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THE COALFIELDS OF VANCOUVER ISLAND

By A. R. C. James, P. Eng.

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PREFACE

Much of the historical, geological, and economic information about the Vancouver Island coalfields is contained in books, reports, and papers which are now either out-of-print or have remained unpublished. It has been writer's intention therefore in this Report to gather together some of this essential information so as to present a short account of the Vancouver Island coalfields, with particular reference to the kind of information needed by those who might be interested in investigating the possibility of a resumption of mining operations. It will be noted, however, that no attempt has been made to estimate the extent of coal reserves on the Island. Bearing in mind the conditions of deposition of the coal seams and the lack of available factual information, it is the writer's opinion that no very meaningful figure for coal reserves can be given at this time. Even if one could work out a figure for reserves, the terms of reference would have to be closely defined, since what may be regarded as reserves may vary enormously according to the prevailing economic climate for the particular mineral, in this case coal. However, the writer has attempted to include information about the most suitable areas to carry out further exploration if justified by the prevailing economic conditions.

A list of principal sources of information on the Vancouver Island coalfields is included under References on Page 32.

A. R. C. James, P. Eng.
Victoria, B. C.
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LOCATION

The coalfields of Vancouver Island are in the central part of the east coast of the Island, extending from Cassidy to Campbell River and up to a maximum distance of about six miles inland from the coast. There are a number of other areas on the Island where coal-bearing sediments occur, but, apart from some very minor production at Suquash near Port Hardy, all commercial production has been limited to the above-mentioned area, and the occurrence of commercial coal seams in any other area is extremely unlikely. The actual areas underlain by coal seams which have been mined is even more restricted, being (1) approximately twenty-five square miles between Nanoose Bay and Cassidy, a distance of eighteen miles, with a maximum inland extension of six miles and a local seaward extension (in Nanaimo Harbour) of about one mile; (2) an area of about twelve square miles east of the east end of Comox Lake and west and northwest of the community of Cumberland, and (3) an area of perhaps one and one half square miles in the vicinity of T'sable River, nine miles southeast of Cumberland.

The topography is that of a flat or gently undulating coastal plain. The surface is mantled to a considerable extent with glacial overburden, but outcrops of the more resistant sandstones are very common in the Nanaimo area, and less common further north. Coniferous forest cover was at one time extremely thick, but most of the area has been logged, and second growth Douglas Fir, Cedar, and Western White Pine predominate, together with considerable deciduous species.

The climate is mild and the precipitation moderate, varying from thirty to sixty inches a year, depending on the locality. Snowfall in the northern part of the area nearer the mountains can be quite heavy in winter.

The east coast of Vancouver Island is well settled and the area is generally readily accessible either by public roads or logging roads.

HISTORY

The presence of coal on Vancouver Island was first reported by natives in 1835 to Dr; William F. Tolmie, who was then serving with the Hudson's Bay Company at Fort McLoughlin (Bella Bella). The following year Dr. John McLoughlin sent the Hudson's Bay Company steamer "Beaver" to check the report. The coal occurrences were situated at two closely adjacent places, Beaver Harbour and Suquash, nine and thirteen miles respectively southeast of the present Port Hardy. By 1847 it appeared that there would be a demand for coal for steamships, and the Hudson's Bay Company arranged for a party of over a hundred miners to be sent out from England. These men arrived in Victoria in June 1849. An attempt to open coal mines in the Beaver Harbour-Suquash area did not prove successful due probably to the inferior quality of the coal seams. Fortunately in the same year (1849) another Indian reported the presence of coal at what is now Nanaimo. The following year a canoe-load of coal was brought to Victoria and Governor James Douglas sent men back with the Indian to investigate and report back. The reports were favourable; by 1852 the small group of miners was moved down to Nanaimo and the first shipment of coal was made to Victoria. The first small mines were opened up on the outcrop of the Douglas seam in the area of what is now downtown Nanaimo. According to early plans the shaft of 'No. 1 Pit' was situated close to the shore a few hundred feet southwest of the Bastion.

The Hudson's Bay Company operated the Nanaimo mines from 1852 to 1862 by which time production had gradually increased to about 20,000 tons a year. In 1862 the company disposed of its coal properties to James Nicol of Winchester, England, the brother of the manager of the mines, who formed a company called the Vancouver Coal Mining and Land Company. This was one of two companies which dominated the Vancouver Island coal-mining industry throughout its early productive years. With one change of name (in 1889 to New

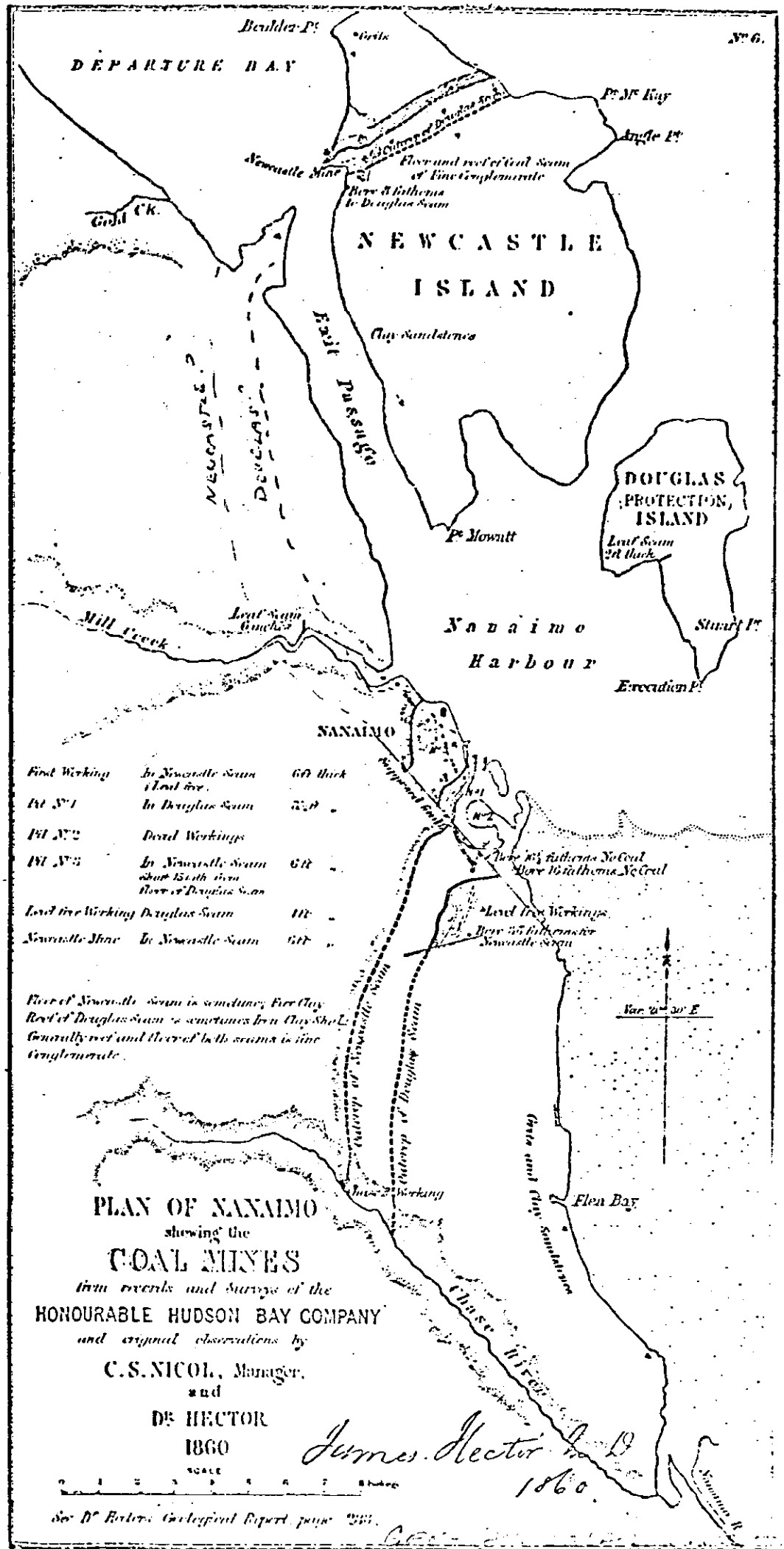
Vancouver Coal Mining and Land Company) it continued to operate the extremely productive Nanaimo Colliery (mining the Douglas and Newcastle seams from the outcrop to points deep underneath Nanaimo harbour and Protection Island) until December 1902. Due to the failure of this company to find necessary additional capital from shareholders it then sold its properties to the Western Fuel Company, a company organized in California. Under several minor name changes this company continued to operate until 1928 when its common shares were purchased by Canadian Collieries (Dunsmuir) Ltd.

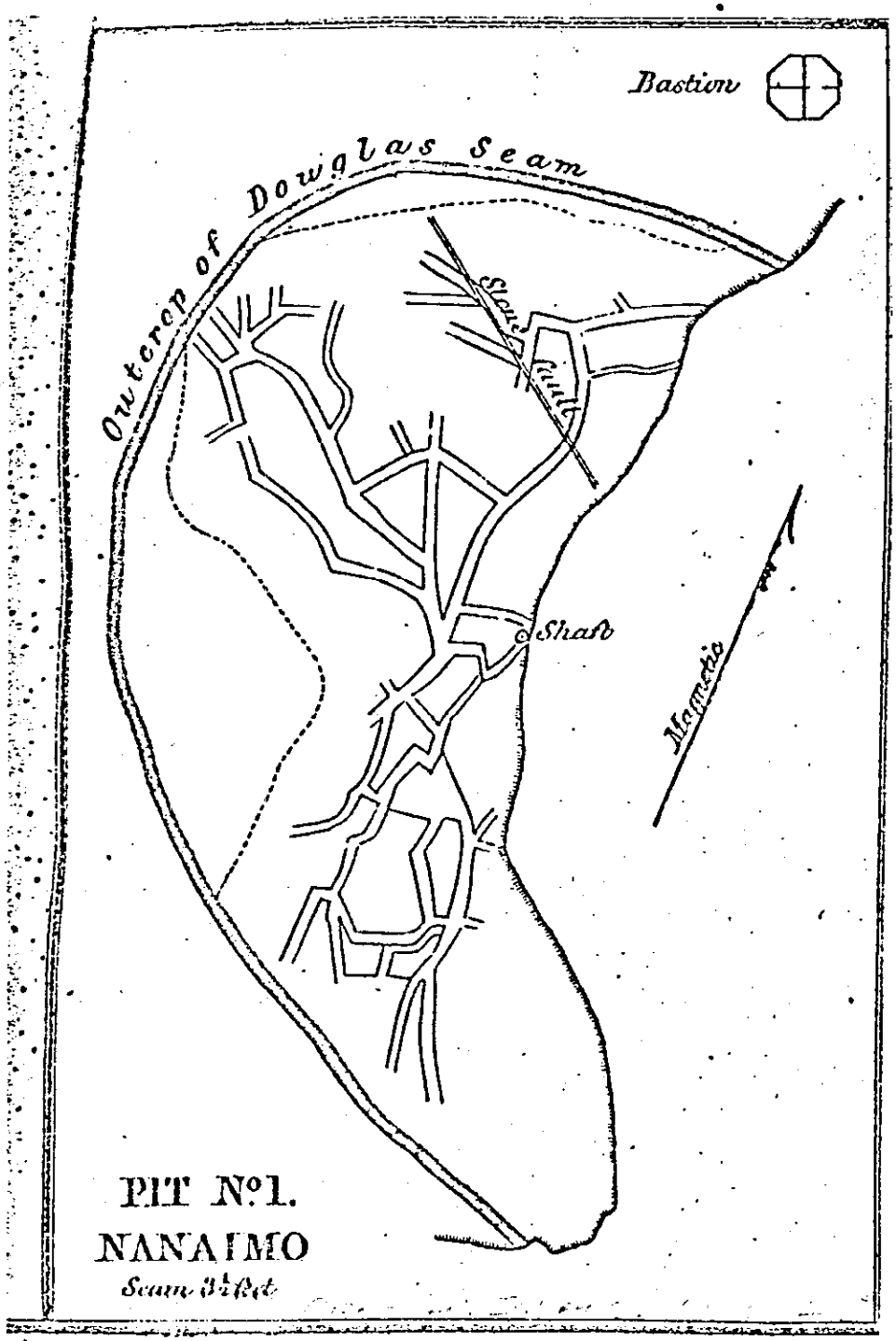
The second dominant coal-mining company on the Island was founded by Robert Dunsmuir who arrived in Nanaimo in 1853 and for several years worked for the Hudson's Bay Company first as an employee and later as an independent contractor mining coal for the company. In 1864 he left to prospect on his own account, and in 1869 discovered the outcrop of the Wellington seam, four miles northwest of Nanaimo. Production from the Wellington mines began in 1871, these mines proving immensely profitable and forming the basis of the Dunsmuir fortune. In 1883 the Esquimalt & Nanaimo Railway Company was formed in which Dunsmuir was a principal, and as a result acquired title to most of the coal lands in the E & N Land grant on the east coast of Vancouver Island.

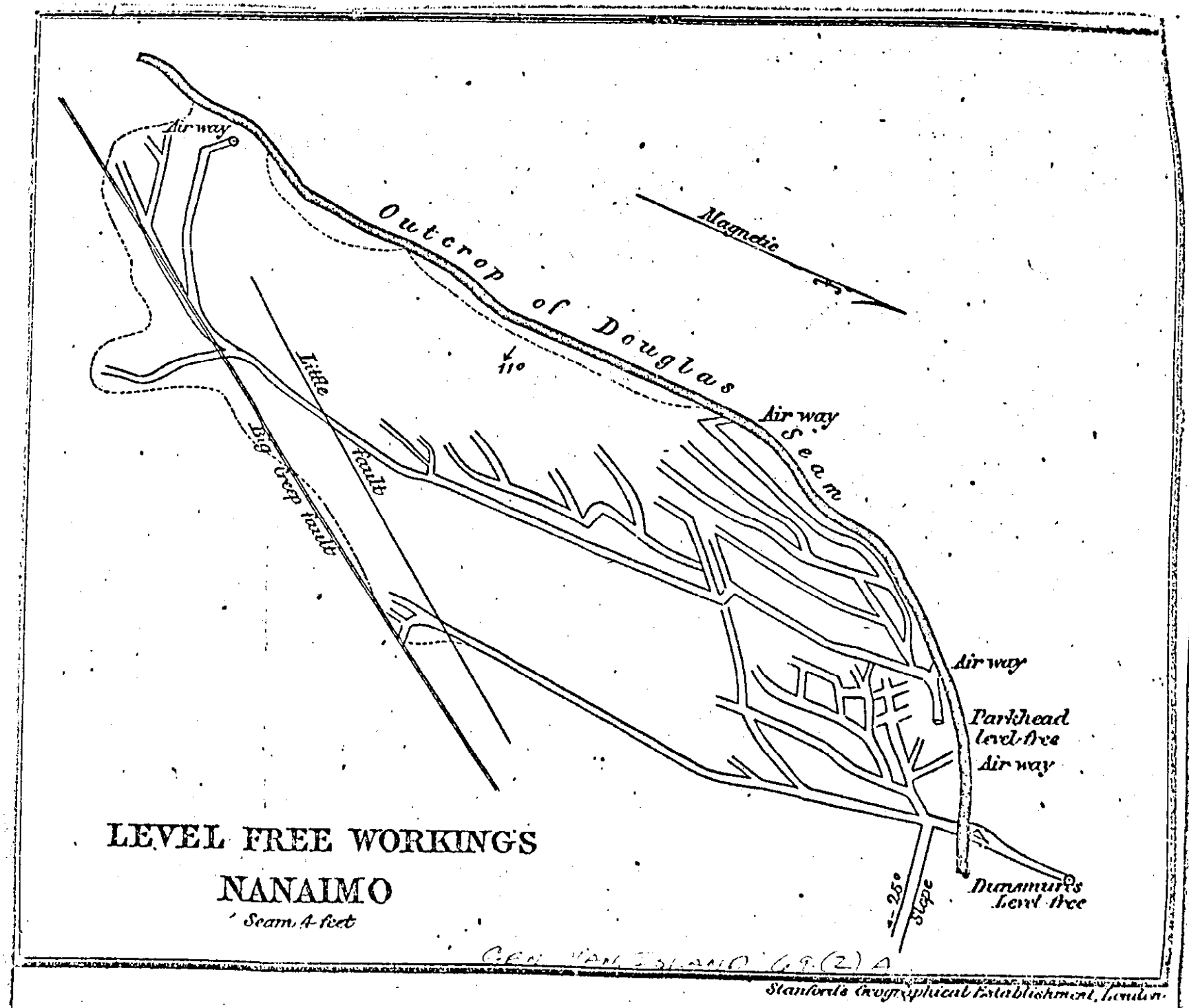
Meanwhile the occurrence of coal in the Comox area had been known for some time, and in 1888 Dunsmuir sent a party of prospectors and surveyors to prepare a mine site. A new company called Union Colliery Company was formed, and production from the new coalfield began the same year.

Robert Dunsmuir died in 1889, and his sons, especially James Dunsmuir, carried on until 1910. By this time Dunsmuir foresaw the end of the export coal trade to California following the discoveries of oil, and so he sold his coal interests to Mackenzie and Mann of Canadian Northern Railways. They set up a company under the name of Canadian Collieries (Dunsmuir) Ltd., which they shortly sold to British interests. This company continued to operate Vancouver Island coal mines until 1960.

In 1928 this company acquired control of the Western Fuel Corporation. The name of this latter company was retained until the closure of the Reserve mine in 1939. After this the only coal operating company on


No 6.
Boulder Pt
DEPARTURE BAY
Pt Mc Kay
Angle Pt
Newcastle Mine
Coal Ck.
NEWCASTLE ISLAND
Clay Sandstones
East Passage
Pt Mowatt
DOUGLAS (PROTECTION) ISLAND
Mill Creek
Nanaimo Harbour
Stuart Pt
Entrance Pt
NANAIMO
Var 22° 30' E
Flem Bay
Chase River
PLAN OF NANAIMO
shewing the
COAL MINES
from records and Surveys of the
HONOURABLE HUDSON BAY COMPANY
and original observations by
C.S.NICOL, Manager,
and
Dr HECTOR
1860
James Hector 1860.


Bastion
Outcrop of Douglas Seam
Slope
South
Shaft
Mammoth
PIT No 1.
NANAIMO
Seam 3½ Ft



LEVEL FREE WORKINGS

NANAIMO

Seam A feet

Geol Surv Canada 6.9.(2) A

Stanford's Geographical Establishment, London.

Vancouver Island during the declining years of the coalfields was Canadian Collieries (Dunsmuir) Ltd. This company had a checquered financial history, but in the fifties was fortunate enough to participate in the Pembina oil fields development in Alberta. The resulting funds were used to acquire lumber interests and the company gradually closed down its coal operations. In the early nineteen sixties it was purchased by American Plywood and is now (1969) known as Weldwood of Canada Ltd.

A number of smaller companies operated in the Nanaimo field mainly during the prosperous years from about 1905 to 1930. Except for the Granby Mining & Smelting Company, which operated the Cassidy mines in the Douglas seam nine miles south of Nanaimo from 1918 to 1932, most of these companies were comparatively short-lived and production was relatively small.

Mention should be made of further attempts to develop coal deposits at Suquash at the northern end of Vancouver Island. A company called Pacific Coast Coal Mines Ltd. drilled near the shoreline in 1908, finding the No. 2 seam at 173 feet. A shaft was sunk to the seam, which was found to contain numerous rock bands, and some development headings were driven in the seam. About 12,000 tons of coal were produced. Work ceased on the outbreak of World War 1, and was resumed briefly in 1920-22. The old shaft was pumped out by Suquash Collieries Ltd. in 1952 but nothing further was done.

During the productive period from 1836 to 1968, a total of about 74,650,000 short tons of coal has been produced from the Vancouver Island coalfields. Of this total, approximately 22,000 tons is believed to have been produced at Suquash, 54,087,860 tons were produced from the Nanaimo field and 20,540,140 tons from the Comox coalfields.

Annual production in the Nanaimo field grew steadily from 16,000 short tons in 1860 to 33,424 tons in 1870. With the opening of the Wellington mines in 1871 and the Nanaimo Colliery in 1881, annual production grew rapidly during the next two decades and by 1891 had reached 1,040,000 tons. The years from 1891 to 1928 were the most productive years in Nanaimo. In twenty-four of those thirty-eight years, annual production exceeded a million tons. The record year was 1922 when 1,427,540 tons

were produced. After 1928 a fairly rapid decline set in, and by 1939 production had fallen to 393,966 tons, and by 1949 to 253,198 tons. After 1954 production was limited to a few very small mines extracting pillars and remnants from the former workings. The last of these closed in 1968.

Perhaps the most outstanding of the Nanaimo mines was Nanaimo Colliery itself, or No. 1 mine as it came to be known. This mine alone produced 18,000,000 tons (from the Douglas and Newcastle seams). It was sunk and commenced production in 1881 and closed in 1938.

In the Comox field three workable seams occur, and these have been mined from a series of mines, among the most important being No. 4, 5, 6, 7 and 8 mines, and the T'sable River mine. Of these No. 4 mine situated at the east end of Comox Lake, three miles from Cumberland was by far the most extensive, probably producing 12 to 14 million tons. The coal was brought by rail to the port at Union Bay and shipped from there. The company's machine shops, coal preparation plant, coke ovens, and wharves were all situated at Union Bay.

Production in the Comox field virtually began in 1888, and in a mere six years had increased to 270,000 tons a year by 1894. By 1904 production had reached 419,800 tons. The best years at Comox were from 1904 to 1921. The record year was 1911 when 488,725 tons were produced. For the next twenty years, until 1951, production in the Comox field remained fairly stable between 200,000 and 350,000 tons a year with one more 'high point', 444,796 tons, in 1944. After 1951 a decline set in. No. 8 mine closed in February 1953, and in April 1960, Canadian Collieries Ltd. ceased operations at T'sable River, production for that year being down to 102,859 tons. A small local company secured permission to continue to work the T'sable River mine, and it struggled on for a few more years. Finally debts and other difficulties forced a closure in 1966, thus bringing production in the Comox field to a close after seventy-eight years.

Mention should be made in passing that coke was produced at Union Bay in batteries of beehive ovens from the eighteen nineties until 1922. Up to about 20,000 tons of coke a year was made from the coking Comox coals.

The Vancouver Island coal industry was largely established on the

basis of exports to the rapidly growing state of California. This was essential because, apart from a few smelters, there was practically no industry and very little domestic market in British Columbia itself. In 1902 a total of 75% of the production of coal was exported to California. The discovery of petroleum in the west about 1902 radically altered the situation; by 1910 only 25% was being exported to the United States, and by 1930 this had dropped to 4%. Fortunately other markets were found in Canada to sustain production. The eventual decline of the Island coalfields was caused by the exhaustion of the easily-worked deposits combined with the failure of the markets following the discovery of oil and natural gas in British Columbia and Alberta and the technical changes arising therefrom such as the dieselization of the railways.

Technically the equipment of the Vancouver Island mines varied from fairly good to very primitive. Electric power was used at a quite early date; by the turn of the century electric motors were being used for underground haulage in Nanaimo Colliery and endless ropes and trolley haulage were in use at this mine by 1920. Small coal-cutting machines of the 'Siskol' type were in use in several of the Nanaimo mines by 1921. Over most of the period, however, the coal was got by pick and shovel, loaded into wooden cars, and then hauled to surface by rope haulages varying from small 'tuggers' to massive main slope hoists. The method of working the mines depended on seam conditions but the commonest method was some form of room and pillar, with longwall practised in the thinner seams. In the latter years in Cumberland a partially mechanized longwall method with coalcutters and face and roadway conveyors was practised. Joy loaders and duckbill conveyors were used at T'sable River mine. Typically the mine workings were supported by a vast mass of locally obtained timbers. The surface buildings, usually erected at minimum expense were invariably squalid and dirty; in the climate of the times any regard for aesthetics either at mine or townsite would have been regarded as frivolous. Coal-mining in fact in this period became synonymous in the public mind with ugliness, danger, and squalor.

In the best years employment was provided for a very considerable number of men: in 1911 a total of 4,676 men were working in the mines. This included 714 Chinese and Japanese. Wages were low by present - day standards (Miners: $3.30 to $5.00 a day in 1913), but not by contemporary standards. Efforts to organize the miners were savagely resisted by

companies and the 'establishment', and led to violence and suppression and, on one occasion, even the drafting of troops into the mining areas. The union did not finally establish itself until the nineteen forties when the industry was in decline.

Accidents in the mines were probably about average for the times, but there were a number of serious occurrences and disasters, especially between 1901 and 1924. A list of some of the principal disasters is given below:-

1887	Explosion at Nanaimo Colliery	148 men killed
1901	Fire at No. 4 mine, Union Colliery, Cumberland	3 men killed
1901	Explosion at No. 6 mine, Union Colliery, Cumberland	64 men killed
1901	Fire at Extension mine.	16 men killed
1903	Explosion at No. 6 mine, Union Colliery, Cumberland	16 men killed
1909	Explosion at No. 2 West mine, Extension	32 men killed
1915	Inundation of water at South Wellington mine	19 men killed
1915	Explosion at Reserve mine, Nanaimo	22 men killed
1917	Explosion at No. 6 mine, Cumberland	4 men killed
1918	Rope breakage at Protection Island shaft, Nanaimo Colliery	16 men killed
1924	Explosion at No. 4 mine, Cumberland	33 men killed
1937	Inundation of water at Beban mine, Nanaimo	3 men killed
1940	Explosion at No. 10 mine, Nanaimo	3 men killed

The cause of the terrible explosion at Nanaimo Colliery in 1887 was never accounted for. The island coal seams, certainly in the shallower workings, were not very 'gassy' with the result that in the early days open lights were allowed to be used where there was believed to be no hazard. This practice, combined with what we would now consider to be inadequate ventilation was the cause of more than one of the early explosions. Certainly the remarkable number of disasters in the first quarter of the century seems to indicate an indifferent standard of management and supervision.

Government legislation to regulate the mines with regard to safety standards was introduced in British Columbia as early as 1877 when the first Inspector was appointed. These Coal Mines Regulation Acts were

progressively revised and extended over the years. In 1913 mine rescue stations were opened in Nanaimo and Cumberland. For many years there were mine inspectors stationed at both Nanaimo and Cumberland as well as mine rescue instructors. A mines inspector was stationed at Cumberland up to the beginning of 1954. The last inspection of a Vancouver Island coal mine was made by the writer in 1968. This was a one-man operation in the Upper Wellington seam near Wellington where Mr. R. B. Carruthers was removing coal left near the outcrop by former operators. Mr. Carruthers, who was over seventy years of age, closed down his operation later the same year.

GENERAL GEOLOGY

Upper Cretaceous sediments of the Nanaimo Group outcrop along the east coast of Vancouver Island and adjoining Gulf Islands for a distance of about 125 miles from a point south of Cowichan Bay to north of Campbell River. A further outcrop occurs in the Port Hardy-Suquash area near the north end of the east coast of the Island and again on the west side of the Island near Alberni. The sediments are underlain by metamorphosed volcanic, sedimentary, and intrusive igneous rocks of Permian and Triassic ages, which also make up the mountainous central core of Vancouver Island. Irregularities in the pre-Cretaceous basement rocks result in the Nanaimo Group forming a number of partly discontinuous basins with the sediments extending rarely more than fifteen miles inland and (on the east coast) generally dipping in an easterly to northeasterly direction. Five basins are clearly defined: Cowichan, Nanaimo, Comox, Suquash, and Alberni. All the basins have some indications of coal formation, but only the Nanaimo and Comox basins have proved of economic importance.

The Nanaimo basin extends from Nanoose Bay to Crofton on Vancouver Island, a distance of thirty-two miles, with extensions across the Gulf Islands to Saturna and Orcas Islands. The inland extension on Vancouver Island is about six miles on an average.

The Comox basin extends from Nanoose Bay to Campbell River, a distance of seventy-five miles, and an average distance of five miles inland.

Productive coal seams underlie only a fraction of the area of the Nanaimo and Comox basins. In Nanaimo, mining has taken place over about twenty-five square miles in all, and in the Cumberland area over about ten square miles, and the T'sable River area about two square miles.

The Nanaimo Group consists largely of conglomerates, sandstones, and shales laid down under marine, near-shore, and land conditions. According to Clapp[1], the lithological character of the Nanaimo sediments indicates very rapid accumulation and deposition. Buckham[2] points out that "few

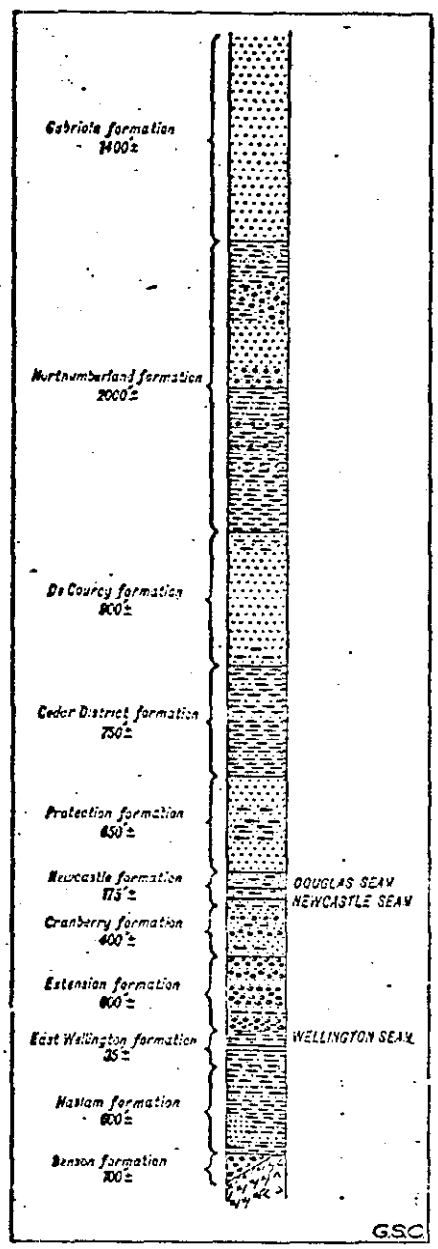


Figure 1.—Generalized stratigraphic section, Nanaimo coal field.

individual beds persist for any great distance. The series is made up of a great pile of overlapping lenses". The total thickness of the series is about 10,000 feet. In the Nanaimo area the average thickness is about 7,000 feet, and in the Comox area up to about 2,000 feet.

In the Nanaimo basin the Group is divided into eleven formations (see diagram) and in Comox, two formations. The productive coal seams in the Nanaimo basin occur mainly in the Newcastle and East Wellington formations, in Comox in the Comox formation. The Comox formation is now considered to correlate with the basal Benson beds at Nanaimo[3] rather than with the Protection formation as was formerly believed. According to Muller[4] the Haslam formation at Nanaimo is palaeontologically equivalent to the Trent River in Comox. "The coal-bearing beds of the Nanaimo area (Extension to Protection formations) appear to be represented in the Comox area by conglomerate and sandstone, mainly known from drill holes, but outcropping north of T'sable River. The base of this formation is disconformable. In places it overlies the Trent River formation, but it cuts deeply into the Comox formation and locally the latter has been removed almost entirely."[5]

The structural pattern of the entire Nanaimo basin, according to Muller[6] "is one of gently northeastward tilted blocks separated by northwest trending faults, downthrown on the southwest side. Along these faults the Nanaimo Group rocks are tightly compressed and highly disturbed; elsewhere they generally dip gently, mainly to the northeast. These faults are two to five miles apart in the southwest part of the basin which is the main coal-mining area." Whilst Muller describes these as a "northwest trending system of normal faults", Buckham[7] disagrees, describing them (with specific examples) as a series of strong northwest trending thrust faults, mainly with their downthrow sides to the northeast with vertical displacements of 150 to 600 feet. Buckham quotes Peacock[8] as concluding that these faults represent renewed movement along pre-existing fractures formed during pre-Upper Cretaceous mountain building. This movement or stress seems to have been a factor in causing pinching and swelling in the Wellington and Douglas seams, the relatively weak floor of the Douglas and roof of the Wellington seam becoming deformed. Further north in the Comox basin these faults are not evident in the area that was mined except perhaps to some extent in the T'sable River field.

In the Comox basin especially, the pre-Cretaceous surface is quite irregular with difference in relief of 450 feet at least. This results in 'barren' areas where some or all of the coal seams may be absent. Similar irregularity can be expected in parts of all the Cretaceous basins of Vancouver Island.

Buckham[9] believes that "the Nanaimo Group was deposited in a sinking depression between two mountain ranges from which sediments were being carried and deposited in the depression". With regard to the deposition of the coal seams, Buckham says: "The seams were originally deposited in low coastal swamps or lagoons protected from the outer sea by barrier bars, and because of this: (a) the seams, as originally deposited were in places dirty and their broad variation into areas of good, thick coal and thin, dirty coal are due to original deposition, and (b) natural limits are set on the field".

ECONOMIC GEOLOGY

Nanaimo Coalfield

The Nanaimo coalfield occupies the northwestern end of the Nanaimo basin, extending roughly from Nanoose Bay to Cassidy. The furthest inland workings were six miles from the coast. The total area underlain by workable coal seams is approximately twenty-five square miles. The coal occurs in the lower part of the Nanaimo Group. The lowest seam, known as the Wellington seam, occurs in the East Wellington formation, about 700 feet above the base of the Nanaimo Group.

The Newcastle and Douglas seams occur in the Newcastle formation, about 1,000 feet above the Wellington, being separated by 600 feet of conglomerate (Extension formation) and 400 feet of shaly sandstones and shales (Cranberry formation). The Newcastle seam is twenty-five to 100 feet (average sixty feet) below the Douglas seam. A few purely local and minor seams such as the three seams overlying the main Wellington seam in the extreme northwestern part of the coalfield have been worked to a limited extent, but nearly all the coal produced in the Nanaimo field has come from the three seams mentioned above.

Wellington Seam

The Wellington seam has been found to vary in thickness where mined from nil to thirty feet, and has an average thickness of four to seven feet. The floor of the seam is usually the firm East Wellington sandstone. The roof is variable in character and minor disturbances in the seam tend to cause variations in the configuration of the roof rather than the floor. These roof rolls are quite common, and in many sections of the seam partings or bands of carbonaceous shale occur. The Wellington, like other Nanaimo coals, is a high volatile bituminous A

coal according to the A.S.T.M. Classification. At least some of the Wellington coal made good coke and the sulphur content was low.

The Wellington seam outcrops in the western part of the coalfield and has been found to have a workable area of twelve miles long and one mile wide. The seam is well developed at the north end; the most northerly workings were in segments of the seam isolated by faults in the Lantzville area. The main outcrop probably starts somewhere north of Departure Bay and continues just to the south of Long Lake and Brannen Lake. Then it swings around to a southeasterly direction paralleling the Millstone River valley and passing immediately east of East Wellington. It was in this northern area that the rich Wellington mines, the source of the Dunsmuir fortune, were located. The seam here, according to Clapp[1], was three to six feet thick and consisted entirely of clean coal.

From East Wellington the line of outcrop runs south past the Nanaimo reservoirs and, at one time, was recognizable at Harewood Plains. In this area, according to Clapp[2], the seam was up to ten feet thick but contained many bands of carbonaceous shale. The Wellington seam outcrops on both sides of the Extension valley (on either side of Extension village) where it averages from six to ten feet thick. West of Extension is the southwest limb of an anticline about a mile wide and three miles long. The seam in this area was very extensively and profitably mined for many years. East of the Extension anticline, however, the seam tended to be thick and dirty and mining operations were not profitable.

South of Nanaimo River a smaller basin existed, similar in shape to the Extension field. Some mining was done on the westerly rim where the coal varied from three to eight feet thick, but little mineable coal was found on the east rim. Nor was the Wellington seam found south of McKay Lake and North Haslam Creek.

Like all seams in the Nanaimo coalfield, the Wellington seam does not persist for a great distance to the dip. Apparently about a mile was the usual working limit. Compared with the great coal fields of the world, this limits reserves to an extremely small figure. In the Nanaimo coalfield the Wellington seam was effectively mined out in eighty years.

Newcastle Seam

The Newcastle seam occurs between the Newcastle and Cranberry formations. According to Clapp[3] it outcropped on both sides of Newcastle Island and again at Pimbury Point. The outcrop presumably ran south through the city of Nanaimo to the Chase River valley. Clapp says the outcrop can be traced as far as South Wellington. However, Buckham describes the seam as "having proved workable only in an area some two miles long by a mile and a half wide underlying Newcastle and Protection Islands." Buckham[4] says "its average thickness is three feet four inches to three feet ten inches, and its extremes where worked, one foot eight inches to eight feet. Its floor is usually flaggy or shaly sandstone and its roof varies from sandy shale to fine conglomerate. Except in the vicinity of faults or rolls, the seam does not contain partings."

Douglas Seam

The Douglas seam occurs in the Newcastle formation an average distance of sixty feet above the Newcastle seam. Its outcrop can be traced for about ten miles from near the north end of Newcastle Island, south of Pimbury Point, through the city of Nanaimo to Chase River. From Chase River the outcrop runs to South Wellington and to Nanaimo River and Haslam Creek. It has been mined over most of this length and up to a maximum distance of one and three quarter miles from the outcrop.

The Douglas seam proved very variable in thickness, ranging from nil to thirty feet, often over quite short distances. The average thickness is probably five to six feet. Roof and floor are quite variable from conglomerate to sandy shale. Usually the variations in thickness are caused by undulations in the floor. In the southern part of the field this is very marked, with startling variations in thickness over quite short distances as

well as some entirely barren areas.

The Douglas seam was mined most extensively underneath Nanaimo harbour, Newcastle and Protection Islands and beneath the mudflats and estuary of Nanaimo River. The original Hudson's Bay workings were in the Douglas seam, as were the greater part of the extensive Nanaimo Colliery workings. At the south end of the field, especially in the Cassidy workings, violent blowouts of gas accompanied by pulverization of the coal were experienced when the workings reached depths in excess of about 700 feet.

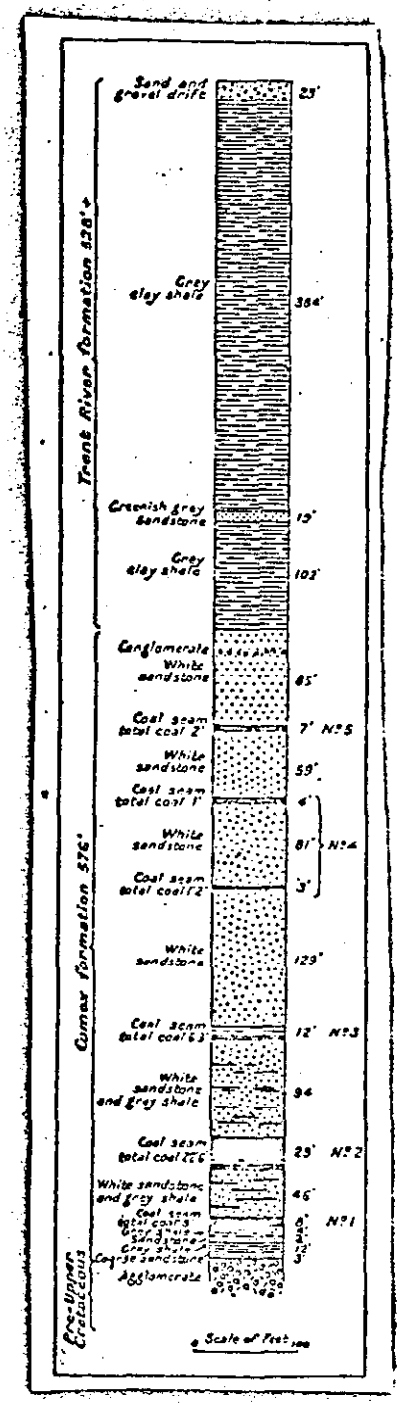
Comox Coalfield

Although the Comox basin, comprising sediments of the Nanaimo Group, extends from Nanoose Bay to Campbell River, a distance of seventy-five miles, no indications of coal seams have been found south of the T'sable River area. Thus all the known coal deposits occur in the area between the vicinity of T'sable River and Campbell River, a distance of forty-five miles, with a maximum inland extension of thirteen miles. Production so far has taken place only in the Cumberland and T'sable River areas which total approximately twelve square miles. In that part of the basin lying to the north of Puntledge River there are known outcrops of coal seams, as will be described, but so far no mining operations have been established there.

In the Comox basin the Nanaimo Group, which forms large open folds, comprises two formations; the Comox formation, consisting largely of sandstones, varies from 80 to 1,000 feet thick, and the Trent River formation, comprising mainly shales, is about 1,000 feet thick and conformable with the Comox formation. The coal seams are all confined to the Comox formation which rests unconformably on a pre-Cretaceous surface of quite variable relief.

There have been two principal producing areas in the Comox field, at Cumberland and T'sable River. Of the total production the Cumberland area produced some eighteen million tons and the T'sable River area, two million.

In the Cumberland area there are three workable seams known as Nos.



Columnar section of Comox and Trent River formations (showing general vertical distribution of coal seams in Tsable River field)

From "The coal measures of Comox and vicinity," J.D. MacKenzie

1, 2, and 4. The seams outcrop in the vicinity of Coal Creek to Puntledge River (although often beneath glacial overburden) over a maximum limit of four miles, with a moderate dip of about 5 degrees northeastward. The maximum limit of workings down dip has been two miles. Of the three seams, No. 4 seam, the lowest seam, has been by far the most extensively mined. This seam varied from three to seven feet thick and consisted generally of good clean coal. The next most productive seam was No. 2 seam which is 120 feet above No. 4 seam. This seam was three feet six inches to three feet nine inches thick. No. 1 seam, the topmost workable seam, varied from two feet six inches to seven feet thick, and was mined at No. 5 and 6 mines. The roof and floor of these seams are usually composed of sandstone beds. All these seams occur, together with a number of other non-economic coal seams, in the lower member of the Nanaimo Group, here called the Comox formation.

As mentioned previously, the Comox formation rests unconformably on the irregular pre-Cretaceous surface. As a result, parts of the Comox coalfield are split up into areas separated by ridges of underlying rock, or in some cases the lower seam only is missing. Sometimes the Comox formation has been eroded and coarse barren sediments laid down on the erosion surface. The T'sable River area, nine miles southeast of Cumberland has been isolated in this way from the Cumberland field. In the T'sable River area, a pre-Cretaceous ridge has divided this area into two separate basins. The upper or westerly portion forms a broadly synclinal basin crossed by two northwesterly-trending fault systems. A seam ranging from six to ten and a half feet thick was mined in this area. The seam was clean over quite large areas, although in places it was unworkable due to excessive rock bands. On the southeast flank of the syncline it pinched out against the unconformable pre-Cretaceous basement rocks.

Some drilling was done by Canadian Collieries in the lower or easterly basin, but no results have been published. The writer was told that this ground was found to be heavily faulted, and did not look very encouraging although seams of mineable thickness were found.

There is comparatively little published information about coal occurrences and deposits north of Puntledge River. The most descriptive

detail is contained in a report by J. D. MacKenzie[5] entitled "Coal Resources of Southern Vancouver Island", issued by the Geological Survey in mimeographed type in 1923. MacKenzie examines the existing data and attempts to arrive at some estimate of reserves. Like most coal reserve estimates MacKenzie's have proved somewhat exaggerated, but his information on the area north of the Puntledge is still of some interest and is therefore quoted here:-

"Campbell River Area. The northernmost 55 square miles of the strip of the Nanaimo series lying along the east coast of Vancouver Island is termed the Campbell River area. It is thickly covered with sand and gravel of glacial origin, but exposures along Quinsam river and on the shore north of Oyster bay, together with the information derived from bore-holes near Campbell River, indicate that this area is underlain by rocks of the Nanaimo series which probably belong to the Comox formation. The general structure of this area is probably that of a syncline, with its axis running nearly north and south.

In this area a coal seam said to be over 2 feet thick is reported as having been found by digging on the shore of Quinsam Lake, and coal has been seen in a creek some 2 miles south of this lake, but its thickness could not be measured. In the bore-holes already mentioned a seam of coal varying from 21 inches to 18 feet was found in three holes.

Quinsam Area. West of the main Campbell River - Courtenay area, and almost completely separated from it, is a patch of the Nanaimo series containing 40 square miles, to which the name Quinsam area is given.

This area is underlain by white sandstones and grey shales of the Comox formation which are disposed in the form of an elongate syncline, separated from the main area to the east by an anticlinal axis, along which are exposed pre-Cretaceous volcanic rocks.

Coal is exposed on Quinsam river, where one seam has 5 feet 6 inches of coal in two benches, and is underlain at a distance of 7 feet by another seam 18 inches thick. Coal is also exposed on Iron

river in two places, and this is possibly another outcrop of the same seam seen on the Quinsam. In one place on Iron river it is 4 feet thick, and 1½ miles down the stream it contains more than 5 feet of coal. On Chute creek, in the southern part of the basin, three seams of coal, 13, 14, and 18 inches thick, have been seen.

Oyster-Tsolum River Area. South of this area there are some 30 square miles traversed by Oyster river and underlain by the Comox formation that so far as known do not contain any coal exposures. No estimate of coal can be given for this area.

Part of the drainage basin of Tsolum river, amounting to 30 square miles, is underlain by the Comox and Trent River formations of the Nanaimo series, which so far as known lie with a low dip to the northeastward.

On Tsolum river one seam 4 feet thick is exposed and it is likely that other seams occur but are obscured by the surface covering.

Dove Creek - Brown River Area. The Dove Creek-Brown River area embraces the 90 square miles lying north of Puntledge river.

The Comox formation outcrops in the western part of this area and is well exposed on Brown and Puntledge rivers and on Dove creek. It has a general low, northeasterly dip, modified by some gentle folds. The overlying Trent River formation outcrops in the eastern part of the area.

Coal occurs in this area in several seams which range in thickness from 1 to 5 feet. Some of them are well exposed on Brown river and Dove creek, and they have been intersected by the numerous bore-holes sunk in this area for prospecting purposes. In the western part of the area intrusions of porphyry of Tertiary age have adversely affected a very large tonnage of coal, and the amount rendered useless by this cause will amount to several million tons."

The writer understands that Canadian Collieries (Dunsmuir) Ltd. carried out exploratory drilling in some of these areas. The results have not been published, but it is believed that no considerable

areas of easily mineable coal were clearly indicated.

Five or six drill holes were put down by private individuals on coal licenses south of Quinsam River and some three to four miles west of Campbell River prior to 1945. These showed the Nanaimo Group rocks to be 500 feet thick about three miles from the coast, increasing to at least 2,100 feet at the coast. Two seams of mineable thickness were cut very close to the base of the sedimentary series. There is some indication that these seams may not be very continuous and that the irregular pre-Cretaceous floor may result in barren areas. However, more detailed drilling might outline several million tons of mineable reserves. An analysis of this coal as received gives: Fixed carbon, 60.6%; volatile matter, 33.4%; moisture, 6.0%; ash, 12.1%.

MINING OPERATIONS AND POSSIBLE RESERVES

Nanaimo Coalfield

In 1950 Mr. James Strang, then Chief Inspector of Mines, wrote a report reviewing the situation in the Nanaimo coalfield, with reference to past and current mining operations and the possibility of future reserves of coal. Substantial parts of this report are quoted in the following pages, the only changes made being minor ones to bring the report up to date:-

"Wellington Seam

At Nanoose Bay, Nanoose Collieries Company operated a mine close to the shore by means of a shaft 133 feet deep. The Wellington seam here was very irregular, the top and bottom benches of the seam being separated by a rockband from two to six feet in thickness. The Company worked an area of coal from the outcrop to the shore line. Along the strike of the seam it extended approximately three quarters of a mile and to the dip about 1,800 feet. The seam extends under the sea but the amount of cover was not sufficient to warrant mining the coal, the probable boundary is another half to three quarters of a mile seaward, but it is doubtful if the thickness of the coal would justify development, even if the cover had been sufficient. The mine did not prove a very profitable operation, due to the excessive rock work and to a number of small faults. The coal was of good quality, but not enough of it.

Lantzville Mine, a small operation, was opened some years later to the west of Nanoose Collieries along the shore of Nanoose Bay. The coal, although of good quality, was thin and the benches of top and bottom coal separated by bands of rock up to six and eight feet thick. (See plans of Nanoose and Lantzville Mines). Travelling southeast from Nanoose Bay, there is apparently a barren area between the Nanoose Mine and the North Wellington field. The North Wellington Mines, operated by the Dunsmuir

interests, covered an area that was the largest continuous area of the Wellington seam and where the coal was mined profitably. In this area were the No. 1 Slope Mine and Nos. 1 to 6 Shaft Mines. The seam varied from three to eight and ten feet, was of good quality and very little rock bands between the benches of coal. Both longwall and pillar and stall methods of operating were used, depending on the thickness of coal. The area mined would be approximately two and a half miles along the strike of the seam and one mile down the dip of the seam. In this area could be included the Northfield Mine, originally owned by the Vancouver Mining Company, later known as the Western Fuel Company. When the Canadian Collieries took over the Western Fuel properties, old Northfield Mine was reopened and a section of solid coal was worked out by the longwall method, completing a fairly thorough exhaustion of the coal in this area of the Wellington field.

The Little Wellington seam was opened over some of the workings of the North Wellington Mines, the mine being known as No. 9. Very little work was done here as the seam was too thin to be profitably mined. It is doubtful if any coal is left in the North Wellington area that could be mined profitably except the few outcrop pillars left leasing from the Canadian Collieries. In looking over the plans of the North Wellington Mines it can be seen that a very thorough job was done in extracting mineable coal.

Travelling south from here several smaller mines were opened along the outcrop of the Wellington seam at East Wellington, the old Chandler Mine, Old and New Jingle Pot (East Wellington Company) and the Wakesiah Mine, two miles west of Nanaimo, owned by the Western Fuel Company. These mines were separated from each other either by faulted ground or the seam was too thin to operate profitably. There is very little possibility of any future mining operations in this section of the Wellington field. Continuing south from this area is what may be termed the Southern limits of the Wellington seam so far as mineable coal is concerned. In this area are the Harewood Mine, Extension Prospect No.4 Shaft Mine, the Extension Mines and No. 8 (Timberlands) Mine.

From north of Harewood, in a south-easterly direction to the south of Nanaimo River, there is a gully which appeared to be formerly an

anticline in the measures and eroded. On the easterly side of this gully is the ourcrop of the coal in which the Harewood, Extension Prospect and No. 4 Shaft Mines were operated, the dip being north-easterly. On the west side of the gully from Extension village to south of the Nanaimo River are the Extension Mines and No. 8 (Timberlands).

The Extension Mines are in an oval basin, with the coal outcropping above the village and dipping in a south-westerly direction. The seam dips for about 3,000 feet, flattens out and rises to the westerly rim of the basin in about another 1,500 feet. The dip of this portion being the usual north-east of the Wellington seam. The Extension Mines area compared almost favourably with the North Wellington area being about two miles along the strike and about 4,500 feet to the dip and rise along the middle of the basin. These mines were extensively worked from 1898 to 1929. Work was resumed at the south end of the Extension area at White Rapids Mine from 1944 to 1950.

South of the Nanaimo River a smaller basin of the Wellington seam existed similar in shape to the Extension field. On the westerly rim of this field No. 8 Mine (Timberlands) operated. The area of mineable coal was small, but the coal was of good quality and the seam varied from three to eight feet with very little rock. On the easterly rim of this basin several prospects were opened but the coal was only a few inches thick and often no coal. The ground was very badly faulted and in the southerly portion of this area the seam was not in evidence at all, apparently being completely washed out by the gravel beds of the Haslam flats.

As stated previously, on the easterly side of the gully running from north of Harewood Mine to the Nanaimo River are the Harewood, Extension Prospect and No. 4 Shaft Mine, the seam here dipping the usual northeast. These mines are supposed to be in the Wellington seam but this is open to question. The seam in these mines did not appear to have the same characteristics as the Wellington seam. The coal was dirty and fine black shaly material being mixed through the coal bands. It may have been a seam deposited above the Wellington in this particular section of the field. None of these mines were profitable operations. No. 4 Shaft Mine, about one mile north of Nanaimo River, extended about 4,000 feet along the strike of the seam and less than 2,000 feet down dip at

No. 1 Slope. The coal at the face of this slope was thin and boreholes ahead showed no improvement. Between the workings of No. 4 Mine and the Nanaimo River there is a bout half a mile of solid ground. This area is being drilled at present to find if there is a possibility of a small operation being developed with mineable coal. With the exception of this particular area and the small area of the Extension field being operated at White Rapids Mine, there is very little of the Wellington seam that remains undeveloped or that has not been proved by prospecting or drilling to be unworkable due to barren areas or faulted areas.

To sum up, the outcrop of the Wellington seam runs along a line approximately from Nanoose south-east to below the Nanaimo River. The outcrop is fairly continuous with a few breaks due to faults and erosions of the seam. From the mines that have been operated it would appear that the maximum distance down dip on the seam was approximately one mile. The two most productive areas of this seam were at North Wellington and in the southern extremity at Extension. In between these areas several smaller mines were operated, Chandler, East Wellington Mines (Jingle Pot), Wakesiah and Harewood and several small prospects. In none of these smaller operations did the seam extend the same distance along the dip of the measures as in the northern and southern parts of the field, and the seam was in most cases thinner and more costly to operate.

Newcastle Seam

The Newcastle seam overlies the Wellington seam by 800 to 1,000 feet and the Douglas seam is 25 to 100 feet higher still in the Lower Nanaimo series. The Newcastle seam, which is under three feet in thickness, does not appear to extend the same distance along the strike as either the Wellington or Douglas. In tests by drilling and prospecting it was only found from Departure Bay south east to Nanaimo. The principal mines operating in the Newcastle seam were the Northfield (Brechin) Mine and Protection and No. 1 Mine, all belonging to the Western Fuel Company, now Canadian Collieries. Several small operations around Nanaimo operated in the Newcastle seam, between Brechin Mine and No. 1 Mine, some of these

lie under the City of Nanaimo.

Part of the outcrop of the Newcastle seam is on the northern part of Newcastle Island and the Hudson's Bay Company had several small mines in this outcrop, numbered 1 to 7. These mines went only a short distance to the dip. Brechin Mine Slope started near the shore close to Departure Bay and dipped under Exit Passage to Newcastle Island. Both the Newcastle and Douglas seams were operated from this mine. No. 1 Shaft Mine, which includes Protection Mine, came close to the boundaries of Brechin Mine. The outcrop of the Newcastle seam can be traced from close to Departure Bay south east to Chase River, but from early records this seam appears to have been worked only to No. 1 Mine. There is no evidence of the seam south-east from Chase River. The thickness of the Newcastle seam averaged three feet and under, in a few isolated sections it was around five feet. The seam generally dipped north-east. Mineable coal was worked from Brechin Mine to No. 1 Mine for a distance of approximately two miles along the strike and for about one mile to the dip. The seam extended under Newcastle and Protection Islands and for some distance seaward. Approximately fifty per cent of this area had mineable coal.

Douglas Seam

The outcrop of the Douglas seam extends from Departure Bay south-east to Haslam Creek, so far as mineable coal is concerned. The outcrop is fairly well defined and shows coal practically the whole length along this line. From the early days of mining in Vancouver Island until to-day, mines have been opened up along this outcrop of the Douglas seam, and also several shaft mines to the dip. In the early days several small mines were opened in the area where the City of Nanaimo is now built. In addition to these, starting from Departure Bay and travelling south-east to Haslam Creek at Cassidy, there are plans of the following mines:- Northfield, (Brechin), Protection, No. 1 Mine, Old and New Douglas Mines, No. 3 Mine, No. 4 Mine, No. 5 Mine, Southfield Mine, Reserve Mine to the dip of No. 5 Mine, Pacific Coast Coal Co. Mine, Alexandria Mine to the dip of No. 5 (Canadian Collieries), No. 10 Mine and Cassidy Mine.

The distance along this outcrop is approximately six miles and the mines along the outcrop show that the coal is continuous as there are only small barrier pillars between them or they are connected. The only exception being a barren stretch between No. 5 Mine (Canadian Collieries) and No. 10 Mine (Canadian Collieries). The Protection No. 1 Mine, Reserve Mine and Morden are shaft mines operated to the dip of the outcrop mines.

As stated before, the Douglas seam floor is not regular but appears to be in valleys, ridges and knolls so that there are areas in this field where the coal varies from a few inches in thickness to twenty feet. This irregular floor also causes quite a number of barren areas. These barren areas are clearly shown on the composite plan of the Nanaimo and South Wellington areas. There is no doubt that there are patches of good coal in the blank areas, but the cost of exploring through these blank areas is prohibitive. In the No. 1 Mine and Protection area the seam extended to the dip approximately 1 1/2 miles from the outcrop and in the Reserve Mine area and in the Morden area about the same. It is evident that the most productive part of the Douglas seam was from the outcrop to about 3/4 miles to the dip and from that line as the seam dipped there appeared to be greater areas of barren ground. It is doubtful if any coal existed more than one and a half miles to the dip from the outcrop.

In No. 1 and Protection Mine a great part of the field was submarine, the Reserve Mine is at the estuary of the Nanaimo River. In the area South Wellington to Cassidy the shore line is a few miles eastward and the Douglas seam does not extend to the sea here. Any coal measures seen on the coast or Gulf Islands at this point seem to belong to the Upper Nanaimo series. In reviewing the work done in the Douglas seam, it is evident that a very thorough job has been done in mining workable coal. The barren areas in each of the mines may contain small patches of good coal but as stated before, the cost of exploration was prohibitive. In most cases they could not be reached now, as they are surrounded by old workings filled with water.

To sum up, in the Nanaimo Coal Field to-day there seems to be only two possible chances of resuming mining operations. One of these is in the area between the face of the old workings of No. 4 Shaft Mine, in the

Wellington Extension field and the Nanaimo River. There is a piece of solid ground about 1/2 mile in length along the outcrop and an indeterminate length to the dip of the seam. This is in the Wellington seam, if it can be considered that No. 4 Shaft Mine is in the Wellington seam. Borehole No. 10, about 3,000 feet to the dip from the outcrop in this section and close to the Nanaimo River, showed very little coal but Borehole No. 12, about 5,000 feet to the dip and close to the Nanaimo River, showed 5 feet 4 inches of coal. Borehole No. 10 may be in the same area along the strike as the lower part of the workings of No. 4 Mine which proved of little value. Between this area and Borehole 12 there may be an area of good coal. It is understood that Canadian Collieries did drill here about 1950. No results were published, but no mining was done here, so probably the drilling was not encouraging.

The other possibility is the re-opening of the Morden Mine. There are approximately 1,800 acres of coal lands in the Morden property. Only 70 acres have been worked. The Morden Mine is entered by a shaft over 600 feet deep and like other mines in the Douglas seam, had barren areas and areas of coal from 3 feet to 8 and 10 feet thick, and in a few cases thicker. The main slope in this mine extends for a distance of almost 2,200 feet. The centre portion of this slope, about 900 feet in length, passed through barren ground, coming again into coal about 4 feet thick. Most of the coal produced in this mine seems to have come from the old slope area in a south-easterly direction from the shaft. The main slope area remains to be proved thoroughly. From the 70 acres that has been developed approximately 7,000 tons of coal per acre has been extracted. If it could be proved that even 1,000 acres of the remaining 1,700 could produce 7,000 tons per acre, this would mean 7,000,000 tons of coal. To do so would mean a fairly extensive diamond drilling programme, probably around 30 holes would be necessary at an approximate cost of $200,000; another $200,000 would be necessary for exploratory work and for opening the mine and installing equipment to put mine on a commercial basis would need, say, $500,000, a total of $900,000. It is doubtful if any company would be prepared to take this risk.

Looking at the composite plan of the Douglas Seam Mines, it will be

noted that Morden Mine lies in practically the same zone along the strike of the seam as the Reserve Mine and between these mines and to the dip of the Pacific Coast Coal Mine, Alexandria Mine and No. 5 Mine (Canadian Collieries) there is an unworked area approximately 1 mine along the strike and from 3,000 to 4,500 feet along the pitch. I believe that several drill holes were put down in this part and proved disappointing, also in the Reserve Mine the cost of driving through barren areas to reach patches of good coal proved too costly to make profitable mining. For this reason it is doubtful if any company could take the risk of spending large sums of money in dewatering Morden Mine, clearing up old workings and driving exploratory slopes and levels in addition to drilling to find out if a profitable mine could be developed."

Comox Coalfield

As has been mentioned previously, three seams were found to be mineable in the Cumberland area: No. 1, 2 feet 6 inches to 7 feet thick: No. 2, 3 feet 6 inches to 3 feet 9 inches thick; and No. 4, 3 feet to 7 feet thick. These measurements of seam thickness apply to the mineable areas only; the three seams are quite variable in thickness in different parts of the field and tend in places to be split up by rock bands and sections of inferior coal. No. 4 seam is the lowest seam, each seam being separated by about 120 feet of sandstones and shales. No. 4 seam is near the base of the Comox formation, and, due to the irregular pre-Cretaceous basement, there are barren areas where this and sometimes the other seams are displaced by the older rocks. Faulting did not present any serious difficulties to mining in the Cumberland coalfield. The three seams generally dip northeasterly at a moderate grade of about six degrees.

No. 4 seam was the most extensively and profitably worked of the three seams. The seam outcrops for about four miles (although partly beneath overburden) between Coal Creek, the east end of Comox Lake, and Puntledge River. It was mined to a very limited extent at Nos. 1 and 2 slopes, both near Coal Creek and in the vicinity of the old Chinatown. It was also

mined from No. 6 shaft, about a mile down dip, under the west end of Cumberland, where the lower seam was cut at a depth of 814 feet. No. 4 seam was mined on a large scale from No. 4 Mine, the main slope portal of which was at the east end of Comox Lake, over a period of about 45 years. The workings extended for nearly one and a half miles to the dip and for over two miles along the strike. The seam was also mined at No. 7 Mine, in the vicinity of Puntledge River, to a rather more limited degree. Attempts to mine No. 4 seam further to the dip were less successful. At No. 8 Mine, where the seam was 1,000 feet from the surface, bands of rock and inferior coal resulted in it being unworkable except in an extremely limited area, and no attempt was made to mine it.

No. 2 seam was worked quite extensively from No. 5 Mine and also from No. 8 Mine which was the last producing mine in the Cumberland area.

No. 1 seam was worked to a small extent at No. 2 slope, and quite extensively at No. 5 and 6 mines under several hundred feet of cover.

As far as reserves in the Cumberland field are concerned, these would lie in the fifteen square mile area to the dip of the old workings, between these and Comox Harbour. Canadian Collieries drilled a number of holes in this area, but the results have not been published. In general, however, it is true to say that the easiest coal has been mined, and bearing in mind the characteristics of these seams to deteriorate to the dip, it seems rather unlikely that there exists any substantial reserves to the dip of the old mine workings.

Nine miles southeast of the Cumberland field is another area containing mineable coal seams in the vicinity of the T'sable River. The writer understands that this field is separated from the Cumberland field as a result of the erosion of the coal-bearing Comox formation followed by deposition of barren sediments. The T'sable River field is divided into two basins, separated by a buried ridge of pre-Cretaceous rocks. The upper or westerly portion forms a synclinal basin crossed by two north-westerly-striking fault systems. A seam ranging from six to ten and a half feet was mined in this area. The workings extended about one and a half miles down the axis of the syncline, and up to about three quarters of a mile along the strike. The roof strata consisted of sandy shales and sandstones. The seam was clean over quite large areas, although in

places it contained bands of rock. On the southeast flank of the syncline it pinched out against the unconformable pre-Cretaceous basement rocks.

Some drilling was done by Canadian Collieries in the lower or easterly basin, but no results have been published. The writer was told that this ground was found to be heavily faulted, and did not look very encouraging although workable seams were found. According to the Royal Commission on Coal, 1946, the reserves of this basin were listed at about three million tons from one seam eleven feet thick. At least one other workable seam (3.4 feet thick) is known to exist in the westerly basin, and the Royal Commission[1] gives over 900,000 tons as reserves for this seam. However, there could be serious working problems after mining and caving the thick seam below it as was done at the old T'sable River mine. It may be mentioned here that the T'sable River coal was found to have a tendency to spontaneous combustion. Methane, however, was almost unknown in the T'sable River field, whereas the Cumberland field was quite gassy in the deeper workings.

There has been no mining in the portion of the Comox coalfield lying north of Cumberland. The coal occurrences and possibility of reserves have been reviewed previously in this Report under 'Economic Geology'. To sum up: it is probable that with careful drilling reserves could be found. However, due to the rather variable, 'lensy' nature of the coal seams, it is questionable whether sufficient readily mineable reserves of the required quality could be proved that would justify the considerable capital cost involved unless of course there was a strong demand for coal.

Coal Analysis

Most of the Vancouver Island coal is classified, according to the A.S.T.M. system of classification by rank, as high volatile A bituminous.

Many of the seams coke quite well but the sulphur content of much of the Island coals rules them out for metallurgical coke purposes.

Many analyses of Island coals have been published. A typical range among the Nanaimo seams is as follows:-

Proximate analysis (as received basis)

Moisture	1.1 - 4.14%
Ash	7.8 - 11.0%
Volatile Matter	33.3 - 43.25%
Fixed Carbon	45.0 - 56.0%
Sulphur	0.4 - 1.24%
Calorific Value (Dry B.T.U.)	12,830 - 13,160

A typical range for the Comox seams is as follows:-

Proximate analysis (as received basis)

Moisture	2.0 - 4.1%
Ash	9.5 - 19.2%
Volatile Matter	28.6 - 35.9%
Fixed carbon	48.8 - 59.0%
Sulphur	1.5 - 2.6%
Calorific Value (Dry B.T.U.)	11,035 - 13,525

Ash fusibility temperatures range from 2000° to 2,400° F.

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APPENDIX

Notes on the Suquash Coal Area

Upper Cretaceous sediments of the Nanaimo group outcrop on the northeast coast of Vancouver Island between Thomas Point at the south end of Beaver Harbour to Port McNeill, a distance of about 20 miles. Coal seams occur in these sediments and a small amount of coal has been mined, principally at Suquash. The following notes contain much of the available information on this area.

TOPOGRAPHY

The coastal area of northeast Vancouver Island between Port Hardy and Port McNeill is of generally low relief, marshy in places, and thickly forested with cedar, fir, hemlock, and second growth spruce for a distance of 2 to 2½ miles inland. The coastal plain is drained by the Keogh and Cluxewe Rivers. The climate is mild but wet, the average annual precipitation being about 95 inches. The principal settlements, at the north and south ends of the area respectively are the communities of Port Hardy and Port McNeill. These are connected by a gravel road. The Port Hardy airport is situated 1½ miles south of Beaver Harbour, and this is also connected with Port Hardy by road. The only other roads in the area are logging roads.

HISTORY

The history of the Suquash coalfield has already been mentioned in previous sections of this report. Indians of the Beaver Harbour area brought specimens of coal to Dr. W. F. Tolmie at Fort McLoughlin (Bella Bella) in the year 1835. In 1847 the Hudson's Bay Company decided to open up a mine in this area to supply steamships with bunker fuel. A party of miners arrived from England in 1849, and mining was carried out on a limited scale until 1852. It is believed that the workings were in outcrops at Suquash, and that about 10,000 tons of coal was mined. The workings were abandoned after the discovery of richer deposits at Nanaimo.

In 1908, Pacific Coast Coal Mines Ltd. became interested in the area. Their operations were at the mouth of Suquash Creek immediately southwest of Single Tree Point, 12 air miles from Port McNeill. Drill holes were put down, cutting No. 2 seam at a depth of 173 feet. This seam was 5 feet 5½ inches thick, but heavily intebedded with shale and inferior coal. A shaft was sunk 200 feet from the shore-line to No. 2 seam. This shaft was a twin-compartment shaft 6 by 10 feet in the clear. Between 1909 and 1914 about 12,000 feet of development drivage was done in the seam. The workings extended 1,350 feet south of the shaft. Two pairs of dip headings were driven east northeast, one for 1,200 feet (1,080 feet beyond the shore line), and the other for 500 feet. A longwall face 800 feet long was opened up to the south of the shaft on the landward side but was only worked on very limited scale. A start was made on the sinking of a large new shaft 1,500 feet southeast of the original one. All work was suspended on the outbreak of World War 1 and was not resumed again until 1920. The original shaft was then unwatered and a considerable amount of location work was done on the surface with a view to handling a large production. However, in 1922 all operations ceased. According to reports, 12,000 to 16,000 tons of coal was mined in the period from 1909 to 1914 by Pacific Coast Coal Mines Ltd.

Nothing further was done until 1952, when a British Columbia company called Suquash Collieries Ltd. was formed. The old shaft was pumped out and access was gained to parts of the old workings which had stood remarkably well due to the strong sandstone roof. Some coal samples were taken and the operations were then terminated. The leases have since reverted to the Crown and no further work has been done.

GENERAL GEOLOGY

Upper Cretaceous sediments of the Nanaimo Group outcrop on the northeast coast of Vancouver Island from Port McNeill to Thomas Point

on the south end of Beaver Harbour, a distance of about 20 miles, and extend for some 2 to 2½ miles inland where they are in contact with Triassic Karmutsen and Bonanza volcanics and sediments. The coastal plain is largely drift-covered. According to Muller,(1) only the basal Cretaceous formation is exposed to any extent. This consists mainly of sandstone members with minor conglomerate and shale and includes the Suquash coal seams. This is believed to correspond in age to the coal-bearing Comox Formation of the Comox area. The total thickness of sediments is not known. The general structure appears to be that of a broad basin dipping gently east northeast at 10 degrees or less. Muller describes the structure as "tilted blocks separated by two or three sets of normal faults trending northwest, north, and northeast". A recent aeromagnetic survey seen by the writer indicates that the sedimentary basin may extend at least 6 miles from shore-line beneath Queen Charlotte Strait, and beyond the east end of Malcolm Island, 10 miles easterly from Port McNeill. The magnetic contours suggest that a pluton may intrude the sediments to within 500 feet of the sea bed north of the west end of Malcolm Island.

ECONOMIC GEOLOGY

The only known occurrence of mineable coal seams is at Suquash. Here two such seams are known to occur and a third is reported. No. 1 seam is from 1 foot to 2 feet 6 inches thick and outcrops at the shore-line and near the mouth of Suquash Creek. This may have been the seam mined in the early days although there are no present signs of old workings. This seam appears to be clean coal of good quality, but has hitherto been considered as being too thin for profitable mining under present conditions. The writer has not seen any analyses of this coal.

The second seam, known as No. 2 seam, was cut at a depth of 173 feet in the Suquash shaft. This seam near the shaft was 5 feet 5½ inches thick, but contained only 3 feet 3½ inches of actual clean coal as the following section will show:-

Coal	6"
Bony coal	1"
Coal	7"
Shale	5"
Coal	3"
Sandstone	1"
Coal	4"
Bony coal	1"
Coal	5"
Shale	3"
Coal	3½"
Shale	15"
Coal	11"
Total	5' 5½"

It will be seem that this section includes 40 per cent of rock and inferior coal, and only 60 per cent clean coal.

The best seam section was at the south end of the longwall at the southern extremity of the underground workings:-

Coal	17"
Fireclay	5½"
Coal	5"
Sandstone	1"
Coal	11"
Bony coal	1"
Coal	7"
Bony coal	1"
Coal	6½"
Bony coal	1"
Coal	5½"
Total	5' 1½"

This section includes only 15.4 per cent of rock and inferior coal and

84.6 per cent clean coal. In the centre of the longwall the seam is 5 feet 2 inches thick with 80.5 per cent clean coal, at the north end 6 feet 11½ inches with 73.1 per cent clean coal. At the end of the first pair of dip headings the seam is 5 feet 5½ inches thick with only 65.6 per cent clean coal and as many as seven bands of rock and inferior coal. The roof of the seam consists generally of a strong sandstone.

Within the narrow limits of the underground workings the seam tends to deteriorate to the north and east and improve to the south and west. Nothing is known of the seam conditions outside this area; several drill holes were put down by Pacific Coast Coal Mines Ltd. at intervals along the coast up to one mile southeast and 1/3 mile northwest of the shaft, but records of the drill logs of these are no longer available. The seam sections within the mine area are certainly not encouraging from an economic point of view. The coal itself is clean and apparently of fair quality. Very few analyses are available, but one which was taken for Suquash Collieries Ltd. in 1952 at a point 75 feet south of the shaft (seam 5 feet 6 inches thick) was reported to be as follows:-

Moisture	5.7%
Volatile combustible matter.....	36.2%
Fixed carbon.....	47.1%
Ash	11.0%
	100.0%
Sulphur.....	0.98%
Calorific value	11,580 B.Th.U.

This coal resembles analytically some of the Nanaimo seams rather than the Comox coals. The ash content is rather high, which of course brings down the calorific value. The sulphur content is rather too high for a good metallurgical coking coal, and in any case nothing is known of its coking qualities.

It will be seen that nothing very useful can be said about reserves

in the Suquash coalfield at the present time. The No. 2 seam appears to deteriorate to the dip and beyond the shore-line. The dip is very gentle in this area (2 to 4 degrees) and there could be an extensive landward extension of the seam to the southeast of the old mine. Whether the seam would be regular enough and clean enough to mine would have to be tested by drilling.

Another possible line of investigation is a third seam, called No. 3 seam, which is reported to have been cut by drill hole at the shaft site at a depth of 445 feet and to be 4 feet thick.

There is also the possibility that careful prospecting may find other coal seams along the coast. Dowling[2] reports that thin seams have been found near the mouth of the Keogh River and south of the mouth of the Cluxewe River. The likelihood of finding seams by drilling on Malcolm Island should perhaps not be entirely ruled out since the island is underlain by rocks of the Nanaimo Group. However, one drill hole was apparently put down many years ago with evidently discouraging results.

REFERENCES

(1) Muller, J. E., Port McNeill and Nanaimo Basin:
Geol. Surv. Can., Paper 67 - 1

(2) Dowling, D. B., Coalfields of British Columbia;
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CANADA
DEPARTMENT OF MINES AND RESOURCES
MINES, FORESTS AND SCIENTIFIC SERVICES
GEOLOGICAL SURVEY OF CANADA

NANAIMO COALFIELD
BRITISH COLUMBIA

PAPER 47-22

Scale: 1 inch to 1 mile

0 1 2 3

CARTOGRAPHY BY THE DRAFTING AND REPRODUCING DIVISION 1947.

LEGEND

MESOZOIC

CRETACEOUS
UPPER CRETACEOUS
NANAIMO GROUP (3–13)

13 GABRIOLA FORMATION: sandstone

12 NORTHUMBERLAND FORMATION: shale, sandstone, conglomerate

11 DE COURCY FORMATION: mainly sandstone

10 CEDAR DISTRICT FORMATION: mainly shale

9 PROTECTION FORMATION: mainly sandstone, coal

8 NEWCASTLE FORMATION: mainly sandstone and shaly sandstone; coal

7 CRANBERRY FORMATION: sandstone, shaly sandstone, conglomerate

7 CRANBERRY AND NEWCASTLE FORMATIONS: undivided

6 EXTENSION FORMATION: conglomerate, coal

5A 5B HASLAM AND EAST WELLINGTON FORMATIONS: 4A, chiefly shale; 4B, chiefly sandstone; some coal

4 BENSON FORMATION: conglomerate

JURASSIC AND/OR CRETACEOUS
UPPER JURASSIC AND/OR LOWER CRETACEOUS

Granodiorite and allied rocks

TRIASSIC AND (?) JURASSIC
UPPER TRIASSIC (MAINLY OR ENTIRELY)
VANCOUVER GROUP

Andesite, basalt; quartzite, argillite, limestone, schist. May include some undifferentiated late Paleozoic rocks

Fault (dot indicates downthrow side)

Coal seam (W—Wellington; D—Douglas; N—Newcastle)

Geology by A. F. Buckham, 1943-1946

Base map by British Columbia Forest Service, 1937, with additions by A. F. Buckham

Main road
Secondary road
Railroad
Post office
Buildings
Pipe-line (or flume)
Wharf
Contour interval, 500 feet

COLUMNAR SECTION

NANAIMO COALFIELD

FORMATION AND	THICKNESS IN FEET	
GABRIOLA	1400′ ±	
NORTHUMBERLAND	2000′ ±	
DE COURCY	900′ ±	
CEDAR DISTRICT	750′ ±	
PROTECTION	650′ ±	
NEWCASTLE	175′ ±	DOUGLAS SEAM, NEWCASTLE SEAM
CRANBERRY	400′ ±	
EXTENSION	600′ ±	
EAST WELLINGTON	35′ ±	WELLINGTON SEAM
HASLAM	600′ ±	
BENSON	100′ ±	BLACK JACK SEAM

LIST OF COAL MINES AND PROSPECTS

1. Lantzville Collieries Ltd., No. 1 mine
2. Wanoose-Wellington Collieries Ltd.; Lantzville mine
3. Little Ash mine
4. R. Dunsmuir and Sons; Wellington Colliery, Dunsmuir's original entry
5. " " Wellington Colliery, Wellington mine, No. 1 slope
6. Canadian Collieries (Dunsmuir) Ltd.; No. 9 mine
7. R. Dunsmuir and Sons; Wellington Colliery, Wellington mine, adit level
8. " " ; Wellington Colliery, No. 1 shaft
9. " " " , No. 2 shaft
10. " " " , No. 3 shaft
11. " " " , No. 4 shaft
12. " " " , No. 5 shaft
13. " " " , No. 6 shaft
14. East Wellington Coal Co. [Chandler] ; No. 1 shaft
15. " " ; No. 2 shaft
16. East Wellington Coal Co. Ltd., [1920] ; East Wellington mine
17. Vancouver-Nanaimo Coal Mining Co., Ltd.; East Wellington (Jingle Pot) mine No. 1
18. New Vancouver Coal Mining and Land Co., Ltd., Northfield mine
19. Western Fuel Co.; Wakesiah mine
20. " Harewood mine
21. " Harewood mine, adit level
22. Canadian Collieries (Dunsmuir) Ltd ; Extension Prospect mine;
23. " Tunnel to Nos 1, 2, and 3 mines, Extension Colliery
24. " ; Extension Colliery, No. 1 slope
25. " " " , No. 2 slope
26. " " " , No. 3 slope
27. " " " , No. 4 mine
28. " " " , No. 6 slope
29. " " " , Vancouver slope
30. " " " , Old No. 1 slope
31. " " " , Beban's mine
32. " ; No. 7 slope
33. " ; White Rapids mine
34 " ; No. 8 mine
35. Wolf Mountain prospects
36. Black Jack outcrop
37. Hudson's Bay Co.; No. 1 pit
38. " ; No. 3 pit
39. " ; Park Head level free
40. Vancouver Coal Mining and Land Co., Ltd.; Douglas mine, water level
41. Hudson's Bay Co ; Pemberton Encampment prospect
42. " ; Newcastle (Sage) mine
43. " ; Fitzwilliam mine
44. Western Fuel Co ; Brechin mine
45. " ; Newcastle shaft
46. " ; Protection mine
47. " ; No. 1 mine
48. Vancouver Coal Mining and Land Co., Ltd.; Douglas slope
49. " ; Douglas shaft
50. " ; New Douglas slope
51. " ; New Douglas mine, adit level
52. Western Fuel Co.; New Douglas [1917] slope
53. Vancouver Coal Mining and Land Co., Ltd.; Southfield No. 1 slope
54. " " ; Southfield No. 2 slope
55. " " ; (Southfield)No. 3 mine
56. New Vancouver C. M. and L. Co.; Ltd.; (Southfield)No. 4 slope
57. " " " ; (Southfield)No. 5 mine
58. Western Fuel Co ; Reserve mine
59. Pacific Coast Coal Mines, Ltd.; South Wellington Colliery, Fiddick slope
60. " " ; South Wellington Colliery, Richardson slope
61. " " ; Morden mine
62. Canadian Collieries (Dunsmuir) Ltd.; Alexandria mine
63. " " ; No 5 mine
64. " " ; No. 10 mine
65. Granby Consolidated Mining, Smelting and Power Co.; " " Granby Colliery, No. 1 mine
66. Granby Consolidated Mining, Smelting and Power Co.; " " Granby Colliery, No. 2 mine
67. Consumers Coal Co., Ltd.; Round Island prospect

NOTE. The Company named is, in each case, the one most prominently associated with the working of the mine. The first mining was in 1852 by the Hudson's Bay Company, succeeded in 1861 by the Vancouver Coal Mining and Land Co., Ltd., in 1889 by the New Vancouver Coal Mining and Land Co., Ltd., in 1908 by the Western Fuel Co., in 1918 by the Canadian Western Fuel Co , and in 1921 by the Western Fuel Corporation of Canada, Ltd., which, although bought in 1928 by Canadian Collieries (Dunsmuir) Ltd., continued to operate mines until 1939. Robert Dunsmuir discovered coal at the Wellington Collieries in 1869, and after 1871 operated as Dunsmuir, Diggle and Co. until 1883. This Company was succeeded in 1883 by R. Dunsmuir and Sons, in 1899 by the Wellington Colliery Co., Ltd., and in 1910 by the Canadian Collieries (Dunsmuir) Ltd. which is still operating in this field.

SYMBOLS USED FOR MINE WORKINGS

Slope or adit
Shaft
Prospect

NOTE. The letter "V" beside symbol indicates that it is an auxiliary opening used chiefly for ventilation

DESCRIPTIVE NOTES

The Vancouver group of metamorphosed volcanic and sedimentary rocks, chiefly andesitic lava, is the oldest known in the area. The rocks are probably mainly of Upper Triassic age, but no fossils have been found in them in this area, and they may include some undifferentiated late Paleozoic strata. They were deformed and mountain-built and were intruded and metamorphosed by granitic and allied rocks, probably in late Jurassic or early Cretaceous time.

A subsequent period of erosion developed a coastal lowland with a relief of about 500 feet. On this were deposited about 7,600 feet of Upper Cretaceous sediments, the basin's group. These comprise conglomerate, sandstone, shale, and coal, in lenzy beds of rapid accumulation. The stratigraphy is summarized in the accompanying columnar section.

Two periods of strong deformation are represented in the Nanaimo area. The first occurred about the time of the intrusion of the granitic rocks. Probably the members of the Vancouver group were then folded and faulted, although no structures have been distinguished as referable to the first period alone. The second affected the rocks of both the Vancouver and Nanaimo groups, and from a study of the regional geology is known to have occurred in post-Eocene time.

The structure of the Nanaimo area is dominated by strong faults crossing it from southeast to northwest. These are parts of a major fault zone extending along the east coast of Vancouver Island for at least 70 miles. Where the faults have been observed in the Cretaceous rocks they are chiefly thrusts. Clean breaks in the measures, where observed, are in the Extension and lower formations, but may occur, unexposed, in higher beds in the southeastern part of the area. In the higher formations only sharp overturned folds, lacking actual rupture of the measures, have been seen. Traced along strike, most faults seem to be of the rotational or hinge type. They strike in general northwest, but considerable divergences were noted, and in places the changes are rather abrupt.

The rocks of the Nanaimo group are also folded, the folds, excepting those associated with dislocations, being broad and open. The strike of the folds generally parallels that of the faults, and the faults, sharp overturned folds, and broad open folds all appear to have been caused by the same stresses.

Coal, from the Upper Cretaceous formations, is the chief economic mineral product of the area. The Nanaimo coalfield has, since 1852, produced almost half the total of coal mined in British Columbia, mainly from the Wellington, Newcastle, and Douglas seams, from which has come more than 90 per cent of the field's total production.

A thin seam occurs near the base of the Haslam formation near Black Jack Mountain (36). The few outcrops seen are thin and dirty.

Several coal seams lie near the base of the Extension formation. At the base is the main Wellington (No. 1) seam; 35 feet above is the Little Wellington (No 2) seam; and 60 and 75 feet above are the Wellington Nos. 3 and 4 seams respectively. These upper seams rarely exceed 5 feet in thickness. The most conspicuous feature of the main Wellington seam is its variation in thickness, due to undulations, chiefly in the roof. It averages 4 to 7 feet in thickness over a workable area 12 miles long and an average of 1 mile wide, exclusive of an outlier of Lantzville. Its floor is usually sandstone, and its roof is commonly shale although sandstone or conglomerate occur in some places. Partings of "rash" (dirty sheared coal) and shale are common in the seam. The most important mines working the Wellington seam were in the vicinity of Wellington and Extension. The productive area near Wellington is bounded by the outcrop and by faults on the north and southwest, and the seam becomes unworkable south of section 17 and east of the centre of range 7, Mountain land district. The Extension coal area is bounded by the outcrop and by faults on all sides but the east, where it was but little mined east of range 1, Cranberry land district. The main Wellington seam was worked in all mines and prospects listed from 1 to 35 inclusive, with the exception of 4, 6, 20, 21, 22, and 27, which worked the No. 2 seam. Both these seams were worked in properties 1 and 16, and the main seam and Nos. 3 and 4 seams in property 18.

A small seam, of very patchy occurrence, is found about 200 to 250 feet above the base of the Extension formation.

The Newcastle seam, at the base of the Newcastle formation, is the most restricted in distribution but the most regular of the three main seams, averaging about 3 feet 6 inches in thickness over a workable area of 2 by 1½ miles underlying Newcastle and Protection Islands. Its floor is usually flaggy or shaly sandstone and its roof varies from sandy shale to fine conglomerate. The seam commonly lacks partings. It was worked in properties 38, 41, 42, 44-47, and 52.

The Douglas seam occurs in the Newcastle formation, an average of 60 feet above the Newcastle seam. It has a workable area 9½ by 1¾ miles. It averages a little more than 5 feet in thickness, but the thickness varies to such the same degree as the Wellington seam, and south of property 53 this irregularity is even more noticeable. Both floor and roof rocks are of variable composition, and undulations, causing variations in seam thickness, are most commonly in the floor. Partings of rock and "rash" are common, and in many places, especially in the south, the seam is strongly sheared. The most important mine in the Douglas seam was No. 1 mine (47), which was operated for 55 years (1883-1938) and yielded about 18 million long tons. Its workings, chiefly submarine, extended from the shafts (47) east to within a quarter mile of Jack Point, and from the Newcastle shaft (45) south to the south shore of Nanaimo harbour. This downthrown part of the Douglas seam, east of the harbour downthrow, was also worked in properties 43, 44, and 58. The part of the Douglas seam west of the downthrow has been worked almost continuously from the Hudson's Bay mines in the city of Nanaimo (37, 39, and 40) for more than 7 miles south to Cassidy, including the Southfield and South Wellington coalfields (48-49, 50-51, and 53-66).

An anticline exposes a coal seam (67), considered by some to be the Douglas seam, on Round Island, but the available information is insufficient to prove this.

In the Protection formation five seams between 6 and 9 inches thick occur in places. This zone is that at which the Cumberland seams occur, but the seams do not occupy corresponding stratigraphic positions.

The experience of 95 years of mining and prospecting has delineated the areas of workable coal with considerable accuracy. It has shown that all the seams become unworkable seaward, an average of about 1½ miles from their extreme western outcrop. The area east of Lantzville mine (2) might support another mine for a few years, and prospecting in the Black Jack area (36) might possibly reveal workable deposits. Apart from these, when the present working mines (33 and 64) are exhausted, there appears little chance of further large-scale operations, although small-scale operations will probably continue for years.

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