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Consolidated
Gold Alluvials of British Columbia
Limited

REPORT

ON

LIGHTNING CREEK PROPERTIES

BY

D. CAMPBELL MACKENZIE, M. Inst. M.M., M.A.I.M.M.
General Manager and Technical Advisor

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NOTE:—Certain plans and Section M of the original report have not been reprinted, for the sake of brevity.

January 12th, 1935.

The Chairman and Directors,
CONSOLIDATED GOLD ALLUVIALS OF B. C. LTD.,
708 Vancouver Block, Vancouver, B. C.

Gentlemen:—

I have the pleasure of submitting my Report on your extensive properties located on Lightning Creek, in the Cariboo District of the Province of British Columbia.

The Report is divided into two sections: the first, a resume of operations carried out from the time I assumed control on July 4th, 1934, up to December 31st, 1934; the second section of the Report will deal generally with the potentialities of the property as a whole, and particularly with the Wingdam Section, which has been extensively drilled.

My contract with your Company, made in London, dated May 22nd, 1934, called on me to leave England about the middle of June to take full charge of your mining operations. It was made perfectly clear that I was to carry out the work of mining the deep "gutter" deposits of Lightning Creek, by the well established and standardized Australian method.

For many years work on Lightning Creek has been delayed, interrupted or postponed, owing, in my opinion, to the following causes:—

- (a) Complete absence of a well thought out policy of underground mining development.
- (b) Inadequate power scheme. In this connection, the use of an expensive steam raising plant, coupled with the high cost of fuel, was responsible for the expenditure of many thousands of dollars, with a consequent high power cost factor for every mechanical operation that was carried out at the mine.
- (c) Lack of co-ordination of drilling records. It should be noted here that, while many holes were bored, quite a number of them were put down with insufficient regard for proper sectionalizing.

To these points it should be stated that, although some millions of dollars have been spent on Lightning Creek during the course of the last thirty years, this money came in in "drips" and "drabs", with the consequence that a co-ordinated policy of development was hardly possible.

I suggest that in the course of my Report it will be shown that the potentialities of Lightning Creek are so great, that you are justified in spending the money which is recommended, and I feel sure, that with a well directed scheme of development, your property at Lightning Creek should develop into one of the biggest mining concerns in the Province.

In this connection, I feel so confident that I can bring your property to successful and profitable production, that I have decided to cancel my other contracts and stay at the mine, at least until that stage is reached.

Yours faithfully,

"D. CAMPBELL MACKENZIE"

D. Campbell Mackenzie, M. Inst. M.M., M.A.I.M.M.
General Manager and Technical Adviser.

**Summary of Operations Carried Out at Lightning Creek,
the Property of the Consolidated Gold Alluvials of B. C. Limited,
From 4th July, 1934, to 31st December, 1934.**

(a) PRELIMINARY INVESTIGATION

When I arrived at the mine at the beginning of July, 1934, I found a crew of some fifty or sixty men carrying out a surface building programme at the Wingdam Section of the property.

In addition, a Number 3 Keystone Drill of antiquated design had just been started to drill the first hole on the "H" line. The drill, although 30 years old, was skilfully operated by foreman driller William Brown and two assistants.

In company with Messrs. Sanderson and Unverzagt, I made a preliminary inspection of the Wingdam Section. Later I traversed the whole of the property from Cottonwood up to and beyond Stanley.

I found that a new Pomona Pump of 1,000 U.S. gallons per minute capacity had just been installed in Number One Shaft. This pump was belt driven from a horizontal steam engine. It started up on the afternoon of 3rd July, and has been working practically without cessation ever since.

I was pleased to note that the Company owned a saw milling plant capable of turning out about 10,000 board feet per day.

The shell of a new bunk house of four floors, and capable of housing 100 men, was completed, most of the lumber coming from the Company's saw mill. This building was on the site of the one previously destroyed by fire, and although built without drawings, it seemed a good job, reflecting great credit on the foreman carpenter. The other main buildings at Wingdam Camp consisted of the following:—

No. 1 bunk house, brought up in sections from Vancouver, and containing, in addition to the sleeping rooms, the kitchen, dining hall and merchandise store.

Assay house, not lined, and unsuitable for a rigorous winter.

Roadside garage, not deep enough to take the Company's motor trucks.

Carpenter shop, one of the oldest buildings in the Cariboo.

Barn or stable, another old building, housing the Company's very fine team of horses.

Bunk house at No. 2 Shaft, a good rough building, but too near the No. 2 Shaft.

The mine office, a very old building with bedrooms. This house is most unsuitable for an office, and a more suitable building should replace it.

A lot of money must have been spent in building the two large shaft houses at No. 1 and No. 2 Shafts.

It seems a great pity that the poppet-legs over the shafts are much too low for economical handling of the gravels, when mining starts. Modern practice is to have the landing brace at least forty feet above the ground level instead of six feet, which is the maximum height at the shafts just described.

In addition to the buildings noted above there were various smaller sheds of a useful size for storage of pipes and oils.

No costing system was in vogue at the mine; the fortnightly pay sheets being made up from the daily time cards by Mrs. Hunger, and it speaks volumes for this girl's attention to detail that very few errors, and those of a minor character only, were found in checking through.

Before I took over, I noticed a spirit of unrest amongst the men, due in a large measure to the fact that their wages were in arrears.

On this matter being put right and a settled policy agreed on, the team brightened up and work went on apace.

I am glad to state that I found the commissary departments in first class order. The kitchen and mess hall were kept scrupulously clean, and the meals were generous and well cooked. This I attributed to the close and friendly liaison kept up between the head cook, Charles Wright, and the store manager, John Morrison.

After a close survey of the property and a perusal of all available data, including reams of material from Mr. Unverzagt's notes, the following tentative policy was decided on:—

- (1) The sinking of a main working shaft on the site of the old Jones Shaft, which is ideally positioned in the rim-rock.
- (2) Installation of a modern power station with Diesel prime movers.
- (3) Acceleration of the drilling programme by the purchase of at least one new drill.
- (4) Examination of the possibilities of the elevated terraces along Lightning Creek with a view to hydraulicing.
- (5) Clearing out of the No. 1 Shaft, with a view to examining it for future work.
- (6) Inauguration of a costing system at the mine, with sufficient detail to show the progressive cost of development.
- (7) Completion of the new bunk house.
- (8) Installation of a fire service throughout the main camp.

- (9) A detailed surveying and levelling programme to include correlation of all boring records. With the exception of the No. 2 underground workings, no reliable plans or levels were available.
- (10) A general geological survey of the Company's property.
- (11) The drainage of the No. 2 Shaft inter-glacial deposit to start after the installation of the power house.
- (12) The stabilization of the Company's leases.

Detailed description of all work performed since I have been in charge have been given in my regular weekly cables and monthly reports, but the following brief resume is of interest in summing up the work done, and its relation to development of the field.

(b) MELVIN SHAFT

The Melvin Shaft is a four compartment, main working shaft, close timbered all the way and conforming to the interleaved sketches and specifications.

The old Jones Shaft was cut over by the new shaft, but unfortunately, in passing the old level off the Jones Shaft, considerable trouble and delay was caused owing to fine sharp sand (carried in suspension in the water) wearing out the pump parts with such rapidity as to seriously interfere with the progress of sinking.

I am pleased to report that this trouble all seems over, and we are expecting better sinking during January, 1935.

The shaft was sunk and close timbered to 161 feet by 31st December, 1934.

Allowing for ample sump room, this shaft will be sunk to an ultimate depth of 280 feet, which our survey indicates will give our main reef drive 30 feet of cover one mile down stream.

The total cost to December 31st of this shaft, including preparatory work, sinking, timbering, shaft house, poppet head gear, and drill sharpening was \$10,190.38.

(c) No. 1 SHAFT

The new Pomona Pump started in this shaft on the 3rd of July. On the 6th of July pump was lowered two feet, six inches, and another inspection was made of the shaft.

Under July 3rd, I have the following note in my diary:—

“Old timber badly out of place. Think it too much of a gamble to use this shaft for “developing. Much prefer Jones old shaft, which is in hard rim-rock after 25 feet.”

By July 9th we were able to get miners to the bottom of the shaft, and started to clear out accumulated silt.

After careful study of this No. 1 problem, relative to getting out a bulk test, I decided that it would be too risky to break through the bulkheads until the power station was installed. I learned that several attempts had already been made to enter the gravels from this shaft with the result that at least two known “caves” had occurred, one of which reached the surface.

At beginning of November started to deepen the No. 1 Shaft, preparatory to driving out a lower drive in rock to the “gutter”.

By December 31st had carried out the following work in this shaft:—

Crosscutting	10 feet
Sinking winze	23 feet
Crosscutting under shaft	25 feet
New level (No. 1 Shaft) in rock.....	164 feet

The total cost of this work including repairs to shaft, putting in guides and cage, driving and sinking, was \$2,416.81.

(d) HYDRAULIC OPERATIONS

On the recommendation of our geologist, Mr. Alex Warneboldt, a party of seven men in his charge commenced testing the auriferous benches on the south side of Lightning Creek below Wingdam. This work was started on July 5th, and by September 31st, test pits with depths totalling 402 feet had been sunk by hand methods.

The information furnished by these tests was so encouraging that it was decided to make a bulk test of a portion of this area.

For this purpose a bulk testing plant was obtained, consisting of a Hall-Scott 100 H.P. petrol engine, and a centrifugal pump with a capacity of about 2,000 gallons per minute. The plant functioned very satisfactorily—pumping water direct from the Creek to the monitor, where sufficient pressure was developed to move up to 300 yards of gravel per day.

This whole plant can be readily moved, and any likely section can be tested to determine whether the values would warrant obtaining water from elevated creeks.

The hydraulicing was carried on continuously from September 11th to November 14th with clean ups on the 1st and 9th of October, amounting to 13.6 ounces. The final clean up

was started on November 14th, but since the bed-rock was found to slope away from Lightning Creek, it was not possible to force the gold into the sluice boxes. The result was that a large amount of gold was left in the pit. Tests taken as the hydraulicing progressed, as well as tests taken of the gravels in the pit, indicated a very good clean up. To raise this gold, a jet elevator was made in our shops, but before it could be used, the weather turned cold and everything froze up.

While it was unfortunate not to be able to recover the gold, the fact that this bed-rock sloped away from the Creek indicates another old channel or "gutter". This has been investigated somewhat and undoubtedly will carry good values in pre-glacial deposits.

The cost of this work up to November 16th was \$4,417.75.

(e) BIG BONANZA OPERATION

Following the discovery of an elevated pre-glacial channel or "gutter" at a slight elevation above Lightning Creek, on the Bonanza Placer Claim, arrangements were made to mine the same by drifting. In the middle of October a camp of fourteen men was established there, and the operation was commenced following the approved Australian method of drift mining. As the channel is above the level of the Creek, drainage is not a serious problem. The overburden is characteristic of the Cariboo, being sand, gravel and slum, all of which stand up very well after the water is removed, and permit safe working.

The method of mining adopted is the "Welsh Bord" single entry method with one main timbered drive. Wings are taken out on either side, and are kept up to the face of the main drive, thus making a single face the full width of the old channel, in this case averaging about thirty feet. The overburden is back-filled into the wings, thus permitting the extraction of the wash gravel without the necessity of removing any of the overburden from the mine.

This operation is in the nature of a test to ascertain whether it would be possible to continue this class of mining throughout the severe Cariboo winter, also to establish working conditions when the main "gutter" is entered at the Melvin Shaft, and plans were laid accordingly. As the drainage from the mine is not sufficient for sluicing purposes, a covered flume or head-race was constructed, extending 450 feet up the Creek to the intake which was protected with wing dams. The sluice boxes are housed in a specially constructed heated building, but no attempt was made to heat the water. So far this winter the whole system has functioned perfectly, and there was no trouble in carrying on operations during the recent cold spell when the temperature sank to 35 degrees below zero.

This is the first attempt in this country to adopt the "long wall" method of mining for the extraction of wash gravel, and as far as I am aware it is the first successful use of creek water during the winter for sluicing.

The main drift has been extended 360 feet and terminates on a higher bench. Our geologist is confident the main "gutter" lies to the north, and we are prospecting to locate the same.

Two varieties of gold have been recovered, Tertiary deep channel gold (coarse and nuggety), and bench gold (reddish, flaky and coarse).

Up to the end of the year, 600 cubic yards had been removed from the workings, and the total costs to that date was \$4,206.81. The total gold recovered amounted to 50 ounces.

The property was recently visited by the Inspector, Mr. Jackson, of the Department of Mines, and he reported his entire satisfaction and approval of all the operations under way, and was enthusiastic about the method adopted at the Big Bonanza. He expressed the wish that it might be generally adopted in the district.

(f) PUMPING REPORT

Immediately on my arrival here, preparations were made to de-water No. 1 Shaft and drifts. The pump, a Pomona centrifugal, with a capacity of 1,000 G.P.M., was put in operation July 3rd, using steam power. This pump has run continuously since that time. As soon as electric power was available from our power station, this pump was equipped with an electric head and the steam power discontinued.

As soon as required pumping was started in the Melvin Shaft. As electrical power was not available at that time, two old steam pumps, a Cameron and a Worthington, which were on hand, were utilized, and pumping was started on August 22nd. Later a Pomona sinking pump with a special motor head was installed.

With the completion of the power station, a transmission line was run to No. 2 Shaft, a distance of approximately a half mile. A 75 H.P. motor was installed to drive the Layne and Bowler Pump, already installed in that shaft. Heretofore, this pump had been driven by a steam turbine head, which was removed and the pump fitted for the new drive.

This pump was put in commission on December 17th, pumping about 1,600 G.P.M., and has been operating steadily since that time. It is estimated that the mine will be de-watered by the end of January.

During the six months covered by this Report, a total of 126,799,910 gallons of water were pumped from these three shafts. Close check was kept on the pumping costs, and it was found that by using steam, the cost varied from 13.4c to 14.4c per 1,000 gallons, while by using power from our new power station, the cost was reduced to as low as 2.83c per 1,000 gallons.

As pumping costs as high as 7c per 1,000 gallons are considered reasonable, our low costs speak very favourably for our new power plant.

(g) MINE BUILDINGS

Subsequent to the 1st of July, the following buildings have been erected, together with the cost of same. The costs stated include plumbing and electrical wiring where the same have been installed.

Power house	\$4,108.32
Melvin Shaft house	210.40
Cottage for the kitchen staff	591.48
New garage	893.75
Stable and barn	231.38
Housing for the three Diesel oil tanks.....	450.00
Powder magazine	500.00
Bunk house at Big Bonanza	341.56
New bunk house	8,632.43

As the construction of the new bunk house was commenced prior to July, only a portion of the cost of the same is recorded in our accounting system.

In addition to the above, additions and repairs totalling \$418.90 were made to the following buildings:—Assay Office, Carpenter Shop, Tool House, Electrical Shop, Mine Office, Machine Shop, Blacksmith Shop and Saw Mill buildings.

Not included in this list is the new Administrative Building, which is in the course of construction.

(h) CAPITAL EXPENDITURE FOR PLANT AND MACHINERY

When I arrived at the property, I discovered that the larger part of the equipment was either not suited to the purposes for which it was to be used, or could not be operated economically. A case in point was the pumping arrangements for No. 2 Shaft. The pump is a Layne and Bowler and is in good condition. Last year it was operated by a steam driven turbine, and constituted the major load on the boiler. The only other load was the single hoisting winch. This boiler was fired with crude oil, and the cost of operating was about \$5,750.00 per month. Under our present method of pumping by electrical power, and at our present costs, the de-watering of this shaft should not cost more than about \$860.00 per month, notwithstanding the fact that four times as much water is being pumped, as was required to keep this mine dry.

Three pulsometers, a type of pump not suited to this class of work, were removed to Vancouver, and offered for sale. A Bury Compressor of 850 cubic feet capacity, belt driven, and much too large for our operations, was sold for \$1,000.00.

Since, as stated, this steam equipment could not be used economically, it was decided to use Diesel units as prime movers and to electrify the equipment as rapidly as possible.

To make the development economically sound, a considerable amount of machinery and equipment had to be purchased, the total amount expended for this purpose being \$64,902.11.

The more expensive items as follows (price includes freight):—

3 Crossley Diesel Units for the power station total- ling 565 nominal H.P.....	\$30,866.23
25 H.P. Pomona sinking pump and motor for Melvin Shaft	1,856.57
50 H.P. Motor centrifugal pump.....	922.50
75 H.P. vertical motor for Pomona Pump, No. 1 Shaft..	2,028.26
20 H.P. pump and motor for Melvin Shaft.....	565.00
Hydraulic outfit	2,539.07
Drill sharpener	996.12
Keystone Drill (No. 5½).....	5,214.41
Oil furnace	289.21
Arc Welder	1,230.00
Pipe threading machine	845.00
Electric Air Compressor	2,709.00
Holman Drifter	731.08
Holman Portable Compressor	3,000.00

An 85 H.P. motor to operate the Layne and Bowler Pump at No. 2 Shaft was rented with the option of purchase.

The capital expenditure for permanent equipment may be recapitulated under the following heads:—

Mine machinery (including drills, etc.).....	\$17,784.99
Power house machinery	33,049.47
Saw mill machinery	128.86
Blacksmith shop machinery and equipment.....	166.56
Machine shop machinery and equipment.....	2,232.30
Shaft houses, machinery and equipment.....	5,919.39
Cook house equipment	19.50
General Store	4.77
Garage	5.13
Dwellings' equipment	43.22
Tool house	4.00
Electric shop	496.05
Trucks	5,025.34
Assay	16.15
Stable equipment	6.38

TOTAL.....\$64,902.11

TRANSPORTATION

For our transport service, we completed payment on the Leyland six-wheel truck, purchased earlier in the year; the total price of which was \$2,900.00. This truck has proved invaluable in transporting freight, and especially in the transport of the Crossley engines, some of the units of which weighed as much as five tons. Two of the small trucks which had exceeded the span of their economical life were traded in on a new Chevrolet truck, with an additional cost of \$789.00. These, together with a small Ford truck, constitute our transport service.

POWER STATION

As already stated, after thorough investigation, it was decided to use electricity generated by Crossley Diesel engines for all power requirements. Orders were consequently placed with the Crossley Company in Manchester for three of the latest type of their four cycle, vertical type units. Two of these are each of 250 nominal H.P., and the third of 65 H.P.

An up-to-date power station, 38 feet by 60 feet was erected to house the power plant. The interior of this building presents a pleasing and unique appearance. All the machinery is stream line, in that there are no pipes showing above the floor. The walls are painted a light colour, the ceiling is carried well up in the principaled roof, and the whole is well lighted.

In addition to the Diesel units mentioned, are the direct connected alternators developing current at 440 volts. The engines and alternators are so arranged that the entire load may be taken on any two units, leaving the third free for any repairs. Besides the usual auxiliaries of a Diesel plant, we have installed in the power station, a Holman Air Compressor, of sufficient capacity for all our work in the Melvin and No. 1 Shafts.

In the development of a "deep lead" mine, the pumping requirements constitute the greatest load on the power station, and our plant was laid out with this factor in mind. In addition to the pumps supplied for the Melvin Shaft and the No. 1 Shaft, which are convenient to the station, a 440-volt transmission line has been constructed about a half mile to No. 2 Shaft, at a cost of \$1,485.00. This will supply power for the pumps there, and also for the new shaft to be sunk shortly, and for electric hoists if it is deemed advisable to install the same.

Power is supplied for all requirements of our machine shop, which, on account of our isolated position, has to be well equipped that repair work may be promptly carried out.

Current for light is supplied for the entire camp, and is sold at a profit to the employees having their own homes.

After several months of operation, I am pleased to say that the power plant has been running perfectly, and has been giving every satisfaction. I am satisfied that for the size, a better plant could not have been obtained. As has been stated elsewhere, by the installation of this station, pumping costs have been drastically reduced, and the cost of generating power now stands at 1.27c per K.W.H., which speaks for itself as to the efficiency and economical operation of the plant.

Immediately prior to the imposition of the new 2c per gallon tax, I purchased four tank cars of Diesel oil, totalling 34,464 gallons, at a cost of \$3,087.65. By making this purchase at that time, the Company was saved \$690.00.

(i) GENERAL STORE

Under the efficient management of Mr. Morrison, the store has been well run, and has shown a steady increase in sales. During July, the sales amounted to \$1,486.68 which increased to \$3,111.80 in December. The total sales for the six months amounted to \$12,639.32. As there is no credit allowed there is no amount to be written off as uncollected accounts.

A stock valued at about \$4,000.00 is carried and is attractively displayed. This includes, in addition to groceries, a general stock of clothing, etc.

(j) MESS HALL

A satisfactory mess is one of the most important factors in maintaining a contented staff of employees, and I am pleased to state that under the able direction of our Chef, Mr. Wright, there has been no complaint with regard to meals. Both the kitchen and the dining rooms are models of cleanliness.

During the period 40,833 meals were served at an average cost of 22½c for which we charged employees 29c.

(k) SAW MILL

As the Company has its own saw mill and its own timber, the costs of lumber are reduced to a minimum. On the 24th of August, an advantageous contract was entered into for the logging of our timber, and following the same policy a contract was signed November 8th, for the operation of the saw mill. As a result the cost of lumber used amounts to \$11.00 per thousand feet for rough lumber and \$12.25 per thousand feet for planed lumber.

These figures do not include stumpage or royalty charges payable to the Government, which vary from 50c to \$2.05 per thousand feet, depending on whether the area cut is free hold, placer lease or timber sale.

I have made strenuous objections to the Forestry Department against the levying of this form of tax on our operations, as I understand mines are exempt until such time as they shall be on a producing basis. Considering the amount invested here, the few hundred ounces of gold, which have been recovered, surely does not warrant the designation of producing mine. It is my desire to lay the facts before the Provincial Cabinet, and I feel sure that a fairer ruling will be given.

The mill is of sufficient capacity to take care of our requirements, and all the timber used in the shafts and below ground, and nearly all used in the buildings is of our own manufacture. During the year the mill produced 583,111 feet of lumber.

(l) CORD WOOD

As cord wood is used for fuel for the steam plant, which still furnishes power for the hoists in both the Melvin Shaft and No. 1 Shaft, as well as heat for the mine buildings, a total of 1,171 cords were cut and burned, at a cost of \$3.50 per cord.

GENERAL SURVEY REPORT for 1934

LEROY S. COKELY, B.C.L.S.

Assistant General Manager and Surveyor

On July 10th, I took charge of the surveys in connection with the Company's operations. At that time, while the property had been more or less continuously operated for the last twenty-five or thirty years, no surveys or levels of any consequence had been made. Our first work was, therefore, to correlate, by accurate instrumental work, the large amount of deep boring which had been done along Lightning Creek. This boring consisted of holes scattered over about a mile of the valley. From this data we were able to make a plan of the "deep lead", with gaps here and there, and to define the grade and depth of the same with reference to the Melvin Shaft, which had just been commenced.

As there had never been any proper programme of boring, a lot of the information had been duplicated, and various portions left undefined. It was our first work, in this connection, to locate lines of bores to clear up the gaps.

With the completion of the "I" line of bores, upon which both drills are now working, we shall have a satisfactory knowledge of the deep gutter from the Melvin Shaft to a point a mile down the valley.

A drilling programme was laid out, with lines of bore-holes at regular intervals across the "lead". And from the logs of these bore-holes cross-sections will be prepared, which are a prime requisite for this method of mining. Most of the boring which has been done heretofore has been by random holes, which did not permit of a cross-section being obtained.

The Company's holdings extend about twenty-one miles, and no map has ever been compiled of the same. As the whole valley is heavily timbered, mapping by the usual methods would have been costly, and would have taken months to complete. However, through the kindness of the Federal Department of Defence, we were able to obtain vertical aerial photographs covering the entire property. To get these reduced to a map of uniform scale requires considerable control work on the ground. The establishment of this control was our next work, and I am pleased to state that it has been completed. The valley of Lightning Creek has been mapped for the first time, and the stream itself is revealed to be of an exceedingly sinuous nature.

The drift mine, known as the Big Bonanza, was discovered this summer, and the Company started intensive operation of the same. This necessitated surveys there prior to working the property, and continuous supervision as the development progressed.

As No. 2 mine will be operated again as soon as it is de-watered, surveys had to be made and calculations prepared with regard to the new shaft—No. 4 Shaft—which is necessary for the further development of the mine. As soon as completed, this shaft will be utilized for the extraction of the inter-glacial deposit, which was worked last year, as well as the deep "lead".

During the season a considerable area was prospected for possible hydraulicing. Test pits were sunk up to a depth of twenty-five feet to determine the depth and position of the reef rock bench underlying the gravel deposits. This all had to be mapped and correlated to determine the probable yardage. A total depth of over four hundred feet of test pits was sunk during the year.

The conclusion arrived at from this work was that it would be profitable to hydraulic these benches, and that they were of sufficient extent to warrant the piping of water from Ramos Creek—a distance of 3,000 to 4,000 feet. Preliminary surveys for the development of this source were made, and it was found that there was ample head available. This creek will be the future supply of domestic water for the camp, as the present source is not adequate for any increase in the demand.

The Company deemed it advisable to secure additional leases on either side of Lease No. 1077, to take care of any bench deposits as well as any tributary "deep leads" or "elevated leads". To this end the survey department was engaged in running the location lines preparatory to staking the additional ground. The location lines of some twenty leases were run on the ground,—working up from the mouth of Lightning Creek, and through the canyon, which was a very difficult place to work in.

From a knowledge gained by a study of the logs of the bore-holes sunk previously, and from a close study of the drilling operations this summer, it is very evident that the "deep lead" contains continuous values which would return a good profit with intensive mining, and that at intervals exist bonanzas which are of a richness hardly creditable.

From examination of the reef rock where exposed and where recovered from the bore-holes it is evident that there has been an enrichment of the "lead" from the country rock. The reef drive, running length-wise of the valley, will form a wonderful prospect tunnel, and is apt to disclose rich quartz veins crossing the valley. Thus the possibilities of the property as regards lode mining will be investigated at little extra expense.

LEROY S. COKELY,

Assistant General Manager and Surveyor.

GENERAL REPORT

General Review of the Lightning Creek Deep Alluvial System with Particular Reference to the Wingdam Section

D. CAMPBELL MACKENZIE, M. Inst. M.M., M.A.I.M.M.

LOCATION

The property is situated along Lightning Creek, in the Cariboo District of the Province of British Columbia and about four hundred and twenty (420) miles north-east of the City of Vancouver.

ACCESSIBILITY

The Government Railway (called the Pacific Great Eastern) runs from Squamish Dock to the railhead at Quesnel, which latter town is thirty-two (32) miles by fair motor highway from the main camp at Wingdam.

Transportation from Vancouver to the Mine is as follows:—

40 miles—Vancouver to Squamish—by scows or ferries which carry the loaded freight cars to Squamish, the starting point of the P.G.E. Railway.

347 miles—Squamish to Quesnel—by P.G.E. Railway, to the railhead at Quesnel.

32 miles—Quesnel to Wingdam—by motor transport.

LEASES AND HOLDINGS

The holdings or rights of the Company are of two distinct kinds, as follows:—

1. The Company holds a lease designated Placer Lease No. 1077, dated March 9th, 1918, which is a consolidation of 20 placer leases, each 800 feet by 2640 feet, and the Bonanza Placer Claim, which has a length of 6,000 feet and a variable breadth averaging about 2,000 feet. This lease extends from near the mouth of Lightning Creek to Beaver Pass, a distance of some 12 miles, with a gap of about 7,000 feet, near Wingdam.

The boundaries of this lease have never been defined on the ground, but the same are controlled by the location posts set at the time the original leases were granted. As these posts were set about 40 years ago identification of the component leases will be difficult, but not impossible, and it is the intention to undertake this work during the coming summer.

Placer Lease No. 1077 expires March 9th, 1938, but the same can probably be renewed without difficulty.

2. The Company also holds certain rights and privileges granted by a Private Act—Chapter 56, Statutes of 1896, as amended by Chapter 59 of the Statutes of 1906.

Among other concessions, the Company has the authority to construct a "tunnel or flume or bed-rock flume" from near the mouth of Lightning Creek to a point about 21 miles up the creek, together with the placer rights to the ground 300 feet on either side of the same.

As this tunnel must from necessity follow the deep "gutter" of Lightning Creek, the location of this strip of ground 600 feet wide must remain uncertain until such time as the "gutter" is defined. As this can only be accomplished by very extensive boring throughout the length of the property, the delineation of this strip can only proceed bit by bit as the boring advances.

Since through a portion of the valley, the only holdings the Company have is this undefined strip of land, it has been deemed advisable to apply for additional leases covering all the land the Company may require. These will be extensive enough to take care of any bench deposits which may carry sufficient value to warrant hydraulicizing. Unfortunately, the present statute does not permit an individual lease to exceed 80 acres. Consequently, a considerable number of leases must be acquired and later consolidated. Negotiations were carried on with the Department of Mines, with a view to either enlarging Lease No. 1077 or obtaining a new lease covering the desired area, but were unsuccessful as the Department was of the opinion that that would exceed its powers. However, the Deputy Minister, Mr. Dunn, assures me that his Department will do all in its power to assist us, and will give us its hearty co-operation.

The locating of these leases will be proceeded with as rapidly as the weather permits, and will be completed early in the Spring. When these additional leases are obtained, the Company will have exclusive placer rights over 7,000 acres or approximately 10 square miles.

In addition to the mining ground the Company owns as free-hold Lot No. 446, containing 160 acres. On this free-hold, is located the Wingdam Camp and the major portion of the permanent buildings so far erected, including the new power station.

GENERAL GEOLOGY

(a) CLIMATE AND METEOROLOGY

The Cariboo District of the Province of British Columbia is typical of most of the elevated hinterlands of Canada. The summers are warm and genial with a nice "fall" season and a cold winter.

During the winter season temperatures occasionally reach 40 degrees below zero, the coldest period usually being from Christmas to the middle of February.

An average of six feet of snow falls during the winter, necessitating the use, by the Government, of snow ploughs to keep the roads open for transport.

Although sometimes cold, the weather is usually dry and bracing, and with ordinary precautions, a healthy climate to live in.

Allowing for ten inches of snow to equal one inch of rain, the average annual rainfall inclusive of snow is probably about 30 inches.

(b) TOPOGRAPHY

The Wingdam Camp is situated not far from the centre of the property, and at an elevation of 3,000 feet above sea level.

Lightning Creek flows through the valley of the same name, one of the many subsidiary sections of the immense watershed of the Fraser River. The confluence of this stream with the Swift River forms a river known as the Cottonwood, which flows into the Fraser River about 20 miles above Quesnel.

The valley of Lightning Creek is flanked on both sides by hills all showing the rounded tops characteristic of repeated glacial action. Some of these hills rise to altitude of over 5,000 feet, which is about the timber line of the district.

The hills are plentifully clothed with timber, mostly Spruce, Balsam and Jack Pine, with a belt or two of Fir.

(c) ECONOMIC GEOLOGY

There are numerous publications and reports dealing with the geology of the Cariboo, but from our own observation and study, it can be briefly stated that the country rocks of the locality are mainly of Pre-Cambrian and Mesozoic origin.

From the Mesozoic rocks the gold found in the shallow post-glacial placers took its origin.

The Gold Schists of the Cariboo Gold Belt (locally known as Cariboo Schist, Rim-rock or Bed-rock) are placed as Lower Palaeozoic (Pre-Cambrian).

Mr. Alex Warneboldt, our own geologist (a gentleman of extensive experience in Africa and Canada) has made an extensive study of the geology of the district through which Lightning Creek runs. He is of the opinion that the ancient pre-glacial "gutter" of Lightning Creek was a natural fissure.

The bottom of the ancient "gutter" lies from about 160 feet to 190 feet below the level of the present Lightning Creek.

The ancient river passed through a very rich auriferous belt of Richfield formation (Pre-Cambrian) as is proved by the extraordinary enrichments at Barkerville (Williams Creek) and Stanley (Lightning Creek).

Numerous auriferous ore bodies must have paid tribute to the ancient "gutter" of Lightning Creek.

It is our geological department's considered opinion that the incredibly rich Williams Creek and Lightning Creek had their "genesis" in the same mountains and passed through the same Pre-Cambrian auriferous belt.

If, as is generally conceded, the value of an auriferous belt is judged by the richness of its "placer" gold, then the hidden wealth of the Cariboo District must be large. Williams Creek, per mile worked, was the world's richest placer creek, and Lightning Creek (in the vicinity of Stanley) came a good second.

In this connection it is interesting to note that Amos Bowman, a Dominion geologist of undoubted experience and merit, in his Government Report on the geology of the Cariboo District, published in 1888, stated under heading of "Importance of Cariboo Gold Field":—

"Cariboo has not only been the mainstay of gold mining in British Columbia for many years, but has proved, for its area, one of the richest placer mining camps in the world; and it would, therefore, appear reasonable to assume the existence in it of rich quartz lodes, from which, by natural processes of waste, the alluvial deposits have been supplied.

"The importance of the Cariboo District will be understood when it is stated that probably half the gold product of British Columbia, since 1860, or not less than \$15,000,000.00 was derived from it, and chiefly from a few miles in length of auriferous drift in several valleys, of which those of Williams, Lightning, and Antler Creeks have been the most productive, and have made Cariboo famous."

Bowman's prediction in the question of rich quartz lodes (as in other matters in his valuable report) is now being fulfilled in the important development of two large quartz mines in the Barkerville District, viz., Cariboo Gold Quartz and the Island Mountain.

Like the lower section of Williams Creek, the lower section of Lightning Creek is still unworked.

This is obviously explained by the fact that further downstream the "gutter" became deeper and loaded with water. This complicated the mining so much as to put it beyond the scope of the comparatively primitive methods of those days.

There has never been any creditable suggestion that the values in Lightning Creek have "tapered out" coming downstream, but rather the consensus of "old time" opinion favours the idea that there is still plenty of gold in Lightning Creek.

In addition to the high values obtained from the original source of supply, there is ample evidence downstream of valuable tributary enrichments to Lightning Creek. Such tributaries as Peters Creek, Wormald Creek, Lovett Creek, Pine Grove, and No Name Creek and further down, Sawmill and the enriched Mosquito Creek, no doubt fed the ancient gutter of Lightning Creek.

Further we have established the fact by our drills, that the bed-rock itself is a prolific source of enrichment. It is, therefore, not surprising that high values are being discovered wherever our drills penetrate the main "gutter" gravels.

Of secondary importance to the main channel, but nevertheless of great economic import, is the location of a moraine of inter-glacial origin, tried out by bulk test during the latter part of 1933.

As will be noted later, from the drilling logs, this moraine is continuing downstream and showing payable values. I attach a great deal of importance to this inter-glacial formation as it should certainly double the productive life of the Wingdam Section. There is also strong geological evidence that this moraine extends upstream to Beaver Pass and possibly near Stanley. Our "I" line of bore-holes has established the fact that the moraine flowed through this narrow part of the valley and, therefore, it is geologically possible that it exists right upstream to Stanley.

Following are extracts from the first report furnished to me by Mr. Alex Warneboldt, after an exhaustive examination of Lightning Creek from Bonanza upstream to the old saw mill, some two miles in extent:—

(1) The first remarkable place, starting at the Bonanza and following up the north side of the Creek, is the sharply curved bench behind and north-east of the Bonanza ridge. The high rim-rock of the Bonanza ridge turns sharply into a bench covered by a slide, the rim-rock being about 60 feet high and sloping down to the Creek. In the old days pay dirt was taken from this high bench at the edge of rim-rock, and at this point I washed some very good pans, but the gold, I think, lies in spots. The high rim-rock drops steadily into the Big Bonanza valley.

The old Bonanza "gutter" passes south-west from this point and, as far as could be seen, the pay gravel lies between bed-rock and a clay bank. This area, joining the Big Bonanza "gutter", should be drilled when the main "gutter" is being tested as it seems to be a high bench of the main "gutter".

(2) Continuing upstream still on the north side is a steep "slide", and on the south side enormous gravel deposits "hill high".

Here the Creek winds its way through a deep, broad valley. On both sides of the Creek in the windings are extensive gravel benches which, in the old days, were worked by Chinese for the surface gold.

The deep channel bed-rock has yet to be located at this point, although local belief is that it lies under the "slide" previously mentioned.

One-half mile upstream, on the south side, is the Horseshoe Slide, and near here on the bank of the Creek, an untouched inter-glacial layer from six to eight feet thick, pushed up and broken off, was found. This layer showed flaky and fine gold, associated with a heavy and sparkling gray sand.

A small sample of this sand containing flour gold was handed to Mr. Unverzagt and returned a very high value gold assay.

In a deep canyon near Horseshoe Slide runs the old Mosquito "gutter".

There is no doubt there is rich gold in this part of the river, but it must be proved by drilling, and the deep channels of both Mosquito and Lightning Creeks located. The benches on the flats between the hills offer possibilities for dredging.

It is considered that the area from the Big Bonanza up to Horseshoe Slide may be one of the richest parts of the property, and should not be neglected.

(3) Near California Creek there is a change in the formation. The valley and flat of this creek is underlain with clay. Pan tests were made on the creek bank in the gravels above the clay and colours of gold were secured in every sample.

The Lightning Creek "gutter" should pass through this valley probably under a clay stratum. No trace of bed-rock could be seen up California Creek, but there are immense deposits of gravels resting on a clay "hardpan".

These gravels are known to contain coarse gold, and later should be tested with a view to hydraulic mining, bringing in a head race from California Creek and sluicing down to the "hardpan" false bottom.

(4) From the section described in No. 3, the Creek passes through a narrow canyon with the high rim-rock of the Mosquito Creek terrace on either side. Further upstream the banks of Lightning Creek flatten out until the bed-rock rises abruptly on the south bank forming a high, steep ridge. On the north side of the river, the bank rises slowly to a ridge and there forms a high, flat bench. This high flat seems to be a high bench of the old "gutter". On this

bench and another lying about 20 feet higher, good values should exist, and it is well worthy of prospecting. Samples taken above bed-rock on the river bank showed good values in coarse gold.

This area is ideally situated for hydraulic mining provided a cheap water supply could be brought in.

(5) The next section investigated upstream was the section between the bridge trail and the trail running out to "contact country" (Pre-Cambrian upstream) and (Mesozoic downstream). About here is the big plateau with high bed-rock we tested last summer, finding that the rim-rock slopes down from the Creek and that as a consequence the main Lightning Creek "gutter" must pass through this plateau from one end to the other. Warneboldt was very impressed with this area as well as the high benches downstream from the bridge trail. Welcome surprises may be expected, but systematic and careful testing must be carried out as a first measure.

At the contact line, the creek canyon ends. On the north side of the Creek a "flat" takes shape with bed-rock lower than the creek level. In the old days the Chinese sluiced the surface of this flat but could not reach the bottom. The Lightning Creek main "gutter" should pass through this flat, heading straight from the "E" line of bore-holes to the "U" valley on the south side of the Creek and thence through the big plateau.

The above report covers about two and one-half miles only of the Company's extensive property. Another 20 miles still remains to be superficially examined.

This work, together with Keystone drill tests, will be vigorously carried on during the coming year.

I have, on numerous occasions, been over most of the ground covered in Warneboldt's report, and am able to confirm his observations.

(d) BORING RECORDS

During the past 30 years, quite a considerable amount of boring has been carried out on the property. The drilling has been concentrated on the Wingdam Section, the furthest line upstream being the "G" line, which is about 1,200 feet upstream from the No. 2 Shaft, where some irregularly placed holes called the "B" line have been drilled. The next line downstream is the "F" line, which cuts through the No. 3 Shaft, and is about 1,600 feet downstream from the "B" line (sic.). A new line called the "J" line has been surveyed about equidistant between "F" and "B" lines, as the present policy of drilling is to have the drill sections at intervals of about 1,000 feet. The next line downstream is the "A" line, which cuts through No. 1 Shaft.

With the exception of the "G" line none of the lines of bores mentioned above have been drilled according to approved methods.

Owing to the drill holes being put down "willy nilly", and not on straight lines, it is practically impossible to get a reliable section across the valley.

As early as possible, steps will be taken to straighten out these lines by drilling other holes.

About 600 feet downstream from the "A" line (i.e. No. 1 Shaft) is the new "I" line which is now being drilled. This line is most important for checking and verification, and also to locate the main "gutter" which appears to be further south than was anticipated.

Another 700 feet downstream is the "C" line, which is one of the best drilled lines on the property, all the holes being drilled evenly spaced on the one straight line, enabling us to get a perfect profile of the ancient valley.

Continuing downstream for another 1,500 feet the "D" line is picked up, which has the extraordinary number of seven holes over a length of 200 feet.

About 900 feet further downstream is the "H" line, which has been drilled by the present management.

This line has five completed holes giving a good section across the old valley.

The "E" line is the furthest line downstream and is about 700 feet from the "H" line.

The line was completed by the present management in order to get a comprehensive section across the old valley.

In addition to above drilling, a large 26-inch diameter hole was put down by the previous management to allow of a deep well pump being installed. The present management put down holes next to the Melvin Shaft to pierce through into an old level driven from Jones' old shaft.

Summary of drilling is, therefore, as follows:—

Prior to 1st July, 1934.....	8,221 feet
From 1st July to 31st December, 1934.....	1,628 feet
Total drilled	<u>9,849 feet</u>

The interleaved cross-section will show, in a graphic form, the profiles of the ancient valley.

The section from the "I" line downstream to the "E" line can be taken as accurate.

Those from the "A" line upstream to the "B" line (both inclusive) have been built up by projection.

VALUES DISCLOSED BY DRILLS

Although the drilling of a "deep lead" proposition is primarily for the purpose of delineating the course or trend of the "lead", still every care should be taken to pan off all sludges so that concentrations of gold may be located. The values obtained from the deep "gutter" holes have been (in some instances) so sensationally rich as to cast grave doubts on their accuracy. Hence every care was taken when the "H" line was being bored, that no error or false enrichment crept in. The "gutter" was reached in two holes bored on the "H" line, the gold being carefully panned off in my presence and weighed in our assay office. Subsequently it was check weighed by G. S. Eldridge & Co., of Vancouver, a prominent firm of metallurgists, who also tested the gold for fineness.

The result in "H" 1 hole was 23 grains of weighed gold (fineness 910.7) equal to 175 dwts. per square fathom.

The "H" 2A hole returned 62 grains of weighed gold (fineness 910.7) equal to 473 dwts. per square fathom.

I had a sample of the bed-rock from this latter hole assayed (as it showed good mineralization) and the assay return was \$8.16 in lode gold per ton.

Quite frankly, in all my experience of "deep lead" mining in Australia, I have never known drilling values to equal those obtained from this "H" line.

Following are the arithmetical averages of "gutter" values on each line, taken from the "E" line upstream to the "A" line at No. 1 Shaft:—

"E" line	74 dwts. per square fathom.
"H" line	324 dwts. per square fathom.
"D" line	493 dwts. per square fathom.
"C" line	225 dwts. per square fathom.
"I" line	49 dwts. per square fathom. (Uncompleted)
"A" line	528 dwts. per square fathom.

giving a mean value for this section of 282 dwts. per square fathom.

The above values must not be taken as indicative of the true value of the "gutter" over its workable width. The rich values may be confined to a narrow section and a certain amount of dilution will take place in mining out ground of lesser value. Again the drilling lines are too far spaced to give an accurate appraisement of the value of the gravels.

But taking all these points into careful consideration it can be said of this section of one mile downstream from No. 1 Shaft, that the values so far disclosed are so consistently high as to lead one to predict that large and generous profits should be assured when it is being mined.

In addition to the work outlined under the headings of "Economic Geology" and "Boring Records", important developmental work has been carried out in the Big Bonanza Section, and also on the hydraulic section, near the old saw mill site.

In addition to the Wingdam Section, important concentrations of gold may be expected at No Name Creek and Big Bonanza.

While high values may be expected in the undisturbed pre-glacial Tertiary gravels, the importance of the inter-glacial moraine worked at the latter end of 1933 in No. 2 Shaft cannot be over emphasized. The location of this deposit so far downstream as the "I" line of bore-holes, supports the assumption that it will also extend to a considerable distance (at least seven miles) upstream.

From my own personal observation during a six months' close study of your properties, I can vouch for the existence of gold at the following points:—

No. 2 Shaft—From mining records and recovery of gold left in the sluice boxes. (Inter-glacial gold).

Melvin Shaft—From examination of samples of a probable "A" vein series discovered in sinking the shaft. This vein system has widened out to 12 feet, and although to date no payable assays have been returned, yet the system is well mineralized and carries appreciable values in gold, silver and copper. This vein system may improve with depth, and will not be lost sight of. (Lode gold.)

"I" line of bore-holes—As reported in our "Boring Records". (Inter-glacial and pre-glacial gold).

Elevated Terraces—In hydraulicizing this area last fall near the "H" line of bore-holes, over 15 ounces of post-glacial gold were recovered and many ounces were left in a shallow pit owing to our inability to get a jet elevator to work before the winter froze the operation up. This work has been given added value owing to the location of an elevated channel, rich enough to hand mine, that may be older than the Lightning Creek pre-glacial "gutter". (Post-glacial and post pre-glacial gold.)

"H" line of bore holes—I saw the gold washed and weighed out of the two holes which entered the "deep gutter". (Pre-glacial gold.)

Test pits on south bank of Lightning Creek—Over 400 feet of test pits were sunk, varying in depth from four feet to 22 feet. Quite 100 pan tests were taken out of these pits, showing nice gold in practically every pan. All these tests were checked over by myself. (Inter-glacial and post-glacial gold.)

Big Bonanza Area—We have taken about 50 ounces of nice gold from our development work at the Bonanza, ranging in size from four dwts. slugs downward. Prior to our taking over, the prospectors had taken out over 60 ounces, containing nuggets up to 14 dwts. in weight. About 70 ounces of this gold passed through our office, in addition to some hundreds of pan tests made from day to day. (Pre-glacial gold.)

I have also handled many samples of gold brought in by prospectors from No Name Creek, Ramos Creek, Norton Creek, Mosquito Creek, and other points just outside our jurisdiction. (Pre-glacial and post-glacial gold).

My experience so far in the valley of Lightning Creek seems to be summed up in the following trite saying:—"Turn a sod anywhere and you'll get some trace of gold."

QUARTZ OR LODE MINING

This section of Economic Geology would be incomplete without some reference to lode mining.

Quite an important section of the development of the property will be the location and subsequent development of auriferous veins. Bed-rock samples we have tested show sporadic veins of quartz and have tested up to over \$8.00 per ton. The big vein series in the Melvin Shaft promises well for depth development, and there are other places where quartz veins are known to exist.

The deep seated rock drives which are necessary in the Australian method of working the main "gutter" will be invaluable in the location of auriferous veins at depth, particularly those vein systems that do not "crop out" on the surface.

In Australia there are many examples of deep alluvial mines continuing as quartz mines, after the "gravels" had been exhausted. One that came under my own inspectorial charge was "The Great Southern Alluvial Mine", which worked for many years as a profit earning quartz lode mine after the alluvial gravels had been worked out. Another typical example was "The Great Western Leads" at Ballarat where the quartz and alluvial were worked simultaneously.

Up to 1926, over \$50,000,000.00 were won from the reefs of Ballarat, Australia, after the association alluvial had been worked out.

Having examined both the Ballarat and Cariboo gold fields, I feel constrained to state that what happened in the former fields has a reasonably good chance of being repeated in Cariboo.

PAST HISTORY

For upwards of 30 years repeated attempts have been made to mine the rich gravels of Lightning Creek, by the "old time" straight over the "gutter" method.

With up to 40 feet of Cariboo "slum" loaded with water to get through it was an odds against gamble and in spite of heroic efforts the "slum" won.

No. 3 Shaft is down about 90 feet and anchored in "slum".

No. 2 Shaft is down about 136 feet at which point "slum" has held it up. Luckily at this shaft the inter-glacial deposit was passed through at about the 120-foot level and, on being drained, this deposit was found quite easy to work.

No. 1 Shaft had a great chance as, after a depth of 80 feet, the rim-rock was entered and the shaft carried down in rock. Had the main cross-cut from the shaft been driven off 40 feet or 50 feet lower and the "gutter" drained off by drill holes, this mine would have been exhausted long ago.

Various attempts were made to enter the "gutter" from the main cross-cut, but all failed owing to the "slum" bursting through. As a result of pumping and shovelling out large quantities of "slum" from this shaft, at least two serious "caves" took place.

Surplus machinery and plant of all descriptions today bear eloquent testimony to the herculean efforts that must have been made to conquer this "slum" bed.

Tests we have made in our assay office, with de-hydrated "slum" prove conclusively that robbed of its high pressure water it becomes a hardish looking substance resembling lightly baked clay, and, therefore, easy to mine.

We have also mined it 30 feet wide at the dry Bonanza without the slightest risk.

The old Jones Shaft, sunk by that famous "old-timer" Harry Jones, recognized today as the best deep "placer" miner who ever entered the Cariboo, was ideally positioned to attack the "gutter" but in the absence of any drilling records, Jones put his level off too high, and after driving a cross-cut 180 feet in rock, burst through into the "slum" bed.

In Australia about 50 years ago, the same problems of running "slum", or "silt" as it is called there, were being met with and millions of dollars and many lives were lost before the late John Cook evolved the method of driving under the "gutter" by deep seated reef drives.

Since this method was adopted in Australia the mining of a deep "gutter" has become a normal mining operation with even less catastrophic risk than quartz, or coal mining.

DEVELOPMENTAL PROGRAMME

Your property is unique in that it runs for a total distance of 21 miles, through the auriferous valley of Lightning Creek. With a property of such extraordinary size the following progressive policy of development has been worked out:—

A study of the accompanying plans and sections will show that we have divided the property into sections of approximately three miles each. Each section will represent a major operation and require one main working shaft, three miles being recognized as the maximum distance which can be economically mined from a main shaft.

The Wingdam Section, being the more developed (by boring) will be the first section to operate on a productive basis. As part of the production scheme for this section, the inter-glacial deposit worked last fall from No. 2 Shaft will form a by no means unimportant nucleus.

The exigencies of the Mine's Act require us to sink another shaft (for safety and ventilation) near the No. 2 shaft and this proposed shaft will be sunk in such a position and to such a depth as to control one mile at least of the main "gutter" upstream.

The complete programme for the Wingdam Section will, therefore, be:—

- (1) Completion of the new Melvin Shaft to an ultimate depth of 280 feet.
- (2) The sinking of a new shaft to be called the Yapp, or No. 4 Shaft, at a site to be finally decided when the main "gutter" is located by drilling.
- (3) The installation of a modern power station, with Diesel prime movers, to enable us to pump at low cost, the large volume of water we will deal with in de-watering the "gutter." (This station was completed towards the end of November, 1934.)
- (4) The completion of our drilling sections "down stream" from No. 1 Shaft. (We are drilling our last line now.)
- (5) The carrying out of further drilling "upstream" from No. 1 Shaft. (The No. 2 drill is now on the new "J" line and when it has been reconditioned will start drilling on that line.)
- (6) The raising of the shaft house at No. 2 to enable us to deal economically with the "gravels" mined from the inter-glacial deposit. In this connection, we intend to use the No. 2 Shaft, pending the sinking of the "Yapp" Shaft, and we have an understanding with the Inspector of Mines we can do so, if we "retreat mine" the area already blocked out.
- (7) The development of Ramos Creek as a source of water for hydraulic and camp purposes. (Preliminary surveys have been made.)
- (8) The utilization of No. 1 Shaft for the quicker entry into the rich pay gravels in that vicinity. This will only be possible if the hydrostatic pressure is low enough to allow for safe entry, otherwise the main reef drive from the Melvin Shaft may have to be depended on to drain the "gutter".

METHOD OF WORKING

The mining of a deep alluvial deposit in Victoria, Australia, is carried out either by the Ballarat "panelling" method, or the Chiltern "blocking out" system.

No matter what method is used the main shaft is sunk in the rim-rock (i.e., the country rock forming the sides of the ancient valley), the steeper side usually being selected— all other things being equal. By sinking the shaft away from the "gutter," and driving, (still in rim-rock) at the correct calculated depth under the "gutter," all the risks attendant in sinking right over the "gutter" disappear.

The main shaft being duly sunk to the required depth a crosscut main reef drive is driven, usually by the shortest route to the "gutter" and from 40 to 60 feet vertically under it. This main reef drive is continued right across the "gutter," bores being put up at short intervals into the "gutter" for the threefold purpose of (1) testing the value of the gravel, (2) determining the width of the "gutter" and (3) "bleeding" the "gutter" (i.e., draining the water out of it).

When the "gutter" has been drained by continuous pumping, **but not till then**, the upper level from the main shaft is driven across into the "gutter" at such a level that the deepest point of the "gutter" is reached allowing for one foot of bedrock, which is always mined with the pay gravel. The leading gravel drive is then started up and down stream and in the Chiltern method is usually kept from two to three hundred feet in advance of the main reef drive, thus acting as a pilot drive. Owing to the Lightning Creek main "gutter" being confined in the limits of a comparatively narrow valley it is considered that a drilled cross-section every 1,000 feet will obviate the necessity of the pilot gravel drive, which is usually a wet drive. At varying intervals up to 300 feet cross drives are driven at right angles to the leading "gutter" drive and continued across the "gutter" until rim-rock is reached on either bank. At intervals of 46 feet, blocking drives are driven at right angles off the cross drives, i.e., parallel to the leading "gutter" drive. Deducting six feet for the width of the blocking drives, leaves 20 feet on each side of a blocking drive for each party of miners.

The whole width of the "gutter" is then mined out in one face, all refuse and overburden being stowed away in the mined out gravel.

Ventilation is assured by carrying a small rim-rock drive along on the same level as the "gutter" and connecting this (at half-mile intervals) with the surface by means of a small rarifying shaft.

The above system is the one we intend adopting here with certain modifications to suit local conditions.

Our development work at the Big Bonanza has already materially helped us to establish mining conditions. In the Bonanza tunnel, the gravels are overlain with "slum", **which has the water drained out of it**. Under these conditions, it is one of the easiest and safest materials to mine I have ever seen.

Loaded with water, the "slum" becomes a menace, and is the primary cause of the many abortive and expensive attempts to open up this property.

GENERAL ECONOMICS

(a) CAPITAL REQUIRED

Australian experience and practice show that it takes from \$225,000.00 to \$275,000.00 (in Australian currency £45,000.00 to £55,000.00) to equip and develop one main working shaft to deal with 75 square fathoms per day.

Owing to the rather adverse geographical position of Lightning Creek, rendering transportation costs higher than under Australian conditions, I consider that at least \$300,000.00 should be available for each major operation.

From 15 months to two years is necessary for full development to allow of a reasonable amount of time for drainage of the "gutter."

(b) PRODUCTION COSTS

Production costs in Australia vary between \$16.00 and \$17.50 per square fathom treated. Allowing for the higher wages in British Columbia, and, making as full use as possible of the contract system, working costs at Lightning Creek should not exceed \$20.00 per square fathom.

With gold selling at \$30.00 per ounce, it will take values equal to 13.5 dwts. per square fathom to cover all production costs.

A square fathom produces from 4 cubic yards upwards, depending on the thickness of "pay gravel" that is being mined.

(c) PROFITS THAT MAY BE EXPECTED

Until bulk testing has given us a more accurate idea of the value of the pay gravels, the following tables have been worked out showing the yearly profits that might be expected with gravels of varying values.

The tables are worked out from the following data:—

- (1) 300 day working year.
- (2) Gold selling at \$30.00 per ounce.
- (3) Working costs \$20.00 per square fathom.
- (4) Output of pay gravels:—

25, 50 and 75 square fathoms per day,
equals 7,500, 15,000 and 22,500 square fathoms per 300 day year.

The output from the inter-glacial deposit at No. 2 is shown as 7,500 square fathoms per year. The deep "gutter" gravels from the Melvin Shaft are calculated firstly on an annual production of 15,000 square fathoms and secondly on a full production basis of 22,500 square fathoms.

TABLE 1
INTER-GLACIAL DEPOSIT No. 2 SHAFT

Annual Output in Square Fathoms	Value Gravels in Dwts per Square Fathom	Value of Output in Dollars	Total Annual Costs in Dollars	Indicated Gross Profit in Dollars
7,500	20 dwts.	\$225,000	\$150,000	\$ 75,000
7,500	25 "	281,250	150,000	131,250
7,500	30 "	337,500	150,000	187,500
7,500	40 "	450,000	150,000	300,000

TABLE 2
DEEP "GUTTER" GRAVELS—MELVIN SHAFT

Annual Output in Square Fathoms	Value Gravels in Dwts per Square Fathom	Value of Output in Dollars	Total Annual Costs in Dollars	Indicated Gross Profit in Dollars
15,000	60 dwts.	\$1,350,000	\$300,000	\$1,050,000
15,000	80 "	1,800,000	300,000	1,500,000
15,000	100 "	2,250,000	300,000	1,950,000
15,000	120 "	2,700,000	300,000	2,400,000

TABLE 3
DEEP "GUTTER" GRAVELS—MELVIN SHAFT

Annual Output in Square Fathoms	Value Gravels in Dwts in Square Fathom	Value of Output in Dollars	Total Annual Costs in Dollars	Indicated Gross Profit in Dollars
22,500	60 dwts.	\$2,025,000	\$450,000	\$1,575,000
22,500	80 "	2,700,000	450,000	2,250,000
22,500	100 "	3,375,000	450,000	2,925,000
22,500	120 "	4,050,000	450,000	3,600,000

It must be particularly noted that in above tables, the total annual costs refer only to the mine end.

No allowance has been made for the following items:—

Vancouver Office (including Directors' fees); London Agency; Taxation and Lease Rentals; Insurance; Development of field outside Wingdam Section; Legal Expenses.

PRODUCTION FROM WINGDAM SECTION

Our present proposals are to bring the Wingdam Section into production as early as possible.

We are pumping the water out so steadily at No. 2 that it looks as if we will be producing there earlier than I anticipated.

The Melvin Shaft will come into production at a later date, depending entirely on the rapidity with which the gravels can be de-watered.

We are, for a start, working on the assumption that we can maintain an output of 7,500 square fathoms per annum from the No. 2 inter-glacial deposit and 15,000 square fathoms per annum from the Melvin Shaft. In this latter case the "gutter" is so narrow, there is a grave danger (with the bigger output) that production may overtake development too rapidly and cause a "jamb." Therefore, until working conditions have been established it is safer to estimate on the smaller output.

From the information I have to hand, I cannot see the values in the inter-glacial falling below 20 dwts. per square fathom, nor the values in the drilled section of the Melvin operation falling below 60 dwts. per square fathom, and using these conservative minima, I anticipate the following results:—

ANTICIPATED RESULTS

No. 2 Shaft Inter-Glacial:—

Indicated gross profit (as per Table 1.).....	\$ 75,000.00
Melvin Shaft Deep "gutter" (as per Table 2.).....	1,050,000.00
Total from Wingdam Section.....	<u>\$1,125,000.00</u>

CONCLUSION

After six months' close study of the Lightning Creek proposition, I consider I should be qualified to give an authoritative opinion as to its merits or otherwise.

Many engineers have reported on this property, and without exception they have agreed that its potentialities as a gold producer are unique.

Whenever the questions of hydraulic or "slum" difficulties have arisen, they have been solved by a stroke of the pen. For three decades strenuous efforts and hundreds of thousands of dollars have been spent and yet the gold still remains "in situ".

The solution of the Lightning Creek problem will not be found in the discounting of the water and "slum" problems, but rather a means of circumventing them.

Robbed of its high pressure water, Cariboo "slum" is an inert, lifeless material that can be safely mined.

In the Australian method of "deep lead" mining, the de-watering of the "gravels" before mining is the primary consideration and I am confident that in the adoption of that method at Lightning Creek lies the solution of the whole problem.

Accordingly, development of the property is being carried out in strict conformity with the Australian method.

This is the first occasion in Canada, I believe, that this method has been started and I know that the "eyes" of the whole of the B. C. "placer" engineers and the Provincial Department of Mines, are focussed on Wingdam and our methods.

A great deal of responsibility is resting on my shoulders in establishing the Australian method here, owing to the lack of a trained staff.

However, in Mr. Cokely and a few of the more junior members of our small staff, I have a nucleus of an enthusiastic and loyal executive.

The answer to what I think of the property is summed up in the fact that I am willing to stay here and take my chances with it.

Yours faithfully,

D. CAMPBELL MACKENZIE, M.Inst.M.M., M.A.I.M.M.
Technical Adviser.