal companies' and the mining companies' properties largely held by American syndicates, or are there many English mining companies in Vancouver P

Mr. SUTTON: That is one of the things we want you in this country to consider. We want our own people to take up these things more than the Americans. I am pleased you have put that question, for I felt very sorry to learn that an English colliery company that had been at work for thirty years had recently sold out to an American company. It is with great regret I have to state that though the bulk of the coal measures are held by a Scotchman, the Americans are coming rapidly to the front in various enterprises. A Scotchman, whose father went out many years ago has managed to obtain possession of the bulk of the coal areas.

Mr. ASHWORTH: I think that is a point for us to consider. Mr. Sutton and others who come from Canada, or British Columbia, want to encourage the people of this country to take a more special interest in the development of the mineral wealth of British Columbia and Vancouver Island. That was my impression when I went all through British Columbia, through the kindness of the Canadian Pacific Railway Company. I found that so many of the Americans were getting the pick of the minerals, and not only was that the case with respect to the minerals, but they were also acquiring much valuable agricultural land in the North West. If we wish to be Imperialistic, it is very important that we should send our money there direct instead of passing it through New York, and I believe if our mining magnates and others would invest their money direct in that country instead of through the several exchanges, they might reap a small percentage to begin with, and the ultimate result would be beneficial to themselves and the country.

Mr. SUTTON: That brings up a question which I have often considered. Englishmen wish to have things brought to them instead of, like the Americans, going out and looking for them. Americans are alive to the necessity of sending out agents in advance. These agents are on the alert for good things, and when any new discovery is made they quickly seize it for the benefit of their patrons. Then the Americans sometimes unload on the British public. I would urge you to form your companies beforehand and send a good man out, and let him look around and be ready to pick up any good thing that presents itself. The Le Roi Mine was a good mine, but the British public paid too much for it. It was beginning to look a bit dubious, so its owners thought it time to load it on to British capitalists, and they did so at a high price. It is a good mine: I have nothing to say against it. Still too high a price was paid for it.

Mr. SYDNEY A. SMITH: Is there much inducement to British people to invest when the product only yields 2 dollars a ton and wages are 4 dollars a day?

Mr. SUTTON: The anthracite coal will yield an *extra* profit of two dollars a ton over that of the bituminous coal. That was what I meant to say. The selling price varies from 3 to 4 dollars a ton on board ship, and is retailed, at about *6h* dollars a ton.

The PRESIDENT again acknowledged the Society's indebtedness to Mr. Sutton, and assured him that the members of the Society would willingly assist him in any enquiries he wished to make in this country.