ASSESSMENT REPORT

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REPORT ON
CARBON RIDER COAL DEPOSITS
Peace River, British Col.

By:
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CONCLUSIONS: The detail considerations set out in this Report allow the following conclusions:

1. In the Peace River District between Hudson Hope and Finlay Forks exists a coal bearing area in which two certain - Hudson Hope and Carbon River - and three probable - Pine Pass, Commotion Creek and Ottertail Creek - coal producing basins will be developed;

2. In the Hudson Hope and Carbon River basins enough preliminary geological and other examination work has been done to warrant the statement that in each will be finally proven very large reserves of very high grade coal - low in ash, and high in BTUs;

3. In the Carbon River Basin the coal that can be produced will have the following average proximate analysis:

Loss of air drying 2.05%

Analysis on air dried coal:

Moisture	3.05%
Volatile Matter	22.96
Fixed Carbon	71.83
Ash	2.16

BTUs per pound	13,910
Fuel Ratio	3.17
Sulphur	0.77

4. The coal has other very superior qualities: It is second to none, and far superior to any competitive coal, in its ability to stand weathering and to resist crumbline and crushing when handled and shipped;

5. In the Carbon River basin in the six miles of its known length there is a minimum area of twelve square miles underlain by coal and for the probable twenty-five mile length considerably over fifty;

6. On the one stream where detail study has been made are exposed ten coal seams varying from thirty inches to seventeen feet in thickness for an aggregate minimum of 33.8 feet and a probable maximum of 50.1 feet of coal in 493 feet of coal bearing measures;

7. These ten seams are almost certain to be found under 6.5 square miles of the basin and there has not been recorded any observation to indicate that they do not exist under the whole fifty;

8. The two seams designated F and G, with their carbonaceous shale marker, have been followed for something over six miles with good indications that they extend at least three and one-half more, and there is no present reason to doubt their extending for the full probable twenty-five mile length of the basin;

9. In the presently assumed central portion of the basin the coal seams are proven to extend for a minimum width of two miles with every indication that it will exceed three;

10. On the basis of the observations plotted over a length of six miles, it is estimated that there are practically assured in the F and G seams alone a reserve of 145,000,000 tons with the average analysis given in 3 above; and a fairly probable potential reserve for all the ten seams in the whole fifty square miles in excess of 2,700,000,000 tons;

11. The conditions under which this Coal exists are so favorable for its extraction that the cost per ton when producing one million tons annually is estimated at $2.85,. and when the production, is three million tons, $2.67;

12. The present markets thirsting for this coal extend from Port Arthur in Ontario to all points along the West Coast of North America, and at the present time probably aggregate a minimum of five million tons annually; but with the almost certain rapid curtailment of oil production in California, this market should within a few years increase by leaps and bounds;

13. The high quality of this coal warrants a sale price in its normal market at least fifteen per cent higher than any competitive coal, and the average price at which it will probably be sold will net a gain, when selling one million tons annually, of from $0.45 to $1.45 per ton and, when selling three million, of from $0.63 to $1.63;

14. To bring this property to a production of- one million tons annually will require $5,100,000 and to reach three million tons, $12,900,000;

15. Before provision for Federal and State or Provincial Income Taxes, the net profit, when producing one million tons annually, will mean a percentage return varying between 8.8 and 25.8; and when producing three million, between 14.7 and 38;

16. Considered as coal minin development, this business is fully warranted, but unfortunately there is presently no railway to transport this coal from mine to markets;

17. At an estimated total cost of $13,000,000 - $60,000 per mile - the required 220 miles of mainline - 85 to 110 lb. rail - railroad to connect this basin with the Canadian National at Prince George can be built;

18. Such a railway will not only have the coal output as freight but should also have some 300,000 tons of paper pulp end 600,000,000 board feet of timber products annually from the Peace and Finlay River areas that it will tap; and if extended easterly to reach the Peace River agricultural district would obtain from that area all the grain that is sold for export; and

19. To any organization with the finances necessary to provide the railway and mining development required, the writer does not hesitate to recommend the detail study of this prospective business.

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INTRODUCTION

Western North America has long been dependent for its required supply of high grade coal and coke on imports from England or Australaasia, and only since the war, from West Virginia. The discovery and development of petroleum in California, Mexico and South America gave it a fuel, for all but iron and non-ferrous blast furnace operations, more satisfactory in every way than coal, so the coal bunkers that were formerly found in all West Coast ports disappeared.

Before World War II certainbasic economic conditions were disadvantageous for a profitable iron producing business on the West Coast. The eastern iron plants, long established with ample relatively inexpensive labor, ore and fuel supply, could manufacture iron and steel products at far less cost than could be done- on the West Coast, with its limited labor supply and relatively higher wages. Further, water delivery through the Panama Canal kept transportation costs to the West at a low legel.

With the demands of the present war for petroleum products causing a production far exceeding that warranged by proven and developed reserves,. the future supply of those materials from California oil fields is due to be decreased and within a relatively short time not only must other fuels be found but the coal reserves must be drawn upon to produce lubricants and gaseous fuels for internal combustion engines. Then too, a shift of population from east to west and-the establishment of basic iron products' industries on the West Coast has created a demand for metallurgical coke.' As a result the demand for any coal in general, and high grade coal in particular, has mushroomed over night.

Along the West Coast there are no known or potential reserves of such coal. Many might have thought that Alaska could produce it in quantity - but experience over the last twenty-five years has proven that only a rosy dream. The nearest developed sources of coal that could fill the bill are those of Utah and the Crow's Nest Pass country of British Columbia. But the former field will be hard pressed to supply the rapidly increasing iron production in that state and the latter coal is really not very good. While there are immense reserves of coal - mainly sub-bitmminous and lignitic - known in California, Washington, Oregon, British Columbia and Alberta, thos presently developed and provided with transportation yield only a very poor; grade almost wholly unfit for metallurgical purposes but will become increasingly valuable as sources of lubricants and gasoline fuels for internalcombustionengines.

For a long time the existence of coal - equal to or better than the West Virginia and Welch coals - in the Rocky Mountain region of the Peace River area of British Columbia has been known, but a lack of transportation facilities - a rialroad of standard main line specifications - has prevented its development. However, now the need of such a coal for the serving of the West Coast of North America demands the provision of the needed railroad and the development of enable large sdale production of this long known potential reserve.

The purpose of this Report is to present a program by which at least one of the known coal-bearing basins - Carbon River - may be developed and the railway required to enable this coal to fulfill the present pressing and growing market be provided. Such a railway would also provide an outlet for the coals from the Hudson Hope, Commotion Creek and Pine Pass basins (the market for these high grade coals being ample for the probable production from all of these) and bring the pulp and timber products from the Parsnip, Finlay and Peace River drainages to a waiting market,

OBJECT & SCOPE OF REPORT

This examination was made primarily to confirm the statements made by Cowper Rochfort, one of the owners of the presently held ten coal mining leases, and the data presented by E. W. Beltz in his report made in September, 1928; Simultaneously therewith statements made by McLearn, Galloway, and others were also combed for facts, dated and estimates to be examined, and as far as possible also confirmed or refuted.

The scope covers not only the gathering of new and confirmation of presently-known data and the correlation of the numerous seams of coal themselves but the larger one of transportation of the coal to the markets hungry and waiting for it. This latter phase is really the more important, for *no matter* how large are the reserves and high the quality of the coal, the deposits *are* worthless until the coal can be brought to the consumer.

HISTORICAL & PRESENT OWNERSHIP

Peter Pond, a factor of the Hudson's Bay Company at Athabaska Landing, writing in his diary in 1788, notes that Indians from West of the Rockies "coming through their Underground Passage " brought with them samples of "bitumen". This was undoubtedly coal from the seam (now known as the (Gething) outcropping in the Rocky Mountain Canyon - their "Underground Passage" - above Hudson's Hope,

Gething has held his leases since early in this century, buty Cowper. Rochfort asserts that he was the first to find the seam on Carbon in 1908. This claim is disputed, but at least he was the first to draw serious attention to them. He made-his applications for leases shortly thereafter and obtained assistance from Pat Burns of Calgary in maintaining them. Through giving this assistance, Pat Burns, as evidence by a written document, obtained a one-half interest in Rochfort's holdings, Upon Burns' death this interest passed to the Burns Foundation. At the present time, ownership of the leases (numbered 319 to 328 on Plate IV) is held equally by Rochfort and Burns Foundation, subject to the latter's being repaid all the advances - around $45,000 plus *interest* - out of the first monies received. The pres*ent* option to lease is from these'two interests.

Just prior to Workd War I, Lord Rhondda, owher of coal mines in Wales, 'and then engaged in colonizing the Peace River Country, became interested *in* this coal to an extent which caused him to have an examination made by one Christie, a mining engineer of West Virginia specializing in coal. Rochfort states that as a result of Christie's report, Rhondda determined to provide the needed transportation and had a line surveyed from Carbon River to the Inside Passage at Alice Arm. The war prevented consummation of this plan, and Lord Rhondda's death ended it,

About 1921 the claims were surveyed and ten of the original twenty were convertad to leases. Those were continued to be held and in the early thirties, Rochfort interested the American International Corporation to the extent of paying up the rentals, delinquent for many years, and re-establishing the leases in good standing, According to Rochfort; that Corporation's

plans were coupled with extending the Pacific Great Eastern Railway (owned by the British Columbia government) to tap the Peace River agricultural area, passing the mouth of Carbon River. When the colonization scheme, on which this plan was based, fizzled, the American International Corporation dropped out of the picture.

In August, 1928, E. W. Beltz, for Stuart and Batten of Vancouver, visited the property and a copy of his report of the examination he then made is in the Appendix to this document. His maps were used as the basis for most of the plates for this report,

From then to 1942 nothing was done. The owners once or twice even failed to pay the rentals and do the assessment work, and thus lost the leases. Through Rochfort's efforts, seven of these were re-established in 1942, and three in 1943.

In the fall of 1942, Rochfort and Walter Wrigley made an inspection of the leases - Rochfort's first visit for about twenty years. They took in hand augur and explosives and Wrigley ran three short drifts on three separate seams, and one open cut on another, all on Eleven Mile Creek. Wrigley also traveled south up Carbon River for some fifteen miles above the south boundary of the present leases.

Then in July, 1943, the writer headed a party of from five to seven into the area and the examination he made is the basis of this Report.

ACKNOWLEDGMENTS

In the course of making the examination and preparing this Report, the following articles and reports were consulted either in the office or in the field:

McLearn, F.H.: Mesozoic of Upper Peace River, B.C. Summary Report - Geological Survey of Canada, 1920, Part B;

McLearn, F.H.: Peace River Canyon Coal Area Summary Report, G.S.C. 1922, Part B;

Galloway, J.D.: Annual Report Minister of Mines, B.C., 1923, pages 141, 142-A;

Kitto, F.H.: The Peace River District, Canada, 1920;

White, James: Fuels of Western Canada; Commission of Conservation, Canada, 1918;

Beltz, E.W.: Carbon River Coal Claims; a report of an examination made the latter part of August, 1928, by the firm of Stuart and Batten, Consulting Engineers of Vancouver, B.C., for Pat Burns and Cowper Rochfort;

Rochfort, Cowper: Various Reports and Statements; and Various Annual Reports of the Canadian Federal Government, Dept. of Trade and Commerce; Coal Statistics for Canada.

Without unnecessary and, to the writer's mind, useless cross reference, the authority for each fact or statement taken from the various articles above referred to is not always indicated. To anyone sufficiently interested in the geology of the area, it is recommended that the first two referenced be read in their original versions. To those interested in the Coals of Western Canada (as of 1918), from which a knowledge of the quality of the competitive coals maybe learned, James White's panphlet should be read. Of course, since 1918, the Sheep Creek anthracite area has been reported on and much has been ascertained of the Carbon River Field.

ACCESSIBILITY AND ROUTE:

As of the date of this Report, the Carbon River Field is best reached as follows:

A - Rail over the Edmonton, Dunvegan and British Columbia Railway 495 miles from Edmonton to Dawson Creek;
B - Over ths Alaska Military Highway 59 miles from Dawson Creek to just beyond Fort St. John;

ACCESSIBILITY AND ROUTE (continued)

C - From St. John to Hudson Hope, at the lower end of the Rocky Mountain Canyon of the Peace River, *travel* is five miles over the Alaska Military Highway, thence 57 miles over an only slightly improved road with steep grades to the Peace River and thence up the Peace River benches and flats;

D - Around the Peace River or Rocky Mountain Canyon to the foot of navigation on the Peace - 14 miles; whence motor boat may be used about 34 miles to the mouth of Carbon River. However, as the trip is generally made before the launch is used, the road up the Peace is travelled for a further 22 miles to James Beattie's Ranch, cutting the river travel to 12 miles; and

E - By pack and saddle horse up a very much neglected trail to the centre of Carbon River presently held claims - about 15 miles - to the Creek known as "Eleven Mile".

During the open season this routing requires, when conditions are right, about five days. However, during the spring break-up and summer rainy season any number of days may be lost between Fort St, John and Beattie's Ranch awaiting roads dry enough for truck travel. While passenger cars can be *worried through, it is safer to use a* truck with at least dual rear tires. and a high clearance. Under average conditions two ton trucks do haul from four to six tons of coal over the summer roads and larger loads over the winter road - provided snowdrifts are kept cleared.

The time can be cut materially by using established plane service from Edmonton to Fort St, John - about three to four hours' flying time - and rented float plane from Lake Charlie, near Fort St. John, to the Peace River at the mouth of Carbon River - probably 60 to 70 minutes flying time. In winter ski-equipped plane could be used in this latter stretch.

At Beattie's Ranch one can rent a half.-ton pickup to travel between there and Hudson Hope; the necessary outboard launches to get to Carbon River for further up the Peace to Fort Grahame on the Finlay River; and the horses for riding and packing up Carbon River - these being sent up the left limit and then swum across the Peace. just above the mouth of the Carbon.

Mail leaves Fort St. John every Thursday for Hudson Hope - returns every Friday. Mail leaves and returns to Hudson Hope the first Tuesday in each month for Gold Bar - the Post Office at Beattie's Ranch. But during the summer at least, persons traveling frequently between Hudson Hope and Beatties' Ranch bring in and take out mail. A telephone line connects Fort St. John with Hudson Hope and there is still at Beattie's Ranch the radio telephone set used before the war to communicate on pre-arranged shhedule with the net-work tied into St. John.

The present means of surface communication between Beattie's Ranch and the Alaska Military Highway are inadequate for any regular or heavy traffic and even for any serious work in the Carbon River area would have to be partly relocated and wholly built at considerable expense. Under present conditions any large amount of freight coming in would better be moved during the winter when the roads are frozen and it could be delivered right on the Carbon.

For handling large pieces of freight there should be derricks at loading and unloading points and larger boats with inboard motors or barges with diesel-driven tow boats.

The trail up the Carbon River needs considerable work done now to make it a fair one. It could very easily be widened for all year tractor and trailer travel. There would only be one place where for a short distance might any rock work be required and only in one place - the "slide" would any grade over the top be necessary. By using fairly large tractor and high wheeled or runner trailers, so the Carbon could be crossed, would the rock work stretch and the grade be obviated. In that event, however, communications would be impaired during the freeze up, the thaw and storms. Local trappers say that the Carbon does not freeze over solidly and the ice coould not be travelled safely by large. equipment.

INSPECTING THE AREA:

Owing to the trouble the writer had in getting started on his inspection of the then known coal exposures, it seems quite necessary to make some record of the best trails to follow in any attempt to see the exposures. The best time is at low water from August 15th to September 15th. An important point is the lack of horse feed in the area; one should keep at least two horses with the part, and feed must be taken in for them. So far as is known at this time, (7/31/43), Eleven Mile Creek is about the center of the coal basin and on the left limit of just below its First Falls (Belts), hereinafter referred to as Camp Falls, is an excellent location for a preliminary camp. It will be assumed that the next inspection will consider the trails as they now exist. By this outline, it is hoped that some of the unnecessary delays experienced this year, may in the future be prevented.

Undoubtedly the first night's camp will be at the mouth of Carbon River, and the start by saddle and pack horses made from there in the early morning. The writer found Jim Beattie's Ranch, (a very good place to stay), had good stock and help to handle them and deliver them at the starting point. He also has the boats to convey the party and outfit from the end of the road to the mouth of Carbon River. His son Robert (an excellent man), did the packing and this knows the trail to Camp Falls.

If it is known far enough ahead that a party is going in, it would be well to arrange with Beattie (sending him money) for two men to go in ahead and clear the trail - cutting out the windfalls and making new trails around those stretches that may have been washed out by the intervening high water. That will then establish the trail at that time to Camp Falls.

However, if this is not done and Bob Beattie is not the packer, then these notes are needed. In leaving the Peace, follow the trail to the upper cabin and cache, and there make a right angle turn due west following the old trail which keeps well to the right and a considerable distance west of the Carbon River Stream, not coming back to it for about three miles.

The trail will at times disappear, particularly near the *river* bank, where it has been washed out. At all such places, immediately find 'the old trail beyond the washout and cut a new one *between* the old stretches. This sounds so fundamental as to seem unnecessary to state, but this party was several times delayed because this was ignored. At many of these places, others have cut "makeshift" trails for long distances, and these are not at all satisfactory and *are* difficult to follow. Always come back to the old trail in shortest possible distance.

At about mile four, the trail *passes over* an outcrop known as Four Mile Rock and about Mile Five occurs a steep ascent over a rock bluff coming to the River. If the water is low enough, time will be saved in avoiding this by fording the River and then coming back. Incidentally, at the upper end of this bluff the first coal seam - in the bed of the river - of poor quality and marker falls were seen.

Just below Seven Mile Creek, is an old cabin. The trail beyond this cabin fallows the bank and in large part has been washed out. Stick to the bank and do not go back into the timber. A short distance beyond Seven Mile Creek itself is reached - a good camping place. The, writer did not ascend Seven Mile Creek. On Carbon River, coal appears ppppsite the cabin and also opposite the mouth of Seven Mile Creek.

Beyond Seven Mile, cut left to the main bank and follow the trail close to the bank, crossing a beaver dam and staying on the bar all the way to the "Big Slide", at the north end of which is a shallow ford: 'cross and come back on the bar'beyond. Nine Mile Creek is a small one manifested mainly by a swampy place in the trail and on the flat beyond are the remains of an old survey *camp* - about 1920.

At Ten Mile - a fair size stream - stay close to the Carbon, even keeping down on the gravel until past the next slough - an old course of Carbon River - just a short distance. There watch for an abrupt right angle turn to east or loft to get onto the bar which the *trail* follows for a short distance before cutting back to the bank. On the bank the trail has been washed out at several points and parts of what remains may slide into the river, so take care with the horses. Really, a new trail should be cut to by-pass this bad stretch.

INSPECTING THE AREA -(Continued)

Then one comes to a newer cabin - Stott's - and cache. Beyond the old trail follow the bank but it may be better to take to the bar, climbing the steep bank after a short distance. Once up the bank on the trail, stick to it even though it may need a little widening. However, if considered preferable, when the steep pitch in the present trail is reached, one can go down to the bar.

If one stays on the old trail (not widened this season), it comes out at Camp Falls, which can be heard long before seen or reached. If one follows the bar, cut right when the first of the mouths of Eleven Mile is reached and take the trail to the bench. Rather poorly blazed trees may be followed.

ELEVEN MILE INSPECTION:

To see the exposures on this creek - which may be waded upstream only during low water from August 15th to September 15th - go up the right limit on what is now only a foot trail. To reach it, cross the stream at the lower end of the Camp Falls' pool - a marvelous fishing place - go downstream about fifty feet taking the trail leading up the steep bank. This start is now well blazed. Upon the third bench are two trees squared with blazed trees going westerly and southerly - the former mark the trail wanted. The latter will be referred to later as the start of the "Upper Carbon" trail.

Not very far long the Eleven Mile trail is another squared tree; Going north and straight down the bank, one comes to the creek and the coal on the left or north limit can be seen. Continuing up the trail one passes an outcrop and a short distance beyond comes to another squared tree with a trail also going north straight down to the creek. On the opposite side will be seen three openings in three seams of coal with a small seam above.

Again continuing up the main trail one soon hears the Forks Falls and sees the large 17-foot seam standing almost vertical here and extending up both branches. Just before reaching the Fords, there is a trail to the right leading to an open cut in a seam on the right or south bank.

One can go up the East Fork by working along the foot of the slide and crawling over a low cliff, coming out on a flat. There is no trail on this flat, but from its upper end can be seen two seams of coal away up in the cliff. These can be reached by going up through the timber.

After West Fork valley turns south, there is a very large exposure on its right limit. The best way to reach this point is to take the trail from the camp leading due north along the blazed trees. This trail cuts into the Trapper's Trail coming from Stott's cabin. It is not well blazed so care must be taken in following its course away back from Eleven Mile and high on the hill. At probably 2.5 miles it cuts south straight down the steep hill to the West Fork, intersecting a very old trail which it follows for probably a mile, coming out at an old and new cabin - the end of the trail.

From the Junction of Trappers' Trail and the old trail just across the West Fork is a bluff containing the coal exposures at that point. One might have to go out through the willows to see it.

From Camp Falls camp, a trail is blazed westerly that leads up the high bank on the left limit of Eleven Mile, and at about 600 feet is just above the first coal exposure in that wall. One can continue upstream on this poor trail but it was found very difficult and almost valueless, although the three openings earlier mentioned as visible from the other side can be reached from it.

UPPER CARBON RIVER TRAIL:

The trail coming up Carbon River crosses Eleven Mile just above its mouth and immediately starts up the hill and continues to climb until it reaches the high flat - the fourth bench. Do not attempt to follow Carbon River south of Eleven Mile as the canyon is soon reached. That high trail is referred to as the "Half Hitch" trail because a small spruce on it has grown into a perfect half hitch. It is also called the "Tobaggan" trail as one time it was a main north-south artery for bringing out furs.

UPPER CARBON RIVER TRAIL (continued)

One desiring to go up Carbon River from Camp Falls camp may cross Eleven Mile at the pool and go down the right bank to Half Hitch Trail, but a much shorter way has been found. At present it is not suitable for horses but could easily be made so.

Earlier herein reference was made to the "Upper Carbon" trail.- Turn off the Eleven Mile trail at those first squared trees and follow the twin blazed trees up that steep bank to the high flat and then follow the single blazed trees. First an old trail is met - where squared trees are markers - go across it following the blazes through thick small timber for a very short distance, where squared trees again mark the Half Hitch trail. Incidentally, only a short distance south of this junction is the little spruce with the half hitch.

Proceeding south on this trail one comes to old squared trees on the east - west line from Eleven Mile forks to Carbon River - the boundary between L.319 and L.322. By following this survey line east, one takes what is later called the "Carbon River Canyon Loop".

The Half Hitch trail continues south on this high flat and traverses some swampy land. At about 1.25 miles from that boundary line, it turns sharply east and descends a steep hog back to the river. One on foot can work his way along the foot of the slide here, but if a pack train is to be taken further south, a wholly new trail should be cut from the high flat around the upper end of this slide.

From here south the Half Hitch trail is in a sad state and should be cleared and where necessary to get around slides and bluffs probably new locations made. The writer made this all on foot and followed the water - skirting slides and climbing up the bluffs; with horses one could ford to the east bank.

About two miles above the slide mentinned where the Half Hitch trail came down, the steep hog back will be seen some squared trees and blazes pointing to the river. At this point the river hugs the rock exposure on the right or east limit, and in it can be seen two seams of coal - probably the F and G.

About one mile farther on the river hugssthe left limit and flows over a reef. From the large amount of float coal immediately below this crossing it is believed that two seams (probably F and G) cross here.

The writer has not been byond this point, but one of his party - Walter Wrigley - for two days in 1942 went south along the remnants of the Half Hitch trail an estimated distance of twelve miles, to a point where apparently the Carbon split into two main branches. In low water with horses the stream could be easily forded and travel made less difficult. It is worth while country for as far as Wrigley went he found the same excellent coal in the gravels of all streams coming'from the west. In fact a striking feature in this whole area is that practically every stream bed carries coal.

CARBON RIVER CANYON LOOP:

Leaving the Half Hitch trail at the boundary line between L.319 and L.322 one travels 'east for about a half mile and comes to Carbon River at the head of the Canyon. There coal exposures are seen on Cight limit. One can walk downstream - along a series of wonderful fishing pools where many large and small fish are seen in the sunlighted waters - and come shortly to a large seam of coal in the bluff and just beyond another above it. Then down about 2,000 feet is another seam in the water and just below at the lower end of the canyon on the right limit are seen two more seams - those first seen away up Carbon River and at head of canyon. Here the river flows over the marker wall cutting across the stream.

Then the left limit flat is followed to Eleven Nile and up the right limit of Eleven Mile to Camp Falls,

TEN MILE CREEK:

To inspect the showing in this creek, go up the flat on the north side of Ten Mile picking your way about 400 feet back from the stream, until the closing of the walls forces one into the short canyon. On the north side about 100 feet above this canyon a six foot seam outcrops - probably F. Immediately above the strata flatten and the stream coming from the west follows the shale marker of the F seam.

No coal seams ware seen for two miles, fut float coal was present in the gravel. As the valley widens it is not believed any outcrops will be seen for some distance.

NINE MILE:

There is not trail up Nine Mile. One can go up the south side around the 60 foot falls, about 1000 feet from Carbon River, and then follow the creek for about two miles coming to the large seam (6 feet) exposed for about 300 feet in the stream. This exposure was sampled by both Galloway and Beltz.

TOPOGRAPHY:

Carbon River occupies a valley traversing about the center of the Rocky Mountains at this lattitude. It is roughly 40 miles from the foot of the west slope - the trench of the Parsnip and Finlay Rivers, which join to form the Peace - and the same distance from the corresponding line to the east - a north-south line passing about through Hudson Hope.

At this lattitude the Peace River has cut a trench right across the main uplift of the Rockies, making the lowest pass - about 2000 feet above sea level at Finlay Forks - any place through the Rockies.

The ranges on each side of Carbon River have fairly well rounded slopes rising from about 1800 feet at the mouth to 4000-5500 at the crests both east and west. Thus the relief is from 2300 to 3700 feet.

Carbon River itself rises from 1800 feet at its mouth to 2500 at Eleven Mile - 700 feet in twelve miles or about 60 feet per mile. It is probably somewhat steeper for the next mile through the canyon but for the 15 miles above it runs through a wide valley, where the grade has dropped to about 45 feet pef mile.

While Carbon River has moderate gradient, those of its tributaries in their lower stretches at least, are much higher. These are indicated by the series of rapids on Seven, Ten and Eleven Mile Creeks in their lower 8000 feet and by the sixty foot falls on Nine Mile. Above these steep lower stretches, the valleys open out and the gradients drop.

The right, or east, tributaries fall 3000 feet in two or three miles, while those on the opporite side fall 3500 in five or six miles. The post glacial gravel banks along Carbon River give a semblance of a much rougher area than really exists.

Along the Carbon River below the canyon, first on one side and then on the other, are alluvial flats 1000 to 3000 feet wide, but above the canyon these flats are very much wider.

GEOLOGY: General:

McLearn, in the references already given, treats fully of the geology of this district. A reading of those two articles is suggested. The following is only a short summary of those articles and aims only to give the most important points:

The rocks outcropping are classed as Cretaceous and named the Bullhead Mountain Formation. The lower member consists of, several thousand feet of coarse sandstones and conglomerate while the upper or Gething comprises from 500 to 1500 feet of fine grained sandstones, silts, and shales. While some thin coal beds are found in the lower, those described herein are wholly in the upper. On a considerable portion of the area unconsolidated sands and gravels - up to several hundred feet in thickness - of Quaternary age cover the Cretaceous.

GEOLOGY: General (Continued)

The Quaternary deposits accumulated toward the end of the glacial period. The then Peace River gut, north of the present canyon, was blocked and the deposits were held in the basin thus formed. The drainage later found a new channel and in cutting the present Rocky Mountain canyon, ending just above Hudson Hope lowered its base level and removed a large portion of those deposits, leaving high banks not only on the main Peace River but also on Carbon River and the other tributaries.

The actual extent of the coal bearing member in this district has not as yet been determined. The coal seams exposed on Ottertail and Fisher Creeks, tributaries of Peace River, and on Commotion Creek and Pine River, south of the head of Carbon River, are all probably related to these better known in the Hudson Rope and Carbon River basins. At any rate, coals of similar characteristics are found in like enclosing rocks in all those areas.

The importance of this wide distribution of similar coal in this district is manifest in determining the probable size of the coal producing region that may be developed in this general area. While the likelihood of finally developing five producing "sub-basins" apparently diminishes the importance of any one, the fact that tne markets available for such a coal are large enough for all forecasts enough tonnage to warrant the rail transportation so sadly needed to bring this coal out to the markets thirsting for it.

DETAIL:

So far as was learned the contact between the two divisions of the Cretaceous crosses the Carbon River about four miles south of its mouth and continues on the east side as far south as outcrops permitted observations. ~~This~~

While a few thin lenticular coal seams have been observed in the lower member, the really important seams are in the upper. The only attemp to measure the thickness of this upper member on Carbon River was made by Beltz on the section exposed by Eleven Mile creek. He places this thickness at about 500 feet. The writer believes that search to the west will add materially to this. in the vicinity of Hudson Hope, McLearn found about 1400 feet of these measures,

In this Report, Belts describes in detail the coal seams exposed in Eleven Mile canyon from Camp Falls west to the forks. it does not seem necessary even to summarize here that description as by turning to the Appendix it can be read. That description shows that Beltz has recognized ten seams of commercial importance. These , with the intervals between, are, from highest to lowest observed:

Seem A	3.4 feet
Interval	100 to 110 feet
Seem B	0.4 to 2.5 feet
Interval	10 to 11 feet
Seam C	5.6 feet
Interval	50 feet
Seam D	2.6 to 3.00 feet
Interval	60 feet
Seem E	2.8 to 4.6 feet
Interval	80 to 90 feet
Seem F	15 to 17 feet
Interval	14 feet
Seam G	6.0 feet
Interval	50 to 70 feet
Seam H	4.0 feet
Interval	33.0 feet
Seam I	4.0 feet

Thus, out of a total thickness observed of from 436 to 493 feet, there are from 33.8 to 50.1 feet of coal in seams of commercial importance. These ara minimum figures as only the lower section of a probable total of about 1400 were seen end examined.

STRUCTURE:

Belts has plotted in a Plate the structure as interpreted from his observations along Eleven Nile Creek and in the Carbon River canyon to the east and in the report states: "The work done to date shows the structure to be a broad syncline or trough with a number of subordinate folds. The center lies

just west off Carbon River and the trend is roughly parallel to the same stream. The Carbon River is cut chiefly in the Gething member which occupies the syncline. A few small faults were observed".

Again referring specifically to Eleven Mile Creek Canyon he writes: "The structure in this section consists of two synclines or troughs separated by a short terrace or flat 400 feet long. The strata dip from 5 degrees to vertical. Over the claims as a whole only scattered data were found regarding structure. This data, however, indicates an undulating. structure with average dips from 5 to 20 degrees. Short abrupt and often steep folds are likely to be found locally and also some small faults".

Apparently Belts confined his work to Eleven Mile Creek and north thereof. Having covered the same ground, and being in substantial agreement with Beltz's conclusions in that area, the writer, wishing to widen the area of observations, worked up Carbon River, reaching a point about five miles above the locale of Belts's cross section along Line A-B. To the north of Eleven Mile his observations covered a further four miles, making for both an overall length along the axis of the main fold about nine miles.

The significant structural feature as outlined by the observations of outcrops along those nine miles of Carbon River is the N-13°W strike of the axis of the fold and of the coal seams dipping from 70 degrees to the west at the most southerly observation through 60-50-45-55 to 50 at the most northerly. This indicates extreme regularity along that line for that distance.

That line happens to follow along the bed or beds of alternating carbonaceous shales and thinly and thickly bedded sandstones in which are found the 17 and 6 foot seams (Beltz F and G) separated by an interval of about 14 feet. Whenever observations could be made the underlying six foot seam was always clean coal. On the other hand, the clean coal in the seventeen foot seam varied from 4.5 to 17 feet and when less than 17 feet the deficiency is made up of highly carbonaceous shales.

Where observations were obtainable immediately west of this line the dips flattened to from 3 to 20 degrees to the west, suggesting that there may have been along that line not only a bending but a break and a slight displacement. If the topography is any criterion this low dip continues for some 2500 to 3000 feet westerly) where the next series of observations were made on Eleven and Ten Mile Creeks. There the F-G marker appears with an easterly dip of from 25 to 36° thus indicating the syncline shown by Beltz.

Significantly on Eleven, Ten and Nine Mile creeks - a north-south distance of approximately three miles and apparently about 2000 feet westerly and parallel to the nine mile line of steep westerly dipping strata following Carbon River - occur falls, gorge and falls respectively. Near the falls and in the gorge on the first two the F-G marker and coal outcrop. On Nine Mile they must be in the cliff under the falls and be masked by the vegetation.

Then farther west on all three creeks the formation is gently undulating, Only at the forks of Eleven Mile were the vertical dips found.

From these observations, considering those of Belts as well as of the writer, therewould seem to be a width of something over two miles, with, from east to west, the following sequence:

A gentle westerly dip increasing in steepness until 45 to 70 degrees aiong tne Carbon River; then an abrupt change to a flat westerly dip for some 2500 to 3000 feet with a gentle change to a medium easterly dip 25 to 36 degrees; and then the undulations noted by Beltz on Eleven Mile. Belts has attempted to correlate the seams in the various observations he made.

MINING CONDITIONS:

On the whole the conditions under which mining operations would be conducted may be said to be very favorable. Once camp or camps were established and means of communications constructed, the fairly mild five-month winter would be no obstacle at all. Labor and supplies would come at considerable less cost than in Alaska and the YUkon to the north and the States to the south.

For the most part the roofs and floors of the mineable seams comprise hare, dense sandstone that will provide excellent footing for stulls which can be cut on any part of the surface overlying the seams. While only a small number of coal seam exposures have been examined, these indicate, with one exception, over long stretches either a very regular dip and strike or a gradually changing one. The close spacing of the seams will allow of working several through one main entry and the nature of the enclosing rocks indicates a very high probable recovery of coal. The coal is so hard and resistant to weathering that by suitable washing plants all foreign matter could be removed and a very clean coal marketed.

For all conceivable purposes, except unusually large timbers, the abundant forests covering paactically the entire area will furnish all the timber products - poles for stulls, logs for buildings and railroad ties and trees for lumber - that can ever conceivably be required and leave a large quantity for sale. It is an area weel covered with small timber of excellent quality. The trees comprise spruce, lodge pole pine, cottonwood, asp, and alder in commercial sizes. If fire is kept out and only annual growth cut, this supply will be perpetual.

The flats along the Carbon are of ample size for any yards, shops or washing plants that may be needed and excellent camp sites where water may be brought in under pressure and drainage constructed into gravel flats for each of the many mining operation; that may bc required are plentiful.

Grain, hay and vegetables in any amount that may be demanded can be grown on the flats along the Carbon and Peace. Herds of dairy cattle could supply butter, cream and fresh milk; beef, cattle, sheep and hogs could suppiy all meat; while fowls could give both eggs and meat,

It headly seems necessary to add that fish - trout of several kinds and grayling - exist in abundance in all the streams and it would seem there would be sufficient even when the field is at its maximum production.

The one factor lacking to make this area a large producer of excellent coal is the means of transporting the product to its waiting market - and that transport must be a railroad, which subject is fully treated elsewhere herein.

PROCUCTION:

Even though the existence of coal has long been known at Hudson hope and on Carbon River, there really has been no production. However, during the winter of 1942-43 the road from Fort St. John to Hudson Hope was improved so coal could be brought to the Alaska Military Highway from some of the seams found well up the slope on the north side of Peace River in the Gething formation. However, mining of these seams did not produce the needed coal of high quality.

So just recently mining of one of the Gething held seams - not the Grant, which lies at the bottom of the canyon - started. The writer saw several truck loads of this coal and found large crystals and small stringers of pyrite in every piece examined. The sulphur content must be so high that this coal is not fit for metallurgical purposes.

In 1923 several tons of "Gething" coal were rafted down the Peace River to the corssing and a test made by the Edmonton, Dunvegan and B.C. Railway. In the Appendix is a copy of this letter. The important facts are summarized:

	Gething Coal	Canmore Coal
Coal consumed - Lb.	17,872	13,777,
Water evaporated - Lv.	142,740	75,750
Water evaporated per Lb. coal	7.97	5.5
Ashpan dumped	Once	4 Times
Cinders produced - Lv.	179	860

The following extracts are pertinent: "Hudson's Hope give off an intense heat, burns a clear white flame, burns as freely as Pittsburgh Coal but no smoke; when fire is replenished a few cinders are discharged from stack.

(continued).

"This coal-does not coke, but when burning has the appearance of coke. The Canmore coal used in the comparative test was lump coal 2nd a good sample of the best Canmore.

"In the tests with Hudson's Rope Coal the grates were not shaken between terminals and a thin fire was maintained; It was necessary to keep a light fire as otherwise it would have been impossible to contol it when engine was shut off".

DEVELOPMENT:

In all these years that Rochfort and associates have held these leases, no real development work has been done. Reports by Christie and Belts seemed to satisfy the owners that a large potential of high grade coal existed but it was a waste of money and effort to undertake development until railroad transportation were available. This seems a sensible conclusion and that conditinn exists today, Adequate transportation is the first essential to any program of prospecting, development, equipping and production.

SAMPLING: General

The writer took samples from thirteen different places, these being more likely from different locales in the same seams rather than from different seams; They were taken not to determine the quality of any one seam but to get an idea of the quality of the average production that could come out of the seams of Carbon River Basin. Undoubtedly when the seams are opened up and carefully taken samples of the slightly different characters of coal are analyzed, differences in the various seams may be revealed. As a whole, the work to date indicates that the coal has inherent poor 'coking qualities. McLearn, in his study of the Rocky Mountain area, shows how different sections of the ssme seams have different qualities and found the lower 10" of the Grant seam was coking.

Of the writer's samples, those from all but 8, 9 and 11 were channelled sections cut clear across the seams and are really representative, insofar as a surface or near surface coal exposure can be. Samples 1, 2, and 3 are the deepest and all probably four feet from the surface. Sample 7 was cut from the surface to the floor. Sample 10 (Carbon River Canyon) was from the surface exposure at the top and about 18" from the surface at the bottom. The upper 2.5 feet were finely fissured with clay infiltrated, while the bottom 2.8 feet were solid hard shiny coal.

Sample 9 was from-float and is rather a specimen than a sample. The same may be said for 8, Sample 11 was from two hard shiny slabs and does not represent the whole seam.

The above statements are based on the detailed notes of the sampling data as found in the succeeding pages. The results of the analyses of these samples are found in Table 2 of Quality of Coal.

SAMPLING: Detailed

Samples 1 to 4: These samples come from the north wall of Eleven Mile Canyon about 1500 feet upstream from Camp Falls. In 1942 Wrigley ran three short entries into three of the four seams exposed and at this point the strike is N 180 W and the dip 30° plus or minus to the south-west.

Sample 1 comprises a very hard compact coal with bright shiny streaks in a duller ground mass. 1% is about four feet from the surface and represents a seam 5.2 feet thick.

Sample 2 represents four feet of the very hard bright coal with some dull streaks making up this seam about four feet from the surface.

Sample 3 is the coal from a channel sample cut across the exposure in the face of the cliff. It is a hard dense coal, very difficult to pick.

Sample 4 is from a 4' channel in the lowest lying of the four seams. It is similar in quality to the other three.

Based on physical appearance the coal in all these seams is of the same quality and if the seams sampled cover any sizeable area, could all be mined through common main opening and haulage way.

Sampel 5 is cut from a 36" seam outcropping on the right limit of Eleven Mile about 750 feet below the forks. There wrigley in 1942 ran a short opencut and exposed the somewhat weathered coal. In appearance it is similar to that of Sampää 3.

Sample 6 is from a channel cut across 4.3 feet of coal exposed in the face of the north wall of Eleven Mile Canyon about 500 feet upstream from Camp Falls. This sample was cut from the face that has stood 'since the creek cut down from that elevation to its present line some 40 feet below, The coal is very bright and bard. It appears very high grade. Several *large* pieces from this face were brought out to show its resisting quality to weathering.

Sample 7. On the south side of the pool below Camp Falls occur 29" of mixed coal and slate (not sampled), followed by 21" of sandstone resting on four feet of very fine coal with a sandstone floor. The seam strikes N 31° E and dips 10° N 31° W. This sample - really outcrop material - comes from a channel cut from the southeast side of the four foot hole exposing this coal - rather dull with very hard layer at the bottom.

Beltz refers to this outcrop as at least 30" of probably the same seam as his H. If so, I seam should be below.

Sample 8. Under "Extent of Field" mention is made of "marker" crossing Carbon River at strike N 42° W with dip 36° N.E., at most southern point reached by writer. There were two gaps in this outcrop of shaly rock and it is believed that coal occupies these gaps for immediately downstream the gravel is full of coal and pieces picked from the gravel comprise this sample.

Sample 9. About one mile further north, or downstream from the "marker" mentioned immediately above, the river flows against strata on the right bank dipping about 70° westerly. The strike of the strata is about N 13° W. One six foot (estimated) seam is paralleled about 700 feet downstream by a 4.5 foot (estimated) seam in the footwall. The shaly rock associated with these seams strongly suggested that these outcrops are of the F and G seams.

The water was so high that the stream could not be forded but pieces of float in the gravel were picked up and comprised this sample. Naturally both 8 aud 9 are not truly samples but give indicative information.

Sample 10. At the head of Carbon River Canyon, the stream flows along steeply dipping strata - 55° to west - on the right or east side (as at Sample 9) and flatly dipping - 15° to 20° to west - on the left or west side. In this left side, about 20 feet above the water, a 5.3 foot seam outcrops and about 15 feet above is a second 4 foot seam. Sample 10 is a 5.3 foot channel from the lower seam - probably G, The upper 3.5 feet comprises the only crushed coal seen by the writer and the lower 2.8 feet is a very hard shiny coal.

Beltz sampled this seam - his No.5 - and determined it as the F seam. The high ash content is due to clay infiltrating into the seams of the crushed part.

The writer's obserfations here are shown diagrammatically in Plate' VIII. Unfortunately the stream prevents observing just what occurs. This section resembles the situation at the forks of Eleven Mile where seams F and G stand vertical with moderate dips on each side. The strata on the right limit comprise thinky bedded carbonaceous shales between the-coal seams.

Sampää 11. About 15 feet above sample 10 a four foot seam outcrops. Its position was such that no sample could be cut and two slabs were picked down and broken up for a sample. This was a hard shiny coal.

Sample 13. About 2000' below 10 and 11 a 26" seam of real hard bright coal striking N 12° W and dipping 20o to west plunges with the enclosing sandstone into the deep pool there. When visited first, it was not sampled but when a large piece taken from the gravel immediately downstream and placed in a campfire proved to be excellent coking coal, the exposure was revisited and a channel cut across the exposure gave the material for 13. Also. several pieces were brought out for further study.

Sample 12. About 100 feet above Ten Mile Canyon - only a short one where the carbonaceous shales outcrop - is exposed a 5.4 seam of coal striking N-S and dipping 36° E. A channel across this exposure gave the material for sample 12 and some extra pieces were also brought out. This is a hard shiny coal and is believed to be F seam.

Immediately to the west, the dip flattened to 5° E and for two miles maintained that same dip. About one mile upstream the carbonaceous shale appeared as the bedrock of the stream, but no coal seam outcropped.

At the most westerly point reached, the valley opened out and the country flattened so no outcrop above seemed likely. In the gravel were many pieces of the usual excellent bright coal found *in* so many streams in this region.

ANALYSES: Various Competitive Coals

Before proceeding to outline the quality of the coal, all based on samples obtained really at the surface, the deepest being four feet,, it would seem well to set out the analyses of the other coals with which Carbon River products will have to compete. These are found in Table 1.

Carbon River Coals: In Table 2 are the results of-analyzing Carbon River coal: taken by Beltz - the first five; Galloway - the second five; and Stines - the last thirteen. The eleventh and twelfth are probably analyses of specimens, rather than samples, taken by Rochfort and Kitto.

Rochfort claims that "hundreds of assays on this coal have been made by the University of Alberta" but the writer has not seen any of these. From his inspection of the property he does not feel that such "assays" are worth much as they were probably made only on "specimens" of coal and not on "samples". The writer believes that the only representative sampling done (other than his own) is that outlined in Belts's report, and only the'first - those taken by him - really mean anything. Notwithstanding that statement, Beltz's complete list ii! given in Table 2.

Samples 1 to 5 in Table 2 were taken by Beltz in 192% and analyzed by G. S. Eldridge and Company, Vancouver, B.C.

Samples 6 to 10 were taken in 1922 by J. D. Galloway and appear on Page A-141 in Annual Report of Ministerof Mines of B.C. for 1922.

Sample 11 was taken by C. Rochfort and analyzed by Hayes and Son, Toronto.

Sample 12 was taken by F. H. Kitto, analyzed by E. Stansfield, Ottawa, and appears on Page 16 of his "The Peace River District Canada" - 1920.

The remaining samples, also numbered from 1 to 13 were taken in 1943 by Stines and analyzed by Gutberlet Laboratories, Seattle.

The writer believes that his 13 samples are more representative of the Carbon River coals than the others. Notwithstanding that, Beltz's and the writer's results are compared. The average for each and both combined are:

	Beltz's	Stines'	Both.
Samples			18
Moisture	4542	3 %	3.4%
Volatile Matter	25.74	22.70	23.55
Fixed Carbon	61.19	71.2%	68.47
Ash	8.60	2.92	4.30
Sulphur	0.61	0.75	0.71
B.T.U.	12,252	13,804	13.373
Fuel Ratio	2.3%	3.14	2.90

The controlling difference is in the ash content - about three times as high in Belts's samples. Due to this over half of the lower fixed carbon in his is accounted for. Belts explains the high ash content as due in large part to clay that had infiltrated into the outcrop, which is what he sampled. Certainly the average of these 1% samples (the last column above) is the poorest that could be expected from this field.

As remarked when the details of the writer's sampling were given, numbers 8, 9 and 11 were not samples, rather specimens, end 10 was of an outcrop which showed at the top crushed coal into the seams of which clay had infiltrated. Therefore, only the other nine are really representative and the average of the proximate of these is:

Loss on air drying , 2.05%

Analysis of air dried coal:

Moisture	3.05%
Volatile Matter	22.96%
Fixed Carbon	71.83%
Ash	2.16%

BTU per pound	139910
Fuel Ratio	3.17

For the i3 samples, the correspond figures are:

Loss on air drying 2.05%

Analysis of air dried coal:

Moisture	3.09%
Volatile Matter	22.70%
Fixed Carbon	71.28%
Ash	2.92%

BTU per pound	13,804
Fuel Ratio	3.14
Sulphur	0.75

On the basis of analyses, this is an outstanding low ash and sulphur and high heat value coal for all purposes, except coking. Sample 1 showed a poor coking quality and sample 8 only fair. On the basis of the ash content of the coal, any coke that would result could not be expected to be very strong.

The fact that noen of the samples showed coking qualities comparable to that one piece coked in the Ten Mile Camp fire is surprising. As noted later, when giving McLearn's results on the Grant seam of the Hudson Hope sub-basin, one stratum of a seam may be coking coal, while the balance is not. No sampling by strata was done on Carbon River seams.

Before leaving this matter of coking quality, the writer has found that often the mixture in proper proportion of a high volatiel and a low volatile coal, each by itself non-coking, produces an excellent coke. In the Urals of Russia a fine coke for iron smelting was made by mixing 60% of a fat coal from Minusinsk with 40% of an anthracite from the Urals. Undoubtedly it is only a question of a relatively small amount of research to find the proper mixture of one of the low grade high volatile and ash Pacific Coast coals or petroleum refined residue and this Carbon River coal to give the desired result., The problem of making a high grade coke from this coal should not be a difficult one to solve.

A composite sample made up of equal parts of samples 1, 2, 6, 7, 12 and 13 was sent to Ledoux for both proximate and ultimate analyses and the results will later be added to this Report.

Hudson Hope Coals; In the second reference given under acknowledgments, McLearn described in detailthe coal seams exposed on the Gething property and the Hudson Hope Area. In that Summery he gives several analyses of the various seams he sampled. These are gathere in Table 3.

By combining the last nine analyses in groups of three, the average for the three strata sampled and for the Grant seam become:

	Moisture	Volatile	Fixed Carbon	Ash	EL!
Bottom 8.7"	0.67	23.23	73.33	3.70	14,785
Middle 21.7"	0.67	19.43	77.20	2.70	14,900
Top 35.3"	0.67	19.47	74.70	5.17	14,360
Whole Seam	0.67	20.00	75.24	4.09	14.583

With that as the average for the Grant seam and taking the figures in Table 3 for the other seven seams, then the average for the Hudson Hope Sub-basin is:

Moisture	1.48%
Volatile Matter	23.24%
Fixed Carbon	69.3%
Ash	6.90%
Fuel Ratio	4.98

By referring to the calculated average of Stines' thirteen samples, the very great similarity of the analyses of the coal from the two sub-basins is seen. The difference in fixed carbon is practically the difference in the ash content. The Grant seam coal, on basis of BTU, is very superior and contains coal between bituminous and anthracite in character.

McLearn describes six seams: Grant from 5.25 to 5.9; Mogul 3.16 to 4.67; Galloway 4; Johnson Creek 4.1; Titan 4.4; and Milligarn 2.4 to 2.46.

TABLE1

	Loss in Air Drying	Mois-ture	Vol.. Com.	Fixed Carbon	Ash	S	BTU
Bankhead	0.5	0.5	11.7	75.7	12.1	-	13,250
Crow's Nest Pass -							
-Dominion	1.3	0.7	24.9	54.7	19.7	-	11,640
-Michel	1.2	0.7	22.4	65.0	11.9	-	13,260
-Bellevue	0.7	0.2	27.6	56.8	16.4	-	12,370
-Coal Creek	0.9	1.3	26.0	63.8	8.9	-	13,640
Canmore	0.0	0.9	14.0	79.7	5.4	-	14,470
Brazeau	1.0	0.9	16.5	70.6	12.0	-	13,480
Jasper Park	1.8	0.5	lS.S	58.9	21.8	-	11,790
Drumheller	7.2	8.8	34.6	48.4	8.2	-	10,350
Mountain Park	1.4	1.9	30.9	62.9	4.3	-	14,400
Nanaimo-Douglass Seam	0.6	1.6	40.6	47.7	10.1	-	12,620
-Newcastle	0.5	1.9	40.7	45.7	11.7	-	12,230

(The above are from Page 16 of James White)
(The following are taken from Page 20 of same, and are of competitive United States Coals):

IndianaCoals	6.0	10.9	35.7	42.3	11.6	3.5	11,280
Georges Creek, Md.		1.9	12.9	79.4	5.5	0.3	------
Ohio Coals	3.2	5.3	36.2	48.9	9.6	3.1	12,273
Penn.-Ellsworth	1.0	1.6	35.8	56.8	5.8	0.9	14,013
-Ligomier	3.2	4.1	20.6'	62.8	12.5	2.1	13,153
Virginia Coals	2.1	2.7	31.9	61.7	3.9	0.5	14,042
W. Virginia Coals	2.3	2.1	27.8	62.8	7.3	1.3	14,130
Utah-Kenilworth		5.01	43.68	46.51	4.80	0.41	12,821
Washington-Carbonado 1.	-	3.38	32.21	49.53	14.88	0.45	12,247
-Bayne 2.	-	5.10	30.80	56.00	8.10	0.36	12,850
-Wilkeson 3.	-	2.50	37.70	61.30	8.50	0.42	13,800
-Roslyn	-	3.77	37.69	47.05	11.49	0.47	12,762
W. Virginia-Island Cr.	-	2.78	36.06	55.71	5.45'	0.98	13,997
Wyoming-Kemmerer		3.94	40.09	49.00	6.97	0.60	12,886
-Rock Springs	-	8.53	35.50	50.39	5.48	0.78	11,883

TABLE .

SEAM	THICK-NESS	SAMPLE	MOIS--TURE	VOLATILE COMB.	FIXED CARBON	ASH	S	BTU
	2.0	1 Be.	2.8	23.12	66.38	7.62	0.72	13,060
	5.4	2 "	4.9	25.74	56.22	13.06	0.73	11,180
E	4.6	3 "	3.7-	26.90-	63.88-	5.52	0.58	13,160
xc	5.5	4 "	4.3-	28.12	64.32	3. 1%	0.65	12,850
F	6.0	5 "	6.4	24.84-	55.10-	13.60-	0.59	11,010
G	4.5	6 %a	2.1-	22.00-	69.40-	6.50	----	-------
	5.4	7 "	5.5	24.80	61.50	8.20	i-m-	-------
	2.1	8 "	3.4	26.20	67.70	2.70	----	-------
	1.3	9 "	2.9	23.70	56.20'	17.20	----	-------
E	4.6	10 "	4.6-	25.20-	66.60-	3.60	----	-------
	---	11 Ro	1.07	23.32	74.28	1.34	----	15,000
	---	12 Xi	1.05	20.80	77.10	2. 10	----	14,800
C(?)	5.2	1 St.	2.12	21.48	72.95	3.45	**0.80**	13,950
D(?)	4.1	2 "	2.76	22.14	73.55	1.55	0.66	14,014
B(?)	2.5	3 "	2.92	21.3%	74.02	1.6%	0.74	14,012
(?)	4.0	4 "	2.09	22.91	73.52	1.4%	0.74	14,105
B(?)	3.0	5 "	2.76	23. 14	72.50	1.60	0.77	14,012
E	4.3	6 "	3.26	24.64	69.90	2.20	0.64	13,888
H(?)	4.0	7 "	3.82	22.08	72.04	2.06	0.77	13,824
G(?)	Float-51	?8 "	2.4%	21.42	72.75	3.35	0.77	14,108
G(?)	Float ?	9 "	1.51	20.01.	77.32	1.16	0.64	14,635
? F	5.3	10 "	4.30	25.60	61.75	8.33	0.74	12,533
?	3.0	11 "	h.. 4%	21.42	68.40	5.70	0.72	12,989
G(?)	5.40	12 "	3.62	21.63	72.47	2.28	0.6%	13,841
x(?)	2.2	13 "	4.13	27.27	65.50	3.10	1.10	13,547

TABLE 3

	MOIS-TURE	Vol. MATTER	FIXED CARBON	ASH	S	BTU
Main Gething Craek	1.6	26.3	64.0	8.4	**0.5**	13,350
North Br. " "	1.0	24.5	65.9	8.6	0.7	13,820
Average of 3 main Gething Creek	1.0	24.6	7c.7	3.7		
Little Mogul	2.7	24.3	62.5	10.5		
Mogul Creek	1.2	22.9	71.3	4.6		
Earle Narrows	1.4	22.7	7137	4.2	0.9	14,220
Moosebar	2.3	21.2	73.0	3.5		
Grant Seam -						
300' W of x cut-Lower 9"	0.6	23.6	72.4	3.4		-
-Upper 5'	0.8	20.4	75.4	3.4		-
Cliff Ent. to West X Cut - Bott.11"	0.7	24.6	72.6	2.1		-
- Upper 4'6"	0.6	18.7	78.1	2.6		-
35' in tunnel - Bott.8"	0.7	22.0	70.8	6.5	0.7	14,440
-Mid.23"	0.6	19.5	77.0'	2.9	0.7	14,940
-Top 38"	0.7	19.6	74.4	5.3	0.7	14,420
Tunnel at x cut -Bot.9"	0.7	22.9	74.0	2.4	0.7	15,130
-Mid.20"	6.8	19.3	77.3	2.6	3.7	14,960
-Top 36"	0.7	18.7	74.5	6.1	**0 . 6**	14,300
Face Tunnel 9-26-23						
-Bot. 9"	0.6	24.8	75.2	2.4		
-Mid.22"	0.6	19.5	77.3	2.6		
.-Top-32".	0.6	20.1	75.2	4.1	-	

(The bottom *stratum* makes good coke)

Riverside	0.7	18.8	74.9	5.6	0.8	14,400
Galloway's Sampling -						
Upper 18"	0.8	18.. 9	76.6	3.7	0.8	14,590
Lower 30"	0.9	19.3	76.1	3.7	0.9	14,550

OTHER QUALITIES:

The characteristics of the Carbon River and Hudson Hope Coals are so similar that the discussion of the other qualities applies equally to both. McLearn's statement: ".... and ideal coal for all purposes, burns readily, is smokeless and gives a high heat", used in describing the Hudson Rope coal applies equally to that from Carbon River, The same is true of his conclusion that it is the "equal of the best Welsh and West Virginia coals, does not weather and, owing to its compactness, stands shipping very well."

ASB CONTENT:

An ash content of 5.90% for the Hudson Rope and 2.92 for the Carbon River puts these coals, from the point of view of transportation cost per unit of heat value, in a class by themselves. This is particularly important in a field so far from its present markets as this one is. The relation of the ash content of a coal to the matter of equipment required to produce a given amount of heat is well set out by James White on Page 31 of Fuels of Western Canada: "In the United States, the non-preventable ash content of clean bituminous coal varies from an average of 6 per cent in Wyoming coal to an aver of 16 per cent in Colorado and, for the whole country averages about 10 per cent. In good practice, 10 boilers of 500 h.p. capacity each will generate 300,090 lbs. of steam per hour with coal carrying 10 per cent ash. if, however, the coal carry 15 per cent ash'- 5 per cent more than normal - it will require 15 boilers to generate the same amount of steam. If it carries 21 per cent of ash, it will require 20 boilers to do the same work".

In the matter of transportation, the higher the ash content the greater the freight charge on the heat actually produced from burning a ton of the product. The analyses show that the "non-preventable" ash content of the Carbon River coal is low and it is thus exceedingly important for this area that only "non-preventable" ash be shipped. If proper means of cleaning the coal are taken, there is no reason why the ash content cannot be kept below 3.5 per cent for Carbon River and 6.5 for Hudson Hope. Where the average of the ash content of the competitive coals is around 12 per cent, the saving in coal, for the same steam production, will be 20% by weight. This is a measure of the extra price, as compared to competitive coals now on the market, that may be obtained for this coal due to its low ash content alone.

WEATHERING AND ABILITY TO STAND SHIPPING:

Since these two qualities are related, they *are* diseussed together. These factors are very important in determining desirability of a coal-and therefore its selling price. In these two respects, Carbon River coal stands second to none and is so far above all competitive coals, except West Virginia and Welsh products, that no comparison is warranted.

That this coal can stand weathering is attested by the outcrop of the coal represented by Sampel 6. Where that sample was tekan, the seam is on the north wall of Eleven Mile *Canyon* about 40 feet above present stream level. The time necessary for that stream to cut that depth of hard sandstone is measured in centuries, not days. The fact that the coal outcropping there is still absolutely unweathered and hard and compact, emphasizes its resistance to weathering. Another piece of evidence is the existence of bright, rounded pieces of coal in the gravels of every stream. Such a resistant coal is excellent for stock piling as it will not deteriorate in the relatively short time the longest period it will be likely to remain in such piles.

This ability to stand weathering is a very important factor in determining desirability and therefore selling price of a coal. In this quality Carbon River coal stands second to none and is so far above that of competitive coals (except West Virginia and Welsh) that *no* comparison is warranted.

Its ability to withstand crumbling and breaking when handled is another desirable quality. This coal is very hard and difficult to break into small pieces. This *not* only means less breaking into fine pieces when handled during shipping, but a larger percentage of "lump" from "run of mine". As "lump" commands a premium in price of from 25 to 30% over that for "run of mine", this means a higher average price for the output as a whole.

EXTENT OF FIELD:

By his mapping, Beltz has given some idea of the structure in the vicinity of Eleven Mile. The writer in attempting to confirm this was prevented from making all the necessary observations in the Eleven Mile Canyon from Camp Falls to the Forks, but he did make enough to conclude that, on the whole, he agreed with Belts' conception. The writer's observations noted the similarity of the various outcrops and concluded that in the Eleven Mile Canyon, due to the structure, there was a repitition of the seams and believes that Beltz' designating ten seams in 500 feet of the Upper or Gething number is probably correct. But his own wanderings on wider territory inclines him to believe that a great deal more than 500 feet of this valuable coal bearing member may be represented in the Carbon River basin and that therefore more than ten commercial seams will finally be found.

In coming up Carbon River, the first seam of coal (poor in that exposure) was encoutnered about five miles from the mouth. The strike is roughly northeast and the dip about 5° southeasterly. At that point was first observed the association of coal and sandstone bed, over which the Carbon River waters fell, crossing the valley. This occurrence, the writer has designated a "marker" of a seam of coal.

Ascending the stream, it war noted that while the strikes varied from northeasterly to northwesterly, the dips were low to the south. Generally where steep dips and more variable strikes occurred, they seemed to be purely local and quite likely due to purely localized movements; probably slides caused by the topography and erosion, But, as noted later, there was one exception to this.

To follow this description use Plates I and V. At the Seven Mile Cabin on an east-west strike and a low south dip is an important coal seam followed a short distance above (opposite the mouth of the Seven Mile creek) by two smaller ones. Undoubtedly the coal of commercial interest extends this far north and probably to some point between here and the outcrop noted two paragraphs above.

For one and one-half mile up Seven Mile there are no easily recognized coal seams but at several places the presence of larger proportions of coal in the gravel point to their existence. In the west part of L 327 are exposures similar to those found on both Nine and Eleven Mile, which do contain commercial coal.

Along the Carbon River between the mouths of Seven Mile and Nine Mile creeks, the only rock exposures are the sandstone beds crossing the valley and causing falls in the stream flow. The writer has found elsewhere in this Basin that these mark coal seams and he is certain that they also do it at these points and that coal seams underlie this whole stretch.

The gravels of Nine Mile are full of coal float but the only observed outcrop occurs in the south central part of L 326 where a 5.4 foot seam: dipping 3° eastersly, is exposed for 300 feet along the bed of the stream. The writer did not sample this as he could not get a clean sample. However Galloway and Beltz, both of whom remarked on the infiltrated clay in the fractures, record analysis of samples taken there. Up the stream from this outcrop coal occurs in the wash, proving the formation extends further west.

Again on Carbon River between Nine Mile and Eleven Mile creeks, no coal seams have been noted, but the markers exist in several places. In this area, Beltz, on East Ten Mile Creek opposite Ten Mile Creek, records coal about 1000 and 3000 feet up that stream. The seems noted are not commercial at their exposures but prove the formation there.

Ten Mile creek emerges onto the valley floor of Carbon River after coming through a very short canyon-where the carbonaceous shales associated with the F and G seams are exposed. About 100 feet above the upper end of this canyon a 5.4 foot (Sample 12) seam of coal is exposed on the north wall. This is probably either the F or G seam. There the dip is 36" east.

Ascending this stream, the dip immediately flattens to 5° east and for two miles continues at about that angle. No other coal outcrops were observed but about one mile up, the carbonaceous shales appear as bedrock for the stream. The coal is probably below. At the highest point reached, the valley opens out and the country flattens, indicating no probable outcrop. But at this point, pieces of bright shiny coal oocured in the gravels, proving the existence of coal further to the west.

EXTENT OF FIELD continued:

In the region of Eleven Nile the structure has been so raised that this creek could cut down through it and crosscut the seams, really revealing at least the minimum number of seams that the coil measures contain at this locale.

Fortunately, immediately above Eleven Mile, Carbon River runs for nearly a mile in a canyon which reveals the structure end the seams in a way complementary to the exposures in Eleven Mile canyon. In his cross section above Eleven Mile; Beltz clearly indicates the seams and how they lie. It is quite apparent thet this condition exists for at least seven miles north and south along Carbon for a widthof about a mile.

'In going up the west fork of Eleven Mile, the writer found coal in about the center of L 320. To the east in a stream coming probably from Indian Lake and entering Carbon River in the northeast corner of L 322, pieces of float coal are found for some distance up from its mouth. Here the configuration of the range along the east side of Carbon River indicates that these seams go well up that slope.

All these observations, coupled with the coal exposures on Upper Nine Mile and Eleven Mile , point to the basing having a minimum width of two miles, and the writer believes it is much more.

It would appear that one series of coal seams extends the length of Carbon River canyon end for about four miles south, on same strike by slightly varying dips, and under identical conditions. There can be very little doubt thet these measure along Carbon River ~~xxxxxxxxxx~~ continue in an unbroken line for at least five miles; 2nd if tied into those on East Ten Mile, for something over six miles. The marker for these seems was observed just below Ten Mile. Eest of Carbon River below Seven Mile, Belts records a 50° westerly dip at about where this east leg of the syncline should be, and the writer takes this to be the most northerly observation on the structure, making a probable length of 9.5 miles.

About five miles above Carbon River canyon, a marker crosses the river. There the strike is N 42° W and dip 36° northeasterly. Thus at least from here north a syncline determines the river *course,*

South of the canyon no stream of size enters from the west, but there are three small ones marked by slides of Quaternary grovels at their mouths. In these stream beds are found pieces of coal and in the third or most southerly one, Cowper Rochfort claims back from the Carbon seams are exposed.

Thus the writer has traveled about 17 miles (air line) up Carbon River from its mouth and has seen coal seems in eleven of those. Walter Wrigley, who assisted on this work both in 1942 end 1943, has been on two days' hike above the writer's most southern point and as fer as he went found the same floate coal in the west tribuaaries of Carbon River, but saw no outcrops.

Owing to the high water in Carbon River, the writer did not get across at Ten Mile, but Beltz did go up East Ten Mile. There at the mouth he noted the steep -50° - dip to the west followed by 10° ahd 17° as he proceeded upstream. This flattening to the east is borne out by the slopes of the range on that side and encourages the writer to believe that the contact between the upper and lower Cretaceous is farther east than Belts shows and the probable width of the *basin* correspondingly wider.

Likewise, to the west, the limit has not been found. As far as either Belts or the writer has gone in that direction, the coal exists, so undoubtedly the width of the basin is greater on that side by some at present undetermined distance.

On the basis of these sets of observations, the writer concludes that the Carbon River coal field occupies a basin striking about N 13°W. Its length has been definitely proven by coal outcrops plotted for over sir miles., and inferentially for eleven and one-half: The presenceeof float for twelve-miles further to the south ard the coal outcrop below Five Mile Creek, a further one and one-half mile north, suggest the probable minimum length of the basin to be 25 miles,

Again by observations plotted its proven width in the six mile proven length is in excess of two miles, and it may be inferred at probably three. Relying wholly on topography both north and south of those six miles that width extends for at least thirteen miles and most likely for the additional twelve miles to the south as well, Thus the area of the basin may be stated to be:

Proven	12 square miles
Probable	14 square miles
Likely	24 square miles
Total	50 square miles

TONNAGE OF COAL: Carbon River

As is evident from this Report, no coal can be said to be proven. But on the geological evidence observed, recorded and plotted, it is clear that one is justified in concluding that coal in commercial seam? (30" plus in thickness) exists in very large quantities. From that evidence one would seem warranted in trying to arrive at figures which would represent the tonnages that one can confidently expect in the various areas into which the basin arbitrarily is divided.

Most Probable: It would seem that from Nine Mile creek to the south end of L 319 and 320 - a length of approximately 3.24 miles and a width of two - there exist the ten seams Beltz has plotted. This is an area of 6.50 square miles.

Beltz's work shows from 33 to 51 feet of workable coal in the 500 foot section of coal bearing strata, which would mean from 38,000,000 to 59,000,000 tons per square mile or a total of between 247 and 383 million tons of potential coal.

The writer has traced the F-G seams and marker for a length of about 6.5 miles and with Belts's work shows them to exist over a width of two for an area of 13 square miles. While the F seam has a maximum thickness of 17 feet, observations et various places show that this large thickness is at times only 4.5 feet of clean coal, and for purposes of this analysis that is taken as the average over the area. The G seam lies 14 feet lower and varies from 5.3 to 6 feat in thickness. Assuming 5.5 as an average, there are in the two seams 10 feet of coal, which would mean a minimum of 11,150,000 tons per square mile - if horizontal - for a total of 145,000,000 tons. This quantity of potential reserve the writer considers assured beyond any reasonable doubt.

Slightly less Probable: From Nine Mile Creek north to the coal opposite the Seven Mile cabin is approximately 2.50 miles. From the south end of L 319 to the most southerly seen outcrop is about 3.25 miles. For these additional 5.75 miles over a width of two, there would be an additional 11.5 square miles. If all the seams are proven to underlie this, there would be therein from 437 to 678 million tons.

Fairly Probable: North of Seven Mile cabin the coal beds apparently extend for about1.5 miles, South of the last known outcrop coal float is found in the gravels for 12.5 miles. Thus for fourteen miles at the ends, coal-might be found ard if all the seams exist, there could be an additional reserve underlying some 28 square miles which 'might contain from 1,065 to 1,652 million tons more.

SUMMARY: Thus, the potentialities may be expressed:

MOST PROBABLE		145,000,000 to 383,000,000 Tons
Slightly Less Probable	- from	437,000,000 to 678,000,000 Tons
Fairly Probable	- from	1,064,000,000 to 1,652,000,000 Tons
TOTALS		1,646,000,000 to 2,713,000,000 Tons

Even the assured minimum of 145,000,000 tons makes this a most worth while reserve and the maximum expectancy of nearly two and seven-tenths billion tons would rank it as one of the most important coal fields of Western North America. The writer realizes that the above estimates are based on only a preliminary set of observations, but feels confident that further detail study will confirm them.

Extent of Field (Continued)

TONNAGE OF COAL: Hudson Hope--

From the Hudson Hope area McLearn gives, tentatively, the figure of 84,000,000 tons as the potential reserve of coal on seven square miles. Since it is an excellent coal for domestic and all industrial heating requirements, it will undoubtedly enter into competition with the coal from Carbon River, but that competition need not be particularly feared as it is not as favorably conditioned for extraction. Its market would more likely be to the east rather than to the west. And then, too, the market is ample for any likely production from both fields; or, for that matter, from Commotion Creek and Pine River fields as well.

MARKETS AVAILABLE: As shown under "Quality of Coal", the coal products from this area are so superior that they can compete with any coal in North America. Therefore its markets extend not only all along the Pacific Coast, but also to the Canadian markets to the east as far as Port Arthur, at the Western end of Lake Superior. On the basis of its low preventable ash content alone, it can capture that market at a premium in price of at least 15%.

Then in many cases the haulage differential will be in favor of this coal; The Utah and Wyoming coals have to come by rail about 1300 miles to Seattle; 1200 miles to Portland and 900 to San Francisco. The Carbon River coal has ail rail of 871 miles to Seattle and to Portland of 1060 miles. If rail and water are used, the distance to Seattle will be 890 by rail and 600 by water; to Portland, 800 and 900; to San Francisco, 800 and 1600, respectively. For the Canadian market, West of Lake Superior, the West Virginia coals have to coma some 1600 miles against 1400 from Carbon River.

The above is only for the relatively small non-industrial market. Since the war coal consuming industries have teen built on the coast; Kaiser's iron plant at Fontana and many others along the Columbia. The former requires coke which the research successfully completed can be cheaply made from this coal. If this coking operation is done near any large city, the by-products alone may be sold for a very large revenue.

It is realized that at present practically all the gas used along the Pacific Coast comes from low gri-de oils or refinery waste products but unfortunately for the United States, their potential oil reserves are being depleted very rapidly and it seems well within reason that withing 15 years other fuel resources will have to begin to be called on and within 30 years coal will largely replace oil for the making of gas for domestic use and lubricants and fuel for internal combustion engines.

Then there is the Alaska market. While Alaska has large reserves of ligrite coal it does not produce enough of the right kind of coal for its own use and this year (1943) is importing coal rail-hauled from West Virginia to Pacific Coast ports fcr water delivery to Alaska seaports.

There is the Canadian market east of the Rockies. As shown under transportation it is only 709 miles via Prince George by rail from the mouth of Carbon River to Edmonton - the gateway to the prairie provinces. In 1938 the Prairie Provinces and Ontario, West of Lake Superior, imported over 2,000,000 tons of coal, most of it from Pennsylvania and West Virginia. As shown under "Quality of Coal", those coals average about 10% ash against 3.0 for Carbon River.

The Provinces of Alberta and British Columbia produce about 6,700,000 tons (4,000,000 bituminous) of very inferior coal annually, a substantial part of which can 1-e displaced by Oarbon River coal at a considerably higher price.

at the completion of the transportation facilities required, there would seem to be no question of an immediate market for this coal in excess of 1,000,000 tons annually - 3,000 tons daily - which, by the time the property could be prepared, would have risen to 3,000,000 - 10,000 tons daily,

One Distinct advantage in the Carbon River coal over any other western competitive coal is its ability to stand exposure without weathering or deteriorating in any way, It can be stored indefinitely and is so firm that it handles with a minimum of crushing - in utter contrast to the other western coals.

Markets Available (Continued)

Not only the quality of this coal will cause it to displace the Pennsylvania and West Virginia coals in the Canadian markets west of Lake Superior. There is the question of import duty and exchange. Any industry in Canada that can reduce the pre-war unfavorable balance of trade with the United States will have the full support of the treasury branch of the Canadian Federal government. This letter fact alone practically assured all this west-of-Lake-Superidr market to any Canadian coal of comparable quality.

TRANSPORTATION: As shown under "MARKETS AVAILABEE" rail communication is essential. This should not only be to the west but also to the east.

By surveys already made, it is about 40 miles from the mouth of the Carbon River to Finlay Forks, whence Prince George - a division point on the Canadian National line to Prince Rupert - lies about 180 miles south over a very low divide; making it 220 tiles from the mouth of Carbon River to present railhead. As Prince George is about 468 miles east of Prince Rupert, the total main line rail mileage from the mouth of Carbon River to deep water transportation is just under 690 miles. The rail line up the Carbon River - about 15 miles - is considered as part of the mine plant.

Any railway built to connect the Alaska Railway at Kobe with the Canadian lines would originate either at Dawson Creek - the present terminus of the Edmonton, Dunvegan and B.C. Railway - 4995 miles northerly from Edmonton; or at Prince George; and each would have to pass through Finlay Forks and therefrom follow the same line north.

That line originating at Dawson Creek would keep to the south of the Peace River and at about mile 100 would pass Carbon River and reach Finlay Forks at about mile 140. Such a location cuts across some important right tributaries of the Peace before reaching the Peace at about Hudson Hope.

Any line originating at or near Prince George would ascent to Summit Lake and then proceed down the Crooked, Pack and Parsnip Rivers to Finlay Forks - a very easy line to build and one of very low gradient.

From Edmonton to Carbon River mouth via Dawson Creek is about 600 miles and via Prince George about 709. The latter route has an excellent line on heavy steel for its 489 miles from Edmonton to Prince George while the former is really only 2 logging road on light steel - and would have to be completely rebuilt - for its 495 miles to Dawson Creek.

One other very important consideration: practically all the agricultural products originating in the Peace River District find their markets to be west and when they go out by Edmonton require 1265 miles rail haul to readh Vancouver and 1451 miles to Prince Rupert. On the other hand, if the Prince George outlet were used, and 2 branch road is built from Finlay Forks to Dawson Creek, 140 miles, those products would reach Vancouver with about 1200 miles of rail haul, and Prince Rupert, in about 950, These are important savings, and particularly since this traffic to Prince Rupert would be over a main line - Prince George to Prince Rupert - which before the war only required two trains weekly to handle the traffic.,

Then there are timber products from the area that would be opened up by this line. The British Columbia Government has estimated that the regrowth along will allow an annual production of 300,000 tons of paper pulp and 600,000,000 board feet of lumbar products.

The above clearly shows that the railway via Prince George is one that would not only haul the coal but also,, eventually, get all the great potential tonnage from the Finlay and Peace River countries.

There would atill be the rail line North from Finlay Forks to the Alaska Railway connection, but the determination of its need is not in any way connected with the necessity for a coal outlet. On the other hand, that railway would have to use this Carbon River coal as its source of power.

These 200 miles from Prince George to the mouth of the Carbon River traverses a country of very low relief and on the whole requires only a road bed for the greater part of the way; certainly down the south side of the Peace River from Finlay Forks no construction difficulty would be met and the only real rockwork is around the north side of Mount Selwyn.

Transportation (continued):

It has been suggested, considering only the matter of transporting the Peace River agricultural products by the shortest rail haul to the tide water, that the rail line to Prince George should cross Pine Pass. This route would undoubtedly be considerably shorter but it would be more difficult to build and much more expensive to operate. Via Pine Pass, the road would have to climb to 2850 feet above sea level, while the elevation at Finlay Forks is only just over 2000 feet. Project the line through Pine Pass would tap the coal known there but would bypass that known on Carbon River and in the Hudson Hope area.

While the writer has not the profiles of his proposed line, a comparison of the country to be traversed by this line with other similar projects built under the same general conditions warrants the conclusion that the cost of these 320 miles of standard 110 pound rail main iine road bed with all stations, sidings, shops, round houses, yards, etc., together with the motive power requisite to move the traffic (but *not* the rolling stock) could be constructed and put into operation for $13,000,000 - an average of just about $60,000 per mile of main line.

ECONOMICCONSIDERATIONS: The data by which reliable estimates of capital requirements, production costs, probable selling prices and resulting profits can be made are not available for this district. However, in Coal Statistics for Canada (published annually by the Mining, Metallurgical and Chemical Branch of Dominion Bureau of Statistics of Department of Trade & Commerce), are given certain statistics for the Canadian Coal industry and these as well as other references noted have been drawn upon for the following "guesses":

CAPITAL REQUIRED: According to Coal Statistics it would seem that the maximum capital requirement per ton for any assumed annual output could be approximately obtained from the following table:

COST PER TON OF ANNUAL OUTPUT

	Canada	Canada, excluding B.C.	Alberta
cost - Land, Buildings, Equipment:	$ 6.48	$ 5.w	$ 5.71
Inventory	.34	.34	. 13
Working Capital	.98	.95	1.25
TOTAL	7.80	6.70	7.09

Due to its excessive cost for Land, Buildings, and Equipment - $15.65 - B.C. is omitted from the second column.

Thus allowing for different scales of operation, using the average for Alberta, there would be required for a plant on Carbon River:

300,000 tons annually	$2,500,000.00
1,000,000 " "	7,500,000.00
3,000,000 " "	21,270,000.00

A. T. Churick on Page 7 of his Coal fining Costs, gives the cost per ton of annual output as varying between two and eight dollars per ton. Adopting an average from those the cost of plants on Carbon River would approximate:

For 300,000 tons annually	$ 2,000,000.00
For 1,000,000 " " "	4,500,000.00; and
For 3,000,000 " "	12,000,000.00

For a completely mechanized plant it is believed that these latter figures' would be about the correct ones, At this date no one would Consider any other type of plant. On Page 17-63 of Peele - 1941 Edition - the cost of branch railroad lines per foot of track is given:

Gravel Ballast @ $1.10 per cu. yd. in place	$0.55
Ties 24"c-c, @ 80¢ each	0.40
Relayer 85 lb. rails @ $26. per ton	0.75
Rail splices, bolts and spikes	0.20
Laying and surfacing track, without tie plates.	0.50
TOTAL	2.40

This approximates $12,672 per mile - say $15,000 for Carbon River. Thus the fifteen miles of needed mine railroad would require about $225,000 with a further $250,000 for motive power and enough rolling stock for local purposes. Probably $600,000 would see this line ready to move one million tons annually.

PRODUCTION COST: According to Coal Statistics per ton production costs in Canada are:

	Labor	Power	Other	TOTAL
All of Canada	$ 2,003	$0.220	$0.489	$3.077
Alberta Bituminous ,	1.855	0.168	0.793	2.8%
British Columbia	2.456	0,210	0.970	3.636

On Page 27-24 of Peele the following table is found:

For Nine Months ending December, 1937

	District No.12, Ill. Tons	District No.12, Ill. Av. per Ton	District No.11, Ind. Tons	District No.11, Ind. Av. Per ton
Stripping	7,979,424	$1.4319	4,998,417	$1.4631
Mechanical Loading, underground	16,742,458	1.7457	4,600,134	1.7636
Hand Loading underground	6,747,216	2.1793	410,217	1.9572
Total, Commercial mines	28,044,423	1.7574	10,417,029	1.6326
Total, Captive mines	3,424,675	1.8612	91,739	2.1791
Total, Deep mining	23,489,674	1.8703	5,510,351	1.7962

For 1933-35 on Page 21-40 of Peele appear the details given below:

	PER, TON		PERCENTAGE
Labor		1.0319	65.2
Daymen	0.3784	23.9	
Mining	.5264	33.3	
Yardage & lead work	.5060	3.5	
Mine Supervisory & Clerical	.0710	4.5	
SUPPLIES		.2527	16.00
All supplies except power & fuel	.1760	11.1	
Power Purchased	.0760	4.3	
Mine fuel	.0097	0.6	
Other production costs:		2962	18.8
Salaries & expenses	.0213	1.4	
Taxes	.0229	1.5	
Insurance	.0073	0.4	
Depareciation	.0891	5.6.	
Royalties	.0523	3.3	
Compensation Insurance	.0468	3.1	
Depletion	.0421	2.6	
Company house expense	.0023	-0.1	
Mine Office, code authority, Assoc. dues	.0167	1.1	
Unassigned credit	.0018	-0,1	
		1.5808	100.00

From those references it is seen that there is a large difference between costs in Illinois and Indiana and in Alberta and British Columbia.

Undoubtedly a large part of this is due to more mechanical equipment being used in the States. However, the present production of bituminous coal in Alberta is almost all coming from very gaseous mines where fires are continuous in some area of practically every property and where development cost is high.

Mining conditions on Carbon River are about as favorable as they can possibly be and supply cost should be at a minimum. Taking into consideration all the facts and conditions, it is estimated that mining costs of saleable product will vary between $2.85 and $2.67 per ton.

SALES, PRICES AND GAIN PER TON: Coal Statistics give the average sales prices of coal at mines as follows:

	$ Per Ton	
	Run of Mine	Lump
Alberta	$3.50 to 4.50	$ 4.63 to 5.58
British Columbia	3.82 to 4.18	4.94 to 5.39

Again on Page 36 of 1938 Coal Statistics the following figures are given as yearly retail sales price of bituminous coal in dollars per ton:

Western Ontario	$14.94 to $15.08
Manitoba	10.48 to 11.56
Saskatchewan	8.42 to 9.75
Alberta	4.31 to 7.00
British Columbia	10.40 to 11.75

Thus with Alberta selling prices at mine for "Run of Mine" varying from. $3.50 to $4.50 per ton and the estimated cost of production being $2.70, the profit per ton would vary between $0.80 and $1.80 per ton - say an average of $1.25. But Carbon River coal will command at least 15% higher selling price for a gain of $1.43 per ton.

LABOR DATA: Coal Statistics for 1938 give the following figures:

Percentage of Wage Earners:	Number of Men		Days work Done	
	Surface	Underground	Surface	U'ground
All Canada	27	73	24	76
Alberta Bituminous	27	73	32	68
British Columbia	32	68	35	65

MAX-DAY OUTPUT: In Coal Statistics for 1938 the average output in tons per man-day are as follows:

	1937	1938
All Canada	2.598	2.672
Alberta Bituminous	3.479	3.556
British Columbia	2.156	2.240

On Page 21-35 of Peele the following outputs per man-day for different states have been extracted and tabulated:

	&erase tonnage per man-day	
	Hand	Machine
Pennsylvania Bituminous	3.89	50.80
Utah	1.84	4.80
Washington	2.69	7.70
West Virginia	2.68	52.30
Wyoming	3.85	32.10

The Importance of full mechanization of coal mines is shown by above table. It not only cuts down costs of production, but in a district like Carbon River, where the labor must be brought in and housing provided, it very materially reduces capital expenditure-for camps and simplifies the provision of food and other supplies required by the working force and its families.

On the basis of Coal Statistics figures for Alberta Bituminous Mines, there would be required at Carbon River:

For:	300,000 tons annualy	,315 men
For:	1,000,000 tons annually	1000 men, and
For :	3,000,000 tons annually	2900 men.

Full mechanization should cut those figures by 20 to 25% - to 800 and 2325 repsectively - and camp provision would have to be made for that many for the mining production alone. To care for the washing plants and mine railway system the totals would be increased by 35, 100, and 250 respectively.

PROBABLE FINANCIAL RETURN: While it might seem premature at this time to attempt to appraise the financial return that might be reasonably expected from providing the capital-required to explore, develop, equip, and put into production a coal mining operation of one of several assumed scales of output on the Carbon River reserves, it seems necessary to do so to complete this Report.

The cost of the railroad is not considered in this analysis as its financial justification is based wholly on the return from freight shipments made over it. However, in order to persuade any organization to provide such a transportation facility, the coal output must be a minimum of one million tons annually with assurance of three million tons as the ultimate to be reached within three years from completion of the railway.

As Shown early, the capital required will approximate:

	Tons per Year	
	1,000,000	3,000.00
Mining development	$4,500,000	$12,000,000
Mine Railway	600,000	900,000
	$5,100,000	$12,900,000

The sales, costs and resulting gross gains per year would be about as follows:

	TONS PER YEAR	
	1,000,000	3,000.000
Realized from sales	$3,500,000 to $4,500,000	$10,500,000 to 13,500,000
Total cost of produution	2,850,000 to 2,850,000	8,000,000 to 8,000,000
Gross Profit	650,000 to 1,650,000	2,500,000 to 5,500,000
Royalty and B.C. Taxes	200,000 to 200,000	600,000 to 600,000
Net Profit	450,000 to 1,450,000	1,900,000 to 4,900,000
Net Gain per ton	$0.45 to $1.45	$0.63 to $1.63
Annual percentage return on capital investment	8.8 to 25.8	14.7 to. 38.00

Federal and State or Provincial Income Taxes have not been deducted. What they may be is not known at this time, but experience has shown that under normal peace time conditions such taxes are reflected in the sales prices of the products produced. It is therefore believed that the above percentage figures will hold in future under normal peace time conditions.

PROGRAM: The evidence submitted in Beltz's examination and the writer's work clearly indicated a prospective coal field from which very large tonnage of a very high grade coal over a very long time may be produced. It has been many times emphasized in this Report that without a railway of main line - 90 to 110 pound rails - construction, such a potential reserve of coal is worthless. Therefore any program for developing the field must either include provision of such a railway by the mine organization or be predicated on some one else providing it. In any event, the preliminaries of providing the transportation and exploring, developing and equipping the mines must be carried on currently. The following program is based on that assumption.

TRANSPORTATION: Segeral surveys for rail connection from Prince George to either Dawson Creek or Hines Creek have been made and the results of these surveys should be obtainable at much less expenditure of time and money than would be required to make new ones. The writer feels very strongly that such a line should run from Prince George to Finley Forks and down the south side of the Peace at least to the mouth of Carbon River.

If the coal mining organization is to build and operate this main line railway, then there would be no need to extend east, but if a purely railroad unit will supply the railway, then undoubtedly it should be built east to a connection with the present toad running northwest from Edmonton,

Whether existing surveys are obtained or new ones made, this will be the first step. Coincident with it, effort should be directed to see if the surplus construction equipment (free at the end of 1943) used on the Alaska Military Highway cannot be "lend-leased" for this job of construction. If successful, this would mean a very great saving in capital requirements and should mean no real loss to the U.S.A.

Then commence construction on the location adopted and get construction far enough along so that the larger pieces of equipment needed for the mine can be brought in and be placed to the end that mining on a large scale will be under way when the railway is completed.

MINE: Simultaneously with the first steps outlined above, the preliminaries should be started on the mine. When obtaining some agreement with the B.C. Provincial Government for providing the concessions (not land grants) to the builders of the railway, the obtaining of a preferential position in the selection of coal land on Carbon River should also be negotiated. Assuming successful issue thereto, the program should then be:

1. Make general geological survey complete enough to determine the extent of the coal bearing lands in the Carbon River Field and detail survey in the present known coal areas to a point where a prospecting program can be laid out;

2. Do sufficient drilling or other prospecting to plan the development on a scale assuring an initial minimum production of one million tons annually - three thousand tons daily - to be provided out of new capital and be ready to go into production when the railway is completed; and to be expanded out of earnings and new capital to a production of 10,000 tons daily, approximately 3,000,000 tons annually;

3. Make preliminary plans for camps, equipment, intra-mine and plant transportation, shops, etc., so that as soon as the work under 2 has proceeded sufficiently, the final plans can be adopted and the details worked up; and

4. As soon as 3 has progressed so it can be done, place orders for the needed equipment and materials and get construction under way as soon as possible.

FINANCE: Naturally the money needed for both the preceeding divisions must be arranged before even preliminaries can be started, so that is not considered a step in this program - rather an obvious necessity ante-dating it.

Respectfully submitted,

(Signed) "Norman C. Stines"

Seattle, Wash.,
August 25th, 19.43.

COPY

Mr. J. A. McGregor,
Manager,
Edmonton.

Dear Sir:

In connection with the test of coal received from Gethings Mine at Hudson Hope, I have the following report to make:

1 Cu. Ft. Hudson's Hope Coal weights 50 lbs. as compared with Canmore 54 Lbs.

On October 1st, east way freight engine 6 left McLennan with 21502 lbs. Hudson's Hope Coal on tender. This engine had a full tonnage train 1150 tons leaving and *from* Kinuso To Smith 1375 *tons, arriving at* Smith, a distance of 132 miles, and an elasped time of 17 hours end 45 minutes, there was a large amount of coal still on tender and I decided to try and make return trip to McLennan.

After resting at Smith,' we left Westbound with 1050 tons. On arrival at Kinuso there were 3750 lbs. of coal on tender. The evaporation test for the trip is as follows:

Coal consumed 17852
Water evaporated 142740
Water evaporated per pound of coal 7.99 lbs.
Miles run - 193
Elapsed time - 33 hours

Fire was dumped at Smith in order to caulk engine. On the entire trip ashpan was deumped only three times, the residue from ashpan weighed 674 lbs. This was largely unconsumed coal which had dropped through the grates on account of the large openings. Grates are finger grates.

The cinders taken from ashpan at Smith weighed 179 lbs.. They were afterwords burned in a heating stove and the resultant ash weight 67 lbs.

On October 15, engine 6 on way freight left McLennan with 26428 lbs.. Canmore run cf mine on tender hauling a train of 1050 tons arriving Smith with-1160 tons:

The evaporation test as follows:

co21 consumed 1 3 7 7 3 lbs.
~~Coal consumed~~ water evaporated 75750 lbs.
Water evaporated per lb. of coal 5.5 lbs.
Miles run - 132, elapsed time - 12 hours.

Ashpan dumped four times, weight of ash, and cinders 860 lbs. These tests were made without any change in the draft appliances. After increasing the exhaust tip from $4\frac{7}{8}$" to $4\frac{3}{4}$" another test of Hudson's Hope was made on October 18th with the following results:-

Coal consumed 10202 lbs.
Water evaporated 78810 lbs.
Water evaporated per lb. of coal 7.65
Miles run - 132
Elapse time - 14 hours,

Residue from ashpans dumped at midway on trip and at terminal 400 lbs., this as on the former test being largely unconsumed coal.

The Hudson!s Hope gives off an intense heat, burns a clear white flame, burns as freely as Pittsburg Coal but no smoke, when fire is- being replenished a few cinders are discharged from stack. This coal does not coke, but when *burning* has the appearance of coke. The Canmore coal used in the comparative test was lump coal and a good sample of the best Canmore. In the tests with Hudson's Hope coal the grates were not shaken between terminals, and a thin fire was maintained. It was necessary to keep a light fire as otherwise it would have been impossible to control *it when* engine was shut off.

Yours very truly,

CARBON RIVER COAL CLAIMS

SUMMARY AND CONCLUSION

This reconnaissance examination of the Carbon River Coal Claims was made during the first two weeks of August, 1928, and consisted of stratigraphic studies, measurements of sections, correlation and the taking of samples. Detailed maps, cross-sections and columnar sections were compiled,

The claims are situated in the Rocky Mountains, 35 miles west of Hudson's Hope, B.C. They lie between 2200 and 3500 feet elevation on the well-timbered lower slopes of the range on the west side of Carbon River between Seven and Eleven Mile Creeks.

The rocks exposed in the area belong to the Bullhead Mountain formation, of Lower Cretaceous age and consisting of about 3000 feet of coarse sandstones and conglomerates at the base, and more than 500 feet of interbedded fine sandstones, silts, shales, and numerous coal seams at the top. The upper or Gething Member occurs in a syncline or trough with a number of subordinate folds, and parallels the-Carbon River valley. Superficial, unconsolidated quaternary sands and gravels are found in the valleys to a height of several hundred feet but in many places the streams have cut through them and expose good sections, particularly along Eleven Mile Creek.

On Seven Mile Creek, a short section exposes six seams up to two feet in thickness and below the mouth on Carbon River is a seam 4.5 feet thick. On Nine Mile Creek is a seem 5.4 feet thick and on Eleven Mile Creek a continuous section over a mile long was studied and from *it most* of the data in this report were obtained.

The Eleven Mile Creek section contains 33 outcrops of coal from one inch to 17 feet thick which belong to nine seams of good coal 2.5 feet or more in thickness, and *twelve* to fifteen seams less than 2.5 feet thick. The nine larger seams have a total maximum thickness of 50 feet in a section 443 feet thick. "Commercial seams", therefore, comprise 10% of the section, an unusually high percentage.

The structure in this section consists of two synclines or troughs separated by a short terrace or, flat 500 feet long. The strata dip from 5 degrees to vertical. Over the claims as a whole, only scattered data were found regarding structure. This data, however, indicates an undulating structure with average dips from 5 to over 20 degrees. Short, abrupt; and often steep folds are likely to be found locally and also some small faults.

The thickness of the correlated seams on Eleven Mile Creek are given below:

Seam	Thickness in feet
A	3.4
B	0.4-2.5
C	**5.6**
D	2.6-3.0
E	2.8-4.6
F	4.9-17.0
G	6.0...
H	4.6
I	4.0

The analyses show the seams to consist of first quality bituminous coal with low ash and sulphur content and high calorific value. The data does not permit any definite calculation of tonnage except an estimate that 10 to 20 million tons underlies the square mile adjacent the Eleven Mile section. The total over all the claims is probably in the tens of millions of tons, if not in the hundred millions.

CONCLUSIONS

The Carbon River Coal Claims contain an immense quantity of high grade coal. At least nine seams over 2.5 feet thick have been found, with a minimum total of 33 feet of coal and a maximum of 50 feet and which have been traced or

inferred for distances of 1000 feet to 5000 feet. Not many, if any, of the seams are likely to be found continuous over the whole area as considerable variation occurs, some seams becoming thin and uncommercial or dying out all together. To offset this, however, other thin seams in one section or district may become workable in another section, so that the correlated sections in different areas may have almost the same amount of workable cool per acre but not in identical seams.

RECOMMENDATIONS of the Carbon River Area.

A general geological survey, with further detailed work on the claims would have a considerable value and should be done before diamond drilling the claims or undertaking large scale development. This survey may be done either by the government geological survey, or by private parties. Further geological work will be difficult owing to the thick forest cover and moss on the inter-creek divides, and superficial deposits in the valleys, but it is believed that much data will be found bearing on the stratigraphy and structure of the claims not adjacent to the Eleven Mile Creek. Data regarding the value of other territory outside of the claims would also be obtained. Two to three months would be required for this survey.

During this geological work or in assessment work, some pits or trenches should be dug at the probable position of Seems F & G above the first falls on Eleven Mile Creek in order to get more information about the extent and continuity of these large seams.

LOCATION AND ACCESSIBILITY

Carbon River is southern tributary of the Peace River which lies about 35 miles (air line) west of Hudson's Hope, B.C., and the coal claims are situated along 7, 9, 10, and 11 Mile Creeks, western tributaries of the Carbon River. There are ten surveyed claims, each one mile square. No development work has been done on the claims.

The claims may be reached by two routes:

1. By rail to Prince George, B.C., and then by motor car 32 miles to Summit Lake where small boats start for the Peace River via Crooked, Pack and Parsnip Rivers. Carbon River is about 190 miles from Summit Lake. There are two principal obstructions to small boat navigation, the Finlay Rapids and the Ne Parle Pas Rapids down which boats are usually lined.

2. By rail to Peace River or Grande Prairie, Alberta. From the latter place it is necessary to go by motor car via Pouce Coupe to Taylor Flats on the Peace River, near Fort St. John. Fron Taylor Flats and Peace River, gas boats and steamers go to Hudson's Hope about every eight or ten days. From Hudson's Hope there is a wagon road portage around the ~~Rocky~~ Rocky Mountain Canyon to Beattie's Landing, from which place it is about 9 miles by small boat to the mouth of the Carbon River. From the mouth there is a trappers pack trail to the claims. C. Jones has a small ranch at Carbon River and a few pack horses may be procured there, NOTE: These conditions existed in 1928. Since then the railroad has been extended to Dawson Creek and the Alaska Highway connects Dawson Creek with Fort St. John, a distance of approximately 49 miles, the road to Hudson Hope from Fort St. John has been improved, a distance of approximately 59 miles; from Hudson Rope to Jim Beattie's is around 22 miles by road, and the remainder of the distance to Carbon River can be made by boat - some 15 or 20 miles.

NATURE OF THE EXAMINATION

The chief purpose of the examination was to make a general reconnaissance and determine the character of the region, the extent, thickness, relations and structure of the coal seams. The coals had previously been sampled by Cowper Rochfort and J. Galloway and their general high quality is well established, consequently less time was spent in collecting samples and more devoted to measuring sections, correlation, etc. However, the main seams were dug in deeply and samples taken of as fresh coal as it was possible to get.

NATURE OF THE EXAMINATIONS (Cont.)

Compass pace traverses were made and tied in to the claim lines wherever possible. The thickness of the beds were usually measured with tape but in many places only estimates could be made of beds exposed in the bluffs.

ACKNOWLEDGMENTS

The following reports were referred to:

McLearn, F.H.	Mesozoic of Upper Peace River, B.C., Summary Report G.S.C.1920, part B.
McLearn, F.H.	Peace River Canyon Coal Area Summary Report, G.S.C.1922, part B.
Galloway, J.D.	Annual Report Minister of Mines, B.C., 1923, pages 141-142.
Rochfort, Cowper	Various Reports,

SURFACE FEATURES

Topography.

The Carbon River lies between two of the eastern ranges of the Rocky Mountains about 35 miles from their eastern front which may be placed near Hudson's Hope. These Carbon River ranges have fairly well rounded slopes and the major valley has a moderate gradient but the lateral tributaries rise more steeply to the divides. The relief is 2000 to 3500 feet or from 1800-2000 feet to 4000-5600 feet above sea level.

The Carbon River valley trends North 20 degrees West and rises from 1800 feet at the mouth to 2500 feet at 11 Mile Creek or about 63 feet per mile.. There are narrow alluvial flats ¼ to ½ mile wide along the river, alternating in the upper part with high cutbanks of gravel and sand. The slope from the river to the range on the east is about 3000 feet in 2-3 miles and on the nest about 4500 feet in 5-6 miles. The claims are located on the lower 3005500 feet of the western slope of the valley between 7 and 11 Mile Creeks, Viewed from the creeks the country about the claim seems very rough because the streams have cut deeply into the post-glacial gravels which filled the valleys to a depth of several hundred feet. Viewed from a height, however, the inter-creek divides are seen to be broad, fairly uniform slopes.

Vegetation.

The river flats along Carbon River are covered with mature poplar and spruce and the valley slopes are covered with spruce, poplar, and some pine, 4 to 16 inches, in diameter. There have been no fires in the area in recent years and there is abundant timber for construction and mining purposes,

The ground in the spruce forests which cover the greater part of the area has a thick mat of moss which effectually conceals [redacted] any bedrock that may be present and geological exploration will be difficult except along the streams and the uplands above timber line.

Culture.

On the Peace River about Hudson's Hope, there are only three ranches: C. Jones at Carbon River, J. Adams and J. Beattie, near Adams Creek about ten miles below Carbon River. Beattie's Ranch is the largest and is devoted to raising cattle, horses, and some grain. Jones raises a fine crop of vegetables and berries each year. The settlers eke out their living by trapping in the winter and there are several trap lines along Carbon River. Small trappers' cabins are situated at 7 Miles Creek but they are not suitable for use during the summer.

GENERAL GEOLOGY

Stratigraphy

The rocks exposed on the claims and vicinity are given in the following table.

GENERAL GEOLOGY

Age	Formation Member	Lithology	Thickness
Quaternary		Unconsolidated sands and gravels	200-300
Creteceous	Bullhead Gething Mountain	Pine Sandstones, grey to black shales, ironstone, and numerous coal seams	1400
Cretaceous	" Lower	Conglomerates, coarse sandstones, some fine sandstones, shales and a few thin coal seam.	3000

The Lower Member of the Bullhead Mountain formation consists of conglomerates, coarse sandstones, with some fine gray sandstones and gray shales. A few thin lenticular coal seams also, occur. The coarse sandstones and conglomerates occur in thick beds and are composed of subangular quarts and black chert in about equal proportions giving the rock a "salt and pepper" effect. The thickness measured at the Canyon by McLearn is about three thousand feet. The base on Carbon River was not reached in this reconnaissance.

The lower Bullhead Mountain formation is exposed in the bills east of Carbon River and near Five Mile Creek it is found on the west side es well. On the claims it underlies the Gething member at depth estimated at 1000 ft.

The Gething or Upper Member consists of gray sandstones and silts, gray to black carbonaceous shale, ironstone, a few thin conglomerates, and numerous coal seams. The sandstone shales and coal are interbedded and vary from a few inches to several feet in thickness. The sandstones are fine to medium grained, often carbonaceous, ripple-marked, and places finely crossbedded. The shales are usually silty, gray, dark gray or black, accordarding to the amount of carbonaceous matter contained in them, They are either shaley and finely laminated and fissile. The black carbonaceous shales often grade through impure coal to clean coal. Shale often forms the roof of the coal seams. There are also gradations from the sandstones through shaly sandstones and sandy shales to the shales.

Silicified tree trunks occur in the shales, some of them in the position in which they grew and carborized driftwood occurs in the sandstones.

It was not possible to measure the thickness of the Gething Member In this reconnaissance. It appears that only a part of the 1400 feet exposed at Rocky Mt . Canyon, is present in the Carbon River area, ths remainder having been eroded. About 500 feet were measured in the 11-Mile Section.

The Gething member at Rocky Mountain Canyon contains a Kootenay flora, the age of which is Lower Cretaceous. In the lower member no diagnostic fossils have been found so far and it is provisionally placed in Lower cretaceous by McLearn. No fossils have been collected from the measures on Carbon River but they can be safely correlated with the Rocky Mountain Canyon Section on the basis of lithology.

The Quaternary unconsolidated sands and gravels are more than 200-300 feet thick and occur along the Carbon River and its tributaries to a height of several hundred feet. They were deposited at the end of the glacial period when the Peace River Valley was aggraded to a height severai hundred fee: above the present level; At many places the streams have cut through these sand and gravel deposits and are forming Canyons in which excellent ections may be obtained.

Structure: The work done to date shows the structure to be a broad syncline or trough with a number of subordinate folds. The center lies just west of Carbon River and the trend is roughly parallel to the same stream. The Carbon River is cut chiefly in the Gethin, member which occupies 'the syncline. A few small faults were observed. Details of structure of the coal seams are given below.

DETAILED GEOLOGY

The stratigraphic sections on the coal claims are described below. Each one is in the Gething member of the Bullhead Mountain Formation. The measurements are given ix feet and tenths of feet.

7 MILE CREEK

The greater part of 7 Mile Creek is floored with superficial deposits and only one short section is exposed on the western part of L.327, This consists of about 440 feet of fine sandstones, shales and six coal seams from 0.2 feet to 2.0 feet in thickness. This section could not be corralated with the other sections owing to insufficient data.

The condensed section showing roof and floor of each seam is as follows:

4.0	feet	Gray to black shales with two seams 2" wide mar bottom.
1.8	"	Shiny gray-black coal.
0.2	"	Bright jet black coal
		Contains occasional lenses of bone $\frac{1}{8}$" thick
4.3	"	Gray and dark gray shales
1.0	"	Mixed bright and dull coal, clean.
1.1	"	Hard gray shale with ironstone
1.6	"	Mixed bright and dull coal
1.0	"	Black highly carbonaceous shale.
55.0	"	Sandstones, shales and silts.
0.2	"	Coal
128.0	"	Sandstones, shales and silts.
1.0	"	Dark gray shale
1.0		Clean mixed dull and bright jet coal
3.0	"	Shale
145.0	"	Sandstones, shales and silts
		Section ends.

The 7 Mile section dips 8 to 15 degrees east. For a long distance above and below there are no outcrops and the general structure is unknown.

Near the mouth of 7 Mile Creek on Carbon River opposite the trap line cabin is 4.5 foot seam of very hard mixed dull and bright coal. It is clean except from one lense of ironstone 6 foot long and 6 - 9 inches wide. The roof is sandstone and the floor is shale. A band of crushed coal 1" thick occurs at the top and mother 6" from the top. A six inch seam occurs 900 feet up river from the 4.6 foot seam.

5 Mile Creek A few isolated outcrops and short sections occur on 9 Mile Creek and indicate an undulating structure with dips of 3 to 5 degrees. In the south central part of L.326 is a bluff about 200 feet high consisting of 150 feet of red weathering thin bedded shales, sandstones and silts at the top, then 50 feet which are concealed followed by a coal seam 5.4 feet thick and exposed for 300 foot along the bed of the stream. The roof was concealed by slides of soft shale but it is probably formed of the same material. The seam was partly covered by the slide but the face was cleaned and dug in to a depth of 3 feet where sample #2 was taken. Even at this depth the coal was slightly fractured and fine clay had infiltrated which no doubt added to the ash content. See under heading - Analysis. Ten inches from the bottom is an earthy carbonaceous parting 1" thick, The floor is hard shale.

The red weathering sandstones and shales were found at only three places on the claims and in each case were above a seam measuring approximately 6 feet. The red color is due to the rapid oxidation of the carbonaceous matter in the silts and shales and in an exposure on 11 Mile Creek the oxidation was so rpaid that the rock was intensely vitrified. On the basis of this oxidation and the proximity to a 6 foot seam, the seam on 9 Mile Creek has been tentatively correlated with that below the 11 Mile occurrence and also with that at Carbon River Canyon.

Mr. Rochfort reports another 3 foot seam higher up on 9 Mile Creek but it could not be found. There are numerous slides along this part and no doubt it has been covered.

10 MILE CREEK. No coal seams are reported along Ten Mile Creek and it was not examined in this reconnaissance.

11 MILE CREEK.

This creek, with its branches, affords an excellent continuous section for more than a mile. It contains 33 coal outcrops from 1" to 17 ft. in thickness. However, a couple of synclines, separated by a terrace, and one reverse fault repeat the seams several times and the total number, when correlation has been made, is reduced to nine seems more than 2.5 feet thick and 12 to 15 smaller seams. The structure consists of two synclincs separated by a terrace or flat 400 feet long. The western limb of the western syncline is broad and terminates in a terrace; the crstern limb of the eastern synclinc is also broad and there is a possibility that it terminates in a terrnce or gently undulating structure between lower 11 Mile Creek and Carbon River. One reverse fault with a throw of 30 feet occurs in the middle of 11 Mile Crock section and repeats one of the larger coal seams. From this structure section it will be seen that the lowest of the seams on the outer flanks lies at a depth of about 500 feet in the center of the deeper syncline on the west.

In the discussion below only "commercial" seams will be considered and, following McLearn, a commercial seam is defined provisionally asone 2.5 feet or more in thickness. Each seam will be discussed separately beginning with the highest which is exposed in western syncline. To facilitate discussion the synclines are named "A" and "C" after the seams found in center and highest part of each one.

Seam "A" is 3.4 feet in thickness on both limbs of syncline "A" and consists of clean coal. It is overlain by 12 feet of friable gray shale with harder lense, and underlain by 4.0 feet of friable gray shales. Dip on east limb is 35 degrees West and on west limb is vertical.

Seam "B" has 2.5 feet thickness of clean coal on the cast limb of syncline "A" and dips 15 degrees West. On the opposite flank the correlated seam has decreased to 0.4 feet in thickness, The dip on this flank is vertical. over the coal on the east is 3.8 gray shale grading into sandstone. Below it is 0.6 shale and 7.5 thin bedded sandstones with shale partings. On the West limb there are 4.0 feet of sandstone over the coal and 3.0 feet of shale beneath it.

SEam "C" is exposed five times: twice in syncline "C", twice at the fault on the east limb of syncline "A" and once on the west limb of the latter. It is 5.5 feet thick in syncline "C", all clean coal. On the eastern limb of syncline "A" the seam is repeated by a reverse fault and is 5.6 feet-in thickness; on the western limb it is correlated with 9.5 feet of very black highly carbonaceous shale which contains 3 irregular bands of coal 3 to 6 inches thick. The seam therefore maintains its full width of clean coal for more than 1200 feet along the bed but west of the fault it passes into black carbonaceous shale with bands of coal. The roof of this seam is 1.0 feet black shale followed by shaly sandstones; the floor is variable - either shale or thin bedded sandstones.

Seam "D" is exposed at 2.6 feet of bright coal on the west limb of syncline "C", 2.8 feet of coal on-the east limb of "A" and as 3.0 feet of coal (pinching to 1 foot) on the west limb of the latter syncline. The roof and floor varies at the different outcrops, This seam, therefore, is probably continuous for more than 1500 feet along the bed and maintains a width of 2.6' to 3.0 feet. At the western outcrop it pinches suddenly to 1 foot but this may be a local condition. Seam "D" does not seem to be present on the East limb of syncline "C".

Seam "E" is exposed as 4.6 feet of hard mixed bright and dull coal on the east limb of syncline "C" and is correlated with 2.8 feet of clean coal on the west limb of syncline "A", a distance of 2000 feet along tine bed. Thin black shale occurs at the top and bottom of both outcrops followed by sandstone end shale.

Seams "F" and "G" occur on the west limb of syncline "A" near the forks on 11 Mile Creek. The section adjacent the coal is as follows:

	24.0	feet thin bedded sandstones and aronaceous shale
Seam "F"	15-17.0	feet Cod, partly crushed. Lense of 8 inch Ironstone in middle, also 3 shale partings.
	1.6	" drrk gray shale
	12.0	" thin bedded fine sandstones and silts
Seam "G"	6.0	" Clean Coal
	7.0	" Shale

These seams are vertical and have been traced for 1200 fact along the strike on both branches of 11 Mile Creek. Or. the East branch and to a lesser extent on the west branch thesa seams are overlain by "burned" or vitrified shales and silts and sandstones produced by rapid oxidation of carbonaceous matter.

The position of the east limb of syncline "C" correlated with seams "F" and "G " is marked by a gap in the section where the beds are concealed, and which are probably soft carbonaceous shales or coal. This position is about 500 feet above the first falls on 11 Mile Creek. It is below a 2 feot seam which occurs ct. the waters edge, If the correlation is correct, seams "F" and "G" should be found by trenching or digging a short shaft at this place.

At Carbon River Canyon is a short section not connected with that on 11 Mile Crock. The upper part shows the following sections:

20-30.0 feet plus, Rod shales, silts and sandstone

17.9 ft.	(7.0	"	Black carbonaceous shale
	(4.9-6.0	feet	Coal, shale parting and ironstone lenses
	1.9	feet	Black carbonaceous shale
14'0 ft.	(3.0	"	Hard shaly sandstone
	(2.0	"	Friable grey shale
	(8.0	"	Thick sandstone
	(1.0	"	Thin laminated shale
	6.0	"	Coal
	10.0	"	Sandstone

On the basis of similar red oxidized beds above two seams separated by almost the same amount of shales and sandstones, these seams on Carbon River are correlated with "F" and "G" at 11 Mile Forks. The lower seams in both cases consist of 6 foot of clean coal. The black carbonaceous shales and the coal of the upper seam at Carbon River total 17.9 feet and are believed to be the equivalent of the 17 foot seam at the Forks, Both Upper seams contain shale parting and ironstone lenses and the distance between the upper and lower seams is 14.0 feet in one case and 13.6 in the other. The distance between those occurrences is 4800 feet at the surface, and more than a mile along the undulation of the beds. if the correlation is correct, the lower seam "G" is probably persistent through its full width over that distance and the 17 foot seam "F" is probably no-: less than 4.9 at any point.

Seams "H" and "I" are exposed in a steep bluff on the East Branch of 11 Mile Creek. Each one is four feet in thickness. The adjacent section is as follows:

20.0	Feet	Thick bedded sandstones
4.0	"	Clean coal
3.0	"	Grey shale
25.0	"	Thick bedded sandstones
10.0	"	Grey shale
4.0	"	Coal
35.0	"	Shale
?	"	Sandstone

These seams occur in a small syncline separated from the rest of the section on 11 Mile Creek. They appear to lie below Seam "F" and "G" and the upper one is tentatively correlated with a seam below the first fall on 11 Mile Creek, the base of which seam could not be reached but which more than 2.6 feet in thickness and lies about 50 to 60 feet below the probable position of Seam "G" on Lower 11 Mile Creek.

Distances between Seams. The following table shows the approximate distance bwixt the various seams on the southern claims:

Seam "A"		3.4 feet
Interval	100 -	110.0 "
Seam "B"	0.4 -	2.5 "
Interval	10-	11.0 "
Seam "C"		5.6 "
Interval		30.0 "

(Distances between Seams - continued)

Seam "D"	2.6 - 3.0 feet
Interval	60.0 "
Seam "E"	2.8 - 4.6 "
Interval	80 - 90.0 "
Sean "F"	15 - 17.0 "
interval	14.0 "
Seam "G"	6 0 "
Interval	50 - 70.0 "
Seam "H"	4.0 "
Interval	38.0 "
Seam "I"	4.0 "
TOTAL	493.; Feet

East Creek /off

This crook branches Carbon River on tho east nearly opposite Ten Mile Crock. Anumber of short sections, separated by areas in which the measures are concealed, occur along this crook. The first 4000 feet appears to be in tho Gething Member and beyond that distance are found the coarse cherty sandstones of the Lower Member. The dip in the section varies from 10 to 60 degree? south-west. The gap in the section where 400 feet, more or less, are concealed may contain the seams "F" and "G" or their equivalent.

Five seams from 0.2 to 1.5 feet in thickness are exposed along East Cr. Of this total section commercial seams have a minimum thickness of about 33 feet and a maximum thickness of 50.1 feet of approximately 7 to 10% of the section.

No. of Sample	Moisture	ANALYSIS Volatile Matter	Fixed Carbon	Ash	Sulphur	Calorific Value
1.	2.8	23.12	66.38	7.62	0.72	13,060 B.T.U
2.	4.9	25.74	56.22	13.06	0.73	11,180 B.T.U
3.	3.7	26.90	63.88	5.52	0.58	13,160 B.T.U
4.	4.3	29.12	64.32	3.18	0.65	12,850 B.T.U
5.	6.4	24.84	55.10	13.60	0.59	11,010 B.T.U
6.	2.1	22.00	69.40	6.50		
7.	5.5	24.8	61.50	8.2		
8.	3.4	26.2	67.70	2.7		
9.	2.9	23.7	56.2	17.2		
10.	4.6	25.2	66.6	3.6		
11.	1.07	23.32	74.28	1.34		15,100 B.T.U
12,	1.05	20.8	77 J	2.1		14,800 B.T.U

The first ten samples are non-coking coal; on the last two this quality was not reported.

LOCATION OF SAMPLES

1.	Seam 2.0 feet	Seven Mile Creek
2.	Seam 5.4 feet	Includes one inch earthy coal, Nine Mile Creek
3.	Sean 4.6 feet	Eleven Mile Crock
4.	Seam 5.5 feet	Eleven Mile Creek
5.	Sear? 6.0 feet	Excludes 2 inches of bone, Carbon River
6.	Seam 4.5 feet	Excluding 5 inches bone, east bank Carbon River below Seven Mile Creek
7.	Seam 5.4 feet	Nine Mile Creek, same as No.2
8.	Seam 2.1 feet	Eleven Mile Creek
9.	Seam 1.3 feet	Eleven Mile Creek. Includes shaly coal.
10.	Seam 4.6 "cc"	Eleven Mile Creek, same as No.3
11 & 12		Analysis given in a report by Cowper Rochfort, no localities or thickness as given

Samples 1 to 5 taken by E. W. Beltz, analyzed by G.S. Eldridge & Co., Vancouver, B.C.
Samples 6 to 10 taken by J. D. Galloway and given in Annual Report, Minister of Mines, B.C., 1923, page 141.
Sample 11 taken by C. Rochfort and analyzed by Hayes & Son, Toronto.
Sample 12 taken by F. H. Kitto, analyzed by F. Starsfield, Ottawa.

COPY -1- OR 1, 20 Duplications of preceding report

REPORT on CARBON RIVER COAL DEPOSITS PEACE RIVER BRITISH COLUMBIA by NORMAN C. STINES

Seattle, Washington
August 25, 1943

Extracted from copy in hands of Lt. L. F. Walker. It came from John Burns, Calgary. He says Mr. Stines authorized U.S. Govt. to have copy made for Lt. Walker.

CONCLUSIONS:

The detail considerations set out in this Report allow the following conclusions;

1. In the Peace River District between Hudson Hope and Finlay Forks exists a coal bearing area in which two certain - Hudson Rope and Carbon River - and three 'probable - Pine Pass, Commotion Creek and Otterfail Creek - coal producing basins will be developed;

2. 'In the Hudson Hope and Carbon River basins enough preliminary geological and; other examination work has been done to warrant the statement that in each will be finally proven very large reserves of very high grade coal - low in ash and high in BTUs;

3. In the Carbon River Basin the coal that can be produced will have the following average proximate analysis:

Loss of air drying		2.05%
Analysis on air dried coal:		
Moisture	3.05%	
Volatile Matter	22.96	
Fixed Carbon	71.83	
Ash	2.16	
BTUs per pound		13, 910
Fuel Ratio		3.17
Sulphur		0.77%

4. The eoal has other very superior qualities: It is second to none, and far superior to any, competitive coal,, in its ability to stand weathering and to resist crumbling and crushing when handled and shipped;

5. In the Carbon River Basin' in the six miles of its known length there is a minimum'area of twelve square miles underlain by coal and for the probable twenty-five mile length Considerably over fifty; ,

6. Oh the one stream where detail study has been made are exposed ten coal seams varying from thirty inches to seventeen feet in thickness for an aggregate minimum of 33.8 feet and a probable maximum of 50.1 feet of coal in 493 feet of coal-bearing, measures;

Pages 1 and 2

7. These ten seams are almost certain to be found under 6.5 square miles of the basin and. there has not been recorded any observation to indicate that they do not *exist* under the whole fifty;

8.. The two' seams designated F and G, with their carbonaceous shale marker, have been followed for something over six miles with good indications that they extend at least three-.&d one-half more, and'there is no present reason to doubt their extending for the full probable twenty-five mile length of the basin;

9. In the presently-assumed central portion of the basin the coal seams are proven to extend for a minimum width of two miles with every indication that it will exceed three;

1 On the 'basis of the observations plotted over a length of six miles it is estimated that there are-practically assured in the F and G seams alone a reserve of 145,000,000 tons with the average analysis given in 3 above; and a fairly probable potential reserve for all the ten seams in the whole fifty square miles 'in excess of 2,700,000,000 tons;

11. The-conditions under which this coal exists are so favorable for its extraction that 'the cost per ton when producing one million tons annually is estimated at $2.85, and when the production is three million tons, $2.67;

12. The present market&thirsting for this coal extend from Port Arthur in Ontario to all points along the West Coast of North America and at the present time probably aggregate a minimum of five million tons annually; but with the almost certain rapid curtailment of oil production in California this market should within a few years increase by leaps and bounds;

13. The high quality of this coal warrants a sale price in its normal market at least fifteen per cent'higher than' any competitive coal, and the average price at which it will probably be sold will net ,a gain,. when selling one miilion tons annually, of from $0.45 to $1.45 per ton and, when selling three million, of from $0.63 to $1.63;

14. To bring this property to a production of one million tons annually will require $5,100,000 and to reach three million tons; $12,900,000;

15. Before provision for Federal and State or Provincial Income Taxes, the net profit, when producing one million tons annually, will mean a percentage return varying between 8.8 and 25.8; and when producing three million, between 14.7 and 38;

Pages 2, 3 and 4.

16. Considered as a coal mining-development, this business is fully warranted, but unfortunately there is presently no railway to transport this coal from mine to markets;

17. At an estimated total cost of $13,000,000 - $60,000 per mile - the required 220 miles of mainline - 85 to 110 lb. rail - railroad to connect this basin with the Canadian National at Prince George can be built;

18. Such a railway will not oniy have the coal output as frkight but should also have some 300,000 tons of paper pulp and 600,000,000 board feet of timber products annually from the Peace and Finlay River areas that it will tap; and if extended easterly to reach the Peace River agricultural district would obtain from that area all the grain that is sold for export; and

19. To any organization with the finances necessary to provide the railway and mining development required, the writer does not hesitate to recommend the detail study of this prospective business-c

Pages 4 and 5.

Page 38, 40

In his Report Beltz describes 'in detail the coal seams exposed in Eleven Mile canyon from Camp Falls west to the forks. It does 'not seem necessary even to summarize here that description shows that Beltz has recognized ten seams of commercial importance. These, 'with the intervals between, are, from highest to lowestobserved.

Seam A	3.4 feet.
Interval	100 to 110 feet
Seam B	0.4 to 2.5 "
Interval	10 to 11 feet
Seam C	5.6 feet
Interval	50 feet
Seam D	2.6 to 3.00 feet
Interval	60 feet
Seam E	2.8 to 4.6 feet
Interval	80 to 90 feet
Seam F	15 to 17 feet
Interval	14 feet
Seam G	6.0 feet
Interval	50 to 70 feet
Seam H	4.0 feet
Interval	38.0 feet
Seam I	4.0 feet

Thus out of a total thickness 'observed of from 436 to'493 feet, there are from'33.8 to.50.1 feet of coal in seams of commercial importance. These are minimum figures as only the lower section of a probable total of about 1400 were seen and examined.,

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Again referring specifically to Eleven Mile Creek Canyon he writes :

> "The structure in this section consists of two synclines or troughs separated by a short terrace or flat 400 feet long., The -strata dip from 5 degrees to vertical. Over the claims 'as a whole only scattered data were found regarding structure.. This:'data. however, indicates an undulating structure with average dips from 5 to 20 degrees. Short abrupt and often steep folds are likely to be found locally and-also some small faults."

Page 48, 49

'In 1923 several tons of "Gething" coal were rafted down the Peace River to the crossing and a test made by the Edmonton, Dunvegan and British Columbia Railway. In the Appendix (Page 101 et seq.) is a copy of this letter., The' important facts are summarized:

	Gething Coal	Canmore Coal
Coal consumed; Lb.	17,872	13,773
Water -evaporated - Lv.	142,740	75,750
Water evaporated per Lb. coal.	7.99	5.5
Ashpan dumped	once	4 times
Cinders produced, - Lv.	179	860

The following extracts are pertinent:

"The Hudson's Rope gives off an intense heat, burns a clear white flame, burns as freely as Pittsburgh Coal but no smoke; when fire is replenished. a few cinders are'discharged from stack."

"This coal does not Coke but when burning has the appearance of coke. The Canmore coal used in the comparative test'-was lump coal and a good sample of the best Canmore.

"In the tests with Hudson's Hope 'coal the grates were net shaken between terminals and a thin fire was maintained,. It was necessary to keep a light fire as otherwise it would have been impossible to control it, when engine was shut off."

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QUALITY OF COAL:

ANALYSES:

VARIOUS COMPETITIVE COALS:

Before proceeding to-outline the, quality of the coal, all based on samples obtained really at the surface',, the deepest being fourfeet, it would seem well to set out the analyses of the other coals with which Carbon River products will have, to compete. These are found in Table 1,. page 59:

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CARBON RIVER COALS:

In Table 2 are the results of analyzing Carbon River coal; taken by Beltz - the first five; Galloway - the second

Page 60

five, and Stines - the last thirtcep. The eieventh and twelfth are probably analyses of specimens, rather than samples, taken by Rochfort and Kitto.

TABLE 1

	LOSS IN AIR DRYING	MOISTURE	VOL. COM.	FIXED CARBON	ASH	S	B T U
Bankhead	0.5	0.5	11.7	75.7	12.1	-	13,250
Crow's Nest Pass-Dominion	1.3	0.7	24.9	54.7	19.7	-	11,640
-Michel	1.2	0.7	22.4	65.6	11.9	-	13,260
-Bellevue	0.7	0.2	27.6	56.8	15.4,	-	12,370
-Coal Creek	0.9	1.3	'26.0	63.8'	8.9	-	13,640
Canmore	0.0	0.9	14.0	79.7	5.4	-	14,470
Brazeau	1.0	0.9	16.5	70.6	12.0	-	13,480
Jasper Park	1.8	0.5	18.8	58.9	21.8	-	11,790
Drumheller	7.2	8.8	34.6	48.4	8.2	-	10,350
Mountain Park	1.4	1.9	30.9	62.9	'4.3	-	14,400
Nanaimo-Douglass Seam	0.6	1.6	40.6	47.7	10.1	-	12,620
-Newcast le	0.5		140.7	45.7	11.7	-	12,230

(The above are from Page 16 of James White.)

(The following are taken from Page 20 of same, and are of competitive United States Coals):

Indiana Coals	6.0	10.8	35.7	42.3	11.6	3.5	11,280
Georges Creek, Md.	--	1.9	12.9	79.4	5.5	0.3	----
Ohio Coals	3.2	5.3	36.2	48.9	9.6	3.1	12,273
Penn.-Ellsworth	1.0	1.6	35.8	56.8	5.8	0.9	14,013
-Ligonier	3.2	4.1	20.6	63.8	12.5	2.1	13,153
Virginia Coals	2.1	2.7	31.9	61.7	3.9	0.5	14,042
West Virginia Coals	2.3	2.1	27.8	62.8	7.3	1.3	14,130
Utah-Kenilworth		5.01	43.68	46.51	4.80	0.41	12,821
Washington - Carbonado #1		3.38	32.21	49.53	14.88	0.45	12,247
- Bayne #2		5.10	30.80	56.00	8.10	0.36	12,850
- Wilkeson #3		2.50	37.70	61.30	8.50	0.42	13,800
- Roslyn		3.77	37.69	47.05	11.49	0.47	12,762
West Virginia - Island Creek		2.78	36.06	55.71	5.45	0.98	13,997
Wyoming - Kemmerer		3.94	40.09	49.00	6.97	0.60	12,886
- Rock Springs		8.53	35.50	50.39	5.48	0.78	11,883

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TABLE 2

SEAM	THICKNESS	SAMPLE	MOISTURE	VOLATILE CARBON.	FIXED	ASH	S	B T U
	'2.0	1 Be.	2.8	23.12	66.38	7.26	0.72	13,060
	5.4	2 "	4.9	25.74	56.22	'13.06	0.73	11,180
E	4.6	3 "	3.7 -	26.90 -	63.88-	5.52	0.58	13,160
xc	5 . 5	4 "	4.3 -	28.12	64.32	3.18	0.65	12,850
F	6.0	5 "	6.4,	24.84	55.10	13.60	0.59	11,010
G	4.5	6 Ga	2.1	22.00	69.40	6.50	--	--
	5.4	7 "	5.5	24.80	61.50	8.20	--	--
	2.1	8 "	3.4	26.20	67.70	2.70	--	--
	1.3	9 "	2.9	23.70	56.20	17.20	--	--
E	4.6	10 "	4.6 -	25.20	66.60	3.60	--	--
	- -	11 Ro	1.07	23.32	74.-28	1.34	--	15,000
	--	12 Ki	1.05	20.80	77.10	2.10	--	14,800
C(?)	5.2	1 St	22.12	4 8	72.95	3.45	0.80	13,950
DC?,)	4.1	2 "	2.76	22.14	73.55	'1.55	Q.66	14,014
B(?)	2.5	3 "	2.92	21.38	74.02.	1.68	0.74	14,Q12
(?)	4.0	4 "	2.09	22.91	73.52	1.48	0.74	14,105
B(?)	3.0	5 "	-2.76	23.14	72.50	1.60	0.77	14,012
E	4.3	6 "	3.26	24.64	69.90	2.20	0.64	15,888
H(?)	4i0	7 "	'3.82:	22.08	72.04	2.06	0.77	13,824
G(?)	Float-5	8 "	2.48	21.42	72.75	3.35.	0.77	14,108
G(?)	Float ?	9 "	1.51	20.01	77.32	1.16	0.64	14,635
? F	5.3	10 "	4.30	25.60	61.75,	8.35	0.74	12,533,
?	3.Q	11 "	4.48	,21.42	68.40	5.70	4.72	12,989
G(?)	5.4	12 "	3.62	21.63	72.47	2.28	0.68	13,841
X ?	2.2	13 "	4.13	27.27	65.50	3.10	1.10	13,547

Page 62 and 63

The writer believes that his thirteen samples are more representative of the carbon River coals than the others. Notwithstanding that,, Beltz's and the writer's results are compared, The averages for each and both combined are:

Samples	BELTZ'S 5	STINES 13	BOTH 18
Moisture	4.42	3.09	3.48'
Volatile Matter	25.74	22.70	23.55
F i x e d Carbon	61.19	71.28	68.47
Ash	'8.60	2.92	4.30
Sulphur	0.61	0.75	0.71
'B. T. U.	12,252	13,804	13,373
Fuel Ratio	2.38	3 . 1 4	2.90

The controlling difference is in the ash content -- about three times as high in Belts's samples. Duetathis- over half of the lower fixed carbon in his is accounted for. Beltz explains the high ash content as due in large part to clay that had infiltrated into the outcrop, which is what he sampled. Certainly the average of these 18 samples (the last column above) is the poorest that could be expected from this field.

As remarked when the details of the writer's sampling were given, numbers 8, 9, and 11 were not samples, rather speci- me'ns , and 10 was of an outcrop which showed at the top crushed coal into the: seams of which clay had infiltrated. Therefore only the other nine are really representative and the,average of the proximate analyses of. these is:

LOSS on air drying		2.05%
Analysis of air dried coal:		
Moisture	3.05%	
Volatile Matter	22.96%	
Fixed Carbon	71.28%	
Ash	2.92%	
BTU per pound		13,804
Fuel Ratio		3.14
Sulphur		0.75

Pages. 63 and 64,

On the "basis of analyses, this is an outstanding low ash and sulphur and high heat value coal for all purposes , except coking. Sample 1 showed a pour coking quality and sample 8 only fair. On the basis of the ash content of the coal, any coke that would result could not be expected to be very strong.

The fact that none of the samples showed coking qualities comparable to that one piece, coked in the Ten Mile Camp fire is surprising. As noted later, when giving McLearn's results on the Grant seam of the Hudson Hope sub-basin, one stratum of a seam may be coking coal , while the balance is not. No sampling by strata was done on Carbon River Seams.

Before leaving this matter of coking quality, the writer has found that often the mixture in proper proportion of a high volatile and a low volatile coal, each by itself non-coking, produces an excellent coke. In the Urals of, Russia a fine coke for iron smelting was made by mixing 60% of a fat coal from Minusinsk with 40% of an anthraoite from the 'Urals. Undoubtedly it is only a question of a relatively small amount of research to find the proper mixture of one of the low grade high volatile and ash Pacific Coast coals or petroleum refined residue and this, Carbon, Rivercoal to give the desire result. The problem of making a high grade coke from this coal should not be a difficult one to solve.

A composite sample made up of equal parts of samples 1, 2, 6, 7, 12 and I3 was sent to Ledoux for both proximate and ultimate analyses and the results will later be added to this Report.

HUDSON H O P E COALS:

In the second referende given under acknowledgments McLearn describes in detail the coal seams exposed on the Gething property and the Hudson Rope area. In that Summary he gives several analyses of the various seams he sampled. These are gathered in Table, 3.

TABLE 3

	MOIS-TURE	VOL. MATTER	FIXED CARBON	ASH	S	B T U
Main Gething Creek	1.6	26.0	64.0	8.4	0.5	13,350
North Branch Gething Creek	1.0	24.5	65.9	8.6	0.7	13,820
Average of 3 main Gething Creek	1.0	24.6	70.7	3.7	-	-
Little Mogul	2.7	24.3	62.5	10.5	-	-
Mogul Creek	1.2	22.9	71.3	4.6	-	-
Earle Narrows	1.4	22.7	71.7	4.2	0.9	14,220
Moosebar	2.3	21.2	73.0	3.5	-	-
Grant Seam						
300' W of x cut-Lower 9"	0.6	23.6	72.4	3.4	-	-
-Upper 5'	0.8	20.4	75.4	3.4	-	-
Cliff Ent. To West x Cut-Bot. 11"	0.7	24.6	72.6	2.1	-	-
-Upper 4'6"	0.6	18.7	78.1	2.6	-	-
35' in tunnel -Bottom 8"	0.7	22.0	70.8	6.5	0.7	14,440
Mid. 23"	0.6	19.5	77.0	2.9	0.7	14,940
Top 38"	0.7	19.6	74.4	5.3	0.7	14,420
Tunnel at x cut-Bot. 9"	0.7	22.9	74.0	2.4	0.7	15,130
Mid. 20"	0.8	19.3	77.3	2.6	0.7	14,960
Top 36"	0.7	18.7	74.5	6.1	0.6	14,300
Face Tunnel 9-26-23 Bot. 9"	0.6	24.8	75.2	2.4	-	-
Mid. 22"	0.6	19.5	77.3	2.6	-	-
Top 32"	0.6	20.1	75.2	4.1	-	-
(The bottom stratum makes good coke)						
Riverside	0.7	18.8	74.9	5.6	0.8	14,400
Galloway's sampling						
Upper 18"	0.8	18.9	76.6	3.7	0.8	14,590
Lower 30"	0.9	19.3	76.1	3.7	0.9	14,550

Page 6.5

By combining the last nine analyses in groups of three, the averages for the three strata sampled and for the Grant seam become:

	MOISTURE	VOLATILE	FIXED CARBON	ASH	B.T.U.
Bottom 8.7"	--- 0.67	23.23	73.33	-- 3.70	14,785
Middle 21.7"	0.67	19.43	77.20	2.70	14,900
Top 35.3"	-- 0.67	19.47	74.70	5.17	14,360
Whole Seam	0.67	20.00	75.24	4.09	14,583

With that as the average for the Grant seam and taking the figure in Table 3 for the other seven seams, then the average for the Hudson Hope sub-basin is:

Moisture	1.48%	
Volatile Matter	23.24%	
Fixed Carbon	69.38%	
Ash. --		5.90%
Fuel Ratio		5.98

By referring to the calculated average of Stines' thirteen samples (page 63) the very great similarity of the analyses of the coal from the two sub-basins is seen. The difference in fixed carbon is practically the difference in the ash content. The Grant seam coal, on basis of BTU, is very superior and contains coal between bituminous and anthracite in character.

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OTHER QUALITIES:

The characteristics of the Carbon River and Hudson Hope coals are so similar that the discussion of the other qualities applies equally to both. McLearn's statement: "..... an ideal coal for all purposes, burns readily, is smokeless and gives a high heat", used in desdribing the Hudson Hope coal applies equally to that from Carbon River. The same is true of his conclusion that it is the, "equal of the best Welsh and West Virginia coals , does not weather and, owing to its compactness, stands shipping very well."

ASH CONTENT:

An ash content of 5.90% for the Hudson Hope and 2.92 "for the Carbon River puts these coals, from the Point of view of transportation cost per unit, of heatvalue, in a class by themselves. This is particularly important in a field so far

Page 66 cont'd. and page 67.

from its present markets as this one is. The relation of the ash content of a coal to the matter of equipment required to produce a given amount of heat is well set out by James White on Page 31 of Fuels of Western Canada:

> "In the-United States, the non-preventable ash content of clean bituminous coal varies from . . an average of 6 per cent in Wyoming coal to an average of 16 per cent in Colorado and, for the whole country averages about 10 per cent, In goodpractice, 10 boilers of 500 h. p. capacity each will generate 300,000 lbs. of steam per 'hour with coal carrying 10 per cent ash. If, however, the coal carry 15 per cent ash - 5 per cent more than normal - it will require 15 boilers to generate the same amount of steam. If it carries.21 per cent of ash, it will require 20 boilers to do the same work."

In the matter of transportation the higher the ash content, the greater the freight charge on the heat actually produced from burning a ton of the product. The analyses show that the "non-preventable" ash content of the Carbon River coal is low and it is thus exceedingly important for this area that only "non-preventable" ash be shipped. If proper means of cleaning the coal-are taken, there is no reason why the ash content be kept below 3.5 per cent for Carbon River and 6.5 for Hudson Hope. Where the average of the ash content of the competitive coals is around 12 per cent, the saving in coal, for the same steem production, will be 20% by weight. This is a measure of 'the extra price, as compared to competitive coals now on the market, that may be obtained for-this coal due to its low ash content alone.

WEATHERING AND ABILITY TO STAND SHIPPING:

Since these two qualities are related, they are, discussed together. These factors are very important in determining desirability of a coal and therefore its selling price. In these two respects Carbon River coal stands second to none and'is so far above all competitive'coals, except West Virginia and Welsh products, that no comparison is warranted.

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That this coal can stand weathering is attested by the outcrop of the coal represented by Sample 6 and shown on Photo No. 11. Where that sample was taken the seam is on the north wall of Eleven Mile canyon about 40 feet above present stream level. The time necessary for that stream to cut that depth of hard sandstone is measured in centuries not days. The fact that

Page 68 cont'd, page 75

the coal outcropping there is still absolutely unweathered and hard and compact emphasizes its resistance to weathering. Another piece of evidence is the existence of bright rounded pieces of coal in the *gravels of every* stream. Such a resistant coal is excellent for stock piling as it will not deteriorate in the relatively short time the longest period it will be likely to remain in such piles.

This ability to stand weathering is a very important factor in determining desirability and therefore selling price of a coal. In this quality Carbon River coal stands second to none and is so far above that of competitive coals (except West Virginia and Welsh) that no comparison is warranted:

Its ability to withstand crumbling and breaking when handled is another desirable quality. This coal is very hard and difficult to break into small pieces. This not only means less breaking into fine pieces when handled during shipping, but a larger percentage of "lump" from "run of mine". As "lump" commands a premium in price of from 25% to 30% over that for "run of mine" this means a higher average price for the output as a whole;

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On the basis of these sets of observations. the writer concludes that the Carbon River coal field occupies a basin striking about N 13 degrees W. Its length has been definitedly proven by coal outcrops plotted of over six miles, and inferentially for eleven and one-half. The presence of float for twelve miles further to the south and the coal outcrop below Five Mile Creek, a further one and one-half mile north, suggest the probable- minimum. length of the basin to be 25 miles.

Again by observations plotted its proven width in the six mile proven length is in excess of two miles and it may be inferred at probably three. Relying wholly on topography both north and south of those six miles that width extends for a least thirteen miles and most likely for the additional twelve miles to the south as well.

Page *7 6* .

Thus the area of the basin may be stated to be:

Proven 12 square miles;

Page 76 cont'd, page 77.

Probable	14 square miles;
Likely	24 square miles;
Total	50 square miles.

TONNAGE OF COAL:

CARSON RIVER:

As is evident from this Report no coal can be said to be proven. But on the geological evidence observed, recorded and plotted it is clear that one is justified in concluding that coal is commercial seams (30" plus in thickness) exists in very large quantities. From that evidence one would seem warranted in trying to arrive at figures which would represent the tonnages that one can confidently expect in the various areas into which the basin arbitrarily is divided,

MOST PROBABLE:

It would seem that from Nine Nile creek to the south and of L 319 and 320 - a length of approximately 3.25 miles and a width of two - there exist the ten seams Beltz has plotted. This is an area of 6.50 square miles.

Beltz's work shows from 33 to 51 feet of workable coal in the 500 foot section of coal bearing *strata,* which would mean from 38,000,000 to 59,000,000 tons per square mile or a total of between 247 and 383 million tons of potential coal.

The writer has traced the F-G seams and marker for a length of about 6.5 miles and with Beltz's work shows them to exist over a width of two for an area of 13 square miles. While the F seam has a maximum thickness of 17 feet , observations at various places show that this large thickness is at times only 4.5 feet of clean coal and for purposes of this analysis that is taken as the average over the -area. The G seam lies 14 feet lower and varies from 5.3 to 6 feet in thickness. Assuming 5.5 as an average, there are in the two seams 10 feet of coal, which would mean a minimum of 11,150,000 tons per square mile - if horizontal, for a total of 145,000,000 tons. This quantity of potential reserve the writer considers assured beyond any reasonable doubt.

SLIGHTLY LESS PROBABLE:

Prom Nine Mile Creek north to the coal opposite the Seven Nile cabin is approximately 2.50 miles. Prom the south

Page 77 cont'd, Page 79.

end of L 319 to the most southerly seen outcrop is about 3.25 miles. For these additional 5.75 miles over a width of two, there would be an additional 11.5 square miles. If all the seams are proven to underlie this, there would be therein from 437 to 678 million tons.

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FAIRLY PROBABLE:

North of Seven Mile cabin the coal beds apparently extend for about 1.5 miles. South of the last known outcrop coal float is found in the gravels for 12.5 miles, Thus for fourteen miles at the etids, coal might be found and if all the seams exist, there could be an additional reserve underlying some 28 square miles which might contain from 1,065 to 1,652 million tons more...

SUMMARY:

Thus the potentialities may be expressed:

MOST PROBABLE	145,000,000	**to**	383,000,000 tans
SLIGHTLY LESS PROBABLE	From 437,000,000	**to**	678,000,000 tons
FAIRLY PROBABLE	From1,064,000,000	to	1,652,000,000 tons
Totals .	1,646,000,000	to	2,713,000,000 tons

Even the assured minimum of 145,000,000 tons makes this a most worth while. reserve and the maximum expectancy of nearly, two and Seven-tenths billion tons would rank it as one of the most important, coal fields of Western North America; The writer realizes that the above estimates are based on only a preliminary set of observations but feels confident that further detail study will confirm them.

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MARKETS AVAILABLE:

As shown under "Quality of Coal" the coal prdduots , from this area are so superior that they can compete with any

Page 80 cont'd, page 81. page 82.

coal in North America. Therefore its markets extend not only all along the Pacific *Coast,* but also to the Canadian markets to-the east as far as Port Arthur, at the Western end of Lake Superior. On the basis of its low preventable ash content alone it can capture that market at a premium in price of at least 1 5 % .

Then in many cases the haulage differential will be in favor of this coal. The Utah and Wyoming coals have to come by rail about 1300 miles to Seattle; 1200 miles to Portland and 900 to San Francisco. The Carbon River coal has all rail of 871 miles. to Seattle and to Portland of 1060 miles. If rail and water are used the distance to Seattle will be 790 by rail and 600 by water; to Portland, 800 and 900; to San Francisco, 800 and 1600, respectively.' For the Canadian market, West of Lake Superior, the West Virginia coals have to come 1600 miles against 1400 from Carbon River.

The above is only for the relatively small non-industrial market. Since the war coal consuming industries have been built on the *boast;* Kaiser's iron plant at Fontana and many others along the Columbia.- The former requires coke which with -research successfully completed can be cheaply made from this coal. If this coking operation is done near any large *city,* the by-products alone may be sold for a very large revenue.

It is realized 'that 'at present practically all the gas used along the Pacific Coast comes from low grade oils or refinery waste products but unfortunately for the United States their potential oil reserves are being depleted very rapidly and it seems well within reason that within 15 years other fuel sources will have to'begin to be called on and within.30 years coal will largely replace oil for the making of gas for domestic use and lubricants and fuel for internal combustion engines,

Then there *is* the Alaska market. While Alaska has large reserves of lignite coal it does not produce enough of the right kind of coal for its own use and this year (1943) is importing coal rail-hauled from West Virginia to Pacific Coast ports for water delivery to Alaska sea ports.

There is the Canadian market east of the Rockies. As shown under transport&ion it is only 709 miles *via* Prince George by rail from the mouth of Carbon River to Edmonton - the gateway to the prairie provinces. In 1938-the Prairie Provinces and Ontario, West of Lake Superior,, imported over 2,000,000 tons of coal, most of it from Pennsylvania and West Virginia. As shown under "Quality of Coal "'those coals average' about 10% ash against 3.0 for Carbon River.

EDMONTON, DUNVEGAN AND B.C. RAILWAYS COMPANY

McLennan, Alberta.

October 26, 1923.

6 9 9

Mr. J. A. McGregor,
Manager,
Edmonton.

Dear Sir:

In connection with the test of coal received from Gethings mine at Hudson Hope, I have the-following report to make:

1 cu. ft. Hudson's Hope coal weighs 50 lbs. as compared with Canmore 54 lbs.

On October 1st, east way freight engine 6 left McLennan with 21502 lbs. Hudson's Hope coal on tender. This engine had a full tonnage train 1150 tons leaving and from Kinuso to Smith 13'75 tons, 'arriving at Smith a distance of 132 miles, and an elapsed time of 17 hours and.45 minutes, there was a large amount of coal still on tender and I decided to try and make return trip to McLennan.

After resting at Smith we left Westbound with 105Q tans. On arrival at Kinuso there were 3750 lbs. of coal on tender. The evaporation-test for the trip is as follows;

coal consumed	17852 lbs.
water evaporated,	142740 lbs.
water evaporated per pound of coal	7.99 lbs.
miles run 193	
elapsed time 33 hours.	

Fire was dumped at Smith in order to caulk-engine. On the entire trip ashpan was dumped only three time, the residue from ashpan weighed 674 lbs. This was largely unconsumed coal which had dropped through the grates on account of ,the large openings.. Grates are finger grates.

The cinders taken from ashpari at Smith weighed 179 lbs. They were afterwards burned in a heating stove and the resultant ash weighed 67 lbs.

On October 15, engine 6 on way freight left McLennan with 26.428 lbs. Canmore run, of mine on tender hauling a train of 1050 tons arriving Smith pith 1160 tons.

The evaporation test as follows:

coal consumed -13773 lbs.
water evaporated 75750 lbs.
water evaporated per lb. of coal 5 . 5 lbs.
miles run 132, elapsed time 12 hours.

Ashpan dumped four times weight of ash and cinders 860 lbs. These tests were made without any change in the draft appliances. After increasing the exhaust tip from 4 7/8" to 4 ¾ another test of Hudson's Hope was made on October 18th with the following results:-

coal consumed 10202 lbs.
water evaporated 78810 lbs.
water evaporated per lb. of coal 7.65
miles run 132
elapse time 14 hours.

Residue from ashpans dumped at midway on trip and at terminal 40Q lbs. this as on the former test being largely unconsumed coal.'

The Hudson's Hope gives off an intense heat, burns a clear white flame; burns as freely as Pittsburg Coal but no smoke, when fire is being replenished a few cinders are discharged from stack.

This coal does not coke but when burning has the appearance of coke. The Canmore coal used in the comparative test was lump coal and a good sample of the best Canmore.

In the tests with Hudson's Hope coal the grates were not shaken between terminals and a thin. fire was maintained. It was necessary to keep a. light fire as otherwise it would have been impossible to control it when the engine was shut off.

Yours very truly,

(signed) "M. W. Boucher".

Assistant Superintendent.

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CANADIAN PACIFIC RAILWAY COMPANY

Chateau Lake Louise

Pile 26

Lake Louise, Alberta;
29, 1925.

CONFIDENTIAL

C. F.--T. Rochfort, Esq.,
Rochfort Bridge,
Alberta;.

My dear Rochfort:-

Our Head Office has written me as follows: "The information which you submitted to Mr. Ussher with respect to the Peace River coal deposits is very interesting particularly when considered in conjunction with data which the Company has already obtained on this subject. There seems to be no question whatsoever about there being very large quantities of coal ofexcellent quality not only in the locality to which you referred particularly but also insurrounding territories.. The two principal difficulties. in the way of realizing the benefits of development are,, of course, lack of transportation and the matter of markets. I have no doubt you'are, familiar with features of the Western coal situation having to do with the production capacity of the existing mines and the demand for Western Coal. Since receirt of your communication to Mr. Ussher however I have had some correspondence with Mr. J. A. Macgregor, Manager of the Edmonton., Dunvegan and British Columbia Railway Company and quote below for your information, a letter which he recently addressed to me on-the subject:

"With regard to the, attached correspondence which accompanies your letter of March 30th; I might say that the Carbon Creek (river) coal seams are quite close to the Gethings Creek deposit and. in our investigations we cover both by the general term "Hudson's Hope" as both creeks run into the Peace River in the. rapids near Hudson's Hope".

In 1923 soem thirty odd tons, from the Gethings mine were delivered to us at Peace River Crossing for test purposes and from a sample of the eame the Milton Hersey Company gave us the following analysis:

Moisture	1.20
Volatile	15.00
Fixed Carbon-	79.00
&B . .	3.10
B.T.U. 14.446	

The results of the test on locomotives is well explained in the attached letter from my Assistant Superintendent who travelled on the engines and personally supervised the tests.

Further tests were made'by the Canadian Pacific in the Calgary District from ten tons which we sent to them to try out in "Baker" heaters and in dining cars.' In the former it gave good satisfaction but required careful watching to prevent overheating. In the dining cars it acted well when trains were standing still, hut when running even with all drafts closed, the heat was, too greet end the top of ranges and ovens were too hot for good cooking. This was confirmed by tests in my own car; however, a remedy could no doubt be found in firing lighter and by special drafts.

I asked the Gethings mine to let me have 100 tons early in June for-further tests for which we would pay $8.00 per ton at Peace River but do not think they can deliver at that price at a profit.

If the mines were close to rail transportation the coal would command a high price either for steam or domestic purposes but it is too far away; further, the first fifteen miles of the river trip is through rapids', dangerous at all times but particularly so when the water is low.

The newspaper clippings attached are greatly exaggerated and were contradicted by me at the time of publication."

I want you to treat this as confidential and would explain that they d'o not ask for further information, or hold 'out any encouragement. The first question that suggested itself to me was: is the Gethings coal as good as yours, and is it in as large quantities?

I Hope all goes well with you, the little family end the white faces, and Mrs. Gardon and I are wondesing when you migrate to your new Cadboro Bay home.'

Kindest regards,

Yours very truly,

"Basil Gardon".

Eage 105. CARBON RIVER COAL CLAIMS

SUMMARY AND CONCLUSIONS------

This reconnaissance examination of the Carbon River Coal Claims was made during the first two weeks of August, 1928, and consisted of stratigraphic studies, measurements of sections, correlation and the taking of samples. Detailed maps, cross-sections and columnar sections were compiled and accompany this report.

The claims are situated in the Rocky Mountains, 35 miles west of Hudson's Hope, B. C. They lie between 2200 and 3500 feet elevation on the well timbered lower slopes of the range on the west side of Carbon River between Seven and Eleven Mile Creeks.

The rocks exposed in the area belong to the Bullhead Mountain formation, of Lower Cretaceous age and consisting of about 3000 feet of coarse sandstones. and conglomerates et the base, and more than 500 feet of interbedded find sandstones, silts, shales, and numerous coal seams at the top. The Upper or Gething Member occurs in a synoline or trough with a number of subordinate folds, and parallels the Carbon Rive? valley. Superficial, unconsolidated Quaternary sends and gravels are found in the valleys to a height cf severe1 hundred feet but in many places the streams have cut through them and expose good sections, particularly along Eleven Mile Creek.

On Seven Nile Creek a short section exposes six seams up to two feet in thickness and below the mouth on Carbon River is a seam 4.5 feet thick. On Nine Mile Creek is a seam 5.4 feet thick and on Eleven Mile Creek a continuous section over a mile long was studied and from it most of the data in this report were obtained.

The Eleven Mile Creek section contains 33 outcrops of coal from one inch to 17 feet thick which belong to nine seams of good coal';?.5 feet or more in thickness, and twelve to fifteen seams less than 2.5 feet thick. The nine larger seams have a total maximum thickness of 50 feet in a section 493 feet thick. "Commercial Seams", therefore, comprise 10% of the section, an unusually high percentage.

The structure in this section consists of two synclines or troughs separated by a short terrace or flat 400 feet long. The strata dip from 5 degrees to vertical. Over the claims as a whole only scattered data were found regarding; structure. This data, however, indicates an undulating structure with average dips 'from 5 to 20 degrees. Short abrupt and. often steep folds are likely to be found locally and also some small faults,

C O P Y

REPORT on CARBON RIVER COAL DEPOSITS PEACE RIVER BRITISH COLUMBIA by NORMAN C. STINES

Seattle, Washington
August 25, 1943

CONCLUSIONS:

The detail considerations set out in this Report allow the following conclusions;

1. In the Peace River District between Hudson Hope and Finlay Forks exists a coal bearing area in which two certain - Hudson Hope and Carbon River - and three probable - Pine Pass, Commotion Creek and Ottertail Creek - coal producing basins will be developed;

2. In the Hudson Hope and Carbon River basins enough preliminary geological and other examination work has been done to warrant the statement that in each will be finally proven very large reserves of very high grade coal - low in ash end high in BTUs;

3. In the Carbon River Basin the coal that can be produced will have the following average proximate analysis:

Loss of air drying		2.05%
Analysis on air dried coal:		
Moisture	3.05%	
Volatile Matter	22.96	
Fixed Carbon	71.83	
Ash	2.16	
BTUs per pound		13, 910
Fuel Ratio		3.17
Sulphur		0.77%

4. The coal has other very superior qualities: It is second to none, and far superiex to any competitive coal, in its ability to stand weathering and to resist crumbling and crushing when handled and shipped;

5. In the Carbon River Basin in the six miles of itsknown length there is a minimum area ef twelve square miles underlain by coal and for the probable twenty-five mile length considerably over fifty;

6. On the one stream where detail study has been made are exposed ten coal seams varying from thirty inches to seventeen feet in thickness fox an aggregate minimum of 33.8 feet and a probable maximum of 50.1 feet of coal in 493 feet of coalbearing measures;

7. These ten seams-are almost certain to be found under 6.5 square miles, of the basin and there has not been recorded any observation to indicate that they do not exist under the whole fifty;

a. The two seams designated F and G, with their carbonaceous shale marker, have been followed fax something -over s&miles with good indications that they extend at least three and one-half more, and there is no present reason to doubt their extending for the full probable twenty-five mile length of the basin;

9.. In the presently assumed central portion of the basin the coal seams are proventto extend for a minimum width . of two miles with every indication that it will exceed three;

10. On the basis 'of the observations plotted over a length of six miles it is estimated that there-are practically assured in the F and G seams alone a reserve of 145,000,000 tons with the average analysis given in 3 above; and a fairly probable potential reserve' for all the ten seams in the whole fifty square miles in exeess of 2,700,000,000 tons;

11. 'The conditions under whieh this coal exists are se favorable for its extraction that the cost per ton when producing one million tons annually is estimated at $2.85, and when the production is three million tons, $2.67;

12. The present markets thirsting for this coal extend from Port Arthur in Ontario to all points along the West Coast of North America and at the present time probably aggregate a minimum of five million tons annually,; but with the almost certain rapid curtailment of oil production in California this market should within a few years increase by leaps and bounds;

13. -The high quality of this coal warrants a sale price in its normal market at least fifteen per cent higher than any competitive coal.,. and the average price at which it will probably be sold will net a gain., when selling one million tons' annually, of from $0.45 to $1.45 per toh and,, when selling three, million, of from $0.63 to $1.63;

14. 'To bring this property to a production of one million tons annually wili require $5,100,000 and to reach. three million tons, $12,900,000;

15. Before provision for Federal and State or Provincial Income Taxes, the net profit, when producing one million tons annually, will mean a percentage return varying between 8.8 and 25.8; and when producing three million, between 14.7 and 38;

16. Considered as a coal mining development, this business is fully warranted, but unfortunately there is presently no railway to transport this coal from mine to markets;

17. At an estimated total cost of $13,000,000 - $60,000 per mile - the required 220 miles of mainline - 85 to 110 lb. rail - railroad to connect this basin with the Canadian National at Prince George can be built;

18. Such a railway will not only have the coal output as freight but should also have some 300,000 tons of paper pulp and 600,000,000 beard feet of timber products annually from the Peace and Finlay River areas that it will tap; and if extended easterly to reach the Peace River agricultural district would obtain from that area all the grain that is sold for expert; and

19. To any organization with the finances necessary to provide the railway and mining development required, the writer does not hesitate to recommend the detail study of this prospective business.

Pages 4 and 5.

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In his Report Beltz describes in detail the coal seams exposed in Eleven Mile canyon from Camp Falls west to the forks. It does not seem necessary even to summarize here that description shows that Belts has recognized ten seams of commercial importance. These, with the intervals between, are, from highest to lowest observed.

Seam A	3.4 feet
Interval	100 to 110 feet
Seam B	0.4 to 2.5 "
Interval	10 to 11 feet
Seam C	5.6 feet
Interval	50 feet
Seam D	2.6 to 3.00 feet
Interval	60 feet
Seam E	2.8 to 4.6 feet
Interval	80 to 90 feet
Seam F	15 to 17 feet
Interval	14 feet
Seam G	6.0 feet
Interval	50 to 70 feet
Seam H	4.0 feet
Interval	38.0 feet
Seam I	4.0 feet

Thus out of a total thickness observed of from 436 to 493 feet, there are from 33.8 to 50.1 feet of coal in seams of commercial importance. These are minimum figures as only the lower section of a probable total of about 1400 were seen and examined.

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Again referring specifically to Eleven Mile Creek Canyon he writes:

> "The structure in this section consists of two synclines or troughs separated by a short terrace' or flat 400 feet long. The strata dip from 5 degrees to vertical. Over the claims as a whole only ssattered data were found regarding structure. This data, however, indicates an undulating structure with average dips from 5 to 20 degrees. Short abrupt and often steep folds are likely to be found locally and also some small faults."

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In 1923 several tons of "Gething" coal were rafted down the Peace River to the crossing and a test made by the Edmonton, Dunvegan and British Columbia Railway. In the Appendix (Page 101 et seq.) is a copy of this letter, The important facts are summarized:

	Gething Coal	Canmore Coal
Coal consumed; Lb.	17,872	13,773
Water evaporated - Lv.	142,740	75,750
Water evaporated per Lb. coal	7.99	5.5
Ashpan dumped	once	4 times
Cinders produced; - Lv.	179	860

The following extracts are pertinent:

"The Hudson's Hope gives off an intense heat, burns a clear white flame, burns as freely as Pittsburgh Coal but no smoke; when fire is replenished a few cinders are discharged from stack."

"This coal does not coke but when burning has the appearance of coke. The Canmore coal used in the comparative test was lump coal and a good sample of the best Canmore.

"In the tests with Hudson's Hope coal the grates were not shaken between terminals and a-thin fire was maintained. It was necessary to keep a light fire as otherwise it would have been impossible to control it when engine was shut off."

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QUALITY OF COAL:

ANALYSES:

VARIOUS COMPETITIVE COALS:

Before proceeding to outline the quality of the coal, all based on samples obtained really at the surface, the deepest being four feet, it would seem well to set out the analyses of the other coals with which Carbon River products will have to compete. These are found in Table 1, page 59.

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CARBON RIVER COALS:

In Table 2 are the results of analyzing Carbon River coal; taken by Beltz - the first five; Galloway - the second

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five, and Stines - the last; thirteen. The eleventh and twelfth are probably analyses of specimens, rather than samples, taken by Rochfort and Kitto.

TABLE 1

	LOSS IN DRYING	AIR MOISTURE	VOL. COM.	FIXED CARBON	ASH	S	B T U
Bankhead	0.5	0.5	11.7	75.7	12.-		13,250
Crow's Nest Pass-Dominion'	1.3	0.7	24.9	54.7	19.7	-	11,640
-Michel	1.2	0.7	22.4	65.0	11.9	-	13,260
-Bellevue	0.7	0.2	27.6	56.8	15.4	-	12,370
-Coal Creek	0.9	1.3	26.0	63.8	8.9	-	13,640
Canmore	0.0	0.9	14.0	79.7	5.4	-	14,470
Brazeau	1.0	0.9'	16.5	70.6	12.0	-	13,480
Jasper Park	1.8	0.5	18.8	58.9	21.8	-	11,790
Drumheller	-7.2	8.8	34.6	48.4	8.2	-	10,350.
Mountain Park	1.4	1.9	30.9	62.9	4.3	-	14,400
Nanaimo-Douglass Seam	0.6	1.6	40.6	47.7	10.1	-	12,620
-Newcastle	0.5	1.9	40.7	45.7	11.7	-	12,230

(The above are from Page 16 of James White.)

(The following are taken from Page 20 of same, and are of competitive United States 'Coals):

Indiana Coals	6.0	10.8	35.7	42.3	11.6	3.5	11,280
Georges Creek, Md.	--	1.9	12.9	79.4	5.5	30.3	----
Ohio Coals	3.2	5.3	36.2	48.9	9.6	3.1	12,273
Penn.-Ellsworth	1.0	1.6	35.8	56.8	5.8	0.9	14,013
-Ligonier	3.2	4.1	20.6	63.8	12.5	2.1	13,153
Virginia Coals	2.1	2.7	31.9	61.7	3.9	0.5	14,042
West Virginia Coals	2.3	2.1	27.8	62.8	7.3	1.3	14,130
Utah-Eenilworth		5.01	43.68	46.51	4.80	0.41	12,821
Washington - Carbonado #1		3.38	32.21	49.53	14.88	0.45	12,247
- Bayne #2		5.10	30.80	56.00	8.10	0.36	12,856
- Wilkeson #3		2.50	37.70	61.30	8.50	0.42	13,800~
- Roslyn		3.77	37.69	47.05	11.49	0.47	12,762
West Virginia - Island Creek		2.78	36.06	55.71	5.45	.98	13,997.
Wyoming - Kemmerer		3.94	40.09	49.00	6.97	.60	12,886
- Rock Springs		8.53	35.50	50.39	5.48	0.78	11,883

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TABLE 2

SEAM	THICK-NESS	SAMPLE	MOIS-TURE	VOLATILE COMB.	FIXED CARBON	ASH	S	B T U
	2.0	1 Be.	2 . 8	23.12	66.38	'7.26	0.72	13,060
	5.4	2 "	4.9,	25.74	56.22	13.06	0.73	11,180
E	4.6	3 "	3.7 -	26.90 -	63.88-	5.52	0.58	13,160
xc	5.5	4 "	4.3 -	28.12	64.32	3.18	0.65	12,850
F	6.0	5 "	6.4	24.84	55.10	13.60	0.59	11,010
G	4.5	6 Ga	2.1	22.00	69.40	6.50	--	--
	5.4	7 "	6.5'	24.80'	61.50	8.20	--	--
	2.1	8 "	3.4	26.20'	67.70	2.70	--	--
	1.3	9 "	2.9	23.70'	56.20	17.20	--	--
E	4.6	10 "	4.6 -	25.20	66.60	3 . 6 0	--	--
	--	11 Ro	1.07	23.32	74.28	1.34	--	15,000
	--	12 Ki	1.05	20.80.	77.10	2.10	--	14,800
C(?)	5.2	1 St.	2.12	"21.48	72.95	3.45	0.80	13,950
D(?)	4.1	2 "	2.76	22.14	73.55	P.55	0.66	14,014
B(?)	2.5	3 "	2.92	21.38	74.02	1 . 6 8	0.74	14,012
(?)	4.0'	4 "	2.09	22.91	73.52	1.48	0.74	14,105
B(?)	3.0	5 "	2.76	23.14	72.50	1.60	0.77	14,012
E	4.3	6 "	3.26	24.64	69.90	2.20	0.64	13,888
H(?)	4.0	7 "	3.82	22.08	72.04	2.06	0.77	13,824
G(?)	Float-5'	8 "	2.48	21.42	72.75	3.35	0.77	14,108
G(?)	Float ?	9 "	1.51	20.01	77.32	1.16	0.64'	14,635
? F	5.3	10 "	4.30	2 5 . 6 0	61.75	8.35	0.74	12,533
?	3.0	11 "	4.48	21.42	68.40	6.70	0.72	12,989
G(?)	5.4	12 "	3.62	21.65	72.47	2.28	0.68	13,841
X ?	2.2	13 "	4.13	27.27	65.50	3.10	1.10	13,547.

Page 62 and 63

The writer believes that his thirteen samples are more representative of the carbon River coals than the others. Rotwithstanding that, Beltz's and the writer's results are compared, The averages for each and both combined are:

	BELTZ'S	STINES	BOTH
Samples	5	13	18
Moisture	4.42	3.09,	3.48
Volatile Matter	25.74	22.70	23.55
Fixed Carbon	61.19	71.28	68.47
Ash	8.60	2.92	4.30
Sulphur	0.61	0.75	0.71
B. T. U.	12,252	13,804	13,373
Fuel Ratio	2.38	3.14	2.90

The controlling difference is in the ash content -- about three times as high in Beltz's samples. Due to this over half of the lower fixed earbon in his is accounted for. Belts explains the high ash content as due in large part to clay that had infiltrated into the outcrop, whioh is what he sampled. Certainly the average of these 18 samples (the last column above) is the poorest that could be expected from this field.

As remarked when the details of the writer's sampling were given, numbers 8, 9, and 11 were not samples, rather specimens, and 10 was of an outcrop which showed at the top crushed coal into the seams of which clay had infiltrated. Therefore only the other nine are really 'representative and the average of the proximate analyses of these is:

LOSS en air drying		2.05%
Analysis of air dried coal:		
Moisture	3.05%	
Volatile Matter	22.96%	
Fixed Carbon	71.28%	
Ash	2.92%	
BTU per pound		13,804
Fuel Ratio		3.14
Sulphur		0.75

Pages 63 and 64

On the basis of analyses, this is an outstanding low ash and sulphur and high heat value coal for all purposes, except coking. Sample 1 showed a poor coking quality and sample 8 only fair. On the basis of the ash content of the coal, any coke that would result could not be expected to be very strong.

The fact that none of the samples showed coking qualities comparable to that one piece' coked in the Ten Mile Camp fire is surprising. As noted later, when giving McLearn's results on the Grant seam of the Hudson Hope sub-basin, one stratum of a seam may be coking coal, while the balance is not. No sampling by strata was done on Carbon River Seams.

Before leaving this matter of coking quality, the writer has found that often the mixture in proper proportion of a high volatile and a low volatile' coal, each by itself non-coking, produces an excellent coke. In the Urals of Russia a fine coke for irbn smelting was made by mixing 60% of a fat coal from Minusinsk with 40% of an anthracite from the Urals. Undoubtedly it is only a question of a relatively small amount of research to find the proper mixture of one of the low grade high volatile and ash Pacific Coast coals or petroleum refined'residue and this Carbon River coal to give the desire result. The problem of making a high grade coke from this coal should not be a difficult one to solve.

h composite sample mads up of equal parts of samples 1, 2, 6, 7, 12 and 13 was sent to Ledoux for both proximate and ultimate analyses and the results will later be added to this Report.

HUDSON HOPE COALS:

In the second reference given under acknowledgments McLearn describes in detail the coal seams exposed on the Gething property and the Hudson Rope area. In that Summary he gives several analyses of the various seams he sampled. These are gathered in Table 3.

TABLE 3

	MOISTURE	VOL. MATTER	FIXED CARBON	ASH	S	B T U
Main Gething Creek	1.6.	26.0	64.0	0.4	0.5	13,350
North Branch Gething Creek	1.0	24.5	65.9	8.6	0.7	13,820
Average of 3 main Gething Creek	1.0	24.6	70.7	3.7	-	-
Little Mogul	2.7	24.3	62.5	10.5	-	-
Mogul Creek	1.2	22.9	71.3	4.6	-	-
Earle Narrows	1.4	22.7	71.7	4.2	0.9	14,220
Moosebar	2.3	21.2	73.0	3.5	-	-
Grant Seam						
300' W of x cut-Lower 9"	0.6	23.6	72.4	3.4	-	-
-Upper 5'	0.8	20.4	75.4	3.4	-	-
Cliff Ent. To West x Cut-Bot. 11"	0.7	24.6	72.6	2.1	-	-
-Upper 4'6"	0.6	18.7	78.1	2.6	-	-
35' in tunnel -Bottom 8"	0.7	2z.o	70.8	6.5	0.7	14,440
Yid. 23"	0.6	19.5	77.0	2.9	0	14,940 7
Top 38"	0.7	19.6	74.4	5.3	0.7	14,420
Tunnel at x cut-Bot. 9"	0.7	22.9	74.0	2.4	0.7	15,130
Mid. 20"	0.8	19.3	77.3	2.6	0.7	14,960
Top 36"	0.7	18.7	74.5	6.1	0.6	14,300
Face Tunnel Q-26-23 Bot. 9"	0.6	24.0	75.2	2.4	-	-
Mid. 22"	0.6	19.5	77.3	2.6	-	-
Top 32"	0.6	20.1	75.2	4.1	-	-
(The bottom stratum makes good coke)						
Riverside	0.7	18.8	74.9	5.6	0.8	14,400
Galloway's sampling*						
Upper 18"	0.8	18.9	76.6	3.7	0.8	14,590
Lower 30"	0.9	19.3	76.i	3.7	0.9	14,550

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By eombining the last nine analyses in groups of three, the averages for the three strata sampled and for the Grant seam become:

	MOISTURE	VOLATILE	FIXED CARBON	ASH	B.T.U.
Bottom 8.7"	0.67	23.23	73.33	3.70	14,785
Middle 21.7"	0.67	19.43	77.20	2.70	14,900
Tep 35.3"	0.67	19.47	74.70	5.17	14,360
Whole Seam	0.67	20.00	75.24	4.09	14,583

With that as the average for the Grant seam and taking the figure in Table 3 for the other seven seams, then the average for the Hudson Rope sub-basin is:

Moisture	1.48%
Volatile Ratter	23.24%
Fixed Carbon	69.38%
Ash	5.90%
Fuel Ratio	5.98 2.98

By referring to the calculated average of Stines' thirteen samples (page 63) the very great similarity of the analyses of the coal from the two sub-basins is seen. The difference in fixed carbon is practically the difference in the ash content. The Grant seam coal, on basis of BTU, is very superior and contains coal between bituminous and anthracite in character.

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OTHER QUALITIES:

The characteristics of the Carbon River and Hudson Hope coals are so similar that the discussion of the other qualities applies equally to both. McLearn's statement: "..... an ideal coal for all purposes, burns readily, is smokeless and gives a high heat*, used in describing the Hudson Hope coal applies equally to that from Carbon River. The same is true of his conclusion that it 'is the "equal of the best Welsh and West Virginia coals, does hot weather and, owing to its compactness, stands shipping very well."

ASH CONTENT:

An ash content of 5.90% for the Hudson Hope and 2.92 fer the Carbon River puts these coals, from the point of'view of transportation cost per unit of heat value, in a class by themselves. This isparticularly important in a field so far

Page 66 cont'd. and page 67.

from its present markets as this one is. The relation of the ash content of a coal to the matter of equipment required to produce a given amount of heat is well set out by James White on Page 31 of Fuels of Western Canada:

> "In the United States, the non-preventable ash content of clean bituminous coal varies from an average of 6 per cent in Wyoming coal to an average of 16 per cent in Colorado and, for the whole country averages about 10 per cent. In good practice, 10 boilers of 500 h. p. capacity each will generate 300,000' lbs. of steam per hour with coal carrying 10 per cent ash. If, however, the coal carry 15 per cent ash - 5 per cent more than normal - it will require 15 boilers to generate the same amount of steam, If it carries 21 per cent of ash, it will require. 20 boilers to do the same work."

In the matter of transportation the higher the ash content, the greater the freight charge on the heat actually produced from burning a ton of the product. The analyses show that the "non-preventable" ash content of the Carbon River coal is low and it is thus exceedingly important for this area that only "non-preventable" ash be shipped. If' proper means of cleaning the coal are taken, there is no reason why the ash content be kept below 3.5 per cent for Carbon River and 6.5 for Hudson Hope. Where the average of the ash content of the competitive coals is around 12 per cent, the saving in coal, for the same steam production, will be 20% by weight. This is a measure of the extra price, as compared to competitive coals now on the market, that may be obtained for this coal due to its low ash content alone.

WEATHERING AND ABILITY TO STAND SHIPPING:

Since these two qualities are related, they are discussed together. These factors are very important in determining desirability of a coal and therefore its selling price. In these two respects Carbon River coal stands second to nene and is so far above all competitive coals, except West Virginia and Welsh products, that no comparison is warranted.

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That this coal can stand weathering is attested by the outcrop of the coal represented by Sample 6 and shown on Photo No. 11. Where that sample was taken the seam is on the. north. wall of Eleven Mile canyon about 40 feet above present stream level. The time necessary for that stream to cut that depth of hard sandstone is measured in centuries not days. The fact that

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the coal outcropping there is still absolutely unweathered and hard and compact emphasizes its resistance to weathering. Another piece of evidence is the existence of bright rounded pieces of coal in the gravels of every stream. Such a resistant coal is excellent for stock piling as it will not deteriorate in the relatively short time the longest period it will be likely to remain in such piles.

This ability to stand weathering is a very important factor in determining desirability and therefore selling price of a coal. In this quality Carbon River coal stands second to nene and *is* so far above'that of competitive coals (except West Virginia and Welsh) that no comparison is warranted.

Its ability to withstand crumbling and breaking when handled is another desirable quality. This coal is very hard and difficult to break into small pieces. This not only means less breaking into fine pieces when handled during' shipping, but a larger percentage of "lump" from "run of mine". As "lump" commands a premium in price of from 25% to 30% over that for "run of mine" this means a higher average price for the output as a whole.

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On the basis of these sets of observations the writer concludes that the Carbon River coal field occupies a basin striking about N 13 degrees W. Its length has been definitedly preven by coal outcrops plotted of over six miles, and inferentially 'for eleven and one-half. The presence of float for twelve miles further to the south and the coal outcrop below Five Mile Creek, a further one and one-half mile north, suggest the probable minimum length of the basin to be 25 miles.

Again by observations plotted its proven width in the six mile proven length is in excess of two miles and it may be inferred at probably three. Relying wholly on topography both north and south of those six miles that width extends for a least thirteen miles and most likely for the additional twelve miles to the south as well.

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Thus the area oh the basin may be stated to be:

Proven . 12 square miles;

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Probable	14 square miles;
Likely	24 square miles;
Total	50 square miles.

TONNAGE OF COAL:

CARBON RIVER:

As is evident from this Report no coal can be said to be proven., Rut on the geological evidence observed, recorded and plotted it is clear that one is justified in eoncluding that coal is commercial seams(30" plus in thickness) exists in very large quantities. From that evidence one would seem warranted in trying to arrive at figures which would represent the tonnages that one can'confidently expect in the various areas into which the basin arbitrarily is divided.

MOST PROBABLE:

St would seem that from Nine Mile creek to the south and of L 319 and 320 - a length of approximately 3.25 miles and a width of two - there exist the ten seams Belts has plotted. This is an area of 6.50 square miles.

Beltz's work shows from 33 to 51 feet of workable coal in the 500 foot section of coal bearing strata, which would mean from 38,000,000 to 59,000,000 tons per square mile or a total of between 247 and 383 million tons of potential coal.

The writer has traced the F-G seams and marker for a length of about 6.5 miles and with Beltz's work shows them to exist over a width of two far an area of 13 square miles. While the F seam has a maximum thickness of 17 feet , observations at various places. show that this large thickness is at times only 4.5 feet of clean seal and for purposes of this analysis that is taken as the average over the area. The G seam lies 14 feet lower and varies from 5.3 to 6 feet in thickness. Assuming 5.5 as an average, there are in the two seams.10 feet of coal, which would mean a minimum of 11,150,000 tons per square mile - if horizontal - for a total of 145,000,000 tons. This quantity of potential reserve the writer considers assured beyond any reasonable doubt.

SLIGHTLY LESS PROBABLE:

From Nine Mile Creek north to the coal opposite the Seven Mile cabin is approximately 2.50 miles. From the south

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end of L 319 to the most southerly seen outcrop is about 3.25 miles. For these additional 5.75 miles over a width of two, there would be an additional 11.5 square miles. If all the seams are proven to underlie this, there would be therein from 437 to 678 million tons.

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FAIRLY PROBABLE:

North of Seven Mile cabin the coal beds apparently extend for about 1.5 miles. South of the last known outcrop . coal float is found in the gravels for 12.5 miles. Thus for fourteen miles at the ends, coal might be found and if all the seams exist, there could be an additional reserve underlying some 28 square miies which might contain from 1,065 to 1,652 million tons more.

SUMMARY:

Thus the potentialities may be expressed.:

MOST PROBABLE	145,000,000 to	383,000,000 tons
SLIGHTLY LESS PROBABLE	From 437,000,000 to	678,000,000 tons
FAIRLY PROBABLE	From 1,064,000,000 to	1,652,000,000 tons
Totals	1,646,000,000 to	2,713,000,000 tons

Even the assured minimum of 145,000,000 tons makes this a most worthwhile reserve and the maximum expectancy of nearly two and seven-tenths billion tons would rank it as one of the most important coal fields of Western North America. The writer realizes that the above estimates are based on only a preliminary set of observations but feels confident that further detail study will confirm them.

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MARKETS AVAILABLE:

As shewn under "Quality of Coal" the coal products from this area are so superior that they can compete with any

'Page 80 cont'd, Page 81. page 82.

coal in North America. Therefore its markets extend not only all along the Pacific Coast, but also to the Canadian markets to the east as far as Port Arthur, at the Western end of Lake Superior. On the basis of its low preventable ash content alone it ean capture that market at a premium in price of at least 15%.

Then in many cases the haulage differential will be in favor of this coal. The Utah and Wyoming coals have to come by rail about 1300 miles to Seattle; 1200 miles to Portland and 900 to San Francisco. The Carbon River coal has all rail of 871 miles to Seattle and to Portland of 1060 miles. If rail and water are used the distance to Seattle will be 790 by rail and 600 by water;. to Portland, '800 and 900; to San Francisco, 800 and 1600, respectively. For the Canadian market, West of Lake Superior, the West Virginia coals have to come 1600 miles against 1400 frem Carbon River.,

The above is-only for the relatively small non-industrial market. Since the war coal consuming industries have been built on the coast; Kaiser's iron plant at Fontana and many others along the Columbia. The former requires coke which with research successfully completed can be cheaply made from this coal. If this coking operation is done near any large eity, the by-products alone may be sold for a very large revenue.

It is realized that at present practically all the gas 'used along the Pacific Coawt comes from low grade oils or refinery waste products but unfortunately for the United States their potential oil reserves are being depleted very rapidly and it seems well within reason that within 15 years other fuel sources will have to begin to be called on and within 30 years eoal will largely replace oil for the making of gas for domestic use and lubricants and fuel for internal combustion engines,

Then there is the Alaska market. While Alaska has large reserves of lignite coal it does not produce enough of the right kind of coal for its ewn use and this year (1943) is importing coal rail-hauled from West Virginia to Pacific Coast ports for water delivery to Alaska sea ports.

There is the Canadian market east of the Rockies. As shown under transportation it is only 709 miles via Prince George by rail from the mquth of Carbon River to Edmonton - the gateway to the prairie provinces. In 1938 the Prairie Provinces and Ontario, West of Lake Superior, imported over 2,000,000 tons of coal, most of it from Pennsylvania and West Virginia. As shown under "Quality of Coal" those coals average about 10% ash against 3.0 for Carbon River.

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EDMONTON, DUN-VEGAN AND B.C. RAILWAYS COMPANY

McLennan, Alberta.

October 26, 1923.

699

Mr. J. A. McGregor,
Manager,
Edmonton.

Sear Sir:

In connection with the test of coal received from Gethings mine at Hudson Hope, I have the following report to make:

1 cu. ft. Hudson's Hope coal weighs 50 lbs. as compared with Canmore 54 lbs.

On October 1st, east way freight engine 6 left McLennan with.21502 lbs. Hudson's Hope coal on tender. This engine had a full tonnage train 1160 tons leaving and from Kinuso to Smith 1375 tons, arriving at Smith a distance of 132 miles, and an elapsed time of 17 hours and,45 minutes, there was a large amount of coal still on tender and I decided to try and make return trip to McLennan.

After resting at Smith we left Westbound with 1050 tons. On arrival at Kinuso there were 3750 lbs. of 'coal on tender. The evaporation test for the trip is as follows;

eoal consumed	17852 lbs.
water evaporated	1 4 2 7 4 0 lbs.
water evaporated per pound of coal	7.99 lbs.
miles run 193	
elapsed time 33 hours.	

Fire was dumped at Smith in order to caulk engine. On the entire trip ashpan was dumped only three time, the residue from ashpan weighed 674' lbs. This was largely unconsumed coal which had dropped through the grates on account of the large openings. Grates are finger grates.

The cinders taken from ashpan at Smith weighed 179 lbs. They were afterwards burned-in a heating stove and the resultant ash weighed 67 lbs.

On October 15, engine 6 on way freight left McLennan with 26428 lbs. Canmore run of mine on tender hauling a train of 1050 tons arriving Smith with 1160 tons.

The evaporation test as follows:

coal consumed	13773 lbs.
water evaporated	75750 lbs.
water evaporated per lb. of coal	'5.5 lbs.

miles run 132, elapsed time 12 hours.

Ashpan dumped four times weight of ash and cinders 860 lbs. These tests were made without any change in the draft appliances. After increasing the exhaust tip from 4 7/8" to 4 ¾ another test of Hudson's Hope was made on October 18th with the following results:-

coal consumed	10202 lbs.
water evaporated	78810 lbs.
water evaporated per lb. of coal	7.65

miles run 1 3 2
elapse time 14 hours:

Residue from ashpans dumped at midway on trip and at terminal 400 lbs. this as on the former test being largely unconsumed coal.

The Hudson's Hope gives off an intense heat, burns a clear white flame, burns as freely as Pittsburg Coal but no smoke, when fire is being replenished a few cinders are discharged from stack.

This coal does not coke but when burning has the appearance of coke. The Canmore coal used in the comparative test was lump coal and a good sample of the best Canmore.

In the tests with Hudson's Hope coal the grates were not shaken between terminals and a thin fire was maintained. It was necessary to keep a light fire as otherwise it would have been impossible to control it when the engine was shut off.

Yours very truly,

(signed) "M. W. Boucher".

Assistant Superintendent.

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CANADIAN PACIFIC RAILWAY COMPANY

Chateau Lake Louise

File 26

Lake Louise, Alberta,
29, 1925.

CONFIDENTIAL

C. F. T. Rochfort; Esq.,
Roohfort Bridge,
Alberta.

My dear Rochfort:-

Our Bead Office has written me as follows: "The information which you submitted to Mr. Ussher with respect to the Peace River coal deposits is very interesting particularly when considered in conjunction with 'data which the Company has already obtained on this subject. There seems to be no question whatsoever about there being very large quantities of coal of excellent quality not only in the locality to which you referred particularly but also in surrounding territories. The two prineipal difficulties *in* the way of realizing the benefits of development are, of course, lack of transportation and the matter of markets. I have no doubt you are familiar with features of the Western coal situation having to do with the production capacity of the existing mines and the demand for Western Coal. Sinee receipt of your communication to Mr. Ussher however I have had some correspondence with Mr. J. A. Macgregor, Manager of the Edmonton, Dunvegan and British Columbia Railway Company and quote below for your information, a letter which he recently addressed to me on the subjeet:.

'"With regard 'to the attached correspondence which accompanies' your letter of March 30th, I might say that the Carbon Creek (river) coal seams are quite close to the Gethings Creek deposit and in our investigations we cover both by the general term "Hudson's Hope" as both creeks run *into* the Peace River in the rapids near Hudson's Hope".

In 1923 seem thirty odd tons, from the Gethings mine were delivered to us at Peace River grossing for test purposes and from a sample of the same the Milton Hersey Company gave us the following analysis:

Poisture	1.20
Vdlatile	15.00
Fixed Carbon	79.00
Ash	3.10
B.T.U.	14.446

The results of the test on locomotives is well explained in the attached letter from my Assistant Superintendent who travelled on the engines and personally supervised the tests.

Further tests were made by the Canadian Pacific in the Calgary District from ten tons which we sent to them to try out in "Baker" heaters and in dining cars. In the former it gave good satisfaction but required careful watching to prevent overheating. In the dining cars it acted well when trains were standing still, but when running even with all drafts closed, the heat was too great and the top of ranges and ovens were too hot for good cooking. This was confirmed by tests in my own car; however, a remedy could no doubt be found in firing lighter and by special drafts.

I asked the Gethings mine to let me have 100 tons early in June for further tests for which we would pay $8.00 per ton at Peace River but do not think they can deliver at that price at a profit.

If the mines were close to rail transportation the coal would command a high price either for steam or domestic purposes but it is too far away; further, the first fifteen miles of the river trip is through rapids, dangerous at all times but particularly so when the water is low.

The newspaper clippings attached are greatly exaggerated and were contradicted by me at the time of publication."

I want you to treat this as confidential and would explain that they do not ask for further information, or hold out any encouragement. The first question that suggested itself to me was: is the Gethings coal as good as yours, and is it in as large quantities?

I Hope all goes well with you, the little family and the white faces, and Mrs. Gardon and I are wondering when you migrate to your new Cadboro Bay home.

Kindest regards,

Yours very truly,

"Basil Gardon".

Page 105. CARBON RIVER COAL CLAIMS

SUMMARY AND CONCLUSIONS------

This reconnaissance examination of the Carbon River Coal Claims was made during the first two weeks of August, 1928, and consisted of stratigraphic studies, measurements of sections, correlation and the taking of samples. Detailed maps, cross-sections and columnar sections were compiled and accompany this report.

The claims are situated in the Rocky Mountains, 35 miles west of Hudson's Hope, B. C. They lie between 2200 and 3500 feet elevation on the-well timbered lower slopes of the range on the west side of Carbon River between Seven and Eleven Mile Creeks.

The rocks exposed in the area belong to the Bullhead Mountain formation, of Lower Cretaceous age and consisting of about 3000 feet of coarse sandstones and conglomerates at the base, and more than 500 feet of interbedded find sandstones, silts, shales, and numerous coal seams at the top. The Upper or Gething Member occurs in a syncline or trough with a number of subordinate folds, and parallels the Carbon River valley. Superfieial, unconsolidated Quaternary sands and gravels are found in the valleys to a height of several hundred feet but. in many places the streams have cut through them and expose good sections, particularly along Eleven Mile Creek.

On Seven Mile Creek a short section exposes six seams up to two feet in thickness and below the mouth 'on Carbon River is a seam 4.5 feet thick. On Hine Mile Creek is a seam 5.4 feet thick and en Eleven Mile Creek a continuous section over's mile long was studied and from it most of the data in this report were obtained.

The Eleven Mile Creek section contains. 33 outcrops of coal from one inch to 17 feet thick which belong to nine seams of good cdal2.5 feet or more in thickness, and twelve to fifteen seams less than 2.5 feet thick. The nine larger seams have a total maximum thickness of 50 feet in a section 493 feet thick. "Commercial Seams", therefore, comprise 10% of the section, an unusually high percentage.

The structure in this section consists of two synclines or troughs separated by a short terrace or flat 400 feet long, She strata dip from.5 degrees to vertical. Over the claims as a whole only scattered data were found regarding structure. This data, however, indicates an undulating structure with average dips from 5 to 20 degrees, Short abrupt and often steep folds are likely to be found locally and also some small faults.