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INDEX.

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VOL. IX.

N

O

P

Q

R

S

T

V

W

Y

Z

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BRITISH COLUMBIA
MINING RECORD

Devoted to the Mining Interests of The Pacific Northwest.

PUBLISHED BY

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With this number begins another volume—the ninth—of the B. C. MINING RECORD, and the opportunity is again afforded us of wishing our readers both at home and abroad a most happy and prosperous New Year. During 1901 the mining industry in British Columbia has had many difficulties of an exceptional character to contend against, and unexpected problems have presented themselves which even now are taxing the ingenuity and the thought of our ablest men to successfully solve; these disabilities, notwithstanding the progress within the past twelve months has been gratifyingly substantial, serving not only to renew our confidence in the great future we know awaits the development of our mineral resources, but also to spur us on to greater effort and achievement. In the present number it had been our aim to give a full and trustworthy detailed review of mining operations throughout the Province. Unfortunately, however, it has been found impossible owing to space limitations, to completely carry out this original conception; and we have been compelled, therefore, to hold over for another issue, a number of very valuable papers on the subject of recent developments in districts which, though not yet contributing materially to swell the aggregate of produced wealth, promise in the near future to become important factors in this regard. In concluding this brief introduction we desire to express our sincere thanks to our contributors, mining engineers, mine managers, the Department of Mines and others to whose hearty and generous co-operation and support we are so deeply indebted.

A REVIEW OF THE YEAR.

IN reviewing the year's operations in mining we have again to regret the absence of exact information. Instead of precise facts we have to be satisfied with generalities. The more the mining industry grows in importance the more it increases in complexity, and, in the absence of authentic statistics, the vaguer must any general review become. It would be hardly too much to say that the injury done to the name and reputation of the Province from the lack of information, equals, if it does not exceed, the drawbacks from which the mining industry has suffered during the past year, on account of market conditions, labour disputes and other disturbing factors combined. In season and out of season we have insisted that as some of our mines are owned in the United States, and some in Eastern Canada, and some in Great Britain, the proofs of growth and prosperity are broken up and divided, and not presented as a whole until so late a date that they fail of effect because new modifying circumstances have become operative by that time. For instance, during the year 1900 the output of lead from the Province increased 206 per cent. This startling and significant fact would surely, had it been presented in time, have drawn wide attention to the lead resources of the Province, and assisted the investment of capital in the development of that industry. But by the time it was published, the general impression was that this output had been merely a flash in the pan, and that, under the blighting influence of unfavourable market conditions, the lead industry of British Columbia had been practically extinguished, that the large output of 1900 was rather a tribute to temporary importance, than an indication of future possibilities. That this impression is a wholly false one will not be officially established until probably May or June of next year, and the recuperation of silver-lead mining already in progress, and which may be expected to continue during 1902, will have no official attention attracted to it until 18 months have elapsed. We often see expressions of wonder at the ignorance displayed by outsiders of the achievements, progress, and prospects of the industry of mining in this Province. But what is there to wonder at, when we, whose sole business it is to collect and chronicle the salient facts of the industry from month to month, are obliged, in presenting a review of the year, to apologise beforehand for its meagreness, crudity, and possible inaccuracy, for the simple reason that, instead of dealing with known facts, we are wandering in a maze of inference and conjecture.

The fact which has attracted the most attention during the year drawing to a close has been the position in which our silver-lead mines have been placed by the attitude adopted towards them at the beginning of the year by the American Smelting & Refining Company. By refusing to buy ore on the New York valuation of lead, that corporation was able to close the American market to British Columbia silver-lead ores and bullion, and it did so with a suddeness and completeness which left nothing to be desired. It was necessary thereafter for our ores to be smelted and refined in the United States in bond for re-export or else shipped direct to Europe. This involved a direct loss of ⅝ of a cent. a pound, the difference between the duty on ore and bullion and refined lead entering the United States, and an indirect loss of a cent a pound due to the distance of the English market, and the circuitous methods necessary to reach it. When these charges were coupled with a heavy and continuous decline in the European prices of lead, the outlook before the silver-lead mining industry of British Columbia became very serious indeed. If it had not been that many of our silver-lead ores contain a very high percentage of silver, the industry would have been temporarily extinguished. As it is, instead of a growth commensurate with the expansion of the year 1900, a considerable contraction in the output of lead is noticeable. A rough calculation based upon the United States imports of Canadian lead as given by the Bureau of Statistics of the Treasury, and the shipments of lead ore direct to Europe from the St. Eugene mine, would give the lead output of the Province during the year 1901 at about 25,000 tons, a decrease of 20 per cent, under the output of 1900. In money value, however, the decrease will be very much larger, amounting to about $1,500,000, or between 50 and 60 per cent. In spite, however, of the untoward circumstances which have brought this about, there remains an increase in lead production over 1899 of over 100 per cent.

The Dominion government has endeavoured to relieve the lead industry by assisting the establishment of a Canadian refinery. But various causes have, so far, prevented this project from being matured. The difficulty of location so as to secure all the output of all the mines, and the falling market in Europe, rendering a price at which a sufficient tonnage could be secured, a matter of doubt, have been two of the most important of those reasons. Now, however, it is generally admitted that the price of lead has reached bed rock, and still the silver-lead mines of the Province are continuing to produce in such quantities as to guarantee a sufficient tonnage of bullion, so that the erection of a Canadian refinery is likely to be proceeded with. A steady improvement in production has been noticeable during the closing months of the year and the outlook is not without favourable features.

The Province's output of silver, although it is intimately connected with the production of lead, will not be found to have suffered to anythig like the same extent. There are three reasons for this. In the first place, the reduction in tonnage had taken place largely among the mines which are low grade in silver value, while the production of high-grade dry ores has increased. In the second place, the renewal of operations at the Hall mines during the last six months of the year, replaces a supply totally cut off during 1900, and, in the third place, the gold-copper ores of Rossland and the Boundary contain something in the neighbourhood of one ounce of silver per ton and the increase on tonnage in these mines has been so great as to have an appreciable effect in making up for the defficiency in silver-lead mines. It is questionable whether silver will show a very material decrease this year. It should give evidence of a large increase over 1899 and the industry of silver mining is, apart from the price of silver, which continues to drop, in a thoroughly healthy condition, and likely to continue to exhibit steady and material progress. It is to gold and copper we must look to sustain the reputation of the Province during 1901, particularly the latter.

With regard to copper the only cloud upon the horizon during the year now passed has been the strike at Rossland. This dispute was really the culmination of a long series of bickerings in which the employes and the miners had failed to come to any permanently harmonious understanding. In its effect upon the industry of mining at Rossland it was undoubtedly complicated by the breakdown of Mr. Whitaker Wright in London and the difficulties in which the War Eagle Consolidated Co. and the Centre Star Company to a lesser extent, had involved themselves. Its ultimate effect will not be by any means injurious as it has shown that such a contest is not lightly to be entered into on either side in the hope of an easy victory. We may expect a spirit of compromise and mutual concession to mark the relations between labour and capital in the mining inindustry as its consequence. In spite, however, of this distressing difficulty, and the interruption to which productive operations were subjected on account of it, the tonnage of the Rossland district has increased from 217,636 tons to in the neighbourhood of 290,000 tons, while the very satisfactory position in the affairs of the Centre Star mine during the past year is an indication that a profitable and prosperous future is before the mines of the Rossland district.

The year now drawing to a close is the first complete year in which the gold-copper mines of Boundary district have been continuously productive, and it is not using the language of exaggeration to describe it as a year of stupendous achievement. Contrary to the usual experience of mining districts, the furnace capacity of the smelters has been unequal to the abundance of ore available, and, from the first of January to the present date, there has not been a single interruption to the productive stream. As a consequence the output of the district has grown from 103,426 tons in 1900 to something in the neighbourhood of 375,000 tons in 1901. Were the ore of the same value as that pro-

duced last year this would represent a money valuation of nearly $5,000,000. Unfortunately this is vitiated by the fact that the ore of the Cariboo-Camp McKinney, which is high grade in gold, and ore of the B. C. mine which is high grade in copper, are included. These formed a high enough percentage of the 1900 output to affect the total in a much greater degree than they can that of the present year. But it will not be found very wide of the mark to place the value produced from this district at about $3,000,000, of which $2,000,000 are represented by copper, an amount considerably in excess of the total copper production of last year. If allowance is made for a certain increase observable in the production of the Coast mines, and the resumption of the Hall mines, the output of copper from the Province this year may be safely estimated as obtaining a value of $3,000,000, as compared with $1,615,289 last year. This year, it is likely, will be found to be rather within, than beyond the mark.

With the gold output of the Province it is impossible to deal at the present time in any satisfactory way. It is derived from the many sources, and subject to too many varying conditions, to make any estimate reliable which is not based on actual returns. There will unquestionably be a decline in the output of placer gold, due however, to temporary causes. On the other hand there will be a considerable increase in the output of lode gold. With the exception of a few unimportant producing mines in the Nelson district, which have been in difficulties during the year, all the gold mines in the Province have shown progress. The total gold output of the Province this year should go to $5,000,000, but this is, for the reasons already given, a very crude guess. On the whole, it may be safely hazarded that the gain in gold and copper will more than offset the loss in silver and lead, and that the output of these four metals will be in the neighbourhood of $12,000,000 as compared with $11,500,000 in round numbers last year.

It is very satisfactory to reflect that in a year when such untoward conditions have affected the industry of silver-lead mining, the Province's most important industry, other resources have sufficed to make good the deficit. It is a pity, of course, that the promised great increase in the aggregate output has not been materialised. But it is as well to enforce the fact that this has been due to causes external altogether to the Province.

He would indeed be a bold man who would base an argument on the decline of mining in British Columbia on the results achieved this year. In fact we cling to the idea that if anything we have underestimated the increase in the gold and copper and overestimated the decrease in silver and lead. This decrease also, it should be remembered, is only marked in money valuation. In tonnage, both of ore and metal, the combined mines of the Province show a satisfactory rate of progress, while certainly, more dividends have been paid, and more properties reinvested, during 1901 than during any previous year. The industry of mining is in a thoroughly sound and healthy condition, and if to the productive activity manifested, are conjoined progressive intelligence on the part of the government, and mutual forbearance on the part of both employers and employed, a great increase in the amount of capital invested and consequent stimulus to production may be expected.

ROSSLAND IN 1901.

By F. C. Moffatt.

MINING operations in the Rossland camps during the year 1901, have been sadly restricted by the financial muddle, disturbing factors of labour and company misadventures. It was estimated at the commencement of the year that a production of 400,000 tons might reasonably be expected for the 12-monthly period, making due allowance for accidents. Instead, however, the 1901 output may be more or less accurately placed at between 290,000 and 295,000 tons.

The aggregate is approximately made up in detail as follows :

	Tons.
Le Roi	162,000
Le Roi No. 2	40,000
Centre Star	54,000
War Eagle	20,000
Rossland Great Western	11,000
Iron Mask	4,500
Velvet	550
I. X. L.	250
Spitzee	200
Evening Star	75
Grant	50
Portland	25
Homestake	25
Monte Cristo	25
Total	295,700

From the foregoing it will be seen that the district includes 14 productive properties, but only seven may be regarded as importantly so. These are the Le Roi, Le Roi No. 2, Centre Star, War Eagle, Rossland Great Western, Iron Mask and I. X. L.

The seven mines mentioned sent out approximately about 294,750 tons of ore, the remaining 950 tons of the total given being made up by occasional consignments contributed by the smaller properties. I have included the I. X. L. in the class of larger producing mines because, while the tonnage is small the ore is all picked, and consequently the returns from this property assist very materially in increasing the average value of aggregate output from the district. Much of the ore sent out from the smaller mines was either sold for fluxing purposes or represented trial shipments.

Of the properties outside of those mentioned in the shipping list upon which any considerable work has been in progress during the year may be mentioned the Kootenay mines—comprising the old Columbia-Kootenay properties—a B. A. C. flotation ; the White Bear, Grant, New St. Elmo, California, Green Mountain, Big Four and Abe Lincoln.

Operations were practically suspended during the year on the Iron Colt, Iron Horse, Sunset No. 2, O. K., Monte Cristo, Virginia, Jumbo, Big Four, Gertrude, Novelty and some other smaller properties, all of which are in a more of less advanced stage of development.

In regard to the Le Roi, Mr. Bernard Macdonald made a voluminous report last August, and according to the figures presented by him, the mine had 1,489,000 tons of ore in sight at June 30, 1901, and the total net profit for the year ending at that date was $1,285,388. Mr. R. J. Frecheville, a mining engineer and also a director of the company, who in August last came to

Rossland at the instance of the shareholders, to examine the mine, after a residence of three months spent in investigation utterly disputes Mr. Macdonald's conclusions. This gentleman's detailed report has not yet been made public, but he has meanwhile cabled an advance statement to the London board in which he estimates the ore in sight above the 900-foot level in the Le Roi to be 484,000 tons and places the net profit for the financial year at $585,000. The despatch further states that all of the year's profit earnings have been expended in improvements and that in consequence the mine and smelter are magnificently equipped. It is also intimated that under capable management the property is now in a position to earn dividends for shareholders and that the ore showings in the lower levels are most promising, the shoot at the 900-foot level having widened from 12 to 35 feet in the 170 feet driven along it, with an average value of $15.75. As the average value of the ore sent to the smelter during the 12 months ending June 30, was $13.16 the last admission is an important one. These figures include the cost of mining, smelting and all other charges, so that whatever the ore runs over the figures variously given will be net profit to the shareholders.

If the new manager can carry out his promise of reducing the cost of production and smelting to $7.50 or $7, it will readily be seen that the property, now so well equipped, is likely to make a good showing this coming year.

The interesting table below, which is taken from the report of the Centre Star Mining Company for the year ending September 30, 1901, shows in full detail the cost of the development work done in the mine during the year :

	Sinking Main Shafts.	Sinking Small Shafts.	Raising.	Drilling
Total advance feet	337	50.5	324.5	2,107
COST PER FOOT.				
1. Drilling	$12 95	$7 61	$7 51	$5 43
2. Blasting	4 89	1 77	2 05	0 95
3. Explosives	3 91	3 39	3 27	2 81
4. General mine supplies	2 35	1 54	0 97	0 57
5. Mine lighting—candles	0 62	0 35	0 16	0 16
6. Mine lighting—electric	0 72	0 27	0 19	0 16
7. Smithing	1 09	1 18	0 96	0 69
8. Shoveling—direct	19 66	5 92	0 83	1 11
9. Shoveling—apportioned	1 54	0 55	0 48	0 46
10. Timbering—labour	9 60	1 23	3 05	0 17
11. Timbering—material	3 16	0 12	0 74	0 05
12. Machine drill fittings	1 15	1 23	1 02	0 64
13. General mine labour	7 81	4 33	2 83	2 11
14. Hoisting underground	14 28	7 27	....	0 16
15. Hoisting main shaft	2 19	0 92	0 71	0 65
16. Compressed air	2 03	1 36	1 54	1 07
17. Mine ventilation	1 29	0 81	0 47	0 33
18. Assaying	0 01	0 34	0 31	0 18
19. Surveying	0 59	0 24	0 23	0 17
20. General expense	9 41	4 50	3 70	2 29
Total	$99 16	$44 93	$31 12	$20 37

The table above gives the work done during the year ; I may add that this work made the total accomplished up to the close of the year as follows : Main shaft, 917.5 feet ; winzes and small shafts, 1,643 feet ; raising, 1,841.5 feet ; drifting, 11,289 feet.

Beyond being told that all the profit so far made has been spent in improving and equipping the mine and the smelter, the public is left in the dark as to the state of the Le Roi's accounts. After working the property for three years the company has paid $250,000 in a single 5 per cent. dividend and has equipped its mine and smelter. Presumably the Bank of Montreal debt remains unliquidated somewhere between $700,000 and $1,000,000, and in order to estimated what has really been accomplished it will be necessary to see the figures of the balance sheet, which will doubtless be given when Mr. Frecheville's report is published next month.

The Centre Star and War Eagle have recently been pumped out and work on a small scale has been resumed at both properties. Returns of operations at the Centre Star were presented at the annual meeting in November and show that the indebtedness of the company was reduced from $180,000 to $42,000 in addition to which $105,000 was paid this year in dividends, making a total profit distribution of $175,000 to date. Work will be confined to development operations for at least six months to come.

At the War Eagle if work on anything like an extensive scale is undertaken the property may yet prove to be a valuable mine. Unlike the Centre Star, which is a single claim, the War Eagle comprises a group of five or six adjoining properties, and tests by diamond drill on the undeveloped ground are said to have afforded very satisfactory results. An amalgamation of all War Eagle-Centre Star properties into one company or the acquirement of these properties by an English syndicate is quite among the immediate possibilities.

After the Le Roi itself, the Le Roi No. 2, once it is out of the Whitaker Wright tangle, is the most promising property in the camp. It has paid one dividend this year of $144,000, but at present its real financial position is unknown. The mine is both well developed and fairly well equipped.

In a much less degree the same favourable opinion can be expressed of the Rossland Great Western, with this difference, that it has paid no dividend and possibly is not provided with an adequate working capital. The mine has been more or less considerably developed and is equipped with a good power plant of its own. Its future will depend a good deal upon careful management.

The Kootenay mines are the least satisfactory of the B. A. C. promotions. Development has disclosed large bodies of low-grade ore, but unless some means can be devised for treating the output at a lesser cost the mine can not be profitably worked.

The Iron Mask, which was closed down during the summer, is in a somewhat similar position. The money realized by assessing the stock has been expended and although a great deal of development work has been accomplished, no timbering of any consequence has been done and expenditure in this particular would be very considerable. The company has not announced its future plans. Some 3,500 tons of ore were sent to the Trail smelter during the first half of 1901.

But little change has taken place in the position at the I. X. L. during the year. The high-grade ore which has been sent to the Northport smelter has realized well and the proceeds from these sales have been expended in further developing the property.

Very favourable anticipations were entertained in respect to this year's developments at the Homestake mine in the South belt, though they do not appear to have been realised. Large expenditures have been made during the last 12 months in developing the mine and a good body of low-grade ore has been uncovered, according to the interim report of the directorate in October. Further operations, however, were suspended for want of money to continue. It was said, meanwhile, that the trial shipment to the Trail smelter was disappointing.

The Giant mine has been tentatively operated this year with reasonably satisfactory results, the shipments to Trail having also been encouraging. The property has been acquired under London joint stock auspices, which has taken over the property, and under D. J.

Macdonald's management the mine is being thoroughly prospected, and a supply of power has been made the subject of an arrangement with the owners of the California mine.

A diamond drill has of late been successfully operated on the White Bear and the Green Mountain properties and development work is in progress following the ore bodies encountered by the drill. No discoveries of importance, however, have yet been made on either property.

Although well equipped, the California has not been operated since the early part of the year. The property is said to be waiting for stock market developments, and when these are arranged work will be resumed.

and the Trail smelter for lowering the rates of freight and treatment. At Northport the plant has been greatly enlarged and improved, the Great Northern railway having also lowered the freight rate for the transportation of ore from 75c. to 40c. per ton.

PROGRESS AND DEVELOPMENT IN THE NELSON DISTRICT IN 1901.

By Horace G. Nichols, A. R. S. M.

So many have been the obstacles to be overcome and the difficulties in the path of real progress, during the past year, that at this latter end, it behooves one, in reviewing the present state of development, to

Falls Near Nelson.

Operations at the Velvet mine on Sophie mountain have been conducted under the direction of a new manager during the year. The cost of production was originally disproportionately heavy and the mine is being further developed. A waggon road has also been recently built. When more adequate transportation arrangements are effected the mine can undoubtedly be profitably operated, and the same may be said concerning other properties in the immediate neighbourhood which have been developed with some success during the past year.

The Spitzee has been very successfully developed during 1901. Returns from trial shipments consigned to the smelter have been exceedingly satisfactory.

The smelter situation has changed but little during the year and apparently no agreement has been come to between Mr. Gooderham's syndicate, the C. P. R. give due weight to the moral significance of failures avoided, as well as to the actual success achieved.

A greater hesitation would without doubt, be felt in basing the claims to progress in any district on such negative grounds, were the causes which have so militated against general advancement less widely spread, and their influence of more limited range.

Chief among the causes have been the scarcity of money due in a great measure to the prolongation of the South African war, the continued depression in the silver-lead market and the unsatisfactory relations at present existing in many places between capital and labour.

A discussion on these subjects lies happily outside the scope of this article, let it suffice to say that we dream of an era ensuing, when the possibility of satisfying the Boer appetite for lead, shall have been sufficiently real-

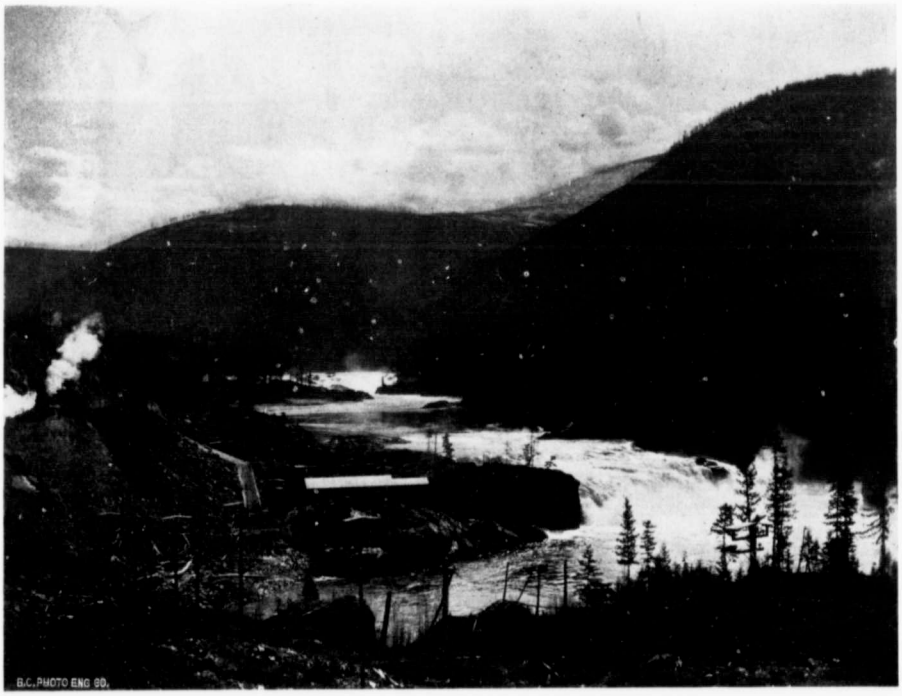
ised, to so reduce the surplus of that metal in the market, as to permit of mining operations being carried on at a profit adequate to the elimination of all causes of dispute and the establishment of a suitable asylum for agitators.

In the Nelson district the conditions obtaining at the commencement of the year were such as demanded every encouragement for the assurance of a satisfactory issue.

A period of relapse, following after a more or less fictitiously inflated condition of buoyancy was in existence and the numberless troubles commonly attending the aftermath of an overboomed camp had to be contended with. The promoter of the wild-cat schemes and irresponsible middlemen had reaped their harvests, at the expense of the district, and the glamour of fabulous unings as the Ymir Gold Mines, Limited, the Hall Mining and Smelting Company, Ltd., in both branches of their operations, the Arlington mine and other well-known producers, from which a distinctly reassuring impression is obtained, not only as to the status and future of these undertakings themselves, but also as to the promise of the district of which they are at present the chief ornaments.

It would seem to be but a conservative forecast to say that Ymir Gold Mines, Ltd., have a mine for whose output, even their well equipped 80-stamp mill will soon be insufficient.

The Silver King mine, the property of the Hall Mining & Smelting Co., after many vicissitudes, would appear to give promise of handsomely repaying the steady application of the company's energies to devel-



Bonnington Falls, Kootenay River, from C. P. Ry.

certainty was gone ; but yet there was developing a new and general feeling of settled industrial progress, enhanced and strengthened by some instances of notable successes in mining undertakings.

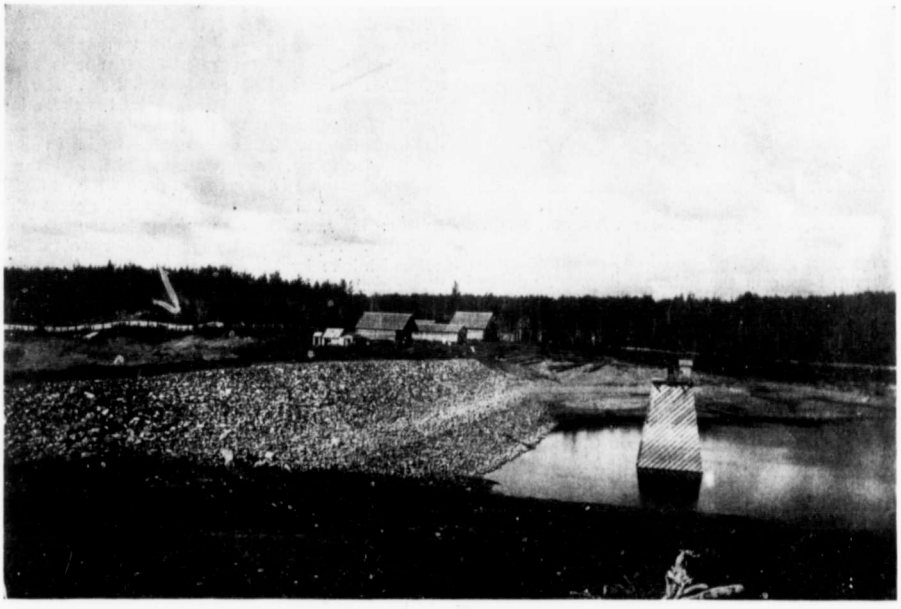
The market effect on a field so circumstanced of further deterrent influences can readily be conceived, and might indeed, at first sight, and for want of impartial consideration, be overestimated, and the noticeable lack of many evidences of actual progress be scored against the country to any great extent, perhaps, not warranted by the actual facts.

The possession of power, and the potentiality of achievement, may be as well indicated by a stand, made in the face of opposing forces, as by rapid advancement along lines of less resistance, and the more hopeful view of the situation is certainly borne out by the results of operations conducted by such undertakopment in the lower levels, a result specially satisfactory in its bearing on the subject of permanence of the ore bodies of the district with depth. During the year some 5,000 feet of development work was done, all below the 500-foot level, and of this total amount fifty per cent. was on and between the 800, 900 and 1,000-foot levels, and the ore bodies thus opened up, have yielded a net profit on working of $30,000 per month since shipping was resumed in July. Two years ago the Silver King was supposed, in certain quarters, to be worked out, so far as ore which could be profitably extracted was concerned, and the present results cannot be afforded too great a significance as evidencing the progressive spirit in general obtaining throughout the district.

As set out in the company's report, the decline in the price of silver and lead, severely felt as it was by the mines upon whose output the smelter was so largely de-

pendent was indirectly as well as directly, responsible for a falling off in the smelter returns.

Another indication of growth is to be found in the suggestion, much discussed during the year of the establishment of a lead refinery at Nelson. Certain steps have been taken with a view to carrying out this project, and it is greatly to be hoped that a rise in the price of lead and silver, in the near future, may lend to the scheme sufficient guarantee of success to ensure of its early materialisation. The adoption of electrical power would, without doubt, greatly facilitate the handling of many properties at present handicapped by reason of the large initial expense requisite for the proving of their merits and for the conversion of so many prospects into a condition of calculable value. And here again it is encouraging to learn that the Hall Mining & Smelting Co. propose to install electrical machinery at their mine and smelter.



View of Morehead Lake Dam and Camp Buildings.

Sustained confidence in the district is also shown by the number of claims recorded during the year, which is in excess of the number recorded in 1900, and by the large number of assessments made, amounting to nearly 1,300.

To sum up, the experiences of the past year in Nelson district afford many indications of an inherent soundness requiring but the re-establishment of normal conditions to produce more active progress and the further development of its resources.

THE MINING INDUSTRY IN CARIBOO DISTRICT, B. C.

By Thos. Drummond, B. Sc., (McGill), M.E., M.C.S.C.E., &c.

THE mining divisions of Quesnelle and Cariboo taken together form what is commonly known as the Cariboo district. It is an area of considerable extent, extending in a westerly direction from the summit of the Rocky mountains practically to the coast line, a distance of about 360 miles, and in a northerly direction it covers a distance of about 170 miles. Its total area threefore is approximately 60,000 square miles.

In a northerly direction running through the centre of the district is an extensive, wide and well-defined trough or valley through which the present drainage system of the country passes.

To the east and west of this level portion of the district the country gradually rises, becoming rougher and more broken till it finally culminates in the rugged snow-clad peaks of the Rocky mountains and Coast ranges. This rougher portion of the country is comparatively unknown so far as developments are concerned, but numerous ledges containing lead, copper, silver and gold have been discovered and in the near future, with the advent of railways, these will undoubtedly become valuable.

This central valley is of great importance to the country. It affords easy gradients for railways and waggon roads, and through it passes the main artery of the country in the shape of the Cariboo waggon road, with its numerous branches to the various mining centres of the district. Then in part it is a grass country supporting numerous herds of cattle, and including a very considerable area of good arable land from which good crops of roots, vegetables and grain are obtained.

From a mining point of view it is of especial importance because it is covered with alluvial deposits in the shape of gravel, etc., all of which is auriferous to a greater or lesser extent. We also know that there are many very extensive systems of ancient channels or buried rivers, much larger and more extensive than the modern ones as can easily be seen; for the agencies which formed these immense gravel deposits must certainly have been much greater than any which now exist. These ancient channels at one time formed the drainage system of the country. As exploited, most of

these channels are rich in gold and where they are crossed by the modern streams these have also been enriched. They are, I take it, the main source of supply of the gold which has been, and will be, obtained from the district.

In distinction to shallow placers these deeper deposits require a heavy initial outlay for plant, exploitation and opening up. The prospects of success, however, are such that the available placer ground promises to yield

Two 8-inch streams opening up Pit No. 2, at S. Fork Mine, Cariboo.

a much greater output of gold in the future than was ever obtained even in the palmiest days of mining in the district. Placer gold is also an indication of quartz gold, and one reason why this has not been found to any great extent near by, is probably due to the fact that the gold has been transported for a considerable distance in these old channels.

British Columbia has produced a large amount of gold as is well known, and the bulk of this has been obtained from the alluvial deposits of Cariboo district. Placer mining therefore is its principal industry, and it is the mining lookout from this point of view which I wish to notice, in reviewing briefly here operations during the past year.

The most important mining centres are Barkerville, Quesnelle Forks, Keithley creek, and Snowshoe creek and Horsefly.

The Consolidated Cariboo Hydraulic Mining Co., Ld.—This mine is situated at Bullion, on the southerly side of the South Fork of the Quesnelle river, about four miles above the town of Quesnelle Forks.

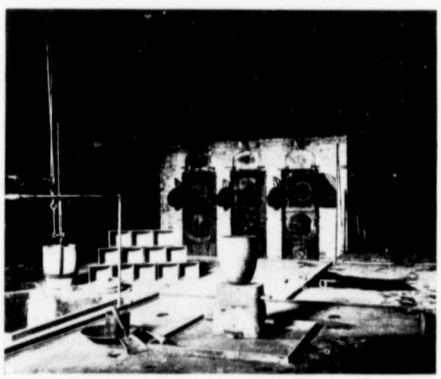
The company hold a number of leases covering the old channel system in this vicinity, which consists of immense deposits of high-grade auriferous gravel.

The water supply is obtained from Polley, Bootjack and Morehead lakes by an extensive system of canals with a delivering capacity at the mine of 5,000 miner's inches of water under a head of 400 feet. In the aggregate this canal system is 33 miles long.

The mine is fully equipped with all the modern hydraulic appliances necessary for working gravel on a large scale.

An electric and power plant was installed this season to light the mine and houses, and to operate drills, etc., for bed-rock cuts, and the company also operate a telephone system 35 miles in length. On May 12 the company exploded a bank blast containing 4,540 kegs, or 113,500 pounds of black powder, which broke up eight acres of ground and made available for washing 4,000,000 cubic yards of gravel. A new camp is also being built near the waggon road and clear of the channel, consisting of five stores, store houses, shops, dwelling houses, residences, etc., and the construction of these will all be completed about the end of the present year. The bank is about 350 feet high and the average value claimed for the gravel is 27 3-10 cents per cubic yard. The mine has produced $1,020,400 exclusive of the amount produced under the management of the original Chinese owners. The total amount of gold recovered this season is $142,000—a falling off from last year due to the unusually dry season and small snowfall of the previous winter. The annual precipitation was 10 42-100 inches less than for the previous year, making an actual shortage in the water supply of 128,428 miner's inches. The season's operations were confined to the removal of the low-grade top material and when the water failed there was uncovered 1,000 feet in length of bottom pay gravel, which will come into next season's work. No dividends have as yet been declared and the profits have been used in extending the water system and enlarging the plant. When this work is completed the mine will be in a position to pay handsome profits.

Roses Gulch Mining Co.—The mine is owned by Messrs. John McRae and James Bain. The water is taken from Roses lake and delivered at the mine with a head of about 150 feet through a ditch about two miles in length. The owners are working in on the old channel coming through Roses lake, and the leases cover one and a half miles of it, and operated in the spring and fall with a small hydraulic plant while the water lasts, with a working season of several months. A permanent supply can be obtained from Spanish lake by building about seven miles of ditch. The bank is about 75 feet high. The top ground carries fair values in fine gold, but the actual pay is about 10 feet thick on bed rock, well washed lead gold and fairly course pieces as large as $17 having been obtained. The available dump into the Quesnelle river is about 400 feet, and the present dump about 150 feet. The property pays a small dividend and with a good



Melting Room at Cariboo Hydraulic Mine, with gold ingot in foreground valued at $134,728.

permanent supply of water it would probably yield good values and rich returns.

Joe Moore Co.—This claim apparently is on a higher channel than the last. The channel was first located by sinking a shaft and this season the claim was opened by drifting through the rim into gravel. The gravel is now being washed through sluce boxes with satisfactory results, I am informed.

(To be continued in our next).

MINING ON THE KLONDIKE.*

METHOD OF "FIRING," ALSO OF THAWING BY STEAM, AND DESCRIPTION OF MINING METHODS USED.

By A. J. Bowie, M.E.

INFORMATION received from an Indian in the spring of 1896 led one, George Carmack, a pioneer in the Northwest Territory, to prospect a tributary of the Troandyke river for gold. His labours were rewarded by its discovery on a stream subsequently named Bonanza creek, about thirteen miles distant in a southerly direction from what is now known as Dawson, estimated elevation 1,012 feet above sea level, distance from St. Michael's on Behring sea, via Yukon river, is about 1,800 miles, Yukon territory.

The Troandyke (Indian name) river, now corrupted to Klondike, enters the Yukon river fifteen miles above Fort Reliance. It is a swift, shallow and clear stream, flowing over a bed of coarse gravel about 175 yards wide at its mouth. Its length is still unknown, though prospectors have ascended it fully one hundred miles, the last twenty miles flowing between low-wooded mountains which descend to the very edge of the stream. The district drained by it above the point where Hunker creek joins (12 miles above Dawson) is a "terra incognita" to the miner. The valley beyond broadens into a plain, and farther on the mountains converge to the stream.

The gold-bearing tributaries of the Klondike rise toward the east and debouche on its southerly side in the following order:

1. Bonanza creek (about 23 miles long) joins the river one and a half miles above the junction of the Klondike and the Yukon. 2. Quigley creek (five or six miles long) debouches about 3½ miles above the mouth of Bonanza. 3. Three miles farther up stream, Bear creek, 12 miles long, empties. 4. Four miles beyond Bear creek is Hunker creek, about 20 miles in length. 5. Slate creek (approximately 12 miles long) meets the Klondike 14 miles above the mouth of Hunker.

Beyond Slate creek, 14 or 15 miles, is the confluence of "Too Much Gold" creek and the river, and between "Too Much Gold" and "All Gold" creek, which is 10 miles beyond "Too Much Gold" and the Klondike, the river forks. The first mentioned creek is estimated to be about 23 miles in length and the latter to exceed 20 miles. The grades of all the creeks are very light. The widths of the creek bottom from rim to rim, vary in the several tributaries. Bonanza creek has been estimated to be from 300 to 1,200 feet — averaging less than 700 feet, and Eldorado creek, a tributary of Bonanza creek, eight miles long, is between hills from 200 to 800 feet apart at their base.

Eldorado creek, the scene of the subsequent gold discoveries, joins Bonanza creek at Grand Forks, about one-half mile above Carmack's Bonanza discovery.

Indian River Division.—Dominion creek, Sulphur creek, Quartz creek, and other tributaries of Indian river, all within 45 miles of the mouth of the Klondike, though situated in the Indian River division of the Yukon district, are considered a part of the Klondike gold fields. (Vid. Appeal of the Yukon miners of the Dominion. Pub. Ottawa, 1898, which gives a most interesting account of the condition of mining affairs in the Provisional district of Yukon).

The published accounts of the richness of Eldorado and Bonanza creek placers caused the "rush" from all parts of the world to this country during '97 and '98.

Mineral Resources.—The mineral resources of this "Land of Northern Lights and Midnight Sun," with the exception of a small area around Dawson (outside of a radius of 50 miles the country is unknown) are still undeveloped, owing to the severity of winters and the difficulties of summer travelling.

Seasons.—June, July, August and September are called the summer months and all the others are included in winter. In mid-winter day is only four hours long, and in mid-summer there are twenty-four hours daylight. The temperature ranges from 95 degrees Fahrenheit in the shade in the latter season to 70 degrees below zero in the winter, a lower temperature than that recorded by Nansen in Greenland, or his recent Polar explorations.

STARTING A SHAFT IN THE KLONDIKE.

Road Trails.—No roads existed in the Yukon Territory, not even in Dawson. Mere zigzag lines through "muck" and water indicated the summer trails. The surface of the ground is covered with moss under which, where undisturbed, the soil is frozen to bed rock at all seasons. The water from melting snows, rains and springs, partially absorbed by the moss, drains through the creeks into rivers which flow to the sea.

Muck.—The soil underlying the moss, locally called "muck" is composed of the lighter silts, clay and sand, constituting a thick bed overlying the auriferous gravels. Surplus waters collect under the moss forming immense pools and quagmires. These bogs or swamps, through which "the traveller flounders painfully" are scattered over plateaux and along the flanks and on the ridges of the highest ranges.

Travel.—The prospector carrying on his back his tools, food and blankets, travels slowly and the work is so laborious "that only strong men dare attempt it and few succeed in getting far from Dawson." No supply station existed nearer than Dawson, and on a thirty-mile tramp a man could pack but a very limited food supply, consequently work has been necessarily limited.

Winter Temperatures.—In winter, travel over these vast solitudes of snow-covered stretches is not inviting.

* Reproduced by special arrangement with the proprietors of *Mines and Minerals*, Scranton, Pennsylvania.

Bleak winds, drifting and blinding snows, temperatures ranging day after day 40, 50 to 70 degrees Fahrenheit below zero, and no shelter beyond the creeks, were conditions to be met which appalled the stoutest hearts, while the remains of many a brave fellow fallen on the trail evidenced the hardships of the country and the severity of the Arctic climate.

Underlying Rocks.—Granite, granitic schists, and metamorphic slates underlie the auriferous wash of the Klondike. The Klondike placers so far as developed have presented no novel geological features.

Origin of the Placers.—Their origin, judging from their composition and positions may be ascribed to erosions occurring at different geological periods in which submergence and elevation were the most important factors. The silts which cover the gravel wash indicate lacustrine origin, and according to the Canadian (Vid. Geological Survey of Canada Annual Report 1887, pp. 42, 42, 46,) geological investigations those of the Upper Yukon appear to have been largely derived from material ground out of the rocks by glacial action. The Klondike fields can be compared to those described by Murchison as occurring on the flanks of the Ural. There are no gold-bearing river channels like those existing in California, nor is there any evidence of gold placers of glacial origin.

Occurrence.—These placers are found along the lines of natural drainage, the topographical features indicating the general direction of the gold alluvions. This does not imply that the miner sinking on a stream flowing in its present course will strike, on first attempt, the channel, but refers to the general course of the wash as indicated by the enclosing ranges.

Depth of Gravel.—The depth of the gravel varies with the waves in the bed rock and its position in the line of wash, ranging in places from only a few inches up to eight or ten feet. This must not be confounded with the "pay streak" which varies in the gravel from a few inches to four feet in thickness and in some instances more, but they are exceptions.

Pay on Bed Rock.—On Dominion creek, 35 miles distant southeasterly from Dawson in the Indian River district, so far as ascertained, the pay is confined chiefly to the bed rock, and it is in such localities that fabulously rich pans are obtained which are misleading.

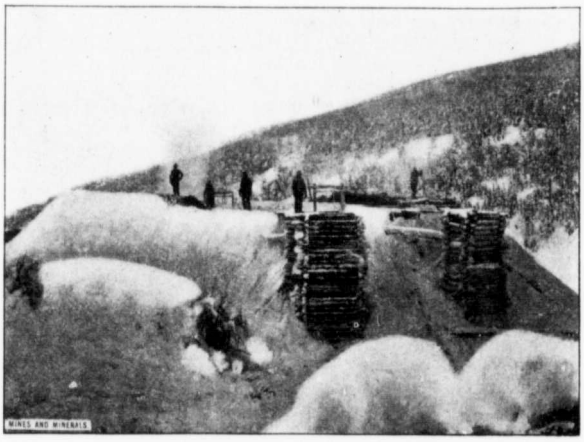
Location of Pay.—The location of pay gravel can only be determined by explorations and, when struck, it requires development to predetermine economical results. These subterranean creeks or gulch channels will be found to follow along between the encompassing ranges in conformity with the bed rock and the shifting of the flow, not in any way indicated by the present surface conditions. (The old channel deposits, where developed, are found to have followed a direct course with large curves, but no sinuosities). Corroborative of this can be cited an instance where, on a Bonanza creek claim, ten shafts were sunk without striking pay, the eleventh shaft finding it. This is not an exceptional case.

Pay Dirt.—The term "pay dirt" is meant to include so much of the gravel and bed rock as can be profitably mined. Pay dirt with this definition is a variable quantity, dependent not only on its gold contents, but on the depth of the gravel and on the cost of labour and supplies. These identical conditions fix the workable width of the wash, even within the restricted lines of the rim rock.

Hill Deposits.—Prospectors in the summer of 1898 discovered by means of shafts, sunk along the hills bordering Bonanza and Eldorada creeks, an upper line of auriferous alluvions several hundred feet above the creek bottoms. The course of this deposit skirts the top of French hill, running down Eldorado to Gold hill, thence to Cheechaco hill, along Bonanza creek across Adams gulch, following Bonanza creek considerably farther down, finally crossing it and debouching near the Klondike. This upper deposit consists of masses of quartz carrying gold. This quartz mass bears every evidence of its reef or vein origin, and as far as developed is from 200 to 300 feet in width.

Value of Hill and Creek Gold.—The gold it contains is worth from $10.50 to $12 per oz., whereas the creek gold, which is well water worn, varies from $15 to $17 per ounce.

Wherever a break in the hillside line occurs, the claims on the creek immediately below are invariably rich. This has been proven notably at No. 17 Eldorado and on the "Dick Lowe Faction," and on No. 2 below Discovery on Bonanza creek, where the working of



DUMPS CONTAINING $450,000, SHOWING SHAFT CRIBBING.

these claims showed the local enrichment of the placers, not only by the increased bullion yield, but by the presence also of the two distinct classes of gold obtained in the "clean-ups."

These local enrichments are in marked distinction to deposits found on the line of the junction of two flowing streams, which are here proven to follow the same course as experienced in Australia, the rich ground being below the junction on gently undulating bed rock.

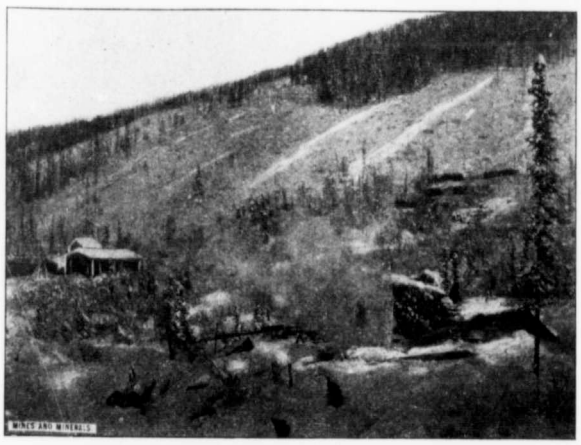
The Lower Klondike.—The Lower Klondike region is very rugged and has been described as "hill crowding hill, mountain jostling mountain, on and on they sweep to the uttermost reach of the vision. (Page 31, Appeal of Yukon miners to the Dominion Government). The remote situation of the mines, the difficulties of travel with attendant privations, high prices of labour and supplies, apart from questions of legislation, have here made mining unique.

The season of 1897-8 found the miner in this bleak district with a general scarcity of provisions staring him in the face, with few tools and appliances for mining at his command. That gold existed in many of the creeks had been definitely ascertained, but how to extract it and mine at a profit taxed his ingenuity. There was no powder at hand, no machinery or steam power

obtainable ; subsequently some powder was obtained and blasting tried on the frozen ground. Apart from its prohibitive cost, the results were unsatisfactory. Recourse was taken to firing.

Free Miners' License.—The creek bottoms and hillsides were fairly well wooded with birch and stunted spruce, and by virtue of the Free Miners' License, any miner had the right to cut all the wood he required for the use of his claim, on any government land not previously covered by a concession. The cost of fuel at this period was that of cutting and hauling. The rapidity with which the prevailing timber was removed and used from the surrounding country seemed incredible. Every one resorted to firing ; the whole country teemed with burning shafts, discharging smoke in volumes, darkening what little was left of daylight.

Channel Mining.— The channels are exploited and mined by means of shafts sunk 30 feet apart when in pay gravel. Drifts opening faces for breasts are driven half way from each shaft forming air connections, the distance of a "box length" (12 feet) being considered the most convenient for skidding. All the gravel with-



Fire Just Starting in Shaft, Klondike Region.

in that distance being worked through the respective shafts.

Shafts.—As a rule shafts are located as near the line of present surface drainage as circumstances and conditions permit. Their depths vary in accordance with their location and the position of the deposits on the creeks. On Dominion creek they may be averaged at 20 feet, on Bonanza, Eldorado and Hunker creeks from 12 to 25 feet, while on Sulphur 40 to 50 feet will be the average required to work the pay streak.

Timbering.—Timbering is rarely required on account of the compact overlying muck, which, after the gravel has been mined, settles down at the point of least resistance, until it rests on bed rock. The surface dirt around the collar of the shaft is generally secured by cribbing with round poles, and as the dumps are raised the mouth of the shaft is built up with notched timbers closely set together. What is most noticeable is the number of shafts required by this system of mining, entailing an enormous expenditure for dead work.

The field presented to the miner is not especially an inviting one for work. The surface in winter is covered with snow or ice, under which lies the moss one or two feet deep, reposing on the soil and muck already described, which in turn overlies the gravel. The location of the shafts having been determined on, mining then commences.

As preliminary to shaft firing, the moss is first removed from the ground with a mattock, then the muck which varies in places from six to forty feet in depth, is attacked with a pick. In a shaft 4 x 6 feet sinking progresses at the rate of five feet per ten-hour shift.

Gravel.—When the gravel is encountered firing is begun, eight to fifteen inches being thawed per burning, depending on the character of the gravel, moderate-sized cobbles carrying the heat deeper than the fine sandy material.

Fires.—The fire made with dry kindling and logs covering the bottom of the shaft is lighted and allowed to burn out, when the shaft is cleaned of the thawed gravel and the burning continued till bed rock is reached. It can be frequently arranged so as to have two fires on a ten-hour shift. The bed rock being reached, drifting fires are started around the sides of the shaft.

Firing for drifting and breasting is totally different from firing for sinking. Dry kindling is prepared and cut in convenient lengths for splitting, say 2½ feet long. This kindling is laid along the face of the ground to be thawed, on cross pieces spaced 2½ feet apart. Over the kindling dry wood and odds and ends of brands left over from former fires are piled, which are in turn closely covered with green wood piled lengthwise, the whole forming an angle from the ground to the top of the pile against the face of the gravel to a height of 2½ feet, carefully banked.

The space between the cross pieces under the kindling is left for purpose of draft and lighting. A fire built, as described on the following page, against a breast 25 feet long and 2½ feet high, requiring half a cord of wood, will thaw about five cubic yards of gravel as it lies in the deposit. Wood for firing formerly cost $25.00 per cord.

Time of Burning.—When the weather is very cold and the draft strong, the fires are not lighted before 10 p. m., and should burn out between 5 a. m. and 6 a. m. the following day, in time for the works to be cleared of smoke and gas to permit the morning shift to resume operations.

Firing on Dominion Creek.— During the winter of 1898-9 on Dominion creek, at No. 13 above Lower Discovery claim, it was found that firing four faces, each 30 feet in length, required the labour of one man two hours daily to cut sufficient shavings with a draw-knife to make the fires, or a daily cost of $2 for shavings. Messrs. Waterman and Mayon, who were working the claim, substituted rags soaked with kerosene. The results obtained were most satisfactory. Ten gallons of kerosene costing $28 last six weeks, as against $84 for shavings. Apart from the saving of time and money the burning of the fires was assured, a most important feature.

This system of mining only allows seven hours' work for the handling of the gravel, the remaining time being required for sawing, splitting the wood, and laying the fires.

Action of Heat on Ground.—When the fires have started and the ground becomes heated the gravel soon drops from above and buries the green wood covering, retaining the heat, which with the smoke creeps along the roof of the drift or breast, making for the shaft. There results a caving of the material along its entire course, particularly around the shaft, the caves extend-

ing to the muck, necessitating the handling of tons of waste, and later, with the advent of mild weather, the destruction of the pit.

Handling of Gravel—The gravel as thawed in the breast, is handled immediately to prevent its freezing back. It is shoveled into wooden buckets holding about 120 pounds each, skidded or dragged to the shaft and windlassed to the surface, where it is dumped alongside of the shaft and freezes over again. There it remains to be thawed out by Nature or otherwise till sluiced in summer.

Work Shut Down.—Breasting and drifting cease with mild weather on account of the water in the drifts, caving of the ground, and dangers from asphyxiation. The gravel being mined and piled in dumps around the shafts, with the advent of the water season, sluicing commences, the necessary preparations for same being made already.

Impounding Waters.—The light grades in the creeks necessitate the impounding of waters to enable the miner to sluice the dirt, and also occasion frequent handling of the tailings. As the claims vary from 250 to 500 feet in length, it is patent how aggravated the situation becomes.

Dams.—It is estimated that an ordinary temporary dam costs per claim $1,000, and structures are known to have required as much as $8,000 to erect. Most all of the dams, such as they are, are sooner or later in the season swept away by flood.

Centrifugal Pumps.—Centrifugal pumps in instances are found to be convenient and economical for supplying water for sluicing and have been found very efficient for draining underground works. In many instances old works have been used as storage reservoirs, and the water snbsequently pumped from them and used for sluicing purposes over and over again.

Canvas Hose.—Canvas hose is an excellent substitute for flumes, where the price of labour and material is so high, and as the quantity of water run per sluice head, here called 60 miners' inches (Canadian measurement), is so small, it can be used to great advantage if one be permitted to take the water out sufficiently high on the creek, above the claim upon which it is to be employed.

Waste Ditches.—The cost of the waste ditches to carry off surplus waters of the creeks depends on their length, which vary with attendant circumstances.

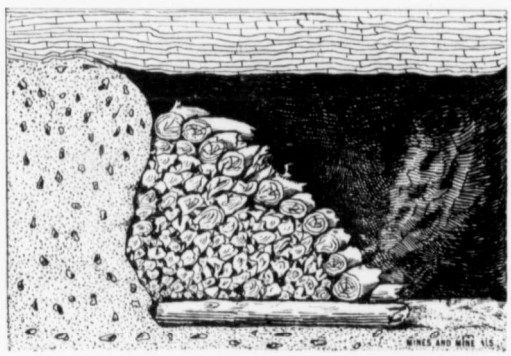
Sluices.—Sluices, so-called, are built of one-inch pine lumber, 12-ft. lengths. They are 11 inches at top, 10 inches deep, bottoms 13 inches wide, 10 inches deep. These boxes are nailed together and made in 12-ft. lengths, and strengthened with strips for small posts, and sills are required. The boxes are set one in the other by dropping the narrow end of the box into the flared upper end; the edges and leaks being stopped with rags. This style of sluice, as set, is well calculated to afford the smallest discharge for the material used in its construction, as well as to entail a continuous loss of grade.

Riffles.—Pole riffles are in general use. The boxes are cleaned up daily after sluicing. No quicksilver is used, the bulk of the gold being caught in the boxes into which the dirt is shoveled. The gold obtained is taken in pans or kettles, panned out, dried and cleaned of sand and iron and ready for the market.

Sluice Grade.—The grade of the sluices is apparently regulated by the idea of the person running the claim. The sluices are placed as close as they can be conveniently to the dumps. When the water season arrives and the gravel is sufficiently thawed, it is shoveled by hand into them. The men along the sluice throw out all the rocks which the water will not carry off. Large rocks are taken by hand and cleaned in the sluices. The attendant expenses of this method of sluicing are considerable.

Economical Question.—The workings of these placers as described brings one face to face with the study of the economical question involved in order to establish a basis for their valuation. It is a well-authenticated fact that ground in several of the claims in the Klondike gold fields have yielded $35 per cubic yard, but neither the extent of the areas nor the cost of working them has ever been stated. Auriferous deposits with a high yield per cubic yard, and a large available area do not alone constitute a rich mine, as the commercial value of a mine is determined by the relation of the yield per cubic yard to the cost of obtaining its corresponding yield in precious metal, or, in a word, the difference between the money yield of the bullion and its cost of production.

Official Data.—Official data on file in the offices of the Canadian government give "the cost of handling dirt (summer work) from ground sluicing to clean-up averaged (labour bills) $5 per cubic yard on the entire quantity moved," and "the cost of handling dirt from shaft sinking to clean-up (winter work) averaged $12 per cubic yard." These are results of workings done on Eldorado creek and Bonanza creek in 1897-8, ordinary labour being $1.50 per hour, and provisions correspondingly high.



Sketch of Wood Piled for Drift Firing.

In 1898-9 ordinary labour on Dominion creek ranged from 80 cents to $1 per hour, the expenses of living being the same as that of previous years. The annexed tabulated statement prepared by Douglas Waterman, Esq., shows in detail the exact cost of the working by the firing system on claim No. 13 above Lower Discovery on Dominion creek, after the ground had been thoroughly opened and all attendant preliminary work comcompleted.

1899.	Feb.	March.	April.
Number of shafts from which dirt was hoisted	4	5	4
Number of buckets hoisted	10,872	13,186	11,910
Cubic yards	400	490	440
Number of men employed	12	12	8
Number cords wood burned	25	25	15
Labour expense	$1,991 25	$2,445 75	$1,625 50
Wood expense	375 00	375 00	225 00
Total expense	2,366 25	2,820 75	1,850 50
Cost per cubic yard	5 91	5 75	4 20

The months of Feb., March and April were the most

advantageous seasons for breasting. Labour was paid $1 per hour. No charge is made for wood beyond cost of cutting and hauling. Distance hauled, one-half mile down hill.

Thawing by Steam.—In the fall of 1898 a small boiler was erected on claim No. 2, Eldorado creek, to experiment on thawing ground with steam, the idea having suggested itself that by a direct application of dry steam more economical results could be obtained than by firing.

The crude test showed that sinking could be rapidly and cheaply done, but it was not considered to be applicable to drifting. Several other trials of steam thawing were made on Sulphur creek in the winter of 1898-9. Although the apparatus used was most inefficient the results were so encouraging that the idea was quickly grasped, and the opening of navigation in 1899 found nearly every scow and steamboat arriving at Dawson carrying in their cargoes boilers of all sizes, from 5, 10, 20, 25 to 40 horse power. The West coast had been scoured for small hoists and boilers; the pipe boiler, on account of its light weight, being the type generally selected. Small hoisting engines and pipe fittings made their appearance, and with the opening of winter work steam whistles echoed all along the creek.

The advantages of steam thawing seemed soon to be recognised by all claim owners who, though they were not familiar with its workings, were afraid some other person might work more economically, so rushed into the market and purchased the plants even before they arrived.

First Experience with Thawers.—The experience with "steam thawers" demonstrated in nearly every case that the capacities of the boilers were insufficient to meet the requirements of the "points" they were using. In general the steam plants were poorly mounted and unprotected against the elements. The boilers and steam pipes were uncovered, and the steam from the boilers to the breasts underground (sometimes 200 feet distant) passed through bare iron pipes.

With the temperature of these creeks far below zero Fahrenheit, it can be readily understood how great must have been the waste of fuel and losses due to condensation. Injectors feeding the small boilers did aot keep up the water supply and permit the generation of sufficient steam to feed the "points," resulting in loss of time and frequent deluging of the pipes.

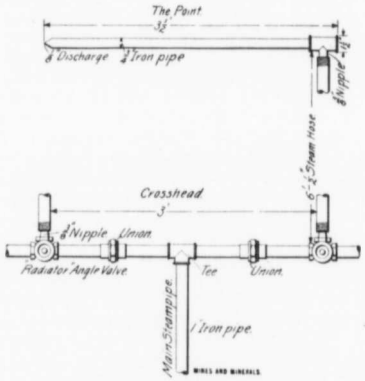
Steam Thawing in 1899-1900.—During the winter of 1899-1900, steam thawing, as the plants were perfected, gradually showed what could be achieved, and the great advantages over the old system of firing, to wit:

1. It can be used at all seasons.
2. Absolute security to life.
3. No loss of time, can be prosecuted continuously.
4. Dead work reduced to a minimum.
5. Saving in handling waste.
6. Absolute control of the heat.
7. Economy in fuel—direct application of the heat.
8. Expeditious and economical extraction of the gravel. Gravel better thawed and with the use of a small hoist, there is additional economy of labour with an increased output.

Thawing Plants.—A thawing plant should consist of a boiler, pipes, set of points, and a hoisting engine with drums complete. The requirements determine the horse power of the boiler, each point used requiring at least two-horse power. The additional power necessary for the hoist depends upon the amount of work to be performed. A 10-point plant should have a 30-horse power boiler. The boiler should supply dry steam.

The pipe boilers, which have been extensively used, are short lived, large consumers of fuel and undesirable. Locomotive boilers have given the best results, but any good boiler will do the work; it is only a question of cost, $100 per horse power being the prevailing rate at Dawson.

Steam Outfit.—The boiler should be fitted complete with steam drum, mud drum, gauges, valves, feed-pump, oilers, wrenches, complete set of tools, including taps and dies,, and sufficient asbestos or magnesia cov-



STEAM THAWING APPARATUS.

ering to thoroughly protect the plant and steam pipes to be used under ground. Special attention should be given to the thorough protection of the main steam pipe leading from the boiler to the shaft.

Feed Pipe.—The size of the main feed pipe is regulated by the number of points; with 10 points a one-inch diameter pipe is necessary.

In the drifts the steam pipe is fitted with unions at convenient distances for disconnecting and drainage purposes. The feed pipe is carried down the shaft, and along the drift to the breast where a T is put in, and a cross-head run the full length of the face to be thawed.

Cross-head.—The cross-head is fitted with valves three feet apart, each point having its own valve. A six-foot length of half-inch steam hose connects the point with the valve.

Points.—The points are made of ¾-inch diameter iron pipe, 3½ feet long, drawn to a point at one end, with 1-8 inch diameter discharge, having on the other end a heavy steel head 1½ inch diameter, 4 inches long welded or screwed on, and into its side is placed a 3-8 inch nipple connecting with the hose.

As the points must be drained each morning a "radiator" valve with a union attached is found most convenient. The hose is fastened to the nipple with baling wire, having first heated the nipple and inserted it hot in the hose. Experience has proven that clamps are of no value. When the pipes have all been connected steam is turned on.

In starting the points they are held against the face one by one, and worked into it as the ground thaws, for about 1½ feet, being driven with a wooden maul the remainder of their length.

The starting of the point (that is to make the point hold its own weight) only requires about five minutes, the point man inserting them one after another, but it will take fully three hours to work ten points in their full lengths. When the points are in a full head of steam is turned on, and they are allowed to remain in the breast until 5.30 a.m., the following day, supposing that the point man commenced his shift the previous evening at six o'clock. When the points are withdrawn

the pipes are disconnected and the water pumped from the sump.

Ground Thawed.—An examination of the ground will show that the breast has been thawed thoroughly six ft. high and eight ft. deep. In contradistinction to the firing system the thawed mass does not require to be immediately removed, the cobbles and stones in the gravel retaining the heat and doing efficient thawing 24 hours later. (The details of the working of the steam thawer were given by Douglas Waterman, who had charge of the "Points" at No. 45 above Discovery, on Sulphur creek).

Illustration of what can be accomplished by steam thawing is readily seen from the following data showing a day's work done in the spring of 1900, on No. 46 above Discovery, Sulphur creek. The owner, Mr. Warren, purchased and erected a 20-horse power pipe boiler and connected up with a one-inch steam pipe, 80 lb. pressure to supply ten points, regulation length, ¾-in. diameter, 1-8 inch discharge.

The points were spaced three feet. The breast had 30 ft. face and the ground was thawed fully eight feet in and to a height of six feet. The man in charge of the points went on shift at 6 p. m. By 10 p. m. all the points were in their full length, and were run until 5.30 a.m. the following day, when they were disconnected to drain and prevent freezing.

The expense account was as follows :

Four miners at 80 cts. per hour	$32 00
Two surface bucket men	16 00
One day engineer	8 00
One point man	15 00
One night fireman	8 00
Three-quarters cord of wood	15 00
Total	$94 00

Work performed was : 600 buckets = 360 lb. gravel each = 180,000 lb. hoisted to surface 50 feet and discharged, costing per cubic yard $1.69. These figures speak for themselves.

Yield and Cost per Cubic Yard.—In discussing this question of yield and cost per cubic yard, one must bear in mind the condition of the labour and supply market, at the periods mentioned. Material not available to-day for mining may five years from now be very remunerative as the country is developed, transportation and supplies cheapened, and rates for labour lower.

The pay streak of to-day refers only to such width of channel as contains sufficient gold to stand the present enormous cost of production. It was considered in '97-8 that ground containing less than 15 cents per pan (a pan is estimated to contain 20 lb. of gravel) was unprofitable to mine.

Labour Rates.—Though labour still remains at 80 cts. to $1 per hour (July, 1900) with the progress in mining, seven cents per pan will now pay handsomely, provided it exists in fair quantities. In a region like the Klondike subjected to many changes, fast and hard lines in the cost of production cannot be drawn. Pioneers are wedded to their own ideas, which they persist in following. In time many of their abandoned and now worked out deposits will be reopened and found profitable to work.

Experience Gained '97-8—The experience of 1897-8 demonstrated the suicidal policy of the firing system of mining. The easily satisfied wants of the old prospector, and the rich placers alone permitted its use, resulting in the bulk of the gold finding its way into the hands of the trading companies, and little accumulated by the miner.

Outside capital is gradually being invested and a few enterprises will be carried out on a scale commensurate with the requirements.

Winter work is performed at a sacrifice of energy and loss of money compared with the equivalent of labour in temperate zones, which has been attested in the hundreds of cases in the Klondike, and evidenced by the numerous civil suits in His Majesty's Courts. Mining is necessarily carried on in the dark ; the costs of handling the gravel are excessive, and it is not uncommon to lose a dump by floods before it can be sluiced.

Dumps.—The dumps represent capital expended, and the longer they lie the larger the interest account, which in a country where money draws from two per cent. to ten per cent. per month, is worthy of consideration, especially where people without capital are compelled to borrow to carry on mining.

Delays.—The long tedious working season, continuous delays, slowly accumulating dumps, a late spring, anxiety over the water, with the uncertainty of the value of the clean-up, and the knowledge of a large expense account for labour and supplies have been a nightmare to many an honest miner.

Advantage of Steam Thawing.—Steam thawing obviates these troubles ; the exploration of the claim and its preparation for mining can be done most expeditiously and economically, the rapidity with which ground can be worked permits the selection of the most favourable season for mining. The simultaneous washing of the gravel enables the miner to know exactly what he can do.

A 500-foot claim, with a pay streak 60 feet wide and 6 feet deep, well managed with a properly-equipped plant, can be opened, developed, and cleaned up in 120 days from the date of the erection of the machinery, pre supposing a fair water season of 60 days. Such a property will pay a handsome profit, with dirt yielding four cents a pan.

Having determined by prospecting the generai course of the pay gravel in a claim (500 ft. location), five or six shafts should be located (100 or 125 feet apart) along the centre line of the deposit. Two steam thawers can then be placed in position. Each plant should consist of one 35-h. p. boiler complete as already described in this paper. One 15 h. p. hoist complete, with sheaves, ropes, buckets, two car tracks complete ; one set of 10 points, necessary pipes, valves and tools. A small circular crosscut saw, which can be attached and run by the hoisting engine, will be found an invaluable adjunct.

The thawers should be located to divide up the work evenly and be, without endangering them, as near as possible to the workings. The six shafts can be sunk simultaneously. For this work each plant will require one engineer ; one fireman ; four labourers. One poin man for day and one for night shift will be all that is necessary for sinking and drifting.

As the shafts reach bed rock, drifts should be started to connect them np. The two down-stream shafts should be connected without delay, and a sump excavated in the lower one. A bed-rock drain carefully covered and protected should, as soan as practicable, be cut in the bottom ot the connecting drift, and its extension carried on in accordance with the requirements of the situation. Provision being always made for the pumping of the water from the lowest shaft in case drainage is required.

When the shafts have been connected, a crosscut should be run from the centre of each drift, the crosscut being driven at right angles to the main drift across the width of the pay channel. A track should be placed along the main drift, and a movable turntable laid at each crossieg as occasion demands. With the completion of this work and the placing of the sluices arranged for direct dumping of the gravel into them as

hoisted, the claim is ready for the advent of the water season.

Breasting.—The method at present followed for breasting, commences work immediately at the shaft, which to say the least is in every way objectionable. Were the deposits covered by a greater depth of material and the channel wider, a modified form of "long-wall system of mining" could be worked to advantage, but the short-water season, narrow channels, liability to trouble from infiltrating waters, and excessive costs in everything, make it desirable to mine out the ground as rapidly as possible, avoiding all use of timbers, leaving the falling waste to take care of itself, keeping the drainage open and the shafts at all times secure and intact.

To accomplish this purpose, breasting with thawers should commence at the intersection of the main drift and with the crosscuts. The corners are first thawed off, and gradually the largest and most convenient faces are afforded for the work. As mining progresses the work nears the pits, the gravel as excavated being transported on trucks to the nearest respective shafts, making the longest haul say 50 feet in main drift. The handling of waste is avoided and the "muck" settles down on the bed rock as the men recede from the worked out breasts, the track being *pari passu* withdrawn, and the turntables retired. Finally all that remains to be excavated is the gravel immediately around the shafts, which can be handled without danger when required. This method insures absolute security to all employed and can be expeditiously and economically carried out.

Cost.—On the basis suggested the following tables give an estimate of the cost of working a gravel claim in the Klondike district with a properly equipped steam-thawing plant, when installed and well managed :

Estimated cost of working claim with one 35-h. p. boiler plant, ten points, 15-h. p. hoist. Labour rate 80 cents per hour ; fuel $20 per cord ; two 10-hour shifts :

Labour	$9,480 00
Fuel	1,800 00
Shafts	3,160 00
Drifts	2,667 00
Sluicing	1,700 00
Management	3,000 00
	$20,807 00

Amount of gravel hoisted and sluiced, 60,000 buckets or 1,000 buckets daily = 3,000 cubic feet = per 60-day season 6,667 cubic yards = cost of $3.12 per cubic yd. or 162 pans per cubic yard = cost .0192 cents per pan.

Estimate of cost of working claim with two 35-h.p. plants, two 35-h.p. boilers, two 15-h.p. hoists and 20 points, two 10-hour shifts, labour and fuel rates at above prices :

Labour	$18,960 00
Fuel	3,600 00
Shaft	2,160 00
Drifts	2,667 00
Sluicing	3,400 00
Management	3,000 00
	$33,787 00

The output of this plant should be 360,000 cubic ft. of gravel during a 60-days season = 13,334 yards, which would make the cost of mining $2.53 per cubic yard, or .0156 cents per pan of 20 lb. of gravel. The estimate of the cost of sinking and drifting is based on the known work which can be done with the points per diem. The sinking and opening up of the claims can be readily accomplished in 60 days making, say, a total season of four months. The estimated cost of two such plants as referred to is placed at $15,000. The plant could not be purchased in Dawson and placed in the mine for that figure. When the claim is worked out the plant can always be used on other claims, or sold. Their value would certainly be 50 per cent. of the original cost if sold off.

Output of Klondike.—Through the courtesy of Chas. G. Yale, statistician of the United States mint, at San Francisco, I am enabled to give the figures of production of the Klondike district, and show the increased yield each year since the discovery.

In 1897 the shipments of gold coming down the Yukon from the Klondike were not carefully segregated from the camps on the American side of the boundary line, and for this reason there is no exact data at hand. The Department of the Interior, at Ottawa, estimated the yield of the Klondike for that year at $2,500,000. At the United States mint at San Francisco, the product was estimated at $2,000,000 which is the same figure stated by the United States Consul, at Ottawa, who considered the estimate of the Department of the Interior as too high.

It will be well, therefore, to consider the lower estimate as correct and place the yield of '97 at $2,000,000.

Since that year more exact statistics have been kept. The method employed is to obtain from all United States mints and assay offices and private refineries and smelters, the amounts received by them from the Northwest Territory. Depositors are all asked for the source of gold so that this record may be kept, and care is taken to avoid duplication of statements. The following record may therefore be considered reasonably correct.

1897		$2,000,000
1898.	Standard Oz.	Coining Value.
Gold	595,318.214	$11,038,478 00
Silver	160,996.14	187,341 00
Total		$11,225,819 00
1899.	Standard Oz.	Coining Value.
Gold	859,281.228	$15,986,627 50
Silver	229,788.95	267,390 77
Total		$16,254,018 27
1900.	Standard Oz.	Coining Value.
Gold	1,197,608.099	$22,275,510 64
Silver	290,920.35	337,467 60
Total		$22,612,878 24

The total output of the Klondike district, Yukon Territory for the four years of its history is thus seen to have been $52,092,815.51.

SOLUTIONS.

By A. A. Watson, Provincial Certificated Assayer, Vernon, B. C.

WHEN we put a piece of sugar in water, what becomes of it? It dissolves. But what is solution? It is not a mere mixture of fine particles, for if we take a microscope and examine a drop of the solution of sugar we do not see any small particles of sugar. So far as can be seen the water is as clear as before, yet we know by the sweet taste of the liquid that the sugar is there. It is in solution. What the condition of solution is has not even yet been placed beyond dispute, but the theory which has obtained the greatest amount of credence is that the particles of a solid, when placed in a liquid in which it is soluble, keep getting smaller and smaller until at last they are separated into their molecules. These molecules in solution are then in the same condition as the molecules of a gas. They are separated from each other, they influence the vapour pressure of the liquid they are dissolved in, and they ex-

ert a pressure on their own account which is sometimes very considerable and can be accurately measured. Another theory which has some supporters is that solutions are compounds of the dissolved substance with the solvent. It has been pointed out that when sulphuric acid is mixed with water heat is evolved, proving that a chemical compound is formed. No doubt this is true in this particular case and the probability is that the first theory is wholly, and the second partially, true. To understand the solution of a solid in a liquid it is necessary first to understand the state of solution of gases in gases. Gases mix in all proportions. Their molecules are free and able to move about in any direction. If two gases are brought together they continue to mix until a uniform mixture is obtained. If we take a flask full of heavy carbonic acid gas and invert a flask full of hydrogen over it, taking care that the openings of the flasks are fitted tightly to each other, in a few days carbonic gas will be found in the upper flask and hydrogen in the lower, although hydrogen, until a few years ago, was the lightest gas known to science. The molecules of gas are always in a state of rapid motion and therefore when two gases are brought together the molecules of one soon penetrate those of the other and in time complete mixture is the result.

Gases are generally soluble in liquids. Their solubility depends upon pressure and temperature. The greater the pressure on the gas, and the lower the temperature of the liquid, the more gas will be dissolved. In the liquid condition, however, the molecules are closer together than in the gaseous condition, and for this reason the solution of a gas in a liquid is not so complete as the solution of a gas in another gas, and the thicker the liquid the less gas it will absorb. Mercury for example, which is nearly solid absorbs very little of any gas, indeed so little that the quantity is difficult to measure.

Liquids, like gases, dissolve each other, but to not nearly the same extent. The molecules of a liquid are nearer each other than those of a gas, and not so free to move about. For this reason some liquids will not mix at all, or only to a very slight degree. Ether and water, for example, will not mix and neither will water and petroleum. Water and alcohol on the other hand mix completely.

Having considered the solution of gases, a case in which the molecules are widely separated, the solution of gases in liquids where the molecules of the gases are free, and in the liquids only partially so, and the solution of liquids in liquids, where the molecules are only partially free, we come finally to the solution of solids in liquids, a case in which the molecules of the one are partially free, and of the other tightly packed together. It is needless to remark that the solubility of solid substances in liquids is very limited. Metals, however, dissolve in some acids, and many organic substances dissolve in water and other neutral liquids. When a layer of water is placed over a soluble salt the salt begins to rise against gravity and to diffuse in it, the motion only ceasing when the substances is uniformly distributed throughout the whole mass of water. This motion may be arrested by bringing between the solution and the solvent a septum which will let the solvent through, but not the dissolved substance. A semi-permeable wall of this kind can be prepared by saturating a porous earthenware cell with a solution of copper sulphate, and then filling it up with a solution of potassium ferrocyanide. A precipitate of copper ferrocyanide is formed on and within the earthen wall through which water, but not sugar solution, can be filtered. If we fill such a cell with sugar solution and connect it with a marometer to measure the pressure: and place it in pure water, we obtain an increase of pressure. A solution of sugar of one per cent. gives a pressure equal to 50 cms. of mercury. This pressure is called "osmotic pressure," and the laws governing it are the same as for gases, the pressure being proportional to the concentration of solid in the liquid. It has been found by calculations based upon the molecular weight of sugar, that the osmotic pressure of a sugar solution has the same value as the pressure that the sugar would exercise if it were contained as a gas in the same volume as is occupied by the solution. This is an important point and sheds a light upon the condition of solid substances in solution.

Solids, when dissolved in liquids, lower the freezing point proportionally, to their molecular weight. For example, if a substance called A has twice the molecular weight of another substance called B, an equal weight of A will lower the freezing point of a liquid twice as much as an equal weight of B. The vapour pressure of a liquid is also lowered according to the same rule when a solid substance is dissolved in it.

When a compound of a metal with an acid, as for example sodium chloride or zinc chloride, is dissolved in water, not only are the fine particles of the salt resolved into their molecules, but these molecules themselves are resolved into their primary elements. It has been found that the osmotic pressure and the lowering of the vapour pressure and freezing point of water when metallic salts are dissolved in it, are twice as great as expected from the molecular weights of the salts. From this it follows that there must be twice as many molecules, and therefore, instead of one molecule of zinc chloride there must be one molecule of zinc and one of chlorine. Another proof of this fact is that if we evaporate a solution containing sodium chloride and magnesium sulphate slowly, at ordinary temperatures, sodium sulphate and magnesium chloride separate out instead of the original salts. From this disassociation of metallic compounds into their elements in solution we get our galvanic battery. When a solution of copper sulphate is made the sulphur combined with oxygen, disassociates from the copper ; now when a piece of zinc is placed in the solution the zinc begins to combine with the sulphur oxygen, to form zinc sulphate copper precipitates, and when a circuit is made a galvanic current is evident.

We see, therefore, that the solution of a solid in a liquid is a continuous process of extremely fine division, the process being continued down to the molecules themselves, and in the case of metallic salts down even to their primary elements.

THE HOT SPRINGS OF SYDNEY INLET.

By T. R. Marshall, D. Sc ,
Edinburgh.

SIDNEY INLET has a bad name. It has the unenviable notoriety of being one of the wettest places of a land of heavy and prolonged rains. But I am a firm believer in the law of compensation and here is a striking example, for Nature has consequently so arranged that the water-logged inhabitants of this region may be provided with a means of driving away the pains of rheumatism by enjoying a further soaking in the hot mineral springs which occur in the immediate neighbourhood. Having heard of the wonderful properties of these heated waters from prospectors who have received material benefit by a course of treatment in the springs, I resolved to pay them a visit in order to prove whether I, also, could obtain relief from recently

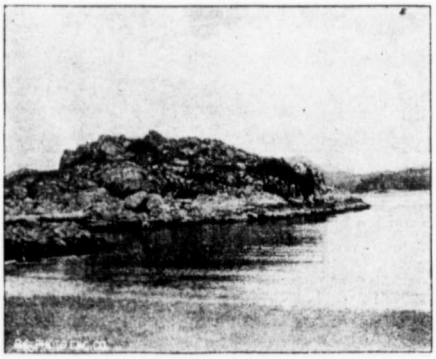
experienced shooting and other pains in my knee joints, the consequence, probably, of several days crawling through soaking sallal and underbrush.

Being of a companionable disposition, I induced a well-known West Coast prospector to accompany me by suggesting that, although he, as he stated, was not inflicted with rheumatism, that anyhow a bath was always beneficial. For some reason he eyed me with suspicion, but my innocent and child-like expression evidently reassured him and we didn't come to blows.

Beach at Sydney Inlet.

Deer Swimming Creek Near the Springs.

We rowed down the inlet one charming summer morning in a little skiff, skirting the north shore towards the open sea and landed at a deserted Indian reservation peacefully situated in a little cove, the only convenient place of landing adjacent to the springs. Here the traveller is completely sheltered from the never-ceasing swell which rolls in from the wide Pacific. The rancherie itself forms an ideal place for camping, as there is an abundant supply of fresh water and an open grassy place for pitching the tents. After lunch and a rest, we continued on our journey and rowed round the point of the promontory and landed at the point where the hot water of the springs meets the salt water. The landing here, even in the calmest weather is a matter of difficulty, and when a storm is in progress, quite impossible. To the less adventuresome, by far the best plan is to land at the rancherie and to make one's way through the comparatively open bush along the centre of the narrow promontory. A good trail could be made in a few hours.



Rocky Promontory, Sydney Inlet.

A Cabin at the Hot Springs.

The geology of this promontory is interesting, the rocks are chiefly sedementaries, highly altered and rendered crystalline by contact metamorphism. The heated waters of the spring well-up from clefts which distinctly mark a fault plane, up which the mineral laden spring rises. The source of heat is most probably occasioned by recent and extensive rock movements. Although I made no chemical examination of the waters it was apparent from the taste that the saline content was small. Silicic acid was present, as the waters in cooling deposited silicious sinter. The mineral in solution was therefore evidently derived from the decomposition of the silicates of the heated rocks by underground waters. We both thoroughly enjoyed bathing in the warm pools below the steaming waterfall, but first found some little difficulty in becoming accustomed to the high temperature of the water. The salts and silicic acid are, however, present in sufficient quantity to act as a mild counter irritant. One remarkable feature of the spring is the large amount of hot water welling up at the extreme end of a very narrow promontory jutting out into the Pacific.

The place is of easy approach. The genial captain of the *Queen City* is always ready to oblige passengers, and he would gladly drop the camper and his boat load of supplies opposite the sheltered cove.

The promontory is an ideal spot for the sportsman, as the waters, at certain seasons, teem with salmon, which may readily be caught with a spoon bait early in the morning or evening. The deer, which seem to love the

salt water and the sallal thickets, are to be found in great numbers. Personally I cannot imagine a more ideal spot to spend a couple of weeks camping during the warm summer months.

The Author, Dr. Marshall, at the Hot Springs.

To those interested in geological phenomena and in the formation of West Coast mineral deposits, there is a valuable lesson to be learned. The mineral deposits of the West Coast are frequently formed along fault planes, and many of the copper deposits are found in rock formations similar to those which form the peninsula. In the fault plane at the end of the promontory, we have actually a mineral lode in process of formation which does not, however, necessarily contain copper.

Cleft in Rocks Through Which the Spring Flows.

It would, however, be interesting to examine the spring for traces of this metal, as this spring is situated on the outskirts of an important copper-bearing mineral belt.

THE MINERAL INDUSTRY ON THE COAST, VANCOUVER, TEXADA AND PRINCESS ROYAL ISLAND, DURING 1901.

By W. M. Brewer, M. A. I. M. E.

WHEN the progress during the past year is considered, on the basis alone of actual accomplishment, there is apparently little cause for exaltation one way or the other. So far as the coast mines are concerned, except as regards the property owned by the B. C. Exploring Syndicate on Frederic Arm, there has been no development performed. On that property a force of miners have been kept at work continually, and according to the reports of the superintendent, Mr. Joseph Argal, the operations have been quite satisfactory. The ore body which has been exposed in the higher levels, has also been exposed on a lower level, after running about 1,000 feet of crosscut tunnelling and upraising. The extent of this body has not yet been determined, but the company is continuing its very admirable policy of steadily prosecuting development work in order to determine the capacity of the mine before attempting to ship or treat ore.

On Howe Sound, a reorganisation of the Britannia syndicate has been perfected, by which Montana men

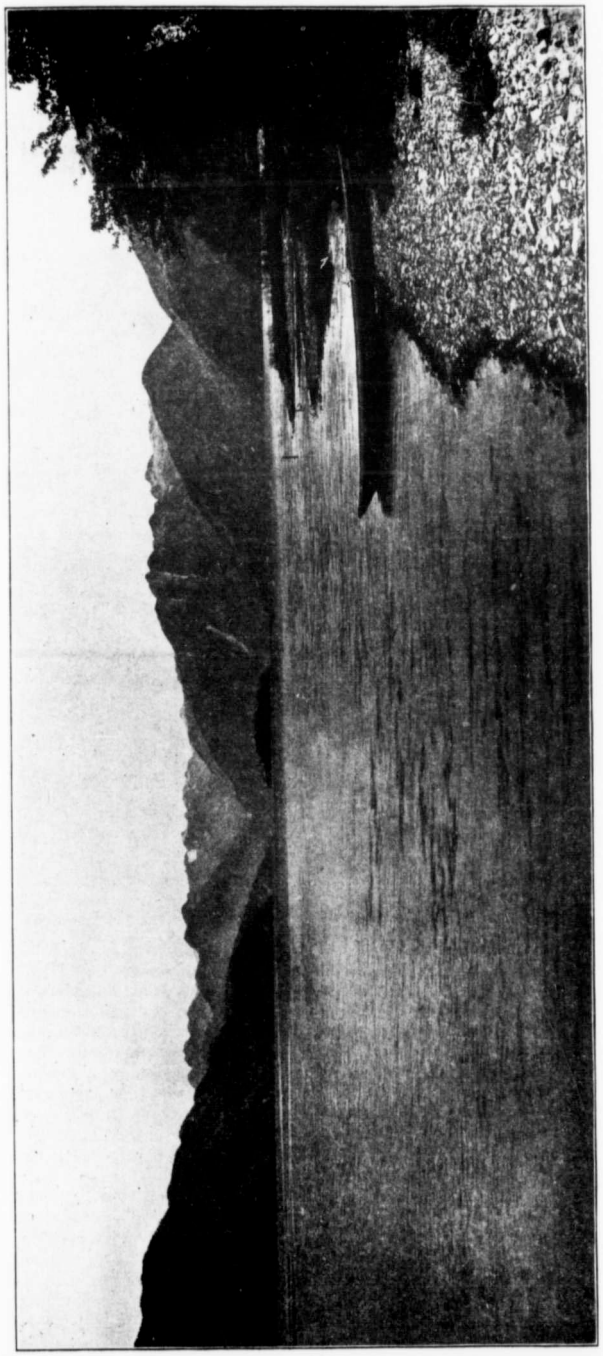
Powell River—Middle Falls.

have secured control of the property, and although no work has been done in the mine itself during the past year, yet surveys have been completed for tramways and roadways to insure transportation facilities from the mine to the beach. It is confidently expected that these will be built early in the coming year, and the necessary machinery installed, in order to commence mining operations on such a scale as is warranted from the development work which was carried out during 1900.

Considerable prospecting and assessment work have been done at Howe Sound, within ten or twelve miles from the Britannia group, and several of these prospects will apparently develop into mines of commercial value.

On the Seamore creek, within fourteen miles from Vancouver, there has not been the activity which was expected from the representations made by the owners of prospects in that region during the fall and winter of 1900 and 1901. The work done there has merely taken the form of assessment work, which the owners of the properties, assert has resulted very satisfactory, by ex-

posing such conditions with regard to the ore bodies as justify them in the confidence they feel in regard to the future of the camp.



PITT LAKE.

Crossing from the Mainland to Texada Island, a review of the year's work warrants the conclusion that on the whole the progress has been very satisfactory.

The Marble Bay mine has been shipping a high-grade gold-copper ore almost continuously during the year. Several months the output has been from this one property a thousand tons per month. A large gang of men have been employed continuously in the mine, and when the grade of ore is taken into consideration there is no question but that the operations have been very profitable. The shipping ore from this mine varies in value from $5 to $20.00 per ton in gold, about 5 oz. of silver, and an average of 5 per cent. dry assay of copper. It is impossible to give the exact figures showing the profits, because the mine is owned individually by a Mr. J. J. Palmer, of Toronto, and consequently no publication with regard to profits is made. The development has been extended to a depth of 360 feet, but the ore has been only staked from above the 260-foot level, leaving the last 100 feet of sinking entirely in virgin ground. The ore body in this mine has maintained its continuity from the surface to the lowest level, its measurements though have varied, as is always the rule in ore bodies of this character, which occur at the contact of limestone and felsite, or limestone and diorite. Production of the property during the past year has been good. The mining plant has been added to by the purchase of a complete concentrating plant with a capacity of 120 tons a day, a sawmill and increased hoisting capacity, the latter machinery has been installed and it is expected that the other will be in operation early in the coming year. When the concentrator is installed the management will have an opportunity to treat the large tonnage of second grade ore which has accumulated on the dumps.

Owing to financial embarassments the progress on the Van Anda companies' properties, has not proceeded as far as otherwise would have been the case ; in fact, for several months the properties were closed down entirely, but the operations which have been carried on, on behalf of the bondholders and latter by a syndicate of prospective purchasers, have been highly satisfactory. The ore bodies have been found to contain the continuity as well as grade, and the writer has no hesitancy in saying that the financial embarrassments which have harrassed this company in the past, have been caused by a mistaken policy of the management rather than through deterioratoin of the ore bodies. The development of the Cornell has been extended 100 feet deeper, where a station has been opened, drifting and crosscutting done, which have resulted in

determining that the ore bodies encountered on the upper level have maintained continuity on this lower level. The development on the Copper Queen has not been extended below the 500-foot level, for the reason that the pumping machinery was required at the Cornell, but when the proposed new machinery is put in place on the latter the prospective purchasers purpose continuing the development, on the former not only to greater depths but also along the strike of the contact at which the ore bodies so far exploited were found.

Work of limited extent has been done during the year in extending the development on the Loyal mineral claim about three miles northwesterly from the Van Anda as well as on the Paris, situated at Blubber Bay, at the northern end of the Island.

On the West Coast the lessees of the iron mines have been working more or less continuously during the year to fulfill their contract made with the Puget Sound Iron company when they obtained the lease of the property.

On the Prescott mineral claim adjoining the iron mine on the southeast, Mr. Lee, the superintendent for the Puget Sound Iron company, has been working a gang of miners, extracting ore from open cuts and during the latter portion of the year, sinking on the proposition, in order to determine the extent and grade of the ore body exposed in the open cuts. This property has the phenomenal record of having produced sufficient ore to more than pay all the expenses from the grass roots. The occurrence is at the contact of limestone and diabase, the outcroppings being magnetite with masses of chalcopyrite as impregnations. The grade is sufficiently high for profitable operations, the question to be determined though is the maintenance of continuity at depth. The character of this ore body is very similar to many on the West Coast of Vancouver Island, on none of which has development been carried to any great depth. Apparently the magnetite derives its origin from the diabase country rock, while the chalco pyrite was deposited as a result of the percolation of copper-charged water through crevices in the limestone and magnetite.

On Vancouver Island, the activity in mining during the past year has been confined almost exclusively to the Mount Sicker and Alberni Canal districts. The several prospects which were discovered and partially opened up in 1898 and 1899 in the Clayoquot and Sydney Inlet, Kuyoquot and Quatsino Sounds, have for the most part received but little attention during 1901. The exception to this general state of idleness, has been at the Anaconda group, Sydney Inlet, where development work has been pushed with a view to determining the value of the group and its capacity as a producer. This work is still being continued, and when these material facts have been determined, there is no doubt but that extensive operations will be carried on, provided the results from the work now going on warrant.

The chief cause for the idleness along theWest Coast on the upper end of the island, has been lack of capital, rather than a lack of prospects with possibilities. The writer has frequently called attention to the unique characteristics of many of the ore bodies in these districts, and the absolute necessity for development at depth in order to establish the value of the prospects, which in many instances have outcroppings of exceptional high grade of chalcopyrite and borite ores. The occurrence of the chalcopyrite as impregnations in magnetite, although very promising on the surface require to be developed at depth in order to determine fully the permanency and extent of the copper value. Up to the present time such has not been done on the most promising prospect, and as the owners lack capital it is necessary to persuade monied men to take hold and demonstrate the possibilities of at least one prospect before any great activity will be resumed.

View of Camp, Britannia Mine.

The Mount Sicker district has produced steadily during the year, and the development which has been carried on, and has resulted so satisfactorily on the Lenora and Tyee claims, justifies the opinion that the camp is permanent and will continue to expand.

The total shipments from the Lenora mine to date may be estimated at about 25,000 tons of first-class shipping ore with probably 30,000 tons of low-grade ore on the dumps. This cannot be treated until local

smelting facilities are afforded, and it will then probably be found necessary to adopt some system of concentration in order to secure the greatest possible profit from treatment of this low-grade ore. During the year a lower-level tunnel has been driven on the Lenora mine, while the upper levels have been extended towards the Tyee ground. A narrow-gauge railway has been built from the mine to the siding of the E. & N. railway track, and is being continued to salt water at Osborne Bay. A town of some 500 inhabitants, with good hotel accommodation, has been built up on the Lenora townsite. The total number of workmen including miners, muckers, Oriental ore sorters, railway hands, and others employed on the Mount Sicker mines has averaged during the year about 200. Besides these a number of prospectors and men employed in doing assessment work have added to the general activity of the camp.

On the Tyee mine the management has been continuing their policy of blocking out ore in sight, to determine the capacity of the mine before attempting to treat or ship the ore. The main shaft has been sunk 235 feet, and sinking has been continued to the 335-foot level, but its full extent has not yet been determined, clearly the ore bodies on the Mount Sicker mines have lenticular structure, but those which have been most fully developed are found to possess large extent. The maximum thickness reaching to 30 feet and sometimes exceeding that, the length of the lenzes is the factor which has not yet been fully determined.

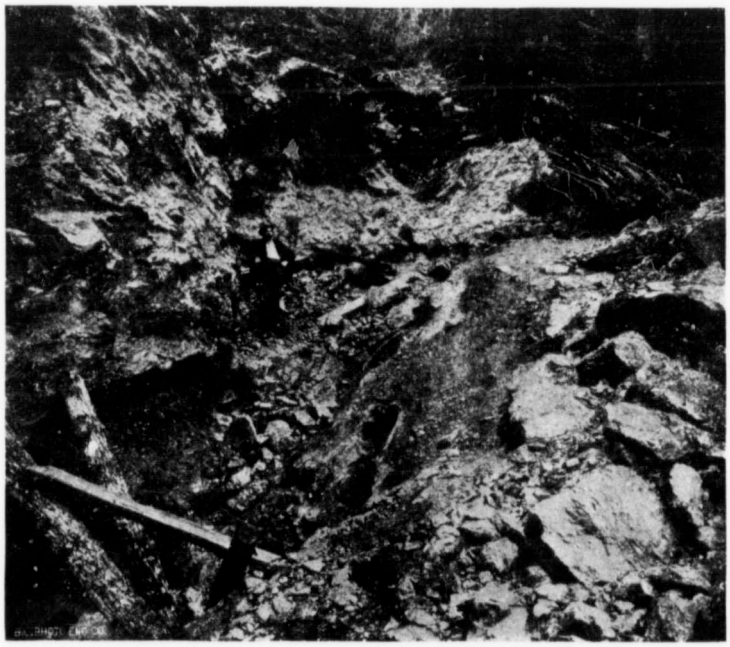
On the Copper Canyon group, which occupies 4,700 feet in length along the mineralised zone, exploitation work has been in progress, and the results from such work are satisfactory in so far as they indicate the great possibilities possessed by this group of claims.

More or less work has been done both to the east and west, along the same zone as that in which occur the Tyee, Lenora and Copper Canyon groups, but none of this work has been sufficiently extensive to warrant any unqualified opinion as to the probabilities of the number of shipping mines which will eventually be developed.

Some prospecting has been carried on towards the head of Cowichan lake, which has resulted in the discovery of galena ore in ledges (reported by the discoverers) to be quite extensive.

On the Alberni canal active operations have been confined during the year to the Three Jays, locally known as the Hayes mine, the Monitor, Golden Eagle, Thistle mineral claims, also to the Sarita, Sechart and Copper Island iron ore mines.

On the Three Jays, an extensive addition to the wharf has been made, bunkers built, ærial tramway one mile in length installed and compressor plant set up and placed in operation. A working tunnel at a level of 425 feet, below the upper working of the mine is being driven, and although it was expected to have to crosscut 700 feet before the ore bodies developed in the upper workings could be intersected, yet it is reported that bunches of ore were struck within 300 feet from the mouth of the tunnel, indicating that there was a probability that ore bodies unknown in the upper levels existed at this lower level, but that considerable exploitation work would be necessary to develop them. Since 1898 the management of this mine has been steadily and industriously engaged in opening up the property to determine its capacity previous to incurring the necessary expenditure for supplying transportation facilities. It is now estimated that there are 70,000 tons of ore in sight in the upper workings of the mine, and when shipments are commenced it will be possible to ship at the



Open Stope, Britannia Mine.

rate of 100 tons of ore a day from these reserves. On the Monitor mine during the early part of the year shipments were made regularly and profitably, but during the summer it was found necessary to suspend these shipments and commence a most thorough exploitation of the property on the same lines as has been pursued on the Three Jays. From the geological conditions it would appear that such work will result satisfactorily. This mine had been shipping from the grass roots, and it is not at all surprising that unlooked for complications were encountered as work progressed. These conditions only serve to emphasise the soundness of the opinion of the writer, that thorough development is necessary in order to determine the capacity of the mine before placing it on a shipping basis, so far as the insallment of the necessary transportation facilities are concerned.

On the Thistle group which was purchased early in the year by a San Francisco syndicate, work has been chiefly confined to the building of a wagon road from the canal to the mine. Owing to the setting in of the rainy season before this work was completed, operations had been suspended until next year.

On the Golden Eagle mineral claim, the work of development which has been carried on since the year 1898, has been pushed energetically. A wagon road has been built connecting this mine with the main Alberni-Mineral Hill wagon road. Although very little is known by outsiders, relative to the work which has actually been done on the Golden Eagle, yet it is only reasonable to suppose, that as a full force of miners has been employed continuously since 1898 the work so far done has been satisfactory to the owners.

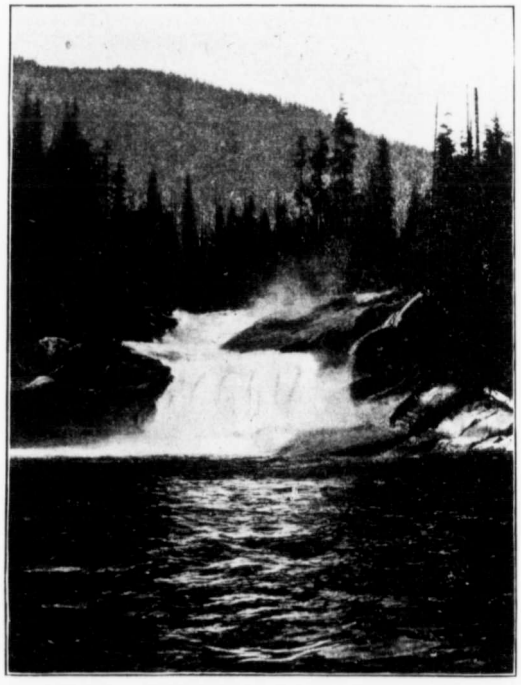
In the vicinity of Port Renfrew of San Juan harbour, development work has been carried on by an English syndicate on mineral claims situated on the Gordon river. This work has been of a prospecting nature to determine the value of some of the occurrences of pyrrhotite located in that vicinity.

THE IRON DEPOSITS AT KITCHENER, BRITISH COLUMBIA.

By Our Special Commissioner.

THERE can be no question that the most important development in mining in this Province during the past season has been the discovery and preliminary work upon the hematite iron ore deposits at Kitchener. These deposits occur in a mountain range running almost due north and south, starting at a point near Goat river canyon and extending northerly about ten miles.

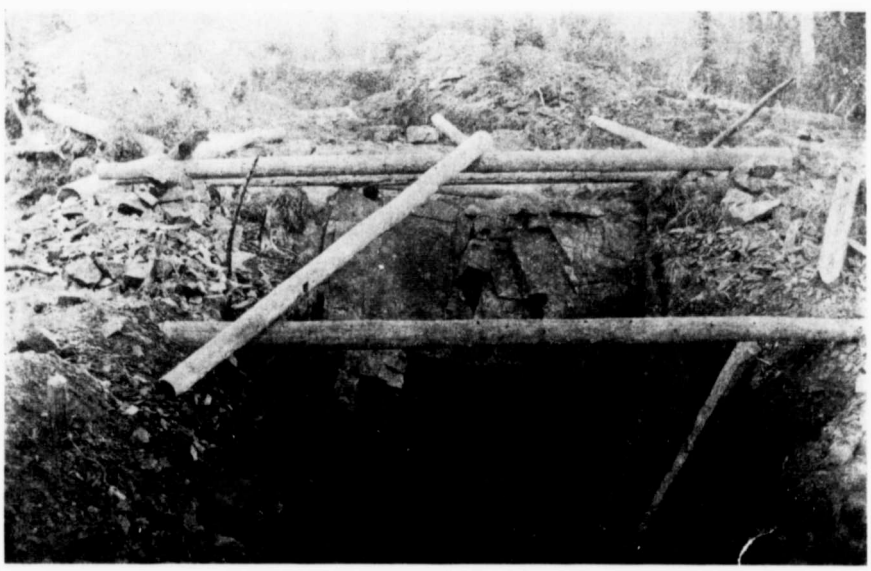
The form of this mountain range is peculiar, presenting the appearance of an inverted boat, commencing with a gradual ascent from the level of Goat river and rising in the course of three miles to an altitude of 6,000 feet, continuing at this elevation with slight undulations for a distance of seven miles, and then gradually sloping down to the former level. It will thus be seen that Iron Range is practically an isolated mountain. Along the eastern side it slopes down to Goat river and on the west to Arrow creek. Twenty miles away clearly can be seen the lofty snow-capped peaks of White Grouse mountain. Along the north side of Iron Range is an easy pass from Goat river to Arrow creek, and as this route was originally thought of for the Crow's Nest line it is not impossible that it may yet serve in connection with the future development of the iron mines; the nearest point to the Crow's Nest line and to the town of Kitchener, at which the iron has been located is about two miles, but it is not impossible that further explorations, which are contemplated next season, may result in proving a ledge down to the level of Goat river; the only difficulty in the way of this seems to be in the exceptionally heavy drift which covers the formation at the southern end of the range. From the most southerly point at which iron has been discovered it has been traced in a series of continuous and parallel ledges for a distance of seven miles; at the south end of the property only two of such ledges have been uncovered in consequence of the difficult nature of the prospecting work, but at the north end of the property there are at least five distinct veins of iron varying from six feet to twenty feet in thickness; in stating this as the width of the veins it is intended to convey the idea that this measurement represents the actual thickness of pure iron, no account being taken of iron-bearing rocks contiguous to the veins which are more or less charged with iron varying from 10 to 30 per cent. One of the most striking features of the formation is the regularity and straightness of the veins, which are persistent with the slightest possible variation in direction throughout the whole course. All the veins dip to the east at an angle of 60 to 70°. The country rock is gabbro-diorite, and this rock forms the western wall of the iron veins; between the different veins, and extending eastward to an extent which has not yet been definitely determined, the rock is quartzite, largely impregnated with iron. In some of the veins the iron and quartzite are mixed to such an extent that the latter carries a very high percentage, but this does uot interfere with the purity and persistency of the true veins of iron.



Clowhom Falls, Industrial Power Co.

The property was first introduced to the notice of Mr. W. Blakemore, mining engineer, of Montreal, in April last, and he was so favourably impressed with the reports made and samples submitted that, on his advice, an influential Montreal syndicate took a bond which allowed them practically the whole of the present season in which to prove the property, on making a moderate deposite. Three months sufficed to justify Mr. Blakemore's opinion, and his associates decided to make an out and out purchase without waiting for the bond to expire; this was effected in August for a sum which is authoritatively stated as $80,000 cash; since then development has been pushed to the fullest extent possible and from the first of May until the end of November something like $30,000 has been spent upon the property, although most of this has been primary work in the

KITCHENER IRON MINES—PROSPECTING IRON LEDGE ON NIAGARA CLAIM.



KITCHENER IRON MINES—ORE EXPOSURE ON KEEPSAKE CLAIM.

shape of trails and bridges and general prospecting, time has been found to exploit the veins and determine

KITCHENER IRON MINES,
Mr. Blakemore, Manager for the Syndicate.

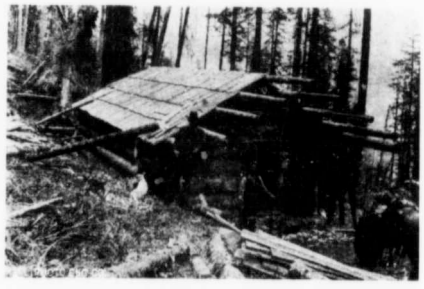
the general character of the property; more than fifty open cuts and excavations have been made upon the iron, several tunnels driven and three shafts started.

SHAFT AND ORE STACK ON AMERICAN FLAG CLAIM.

The principal one was upon an 18-foot vein at the north end of the property and was carried down nearly sixty feet from the surface; at this point the vein was found to continue exactly the same as at the point of exposure, maintaining its thickness and quality. As we were privileged to publish the result of numerous assays in a recent issue it is not necessary to recapitulate them, but it may be broadly stated that at the north end of the property where the work has been chiefly concentrated the average assays have given from 55 to 65 per cent. of metallic iron, and from 5 to 10 per cent. of silica with

IRON ORE DUMP ON RHODESIA CLAIM.

sulphur and phosphorus in negligible quantities. It is not necessary for us to say that this analysis compares favourably with any upon the continent, being as high as Newfoundland or Michigan ores in iron, much lower than the former in sulpher and phosphorous, and at least equal to the Michigan ores in the same respect. So far as proving the property is concerned there is still one important point to determine and that is the depth



CABIN ON NIAGARA CLAIM.

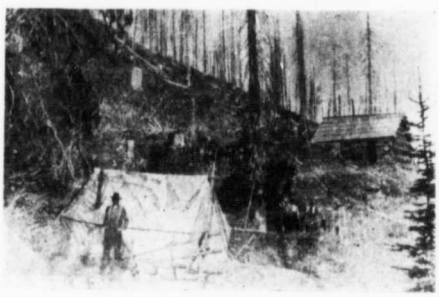
to which these high-grade deposits continue. Whilst 60 feet is the greatest depth of actual working there are exposures of the veins in some of the deep gulches on the mountain side at 600 to 800 feet lower than the extreme elevatiou and in these gulches the quality of

SHAFT ON AMERICAN FLAG CLAIM.

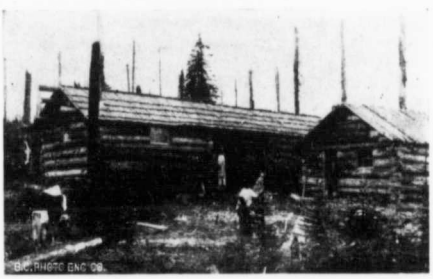
SHAFT AND ORE STACK ON ORAY CLAIM.

iron is the same. There is nothing in the geological formation to forbid the continuance of these regular veins of ore to a considerable depth, and in the opinion of the most eminent expert who has examined the pro-

perty during the present year, a gentleman at the top of his profession in the Michigan iron districts, the probability is that they will continue to a depth of at least several thousand feet; without wishing to in any way exaggerate the extent or value of these important deposits, it is clear that sufficient has been done to justify the conclusion that there is at Kitchener an enormous deposit of the highest grade of hematite ore which cannot fail to play a most important part in the future development of the Province.



Cabin and Camp on Cracker Jack Claim.



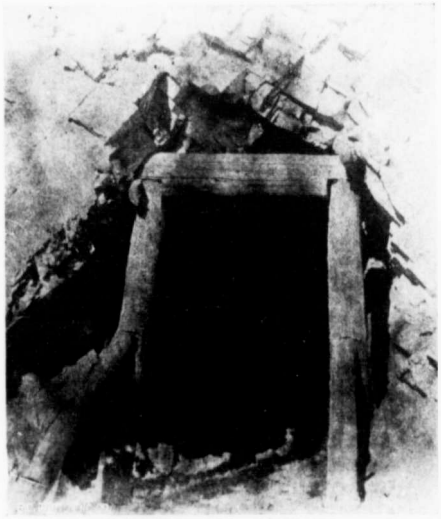
Headquarters on American Flag Claim.

The market, in the first instance, will be for fluxing purposes, and as these deposits are within reach of a number of smelters, both on the Canadian and American side, which are at present purchasers of iron ore; for this purpose there should be an assured market for at any rate a moderate tonnage, the exceptionally high percentage of iron making this a valuable ore for that purpose and renders transportation correspondingly easy. It has already been intimated that next season may see the commencement of shipping, as nothing stands in the way but the construction of a short branch railway. However this may be, we are more concerned to witness the fuller exploration and final development of the property upon such a scale as to justify the establishment of iron and steel works; this is the one thing which the Province lacks to enable it to compete upon successful lines with any other mining district on the continent. We already have in the magnificent coal of the Crow's Nest Pass the highest type of cheap fuel. The metalliferous mines are producing ores which are not inferior to any in the west, and it only remains to establish a permanent iron and steel industry in order, not merely to supply the Province with an article which is so essential in all industrial developments but, as we believe, to establish a large export trade in which the Pacific coast would vie with the Atlantic. After making due allowance for the high rate of wages prevailing at present and likely, perhaps, for some years to be prevalent in the west, it is certain that with an assured market, even for a moderate tonnage of steel, it would be possible to produce this commodity and market it within the Province at a much lower rate than it is possible to import it from the present points of production. A

Pack Bridge Across Goat River.

high authority on this subject has stated that pig iron could be produced from Kitchener ore at a maximum cost of $10.00 a ton, which is about half the cost of imported pig iron in the centre of the Province to-day. There would be a corresponding reduction in the cost of rails, machinery, tools, and the other thousand and one appliances manufactured from iron and steel, the cost of prosecuting our great mining industries would be reduced and the further prosperity of the Province assured. It is not a little singular that Mr. Blakemore, who was the pioneer of the Crow's Nest coal and coke mining in this Province should also be the first to take up an develop an iron property, and if (and there seems no reason to doubt it) the latter is destined to become as valuable an asset to the Province of British Columas the former has already proved itself to be, he cannot but be highly gratified at the results of his labours.

It is only fair in conclusion that a meed of praise should be accorded to Mr, C. Plummer Hill who bonded the claims to the Montreal syndicate. Mr. Hill was one of the earliest prospectors in the Goat river district, coming across the line more than ten years ago, exploring this country when it was almost inaccessible ; during the whole of that time he has held claims in the district, and for seven years at least has done work every season upon Iron Range mountain. His first idea was that he should find copper there and to that end much money was spent, but several years ago he began to appreciate that the large iron veins which were exposed were not as at first thought, simply cappings to copper deposits ; since then he has done considerable work for the purpose of testing its value and having assured himself in the spring of this year that he had a valuable iron property, he lost no time in going east seeking to interest capitalists. To the persistence and pluck of Mr. Hill and the good judgment he displayed in holding on to what was at one time considered a barren mountain range is largely due the present happy state of affairs at Kitchener, and no one will begrudge him the substantial benefit he has already derived from his investment.



Tunnel and Iron Formation on Pacific Claim.

NORTH THOMPSON RIVER AND TETE JAUNE CACHE DISTRICTS.

THEIR TOPOGRAPHICAL, GEOLOGICAL AND MINERALOGICAL FEATURES.

By J. C. Gwillim, B. A., Sc.
Late of Canadian Geological Survey.

In comparison with many other portions of the interior of British Columbia, the district under description has an ancient history. As early as 1812, David Thompson, of the old Northwest Company, journeyed from " Boat Encampment " at the Big Bend of the Columbia through the Athabasca or Yellow Head Pass to Henry House, on the Athabasca river. Mount Thompson, a mountain promontory which overlooks the great valley of the Upper Canoe and Fraser rivers, has been named after him, and it is believed the Thompson river was named from the same source.

During the years from 1871 onwards, the C. P. R. surveyors were engaged in locating a line from the Yellowhead Pass, by way of the Albuda and Thompson rivers, to Kamloops, and a good trail was built. This trail and the evidences of their survey is now pretty well obscured by the growth and decay since that period, and progress in this long north and south valley is very different from what it would have been had the C. P. R. followed its surveys, but the later adoption of the route by the Kicking Horse and Roger's Pass, have left it undeveloped.

Dr. Selwyn traversed the route from Kamloops to Tete Jaune Cache in 1871, at the time the C. P. R. first began its surveys. The trail at that time had not been cut. His account gives little more than the daily happenings and the difficulties of progress.

Dr. Dawson, in his Kamloops map-sheet report, gives the geology and resources of the North Thompson as far as the Indian reservation, 50 miles north of Kamloops. Beyond that point I am not aware of any description of the Upper North Thompson river.

The following is a list of the estimated distances by trail from Kamloops :

Indian reservation	50	miles.
Boulder creek	58	"
Mosquito Flats	68	"
Junction of Clanwilliam river	73	"
First crossing	74	"
Raft river	80	"
Allingham's ranch	95	"
Mud river	103	"
South end Stillwater Flats	116	"
Hell Gate	135.5	"
Blue river	152.5	"
Second crossing	188	"
Albuda lake	204	"
Canoe river crossing	220	"
Tete Jaune Cache	237	"

From Kamloops to the Indian reservation there is a good wagon road. Beyond this point the trail is generally fair but somewhat troubled with a heavy growth of underbrush, and some sloughs which are bad during the flood of glacial water in August. Very little rocky ground occurs, in all about two or three miles near Hell Gate. The rest is bottom land in which is considerable hemlock, cedar, spruce and some white pine. The mountain ranges on either side are low, no peaks above timber line are seen until near Blue river. At this point the valley of Blue river, in an easterly and westerly direction together with a corresponding valley on the eastern side of the Thompson, appears to separate the interior plateau-like country from the rugged snow-patched peaks of the country farther north.

Blue river and Clearwater river (which near the First

crossing) are both streams which showed no signs of glacial water in August, and hence must drain a less rugged country than the North Thompson or Canoe rivers. They both head over towards Quesnelle lake, and flowing, as they probably do, over "slate" rocks of known placer-bearing varieties, they may some day furnish pay gravels. Very little appears to have been done on these two streams so far, excepting by trappers. Heading as they do, not far from the headwaters of Horsefly creek, they have an interest due to the late reports from that district concerning the occurrence of placer gold on the North Thompson and its tributaries. Dr. Dawson mentions Jamieson, Louis and Barriere creeks as affording some gold in 1861. Gold and platinum occur on the bars of the main river up to the mouth of the Clearwater, and probably to a less extent farther up. Also on the Clearwater itself, but no information concerning the tributaries of this stream is obtainable.

Rocky Mountain Peaks.

Dredging of the bars is being conducted at a point about 12 miles up the North Thompson. This work is stated to give satisfactory results.

The rocks from Kamloops north are at first of the Cache creek series, which are known to bear placer gold in other portions of the Province. About Louis creek, Barriere creek, and northwards, are rocks of the Adams lake and Nisconlith series. These are sometimes massive greenstones or diabases, but more often slate-like or schistose. They appear to continue northwards to a point near Allingham's ranch, and are not seen at any place farther north. Throughout these dark slate-like and massive rocks of Cambrian age, there appears to be more or less vein mineralisation. Silver-bearing galena is the principal ore. It has been found on Louis creek, Barriere creek, and during the past season, near the head waters of Boulder creek. This ore does not appear to be exceptionally rich, but values in lead and silver are said to run up to $75.00 a ton. Specimens of quartz-bearing galena picked up near the trail between Raft river and Allingham's ranch, gave an assay of 32 oz. silver—about one-tenth of the rock was galena. Other discoveries near this place are said to give values up to $75.00 a ton.

Robson Peak and Fork of Fraser River.

At the turn northwards of the river near Allingham's, 95 miles from Kamloops, a granite rock appears. This in places appears to consist almost entirely of coarsely crystalised quartz and feldspar, with a little mica, near Mud river it gives place to a more banded and gneissic rock, and this with the former variety constitute the country rock for most of the distance on to the Second

crossing. In this rock at Mud river a deposit of gold and silver-bearing quartz has been worked to some extent, but the costs of doing such work at present are discouraging. Hence it will appear that for about 100 miles north of Kamloops the country is proved to carry gold and silver ores. The district is not one which can be easily prospected on account of the worn-down character of the mountains and the superficial encumbrance of wash and timber. Steamboat navigation is possible and has been carried on as far as Peavine, 90 miles by trail from Kamloops. Above that point rapids and shallow water prevent further progress.

Several areas of more recent stratified rocks occur on or near the valley of the North Thompson. These contain seams of good coal, as shown by an analysis of the deposits, near the Indian reservation, made by the Geological Survey Department.

Hygroscopic water	2.22
Volatile combustible matter	38.10
Fixed carbon	46.76
Ash	15.92
Coke,	59.68

"Last coking gave a firm and bright coke."

Ferry Across Bridge River at Foot of Mission Mountain.

An analysis made by Mr. Johnson, of Slocan City, gave similar results. It is probable that the granite and gneissic rocks found all along the route from Allingham's to Tete Jaune Cache are a part of the Shuswap series. A series represented about Shuswap lake, and between Slocan and Arrow lakes, in West Kootenay. This formation has not yet proved of value in carrying metallic ores. In the district about the head waters of the Thompson and Canoe rivers it is known to carry mica of good size and value. This district is exceedingly rugged, and the discoveries so far made have been by Indians, chiefly in the course of their hunting. The mica is the muscovite, at times of large size and good quality. The principal deposits, so far as known, are those of the Canoe river and Tete Jaune Cache, which have now been taken up for some years.

The vein material or matrix of these mica deposits is pigmatic, a coarsely crystalline mixture of quartz and feldspar, with often many other minerals occurring as crystals in it. Mica of commercial value is always, as far as known, found in such associations and in these oldest crystalline rocks. There is a remarkable absence of dykes or veins, and also sulphide minerals throughout these mica-bearing rocks.

The region under description is, much of it at present, too remote to offer much encouragement to the prospecting of vein minerals. However, the Thompson river itself affords a highway for traffic for boats up to the northern limit of the most probable metal-bearing rocks.

Concerning the district about Tete Jaune Cache, this is at the meeting place of four great valleys: The Canoe and the Thompson and Albuda from the south, the Fraser from the northwest, and the Yellowhead Pass from the east. This pass is 3,723 feet above the sea, and 1,273 feet above the Cache. It will some day be a highway from the plains to the northern portions of B. C. The great north and south valleys also afford possibilities of approach.

The agricultural possibilities are not great. There is some good land along the valley flats of the Canoe river and between it and the Fraser. The climate is dry and the snowfall light in this valley, as shown by the wintering of horses outside. No serious frost had occurred up to the 13th of September.

The photograph of Mount Robson accompanying this article was taken by Mr. James McEvoy, in his expedition of 1898 for the Geological Survey Department. This mountain is a most imposing sight when seen from the lower ranges; it rises at an angle of 60° from the Grand Fork of the Fraser, and its peak is over 4,000 feet above the rather regular rounded summits of the Rocky mountain ranges.

The Ben D'Or Mill.

This mountain appears to be composed of stratified beds and is not of volcanic origin. The banded appearance is due to the bedding of the rocks. Its height has been determined as 13,700 feet above sea level, the highest known mountain in the Canadian rockies.

CADWALLADER CREEK, BRIDGE RIVER.

By W. M. Brewer, M. E., M. A. I. M. E., Etc.

THE progress in this free-milling gold ore camp has not reached the expectations of those interested. In fact when the activity early in the season is compared with the idleness with the latter portion, the progress during 1901 may well be regarded as "crab-like." But there are several factors to be considered which, unless a man is well informed in respect to the district, are likely to be overlooked. In the first place,

the operations which were carried on at the Lorne and Woodchuck mineral claims by the syndicate which bonded those properties during the fall of 1900, were apparently started on the assumption that the ore would continue to carry the same values as had been obtained in the arrastras operated during the summer of 1900. Development work which was performed on quite an extensive scale, demonstrated the fact that with depth the high values carried by the surface ores did not remain constant. Consequently as the holders of the bond had entered into negotiations on a basis of $40.00 ore to the ton, they threw it up when it became demonstrated that the bulk of the ore carried very much lower value. But before this was demonstrated, some $50,000 in all had been expended in development work and the erection of a five-stamp mill.

On the face of it the fact of the forfeiture of this bond after so much work had been performed, would appear very detrimental to the district, but in the writer's opinion this is an incorrect view. As a matter of fact the

Ben D'Or Mine—Showing Tunnels.

development work on these claims demonstrated that the ore bodies maintain continuity satisfactorily to the depth reached, and so far as values are concerned the ore at that depth yielded about the same as anyone acquainted with free-milling gold propositions would have anticipated.

The facts proven merely show that the price asked by the original owners of the properties was exorbitant when all the conditions are taken into consideration. In a word, Bridge River has resolved itself into a camp which will produce a considerable quantity of ore running about $10.00 to the ton, and a limited quantity of higher grade.

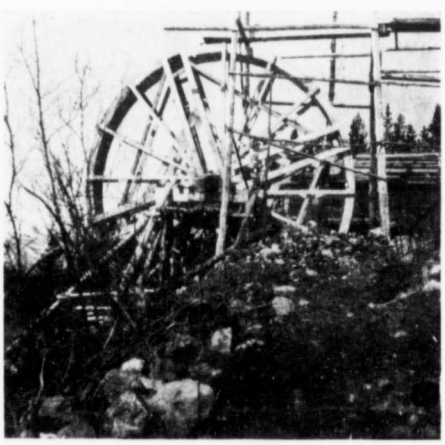
The inaccessibility, for there are no wagon roads, which naturally renders the cost of freight from Lillooet to the mines to be excessive, is the main disability at present retarding the progress of the camp. Give mine operators in Bridge River a reasonable freight rate, and $10 or even $8 ore, of a free-milling or of a partially free-milling character, will yield satisfactory results from a commercial standpoint.

Early in the past year the camp was employing some 70 or 80 miners working on the Ben D'Or, Lorne, Woodchuck and Alhambra groups, but during the fall all operations were suspended. Financial embarrassments, due to various reasons, were the cause of suspension on the Ben D'Or, forfeiture of the bond on the Lorne and Woodchuck groups caused the suspension there, and apparently the suspension at the Alhambra was merely because that group was managed by the same superintendent as the other two.

Past operations on the Ben D'Or have been determined, that with economical and careful management, thoroughly experienced mill men and reasonable crushing capacity, the cost for mining and treating ores in this district should not exceed $6 a ton.

The ore bodies are fissure veins, well defined and permanent. The length of the pay ore shoots, as demonstrated in the underground workings of the Ben D'Or mine, exceed 300 feet respectively, but the vein maintains continuity for about 800 feet on the 200-foot level with only about 150 feet of it too narrow for stoping.

The surface indications point to the maintenance of continuity on the Ben D'Or and adjoining claims for up-



Arrastra on the Lorne Mine.

wards of 4,500 feet, while on the Lorne, Alhambra and Woodchuck groups, it is impossible to determine the maximum length of the veins which occur lying parallel to each other, and trending more northeasterly than easterly, as is the case on the Ben D'Or and adjoining groups.

One fact with regard to the ore bodies in this camp is very gratifying: It is that although natural surface outcroppings are rare because of the covering of decomposed granite or gneiss, yet invariably when this superincumbent mass is removed, either by ground sluicing or open cuts, the vein is found in place of variable thickness from eight inches up to seven feet, and always carrying values. Sometimes the latter run as high as $60.00 or $70.00 to the ton, but usually vary from $8.00 to $30.00 in free gold.

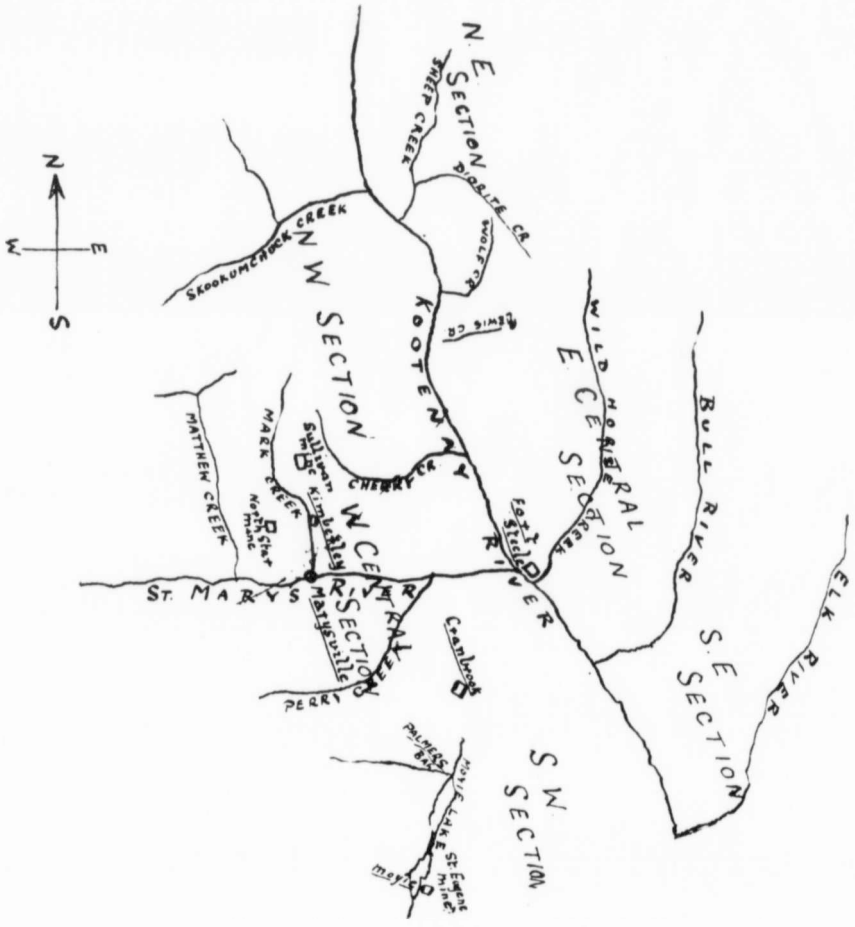
The McGilvary creek mines, situated some 25 or 30 miles southeasterly from Cadwallader creek, have been operated during the season with, it is claimed by the owners, satisfactory results. As the writer has never visited these properties, he is unable to express an opinion with regard to them.

In conclusion these free-milling camps should be considered to-day as merely in their infancy and as offering very promising fields for both prospector and operator.

FORT STEELE DISTRICT—MINING DEVELOPMENT DURING 1901.

By Douglas Lay, A. R. S. M.

THE mining division of Fort Steele is divided by Mr. Armstrong, gold commissioner, into six sections, the position and area of which are shown by the accompanying rough sketch map. This subdivision is adhered to in the following summary of development work:—



NORTHEAST SECTION.

This section is comparatively unimportant, and but few claims are in force.

EAST CENTRAL SECTION.

During the year a very fine bridge has been constructed across the Kootenay river, at Wasa, by Mr. Hanson, which is a very material addition to the transportation facilities of the district.

Canby Group.—Somewhat extensive work has been done on this group, and a ledge five feet wide of concentrating ore, carrying values in gold, lead and copper, has been encountered. Assays taken from time to time have shown total values from $70 to $150.

Wasa Group.—Development work has shown up galena and copper ore.

Dubal.—Development work this year consists of 50 feet of tunnel; the ledge carries values in gold, copper and lead.

Golden Fleece and Stanley.—Work during the year consists of 80 feet of tunnel, and 30 feet of raise. Eight to ten inches of copper pyrites and grey copper have been met with.

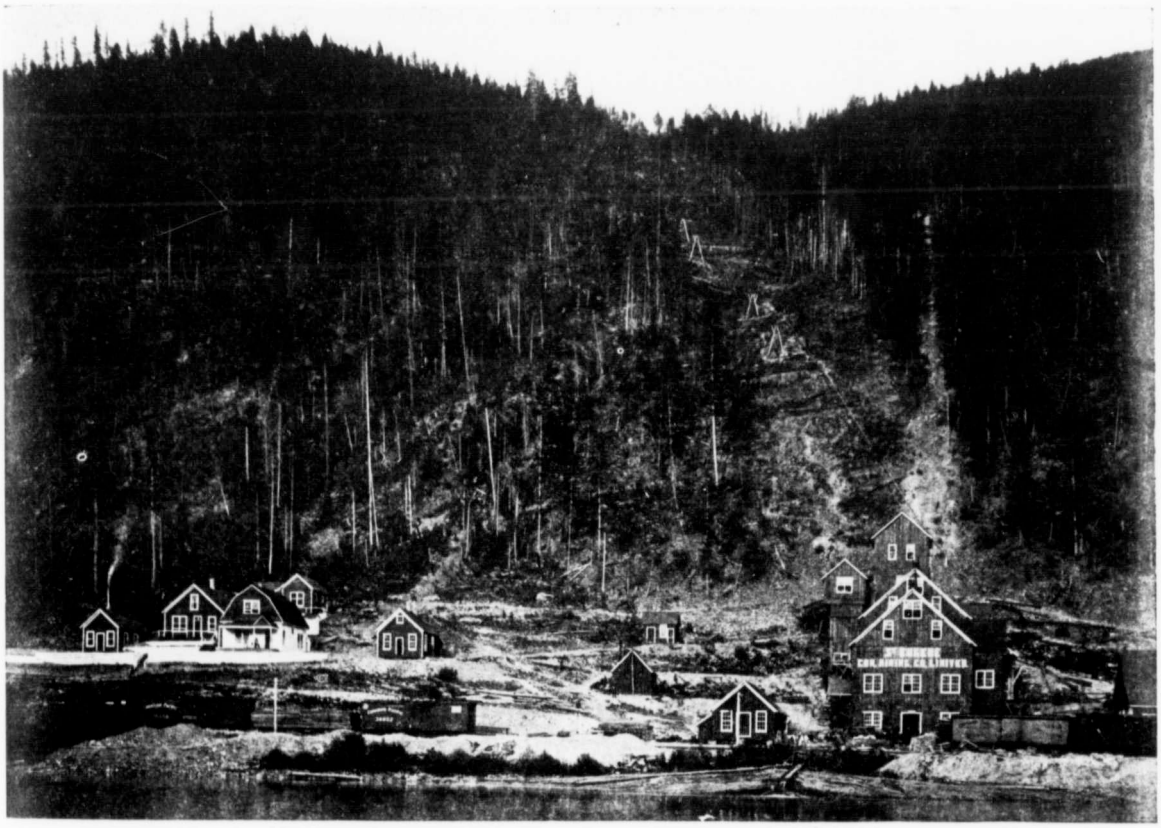
Estella Group.—This is one of the banner properties of East Kootenay, and having been worked for the past six years is now in a highly developed state. Development work this year consists of upwards of 400 feet of tunnels and crosscuts. Work within the year has been confined to following the ledge and bodies of ore, wide in extent, have been shown up. The ore is a concentrating ore, carrying values in lead, silver, zinc, copper and gold. The present proposal of the management is to construct a wagon road from Tracy, B. C., to the mine and to erect a concentrator, when extensive shipments may be expected.

Old Abe Group.—Extensive development work has been done on this property which has lately been bonded for $30,000 to the Green Mountain Consolidated

Mining Co., of Rossland. Work to date consists of several tunnels and drifts. The lower tunnel is 200 ft. long. The lead is found to be 24 ft. wide with a pay chute of ore 4 ft. wide. The upper tunnel is some 80 ft. long and a pay chute is 3 ft. wide, at this point assays give 17 per cent. copper and a total value of some $44 per ton.

Bull River Iron Mines.—Much attention has been drawn during the year to the discovery of iron on Bull river. The deposits are said to rank high as regards freedom from sulphur and phosphorus. Regarding amount of work done I have no information to hand.

been sunk some 80 feet to bed rock, and very rich ground has been encountered, gold values up to $15 and $20 a day per man being now taken out. This fact has led to the application for further placer leases, and much of the ground below this last property has now been staked out, and another shaft is being sunk to bed rock. It will be remembered that Perry creek was the scene of much excitement in the late eighties, just after the Wild Horse rush, when most of the surface gold was taken out. Portions of the surface are, however, still sufficiently rich for "sniping," and last spring and summer men made some $5 a day by this means.



St. Eugene Mine and Mill, Moyie, B. C.

SOUTHWEST SECTION.

The main property in this section is the St. Eugene mine, which of late has been partially closed down. Some twelve men are employed at present effecting development work.

Palmer's Bar, Pekin Claim.—Extensive work has been carried out by D. V. Mott during the year, and an excellent showing has been found.

WEST CENTRAL SECTION.

Perry Creek.—Perry creek has this year been the scene of considerable activity with respect to placer mining. One property (hydraulic proposition) has been bonded to an American syndicate. On another property owned by Messrs. Thomson and Banks, a shaft has

Perry creek country contains many very large ledges of quartz carrying values in gold, which induce the holding of sanguine views as to the future of the district when once thoroughly opened up.

Shakespeare.—Open cut, showing 80 feet of quartz ledge carrying gold in values.

Badger.—Fifty-foot shaft, 10-foot drift on ledge. Assays have shown gold values up to $35.00 per ton.

St. Mary's River.—The St. Mary's river country contains many properties, the ore of which is of low grade but of large extent. It is believed that this district will furnish the much-needed "dry ores" for smelting purposes in East Kootenay. The Sullivan Mining Co. are now proceeding with the erection of a smelter at Marysville, where Mark creek flows into the St. Mary's river.

Town lots have been for some months on the market, and a town is rapidly springing up. The operations of a smelter at this point would not only lead to greater development and activity in this section, but would also give a much-needed stimulus to mining in East Kootenay generally.

Good Hope.—Work done—50 feet of tunnel and cross-cut, good showing of copper ore carrying from 8 to 40 per cent. copper, enriched in many places by native copper.

Great Dane Mines, Ltd.—The Great Dane, White Star, Lodge Pole and Fisher, are now the property of the above company. Up to date some $5,000 have been expended in development work on the group in open cuts and tunnels. On the first-named three claims, a ledge 15 feet wide of solid galena, carrying 6.3 per cent. copper has been encountered. On the Fisher claim there is a ledge of galena 20 feet in width. Transportation facilities have been assured the company by the C. P. R.

Fuller Group.—Large amount of work, but no information as to exact extent.

On a group of five claims belonging to Messrs. Laidlaw and Hughes—work done, 70 feet of shaft.

North Star Mine.—During the year very extensive development work has been carried out and some 1,000 tons of ore have been shipped per month. The North Star Mining Co. has paid in dividends to date $246,000 and has now in the treasury $230,000 not including proceeds of sale of some 1,000 tons of ore, returns for which are not yet to hand from the smelters. The output for the year is some 240,000 ounces of silver, and some 10,300,000 lbs. of lead. Other development work on the North Star hill is as follows :—

Daffodil Fraction.—Tunnel 100 feet ; carbonates encountered ; Crown grant applied for.

Jack Pot Fraction.—One open cut, 131 feet ; one open cut, 23 feet ; one open cut, 22 feet.

Carnation Fraction.—One open cut, 40 feet ; one open cut, 12 feet.

Emerald Fraction.—Tunnel of 25 feet, Crown grant applied for.

Notre Dame.—Fourteen feet of open cut ; good showing of galena.

Aitchtness Fraction.—Shafting, 36 feet.

Sullivan Mine.—This property has been comparatively inactive during the year. The company are now erecting a smelter at Marysville, so that extensive developments may be looked for in the near future. A road for the railway from Kimberley to the mine has been surveyed. Other development in the neighbourhood is as follows :—

Jew Fraction.—Tunnel, 110 feet, showing up iron oxide.

Hidden Hand.—Tunnel, 20 feet, in solid rock.

Stonewall Jackson.—Tunnel, 100 feet, showing small quantity of galena and oxide.

Quantrell.—Several open cuts showing iron oxide.

NORTHWEST SECTION.

This section covers the drainage area of Cherry and Skookum Chuck creeks, and is somewhat difficult of access, there being a great lack of trails. A few of the latter have been constructed this year. The ore of this section is admirably suited for smelting purposes, the gangue with which the valuable metals are associated, consisting very largely of iron oxide and lime, thus rendering the ore almost self fluxing. The inaccessibility of the country is doubtless the reason of there being but comparatively little development work done as yet. What work has been done gives every promise of the section proving fertile in mineral resource.

On group of claims owned by Mr. Huckle, 40 feet of tunnel ; quartz ledge encountered carrying gold and copper pyrites.

Lake and Blanche Claims.—Encouraging results have been met with.

War Eagle Group.—Three claims ; 40 feet of tunnel; 12 feet open cut.

Mother Lode and Copper King.—Tunnel, 50 feet ; 20 feet open cut.

Carbonate King.—Work to date consists of 300 feet of tunnel ; a shaft has also been sunk on the property.

During the year trails have been constructed from the Carbonate King to the Copper Cliff, Iron Mountain, Blanche and Lake claims.

NORTHEAST KOOTENAY IN 1901.

By James Brady, M. E.

COMMENCING at the south end of the district Findlay Creek and Dutch creek have attracted a good many prospectors this season. A number of claims have been taken up and a fair amount of work done on these and previous locations. High grade argentiferous grey copper and galena lodes, some of which are also gold bearing, have been located on the Southwest Fork, where work is being carried on all winter. Copper ores, galena and gold quartz lodes are also found on the main stream, on the South Fork of Findlay creek and on Dutch creek, and as the country is easy of access and the mining region only from 8 to 15 miles from the ranches and townsite on Findlay creek, it is probable that some active mining camps will be established here next season. There is already a good wagon road from the meadows and townsite to landing on Upper Columbia lake, a distance of about 10 miles, and fair trails up the different creeks.

Toby Creek.—The wagon road has been completed to the North Fork, 18 miles from Athalmer landing, and gives access to, and an outlet for, the ores of the Paradise and Silver Belt groups on Spring creek, the Delphine, Hot Punch, B. C. and other claims on the North Fork and higher up the main stream.

The Paradise Co.—Since their shipment of 1,000 tons of carbonate ore this summer, they have been and are continuing the work of development with a view to prospecting their lode in depth, and blocking out ore for future extraction. They will ship at present only the ore taken out in the course of development.

The Delphine Co.—Will haul out about a car load of ore, which is now on the dump—their former shipment having given satisfactory returns—and expect to continue work on the mine.

The M. T. Fraction.—The adjoining claim made a shipment in October of some 17 tons to the Trail smelter. The published returns are as follows :

Two hundred and forty-eight and three-tenths ounces silver and 4 9-10 per cent. copper per ton ; total returns, $2,252.29 ; freight charges from Golden $10 per ton. This claim is being worked under a lease, and the above returns will greatly encourage other miners in the district to develop their claims. There are many other claims in this part of the Province that might be leased and worked to advantage.

I do not know the cost of mining and transporting the M. T. ore to Golden, but the Paradise ore is hauled to the landing, shipped by steamer to Golden and placed f.o.b. the cars at that station for $7.50 per ton. The distance to the Delphine and M. T. Fraction is about 24 miles, and to the Paradise 17 miles.

Further up the main stream are the Hot Punch, Mineral King and other claims on which work has been done this season.

On the range between Boulder creek and Law creek are situated several groups of claims, the Sitting Bull, Silver Thread and Pretty Girl, with the Delos on the north side of Boulder creek below, and the White Cat on the south side above. I am told that some work has been done here this season, but have no particulars.

Horse Thief and McDonald Creeks.—These creeks are now connected with the landing at Peterborough by a wagon road some 30 miles in length, finished this fall. This road is said to have cost $30,000, and as the company which owns the Iron Cap, Red Line and other claims on McDonald creek paid half of the above amount, and had previobsly opened up some of their lodes to a greater depth—as I am informed—than has been attained in any other mines in Northeast Kootenay, it is fair to presume that the properties are developing in a satisfactory manner, and that they will soon become shippers of ore.

On Bugaboo creek, Spillimacheen and tributaries, Fifteen-Mile creek and Canyon creek only assessment work has been done this season.

On the eastern side of the Columbia river, up the Beaver Foot or Ice river and Moose creek, mica, zinc, galena, copper and gold quartz claims have been located and a fair amount of work done. A ton of mica, which is of the kind used for covering boilers, steam pipes, etc., has been shipped to England and returns are expected daily. The Government has had a survey made for a road from the siding at Leauchoil to Ice river, on the east side of the Beaver Foot, and will probably build it in the spring, and eventually carry it on up Moose creek and the head waters of the Kootenay river, thus opening up a very promising field for prospectors and giving access to some fair sized tracts of meadow and agricultural land.

A trial shipment of 1,400 lbs. of ore from the Vermont Creek mines gave the following returns:

Silver 72.41 oz. at 57¼c. for 95 per cent.	$48.27
Lead 60.20 per cent. at 1,587 for 90 per cent.	21.47
	$69.74
Freight and charges $19 per ton	22.32
Net	$47.42

Freight and charges for carload lots would of course be very much less than the above—probably not much more than half.

Near the Big Bend of the Columbia, about 60 miles northwest of Donald, and five or six miles west of the river a fine quality of amber mica has been found and some 26 claims located. A cargo of this mica was brought into Golden by pack train, and will be shipped to market. A high price is expected, as the quality is said to be exceptionelly good and the blocks of large size.

A REVIEW OF MINING OPERATIONS IN BOUNDARY DISTRICT, DURING 1901.

By E Jacobs.

IN reviewing the position of the mining industry in the Boundary district as the year 1901 draws to a close, two chief and striking evidences of substantial progress call for especial notice. These are the large increase in ore production and the establishment and singularly successful operation of two local smelting works. The year 1900 witnessed the advancement of the industry from the purely development period to the initial stage of production, and it was with very much gratification that the present reviewer, after a rather long anticipation of the arrival of such a time, was enabled a year ago to direct attention to the fact that the district had at length attained to a position fairly justifying its earlier claim to be ranked as one of the more important mining sections of the Province. Comparing, though, the position at the close of the year now ending with that obtaining twelve months ago, there is far more abundant reason for pride in the district's present standing as a producer, and there is added cause for satisfaction in that it has been amply demonstrated that local mining and smelting conditions make it possible, with copper maintaining anywhere near its present market value, to profitably operate the immense bodies of low-grade ore occurring in the district. Possibly the most important experience gained during the year is the realisation of the fact that both mining and smelting must, to ensure profitable returns, be carried on on a large scale, and it is especially encouraging to note that both of the mining and smelting companies operating largely in the district are already turning this experience to practical account by considerably enlarging the treatment capacity of their respective reduction works and extensively adding to production facilities at their mines, whilst two or three other companies are actively preparing to similarly provide for the eventual working of their mines and the establishment of smelters along similar lines.

Among other features, also worthy of mention, are the following: The quarrying method of mining ore has

Snowshoe Mine Above the Clouds, Valley of Kettle River in Back Ground.

been successfully adopted; the Granby company's Knob Hill mine, and the B. C. Copper company's Mother Lode mine having opened enormous surface quarries in ore which is sent direct to the smelter as it comes from the quarries, without being sorted at all; and several other mines are preparing to do likewise. The diamond drill has been brought into use in five or six mines, to prospect for ore bodies below or beyond existing mine workings. The Granby company was the first, in recent years, to adopt this method of prospecting in this district, and later the B. C., Snowshoe, Morrison and others followed suit, in some instances with satisfactory results. Railway facilities have, to some extent, been increased, whilst new transportation projects have been started which will benefit the district. The Canadian Pacific railway has added to the number of short spurs from its lines, thereby making ore shipping operations more expeditious and economical at the mines thus convenienced. Of the new railways referred to, two are in course of construction, one from Marcus, Washington, via Cascade City and Grand Forks, to Republic, Washington, and the other a shorter line connecting the two last-named towns. These will bring the Republic and other near-by mining camps on the Colville Indian reservation into close connection with the Granby company's smelter at Grand Forks, whilst the former will give the last-named town a competing railway, which it is intended shall later also tap the chief mining camps of the Boundary. It has been announced that arrangements have been made to shortly commence the permanent survey of the projected Vernon-Midway railway which will, when completed, afford transportation facilities to the very promising mining properties now being opened up on the West Fork of the Kettle river. Arrangements are well forward for supplying the district with electric power, the Cascade Power company being now engaged in completing its works at Cascade City for generating electricity and having its transmission line from Cascade to Phoenix nearly completed. The Granby company has increased the capacity of its power plant on the North Fork of the Kettle river, so it will have ample power for its large increased smelting plant.

Office and Boiler Buildings at Snowshoe Mine.

Snowshoe Mine.—Foreman's Cottage, Boarding House, Bunk House.

Statistics relating to ore production and treatment are given below, but before going into these some general comment on the several mining camps in the district and the chief properties in them that from time to time have had mention in the press, will likely prove of interest. Taking the camps in order of importance, from the joint standpoint of development and production, Greenwood camp (so named officially, but also known as Phoenix camp) easily comes first, both as regards footage of development work done and tonnage of ore shipped. Six months ago the writer compiled statistics of underground work done to May 31st throughout the district, the obtainment and compilation of which occupied more than a week. Lack of time has prevented similar work being undertaken to bring the figures down to date, but it may be stated that the number of lineal feet of work done in underground development of the mines in Greenwood camp has now reached an approximate total of 27,000 feet, or more than five miles of underground workings. Of this total about 11,000 feet has been done in the Granby company's group of mines, about 7,000 in the Dominion Copper company's mines, some 6,000 feet in the Snowshoe, 2,000 feet in the Gold Drop and 1,000 feet in the War Eagle. The two last-named properties have not been at work during the year. The Dominion Copper company shut down its mines a few weeks since, but lately they have been exhaustively examined and sampled by representatives of another company which may shortly take them over. In any case work will probably be resumed in them shortly. Machinery and plant has been added to at the mines of both the Granby and Dominion Copper companies, whilst the Snowshoe quite recently ordered from the Jenckes Machine Co. two additional large steam boilers and the first half of a 30-drill air compressor, the latter to be so constructed as to be suitable for working by steam power or by electricity, similar in this respect to compressors in use at several of the larger mines at Rossland. The Granby company has erected more mine buildings and cottage residences, the latter for married employees, and the Snowshoe company lately built new offices, bunk and boarding houses, and

comfortable villa residences for its mine manager and foreman respectively. Phoenix, situated close to the principal mines of Greenwood camp, is now an incoporated town and is making many street and other improvements, and providing water and other public conveniences necessary for the continued advancement of the town.

Deadwood camp, which ranks next in importance, has three mines at work, viz., the Mother Lode, Sunset and Morrison. The aggregate footage of development work is about 18,000 feet, or nearly three and a half miles of underground work, leaving out of account here as in Greenwood camp, the large area worked in ore stopes and quarries and of this, 7,000 has been done in the Mother Lode, about 4,000 in the Sunset and adjoining Crown Silver (both owned by the Montreal and Boston Copper company), 3,000 in the Morrison, and the remaining 4,000 divided between the Buckhorn, Great Hopes, D. A. and Gold Bug group, Marguerite, Greyhound and Ah There. The Mother Lode equipment includes the largest air compressor yet brought into the district, also the biggest hoist. At this mine, too, is the only conveying-belt plant in the Boundary with its accompanying big rock crusher, the ore being crushed here before going to the smelter. A still larger rock crusher is being put in, this being necessary to keep pace with the increasing treatment capacity of the company's smelter. Several new buildings were erected at this mine during the year, whilst at the neighbouring Sunset a large new hoisting engine is being installed, substantial and commodious boarding and bunk houses have recently been substituted for the smaller buildings previously in use, and ore bins, railway spur, and other shipping facilities were provided, the intention being that this mine will ere long continuously ship ore on an appreciably large scale. Steady progress has been made at the Morrison mine during the year, and recent reports are to the effect that the diamond drill has shown the existence of a promising ore body at the 300-foot level. Test shipments of ore have been made this month to the Trail and Granby smelters respectively, aggregating during the first ten days about two hundred tons. West of Deadwood camp the only district mine worked during the year was the King Solomon, which lately suspended operations after sending to the smelter about 850 tons of copper ore of generally good grade.

Summit camp properties have had a fair amount of attention during the year, but outside of the B. C. mine there has not been very much substantial progress made. A reference to the table of ore shipments will show that the B. C. has contributed in an important degree to the output of the year. Besides making a goodly showing as regards tonnage, this mine is noteworthy as yielding ore of higher average grade than most of the other producing mines of the Boundary. Its output was restricted during two or three months following the curtailment of operations at the Trail smelter consequent on the miners' strike at Rossland, but since then the Greenwood smelter has been able to take more of its ore than earlier. A lot of exploratory work was done on the R. Bell mine, but although the ore met with was of higher grade than is usual in the district it was not in large quantity. Operations were discontinued here early in the fall. The Blue Bell was worked down to about 120 feet, at which depth the ore was cut off by a thick sheet of porphyry, which occurrence is only characteristic of this part of the camp, experience in the neighbouring B. C. mine being that the ore is usually met with again immediately under the porphyry. The owners of the

SMELTER, GREENWOOD, B. C.

Blue Bell having declined to extend the time for making the payments under the bond, work was discontinued and the bond allowed to lapse. The Oro Denoro has been examined two or three times with a view to purchase from the King Mining company, which apparently lacks the capital necessary to make a shipping mine of it, but it is generally understood that prospective buyers were not prepared to pay the price asked for the property. Nothing has been done on the Emma excepting sending a few car loads of surface rock out. The Mountain View and the Rathmullen group have no progress of importance to note. In the neighbourhood of Summit camp the Rambler claim has had attention, and now the diamond drill is to be used to prospect the claim from its 100-foot level, but so far the promise given by the big surface outcrop of mineral has not been realised underground, although the indications are favourable to eventual success.

In Wellington camp both the Winnipeg and the Golden Crown are now at work. The year's record of the Winnipeg is one of plucky and persistent effort to compel success, and it must be gratifying to those who displayed unusual perseverance in developing this mine to think that it is in a more satisfactory position now, from a mining point of view, than at any previous time in its history. Two or three important discoveries were made in the mine and it is now being worked on strictly practical and economical lines, so that its success, in the light of late developments, may be regarded as very probable if not already assured. Here, too, additions have been made to plant and buildings, and the returns now being received from the product of the mine are encouraging the management to prepare for more adequate equipment and enlarged operations. The company owning the Golden Crown having been reorganised, work was lately resumed in the mine. The directors who have visited the mine since the determination to reorganise was arrived at, announced that they will be guided in their development policy by the most competent advice they can obtain, so that the prospects of the Golden Crown redeeming its past appear favourable. The Athelstan was worked for a part of the year and shipped some ore, but at present it is idle, as, too, is the Hartford now owned by an incorporated company.

The Jewell, in Long Lake camp, has had another spell of work, but at the time of writing it is closed down. What is known as the northeast ledge has been sunk on and a long crosscut has been run in an endeavor to find the ledge at depth, but, it is stated, without success. The ledge known as the Jewell, ledge, has, however, been picked up again on the 230-foot level beyond where it faulted, so this fact adds to the value of the mine. The discovery was made, though, after the manager of the mine had left for England, and suspension of work following shortly after, not much is yet known of the conditions under which the ore here occurs. It has been freely stated that a body of ore opened up at the 330-foot level a few weeks ago carries higher values than the ore mined on the other levels and which was already of a grade that left a margin of profit. About 325 tons of the Jewell ore were shipped to the smelter in the fall. The directors in England will probably decide the future operations and further consider the question of putting in a reduction plant, after they have had opportunity of conferring with the manager. Some more prospecting has been done on the Ethiopia, and on the North Star, but little work was done on the other claims in this camp.

The only property at work in the Central camp during the year, outside of doing the annual assessments, was the No. 7 mine, owned by some of the New York mining men who have made a big mine of the Mother Lode. They put in a steam-power plant and extended the levels at 60 feet and 120 feet depth and now the shaft is being sunk to 200 feet or deeper, the stopes in the two levels named being meanwhile got into shape for maintaining a steady output of ore when the snow shall have made the roads good enough to admit of heavy hauling being resumed. About 800 tons of ore from this mine have recently been treated at the Greenwood smelter. The No. 7 will likely give a good account of itself during the coming year. The properties of the City of Paris and Majestic companies have not been worked for some time past, which has been a disappointment to those who looked to this camp keeping its end up this year. In Smith's camp, near Boundary Falls, the Ruby, under bond to Detroit capitalists, is being prospected with indications of its being found to contain ore bodies that it will pay to work. Several car loads of ore from this claim were sent to the Greenwood smelter last month, but the returns, believed to be good, the ore presenting a very promising appearance, have not yet been made public. The Republic group in the same camp, like others upon which work had previously been done, remained closed down all through the year, but efforts are being made to again interest capital in this group.

The Lake is the sole property at present operating in Skylark camp. A steam-power plant was put in last summer and substantial and roomy mine buildings erected. Over the vertical shaft, now down well on towards 150 feet, a well-built gallows frame stands, with provision for automatic dumping of the big bucket. A strong body of iron-copper ore was in the shaft for about seventy feet, but it dipped out at about 100 feet depth. A crosscut will shortly be run to cut it again. At present depth stringers of ore carrying high silver values come in and indications are favourable to good results being obtained here. A little work is being done on a narrow vein of rich ore on the old Providence claim in the camp of the same name. Several prospectors are at work in Kimberley camp, but developments there are not yet attracting much attention. Graham's camp, near Midway, has been very much neglected of late.

Outside camps are not yet making much progress. Up to the West Fork of Kettle river there are some properties that, with transportation facilities provided, would likely soon develop into paying mines, the ore being of a much higher grade than generally occurs in the more favourably situated camps of the district. The Carmi, which shipped nearly 900 tons of ore last winter, is the most developed at present, but the Butcher Boy, Rambler, Sally and two or three others, are also considered good claims. Frank camp, up the east branch of the North Fork of Kettle river, is also reported to have some good showings, but that camp is as yet without wagon road communication and is consequently at great disadvantage in developing its prospects. Much booming was done in the fall by Grand Forks people in an endeavour to attract attention to alleged coal fields, up the main branch of the North Fork, but so far little has transpired to show that the seams discovered are important either in size or number.

The following table shows the quantity of ore shipped during the year by the mines of the Boundary, respectively, as aggregating about 385,000 tons. The actual tonnage for eleven months ended November 30, was 351,942 tons. Adding 33,058 tons for December, which is rather below the output of either October or November, the total of 385,000 tons is well within the mark. For the purpose of comparison the shipments of the individual mines during 1900 are also given :

	Tons—1900.	1901.
Old Ironsides and Knob Hill (Granby Co's) group	64,585	210,564
Mother Lode (B. C. Copper Co.)	6,564	89,384
B. C. (B. C. Chartered Co.)	19,494	44,619
Golden Crown	2,241	....
City of Paris	2,000	....
Winnipeg	1,100	949
Snowshoe	297	1,515
Athelstan	1,200	550
Carmi	....	882
King Solomon	....	850
No. 7	....	805
R. Bell	....	480
Sunset (Montreal & Boston Copper Co.)	....	435
Jewell	160	325
Brooklyn (Dominion Copper Co.)	150	....
Ruby	....	80
Sundry small shipments	1,000	500
Total for 1900	87,741	
Total for 11 months of 1901		351,942
Add December		33,058
Total for 1901		385,000

B. C. COPPER CO'S SMELTER, GREENWOOD.

1901.	Tons.	Daily Average
February (11 days)	3,016	
March	10,519	330 1-3
April	11,322	377 1-3
May	11,830	381 1-2
June	11,206	373 1-2
July	11,943	386 1-4
August (23 days)	6,884	350 2-5
September	11,823	394
October	12,660	408 2-5
November	12,264	408 4-5
December (estimated)	12,648	408
Total	117,115	

The tonnage of the ore smelted at Boundary smelters during the year aggregates about 347,000 tons. The product of the B. C. mine was sent to Trail until August, some 32,000 tons having gone to that smelter from this mine alone. Other mines sent smaller quantities to either Trail or Nelson, thus accounting for the remainder of the difference between the output of the mine for the year and the tonnage treated at the district smelters during the same period. The following figures will show the tonnage of the smelters from the time they commenced operations until the close of the year. The December figures are estimated, but in each case, December being a 31 day month, they are calculated at a similar daily average to that of November. It should be noted that the Granby smelter commenced operations with a single furnace in August, 1900, and that in October following its second furnace had been blown in; also in comparing results allowance should be made for some short stoppages of one or other of its furnaces for necessary repairs. The figures for 1900 are given to make the record complete to date.

In conclusion it may be mentioned that both smelters are doubling their present capacity, and the Granby company is, as well, putting in a converter, to convert the matte into blister copper. Arrangements have been made for the B. C. Copper company's matte being sent to the Granby converter, so both companies will benefit by the provision of this additional plant.

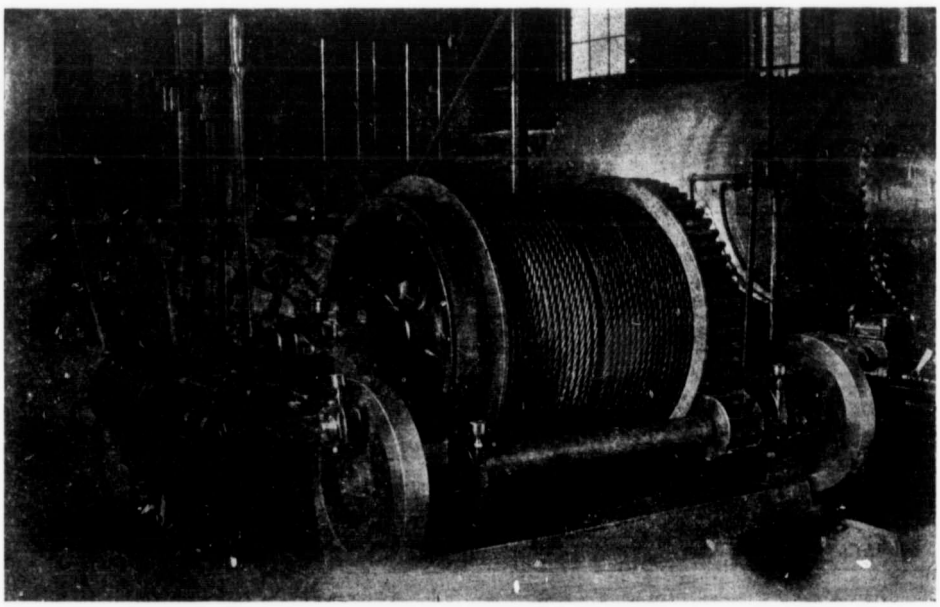
DAM AND HEAD OF FLUME, GRANBY SMELTER.

GRANBY CON. M., S. AND P. CO'S SMELTER, GRAND FORKS.

1900.	Tons.	Daily Average.
August (11 days)	2,901	
September	8,753	291 2-3
October	14,215	468 1-4
November	18,050	601 2-3
December	18,467	595 2-3
Total	62,387	
1901.		
January	17,640	569
February	17,708	632 1-5
March	19,713	635
April	18,995	633 1-6
May	19,075	615 1-3
June	18,510	617
July	18,176	586 1-3
August	18,028	581 1-2
September	20,059	668 2-3
October	20,347	656 1-3
November	20,706	500 1-5
December (estimated)	21,390	690
Total	230,347	

THE FAIRVIEW DISTRICT.

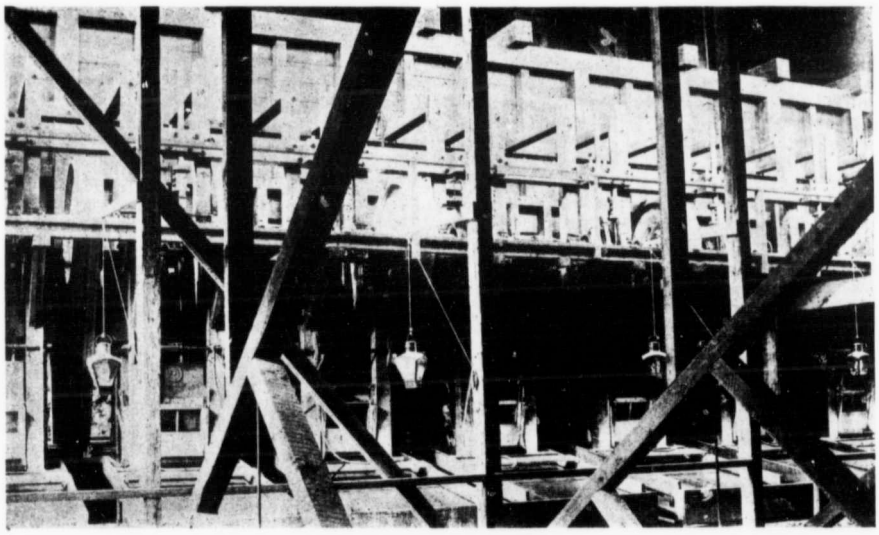
A CORRESPONDENT writes: Operations in this district have been chiefly confined to the development of the Stemwinder mine, one of the properties of the Fairview Corporation, Limited. The concern laboured for a period under financial difficulties, but recently the necessary capital was provided by the shareholders, who consented to a reconstruction scheme upon an assessable basis. The main shaft is down 300 feet and drifts on the different levels to the extent of 4,000 feet, have shown a large quantity of ore. Since the first of the year the shaft has been sunk 120 feet and the third level has been opened up for 200 feet with the happy result of proving the ore at that depth to be of a higher grade than at either of the upper levels. Stations have been made at the three levels, and all is in readiness to supply the mill with ore, as soon as the erection of the large rock breaker is completed. It was necessary in order to get the foundation for the rock breaker to take away the dump which occupied the ground required, and for the past few weeks the stamp mill has been running on the dump with highly satisfactory results. It is expected that by the first of the year that all the work of construction will be completed and it is reasonable to suppose that the work of extraction and development will go on indefinitely, as the quantity of ore in sight is very considerable. In this case, being a comparatively low grade proposition, the principal question is of cheap extraction and treatment of the ore. Over 1,000 tons of dump ore have been treated at the mill, which has proved that the ore is of such a friable nature that over the average can be handled by the stamps. It has also proved that the mill is perfectly adapted for the work. The mill has 10 batteries of 26 stamps and is equipped with all the latest labor-saving devices. The concentrators are handled by 12 concentrators (six Frue vanners and six Henry Norbom vanners). The batteries are fed by 10 Challenge ore feeders, which receive the ore from the bin above, which holds 300 tons. The mill is situated about 300 feet from the mouth of the shaft and a covered track is laid from the bottom of the bin, at the mine, and runs directly into the mill, so that the ore can be dumped at any portion of the bin. A large bin is situated below the rock breaker so that the work of carrying the ore is only carried on in the day time. The concentrators are driven by a 25 h.p. upright engine, and the mill is driven by a 127 h.p. Bates-Corliss engine. These engines are of sufficient capacity to drive a mill of double the size, and it is the intention to add 20 more stamps in the spring, and all arrangements have been made so that these can be added without stopping the present mill, except for possibly a day, to couple the main shaft. The mill is heated by the exhaust steam from the engines, so that no fire is used in the mill. The boiler house is situated midway between the mill and the shaft house and is composed of two large tubular boilers (140 h.p.). The compressor (four-drill Rand) is situated at the head of the shaft and a 35 h.p. hoisting engine is also in this building. A large Blake pump is on the third level and pumps the water from the mine to the mill, where it will be used in case of shortage of water at any time. To the north of the boiler house is situated the saw and planing mill, and all the lumber used in the erection of the mill (except what was on hand) was cut at this mill. The blacksmith shop is situated immediately to the northwest of the shaft house. A Pelton wheel will be installed at this point, which will supply the air for the forges by a fan and operate the electric light plant, which it is expected will be in operation early in the year. At the other side of the road is situated the boarding and bunk houses as well as the superintendent's office and assay



HOISTING PLANT, STEMWINDER MINE, FAIRVIEW, B.C.

office, which is presided over by Mr. T. D. Pickard, Provincial assayer. This gentleman is also the secretary of the corporation, combining two of the most important offices in the gift of the company. The corporation has a good water supply to all buildings, and mine. The superintendent's office and assay office are situated midway and overlooking all the works and are very complete in all details, as is necessary in this important branch of the business.

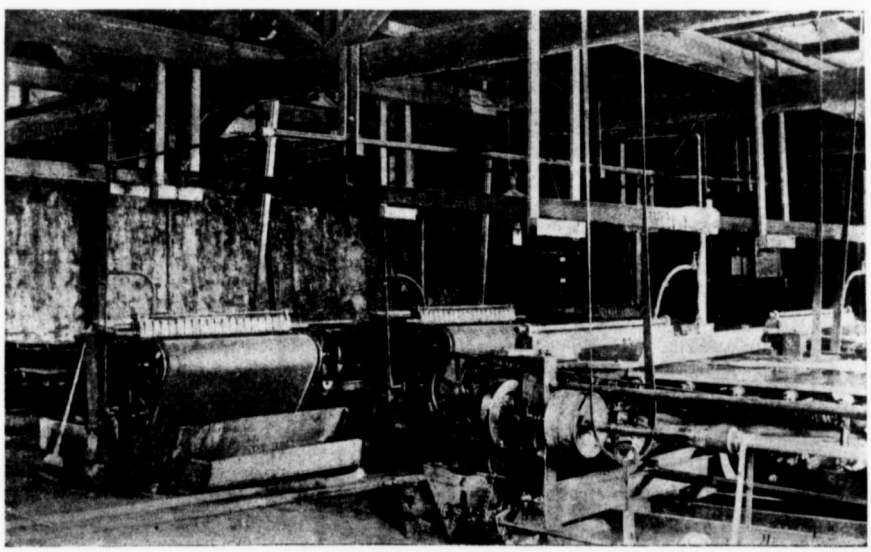
The intention of the corporation is to shortly install



Stamp Batteries, Stemwinder Mill.

the comfort of the workmen has not been forgotten. The boarding house is very roomy and can accommodate 50 men comfortably. The engineer's and mill electric machinery and operate the entire plant by a water power, which will economise considerably.

In addition to the extraction of ore for the mill, the



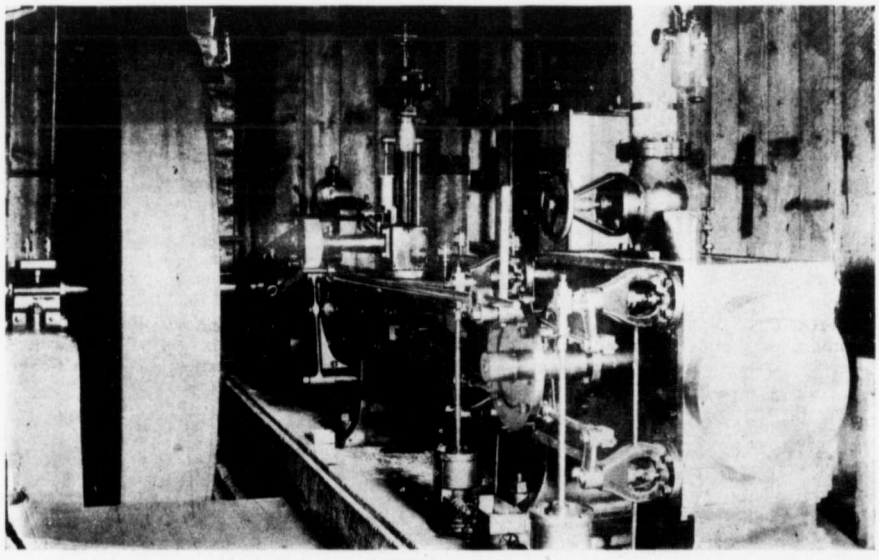
Vanner Room, Stemwinder Mill.

men's bunk house is situated to the left of the boarding house, while the bunk house of the miners is nearer the corporation will continue the work of development, and shortly a shaft is to be sunk vertically on the vein from

the 300 to 400-foot level. When this is accomplished a raise will be made to the surface, coming out immediately behind the mill and all the ore will be hoisted and dumped directly into the mill ore bin, after passing through the crusher, which will be placed at the head of the shaft. This plan is being followed upon the advice of the Provincial mineralogist, Mr. Robertson, and it is expected will reduce the cost of extraction to a very low point. The corporation owns several other promising properties, but no work is being done on them at present, with the exception of the coal measures, situated 10 miles from Fairview, which are being worked in a small way in order to supply the local demand. The intention is to, in the near future, thoroughly exploit this area as the quality of coal now being extracted is of a very high grade.

At the time of writing, December 6th, the ground has been cleared and ore bins erected at the hoist, and within a few days the mill will be supplied with ore from the mine. By New Year results will be known as the clean-up will take place early in January, but the prospects are eminently favourable, and as the company has now a thoroughly practical and experienced man in charge of operations, it may confidently look forward to a long and successful career.

The Dominion Consolidated Company, Limited, operating properties immediately above the Stemwinder, are getting ready to commence active operations, having, it is understood, completed arrangements for large working capital, and a new era of prosperity seems to be with us.



STEMWINDER MILL—127 H. P. CORLISS ENGINE.

NOTES ON RECENT PROGRESS IN THE LARDEAU DISTRICT.

BY J. MCLELLAN, A. R. S. M.

AS somewhat vague ideas regarding mining conditions in the Lardeau, appear to be prevalent in outside quarters, it may be of use, in presenting a few notes as to recent progress, to in the first instance give a short description of the topography and general geological characteristics of the country. The district to which the name of "Lardeau" is commonly applied includes two full mining divisions (Trout Lake and Lardeau), and part of a third (the Ainsworth). It is to the Trout Lake division that the following notes particularly refer, but the general features of the rest of the district are very similar.

This area is mainly composed of semi-crystalline slates and schists, interstratified with occasional beds of altered limestone, which latter, owing to its superior hardness, usually stands out in relief from the adjoining rocks. From the wall-like appearance which is thus often presented by these belts of lime, they have been loccally termed "dykes," and hence such expressions as "the great lime dyke," which is the name applied to a very prominent exposure of this rock which occurs near the summit of the divide between the Duncan river and the forks of Lardeau creek. The general strike of the formation is northwesterly, and the beds in most instances dip at a high angle to the northeast. This dip, however, is by no means universal and occasionally is in the opposite direction.

The crystalline slates and schists, while retaining the same general strike and dip over a considerable area, vary extremely, both in appearance and structure within comparatively short distance, at one place presenting the appearance of a soft fissure shale showing few traces of metamorphism, while at others the rock is hard, massive, and completely crystalline. In colour they vary from grey or greenish-grey, to black.

A granitic exposure of considerable extent occurs about five miles south of the northwesterly extremity of Trout lake, but no discoveries of economic interest have yet been made in this formation.

The veins upon which, up to the present time, the greatest amount of development has been done, follow the general strike and dip of the formation; or, if cutting the bedding planes at all, only do so at a very small angle.

Fissure veins cutting across the formation at a considerable angle, are, however, also occasionally met with both in the lime and slates.

The veins in most instances are of moderate width (one to five feet), but larger bodies also occur, the high-grade ore being usually found next one of the walls, and associated in many cases with considerable quantities of lower-grade material, which, under present conditions, cannot be handled at a profit.

Much of this lower-grade ore, however is amenable to concentration and will probably be treated by some such process at a future period.

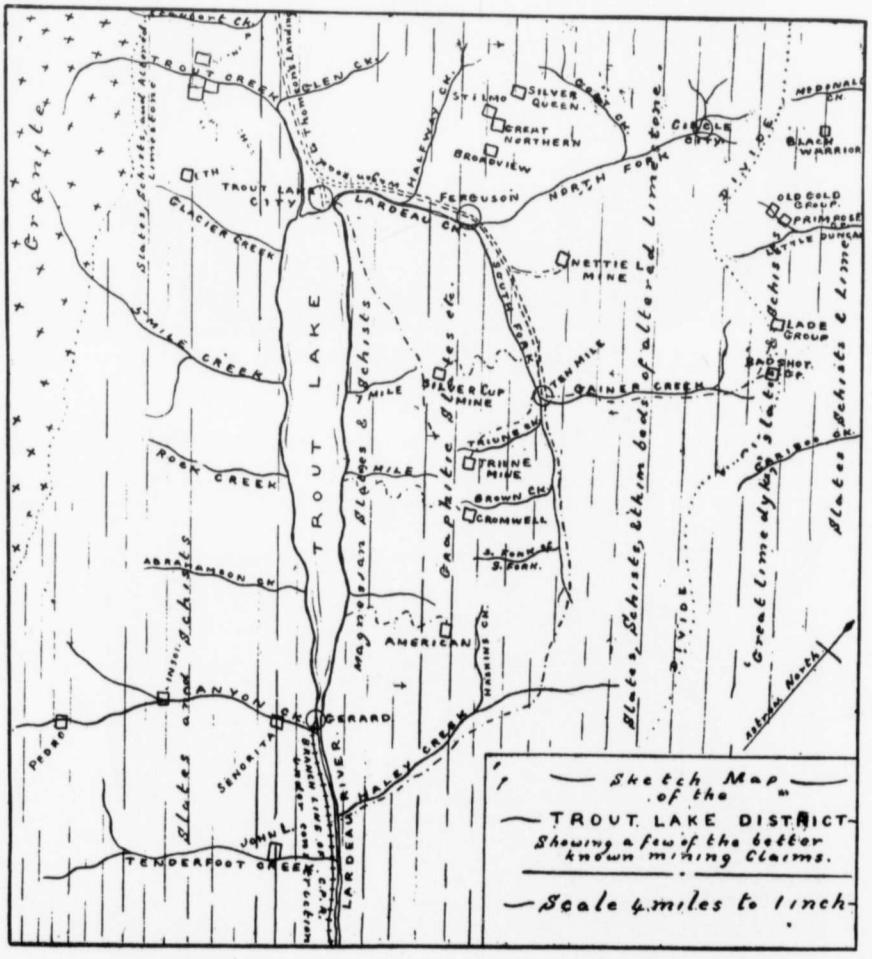
The minerals of most common occurrence are, galena, tetrahedrite (grey copper), zinc blende, and iron and copper pyrites, the gangue being usually quartz, but often with more or less calcite, siderite, etc.

Of those minerals the grey copper is as a rule the richest in silver, but a fine grained zinc blende is also found, especially in the Nettie L. mine, which likewise carries high values.

Topographically the district is of very varying characteristics. The valleys of the Lardeau and of some of the larger creeks, are fairly open, and at many points present stretches of level land, which have been taken up for agricultural purposes.

The smaller creeks, however, cut up the country into a series of deep and narrow valleys, the sides of which, though often very steep, are usually covered with a heavy growth of timber.

The tracks of snowslides, although not often seen in the lower hills, are more frequent with increase of altitude and as the timber becomes more scattered. Many of the creeks have glaciers at their heads, and the country as a whole, at the higher levels, is of a very rugged description.



Of the creeks have glaciers at their heads, and the country as a whole, at the higher levels, is of a very rugged description.

From the above it will be seen that the district is one where most of the properties can be developed by means of tunnels (often along the vein) and so avoid the expense inseparable from shaft work.

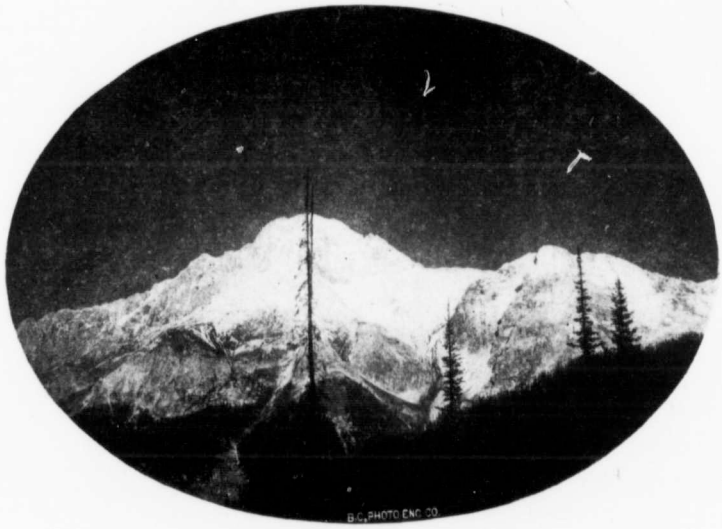
By far the worst obstacle to development in the past has been the lack of proper transportation facilities.

The total ore production up to the present time is in the neighbourhood of 3,200 tons, of an average value of over $140 per ton. When it is considered that this

ore has had to incur a freight and treatment charge of from $30 to over $50 per ton, according to the accessibility of the property, and when the cost of supplies, etc., is also taken into account, it must be admitted that a very fair showing has been made.

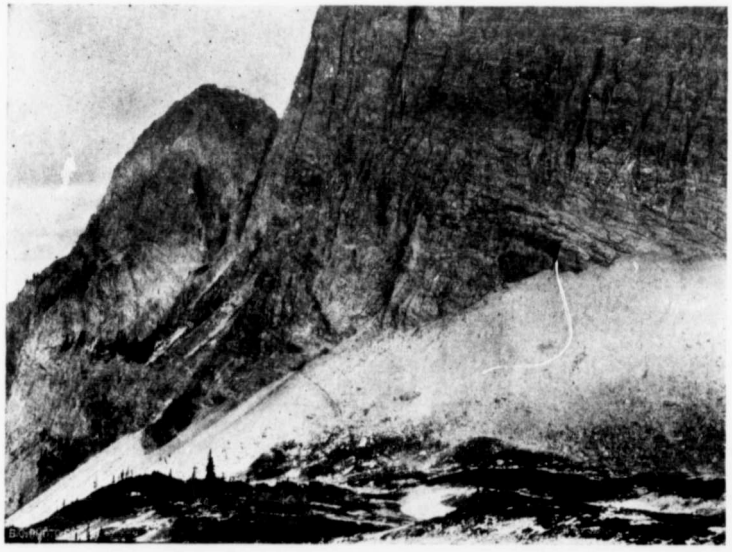
Under the circumstances it is scarcely to be wondered at, that the near approach of a railway is regarded with great satisfaction by those who have interests in the country.

The railway branch, which is being built by the Canadian Pacific, and follows the course of the Lardeau river from the Kootenay lake to Gerard at the foot of Trout lake, has been under construction all summer. The track is now laid for about half the distance and grading of the remainder is being carried to completion as rapidly as possible.



The Great Lime Dyke.

It was hoped that the line would have been in operation during the present year, but this now seems unlikely, although there is little doubt but that it will be ready to undertake the haulage of ore early in the coming spring.



Bad Shot Mine.

The company is building freight sheds at Trout Lake

City and Gerard, the former being now practically completed and ready for the storage of ore.

It is expected that a large proportion of the coming winter's output of ore will be delivered at Trout lake and allowed to remain until the railway company is in a position to handle it in the spring, as by this will be avoided the 12 miles' wagon haul to Thomson's landing and a saving of about $6 per ton effected.

The completion of this branch of railway closes the pioneer stage of development and will mark the commencement of a new era in the history of the Lardeau.

During the present year, while there has been nothing in the nature of a "boom," steady development has been carried on upon the great majority of the better known properties and some new strikes of importance have been made.

As regards the well known properties such as the Silver Cup, Nettie L. and Triune, the returns from their recent small shipment of five tons from this property giving a return of $116 in gold and $12 in silver to the ton. No free gold is visible to the naked eye, but fine colours can be obtained on panning the oxidized surface ore.

The John L. and other properties on Tenderfoot creek, also shows high-grade gold ore, while a recent discovery has been made on the Primrose group, located on the Duncan river slope. In all these cases the gold is associated with iron pyrites. In the case of the Lode group, however, the gold is largely free, though often very fine, but this property seems only an exception to the general rule. The ore shipped from the Silver Cup, Nettie L. and Triune, all carries small values in gold, besides the more important silver values.

It is impossible to estimate the true importance of these occurrences of gold-bearing ore, at the present stage of development, but enough has been done to

View from Bad Shot Mine, B. C.

gradually increasing ore shipments are the best proof of progress. The Silver Cup now employs 40 men, while the Nettie L. has about 25 at work, and both properties are expected to ship largely during the coming winter.

The Triune, owing to its situation, is, under existing conditions, unable to operate during the winter months, and it is now closed down until spring. The last car load of ore shipped from this property netted the owners over $200 per ton, a result which goes to uphold its reputation as one of the highest grade silver-lead mines in the Province. The discoveries of rich free-milling gold ores made in the Fish Creek section during the summer, have induced very careful prospecting for this metal in the adjoining Trout Lake division.

Although little or no free-milling ore has yet been discovered, important gold values have been shown to exist on many properties, especially in the section of country to the north of Trout lake. Iron pyrites associated with a white quartz of a peculiarly dull lustreless character, is the most common gold-bearing mineral.

In a few properties, such as the Cromwell, etc., the gold forms the most valuable constituent of the ore, a show that the Lardeau has possibilities beyond those of a silver-lead camp pure and simple.

A new section to attract considerable attention during the year has been that on Trout creek, about five miles west of Trout Lake City. Some very rich silver ore has been found, and the section bids fair to be of considerable importance as a future producer. The ores consist mainly of grey copper and galena, carrying high values in silver, but very little gold.

Although, on the whole, fairly satisfactory progress has been made, it is regrettable that so little capital has been interested in the country, very few claims having changed hands during the year. Many of the most promising prospects are still in the hands of the original locators, who find it difficult to procure funds for much more than the annual assessment work.

It is to be hoped that the advent of a railway will change this condition of affairs, and that the necessary capital will soon be forthcoming to perform that systematic development, which, to judge from the appearance of their surface showings many of the claims certainly deserve.

SLOCAN CITY MINING DIVISION, IN 1901.

By W. D. McGregor, M. E.
(McGill).

THIS mining division practically consists of an area, irregular in outline, of about 100 square miles. East of the Slocan river and lake (the west side is in a different formation and no work is being done there) and which is all included in the "dry-ore belt" of the Slocan. The surface is extremely mountainous: the main range of the Slocan mountains, 7,000 to 8,000 feet high, forming the easterly boundary, while a parallel range, 5,000 to 6,000 elevation, from one to two miles from the lake and river, fills the west front. A series of openings, binds and cross ranges occupy the intervening space. This irregular mass of mountains is divided in all directions by deep creek valleys, generally heading in typical basins. Faulting contorted strata and other evidences of extensive movement are common. Veins and veinlets, more or less mineralised, are common also.

The general occurrence of faults and the irregularity of ore deposits in the veins, made mining a very questionable undertaking here; but we are learning, and though our progress is slow it is, to most of us, very satisfactory.

The year 1901 has been marked chiefly by the rise of the Arlington to the first place among the Slocan mines, by the increase in the demand for our ores at the smelters and by general development. The record of production is sufficiently satisfactory. Last year the division shipped 2,847 tons. This year to November 13, the output aggregated 5,490 tons, or say 6,320 tons for the year. This estimate is probably below the mark, as a number of properties are waiting for snow to send down their ore by rawhide and sleigh. In any case, however, an increase is shown of 122 per cent. over last year. As all of this, except about 1,000 tons of second-class ore from the Arlington, is high-grade sorted ore I would judge the values to be not far from $375,000. This again must be very nearly the amount expended during the year in the district, upon mining, developing, prospecting, road building, etc. As the district is in a very early stage of development this must be regarded

Slocan.—Looking Up Springer Creek Valley.

Freight Waggons on the Arlington Road.

as a most favourable showing. In particularising the work of the year I shall, for convenience, divide my notes according to the creeks whose valleys furnish access to the various properties beginning with :

Ten-Mile.—The principal mine on this creek is, of course, the Enterprise, owned and operated by the Enterprise Mines Co., of London, Eng. The year has been used in development work and the erection of a concentrator and compressor plant. The results of the development work are said to be eminently satisfactory. There is a two years' supply of ore for the mill and the mine is looking better than at any previous time. This means a good deal, as the mine paid well in the hands of its former owners. Shipments have been small, as only the sorted ore taken out in development has been handled, but by the last of the year, should be in full swing. The Iron Horse group, close to the Enterprise, has been sold to a Pittsburgh company, which has done considerable development and is now installing pumping and hoisting machinery. The Neepawa group has just been bonded, the terms calling for continuous work on the property. A very complete saw-mill has been put in by Mr. Koch, about five miles up the creek. The local improvements are keeping this busy.

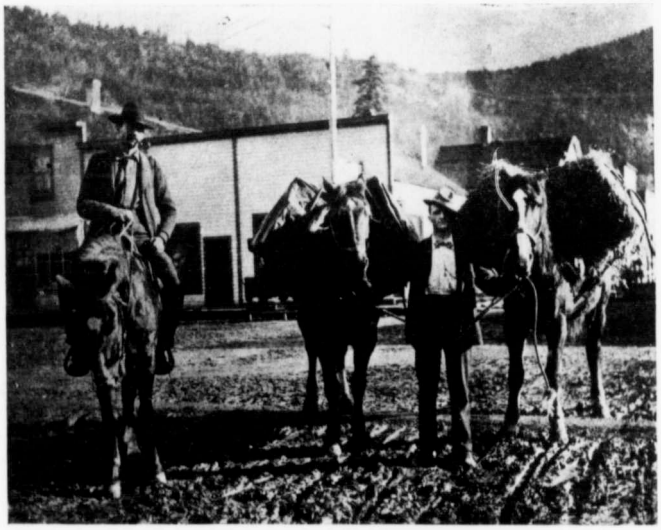
Twelve-Mile Creek.—The year has not been as prosperous here as was expected. The V. & M. mines worked during the earlier part of the season, but lack of funds in the treasury and some dispute among the owners, led to a shut down. We all hope to see them working again in the near future. The Champion group adjoining and on the same vein, has been sold to a Detroit company, which may start in to work it at once. The only property on the creek working at present, is the Myrtle group up at the head, where the owners have one of the best surface showings of the season and have just completed building, etc., preparatory to developing all winter.

Springer Creek.—The Arlington has passed into the rank of the big mines, has paid off much of its indebtedness, built new bunk houses, ore bins, sorting house, manager's house and cottages, keeps its saw-mill running and has had a pay roll of about 140 men. They keep from 8 to 10 four-horse teams busy hauling up supplies and ore down.

The Speculator group adjoining and also under Mr. Collan's general management, has been paid for after a year's active development, and the price paid, $55,000, shows their satisfaction with the property. Here, too, the buildings and surface improvements are convenient and commodious. A telephone wire has been run from the Speculator to the Arlington, on down to the saw mill and then to their office in Slocan. Another wire has been set on these poles and carried over to the Enterprise and down to the saw-mill on Ten-Mile.

The Mahon group still north of the Spectator and on the summit between Springer and Ten-Mile creek, has had a lot of surface work and will continue development next season.

South of the Arlington and across Springer creek some heavy work has been done in order to find the Arlington vein. It is generally thought that this has been accomplished. Several properties have been at work in a small way near the head of the creek, and at least one of these, the Hampton, will keep at work all winter, shipping its high-grade ore—500 oz. or better.



Method Employed of Transporting Supplies to the Slocan Lake Mine.

West of the Arlington the Bondholder and Ottawa are both under lease and taking out ore.

The Tamarac group has been sold and will begin shipping as soon as rawhiding can be done.

Some 200 feet of development work has been done on the Morning Star. The Exchange, working under lease, is also producing some high-grade ore.

On Republic mountain, close to the town of Slocan, a Detroit syndicate has bonded, and will probably have purchased by the time these notes appear, the full string of claims located on the mineralised zone from Springer creek to the Republic, including some 12 locations. The Phœnix-Viking group, on the same mountain, has been purchased by a West Coast (Portland, etc.), syndicate and it will probably be worked on a very large scale this winter. The Transfer group has within the past few

days been put under a working bond to Spokane investors. Besides these I have mentioned there are numbers of claims that have been more or less opened up this season, some have done 100 to 200 feet of work ; some shipped a little ore and generally the work done has improved the appearance of the property.

Lemon Creek.—Near the head waters, the prospectors have been busy developing and reports of both quantity and quality of ore are encouraging. Several miles of new trail have been built but no extensive work undertaken. On the Second North Fork, the leaseholders of the Black Prince have shipped over 150 tons, while the development has shown up the ledge so well that the group has been bonded at the price of $75,000. Several other locations in the vicinity are looking much better for the season's work.

On the First North Fork the Chapleau and Slocan-Kilo Mining companies have, we are informed, been amalgamated with a largely increased capital, but work has not yet recommenced at the mines. The owners on the Legal count on developing all winter, as they are well pleased with the results, so far. The Fourth of July group has made two small shipments, and the Hoodoo group, under lease and bond, has taken out some good ore.

The general outlook is good. The town of Slocan, where practically all of the business for this division is done, is fairly prosperous and has been incorporated this year. There are some 500 men at work and improvement is steady though slow. The coming year should see at least a proportional advance.

Town of Sandon, as re-built, Nov. 1901, Showing Ruth Mill and Star Gulch.

MINING IN THE SLOCAN.

By E. M. Sandilands.

THE past year in the Slocan has possibly been the worst since its discovery, in spite of the fact that to-day it is the richest silver-lead camp in North America. Since its discovery it has had numerous drawbacks and possibly more than any known camp of its age. We have had to contend against low prices of silver and lead, injudicious legislation, labour troubles, and this year added a new difficulty in the action of the United States smelter trust, which practically refused to treat, or even take, our ores. When the trust does condescend to purchase our product it pays us London prices, namely, $1.38 less $1.00 per 100 pounds for transporting the lead. In 1897 we had a tonnage of 33,576 tons, returns for which were approximately $3,280,686 ; in 1898 there were 31,057 tons shipped valued at over $3,000,000 ; in 1899, which was a disastrous year on account of the eight-hour law, about 19,000 tons only were shipped, and in 1900, 35,000 tons valued at about $3,280,000. During 1901 there has been shipped to date 25,675 tons—a very poor showing when taken into consideration that two new dry-ore properties have come to the front, viz., the Arlington and Hewitt, the former producing nearly 5,000 tons and the latter 2,000 tons, so deducting the production from these two dry-ore mines, it reduces the yield from the lead mines to about 18,000 tons. The above figures go to show that the Slocan has not made the progress it should and steps should be taken to improve matters in the future. At several mines operations have been entirely suspended, while others are only being worked in a small way. The excessive freight and treatment charges of $19 per ton, with silver and lead so low, is no encouragement to mining in the district.

No great capital has been invested during the past year, except to a limited extent in the dry-ore belt around Slocan City ; the low freight and treatment charges on this class of ore is decidedly more favourable, as compared with the excessive charges on wet ores.

Below I append a short review of the development at the principal Slocan mines during 1901 :

Slocan Star.—This property is working about 85 men and shipping about 40 tons of high-grade ore daily. Up to within the last three months most of the ore has been treated in the concentrator, but since then the character of the ore has changed, and as the mill failed to save the values, it was decided to ship in bulk and now better returns are being obtained. The mine is looking well, with plenty of ore in the lowest levels. Shipments are being made to the Trail smelter. This company would have paid another dividend had it not been for cost incurred in litigation over a dispute with the adjoining property.

Payne.—Development has been the main feature of this property during the past year, only sufficient ore having been mined to about pay running expenses. The No. 8 tunnel, which has been driven at great expense during the last year and a half, has failed to cut the lead at the lowest level and now a shaft is being sunk

to connect with the No. 8 tunnel. It is expected that ore will be encountered when the break which has cut out the ore above has been passed through. The company have purchased the old Lanark mill, which has been removed to Sandon, and is in course of erection at the terminal of the tramway on the K. & S. It is believed that good results will be obtained from the milling of the dumps. In No. 5 a compressor plant for hoisting and drilling, operated by a gasoline engine, has been installed.

Last Chance.—The long crosscut tunnel, which is being driven to cut the Galena vein, is now in over 2,000 feet and expected to strike the ledge daily. This is a double-track tunnel, and is one of the best and largest tunnels in the Slocan. A force of about 60 men is employed and shipments are being made at the rate of two cars of ore per week. A quantity of ore has lately been discovered in the old upper workings, which were supposed to be stoped out. Air for the tunnel operations is supplied by the compressors at the Noble Five mill at Cody.

Ruth.—Since last February practically nothing has been done on this property, a few men only being employed only in development work. The mill has not been operated since then. The lowest level is being driven ahead and in the spring the mine will be in a

PAYNE BLUFF ON K. & S. RAILWAY, 1,000 FEET BELOW.

BRIDGE ON K. & S. RAILWAY, AFTER A SNOWSLIDE.

SLOCAN LAKE AND S.S. "SLOCAN."

good position to produce regularly if prices justify. The Sunrise, an adjoining property, is looking very well.

Ivanhoe Mine.—Only about half the usual crew have been working at this property for the last eight months and the mill has only been running one shift. Thirty-five men are employed. This property is principally owned by the Minnesota Silver Co., of Duluth. It is equipped with one of the finest concentrators and aerial tramways in British Columbia and is capable of producing continually under the ordinary conditions of metal market prices.

Noble Five.—This property was operated for a period during the summer and previous to the foreclosure of the mortgage by Mr. Dunsmuir, was looking well and paying its way. Several car loads of good-grade ore were shipped from the mine. Mr. Dunsmuir, I understand, intends to operate the property on a large scale when arrangements are finally concluded, whereby the mine will pass into his possession.

American Boy.—A force of about 40 men have been kept continuously at work on this property and regular shipments have been made. This year the A. B. will rank amongst the Slocan's largest producing mines. The mine is looking well and is systematically opened up. Ore is transported to the railway over the Last Chance tramway.

Idaho Mines.—Nothing but development work has been done on this property during the past year. Ore has been encountered in the lowest level, from which it is intended to build an aerial tramway to the company's mill at Alamo, the present surface tramway being too old and practically useless. This property is owned by Mr. G. W. Hughes and the Scottish Colonial Company and is under the former management. Next year the property will be in a position to ship regularly, it having now about 2,000 tons of ore awaiting treatment and shipment. This mine has paid large shipments in the past.

Whitewater.—Most of the early part of the year this property was idle, but since has been in operation several months, two shifts being employed at the mill. The profits of the concentrates are very small and it is questionable how long it will be possible to continue to operate the mine at the present prices of lead and silver. There are 125 men on the pay roll and the mine is shipping about a car of cencentrates per day.

Rambler-Cariboo.—During the summer the company purchased the old Washington mill in McGuigan basin, and re-erected it at the mine. The mill has a daily capacity of 50 tons and will be shortly in operation. From 60 to 70 men are employed and the mine produces about 500 tons of high-grade ore per month. This property is paying regular dividends and the stock is at present the most popular in British Columbia. There is 12 feet of clean galena at the bottom of the shaft at the lowest level. A new hoist is now being installed and when finished the shipments will be considerably increased, the mine being in excellent condition to maintain a regular production. New mine buildings were erected during the summer.

Monitor.—This property is situate close to the town of Three Forks and in convenient proximity to the C. P. R. track. Work has been restricted during year the to development work, in the course of which, however, a sufficient quantity has been extracted to refund to the purchasers the price paid for the mine. The showing in the lowest level is most favourable, and there is on hand and in the ore house 400 tons of 300-oz. ore awaiting shipment. The ore carries very good value in gold and in one instance one car shipment averaged $20 in gold alone, but the general average gold value is about $8. This is the only property from which gold values are obtained in the Slocan. A force of 25 men is constantly employed.

Reco.—Mr. Harris has made several permanent improvements at his mine during the year, among others the erection of a large ore house at the lowest level and also by shortening and improving the trail. Rawhiding has commecned and about 100 tons of ore have already been brought down, with the expectation of shipping 300 additional tons this winter. The mine is looking fairly well and working about 30 men. The low price of silver affects this property more than is the case with some of the other mines on account of the grade of ore. The Goodenough, the adjoining property, is working a few men and has shipped 200 tons this autumn.

Sunset and Trade Dollar.—These properties are situate at the head of the Jackson basin and have within the past year made a very good record. They have a wonderful showing and are likely to become important producers in the future. About six car loads of ore are meanwhile being shipped monthly. The ore is of very good grade. The mine was first worked last fall and since that time has paid for itself. It is owned by Mr. G. Hughes and others.