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E. JACOBS.....Managing Editor

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NOTES AND COMMENTS.

It is stated that the Rossland Mines, Le Roi, Le Roi No. 2, and Centre Star are all making profits and will pay further dividends this year.

The *Boundary Creek Times* states that the Canada Western Oil Co., Ltd., of Greenwood, enjoys the enviable distinction of being the only holder of an oil lease in the province.

At the Payne mine the shaft from No. 8 tunnel is being sunk, and the mill is being run two shifts. Occasional shipments both, of galena ore and concentrate, are being made.

Ore is being shipped from the Monitor mine, near Three Forks, to the concentrating mill at Rosebery, on Slocan Lake, owned by the Monitor and Ajax Fraction, Ltd. The same company is making preparations to send ore from the Bosun mine to Rosebery.

The *Phoenix Pioneer*, in its issue of June 16, observed: Boundary's monthly payroll, distributed for the most part this week, again runs over \$100,000 for the past 30 days. This is doing very well for a district with about 10,000 population.

Recent numbers of the *British Columbia Gazette* contain notices giving definitions, to be substituted for those at present in force, of the boundaries of the following mining divisions: Cariboo, Omineca, Skeena, Kamloops, Nicola, Similkameen and Yale.

A lot of zinc ore, about 400 tons, is being shipped from the Ruth mine, Sandon, to the Kootenay Ore Co.'s works at Kaslo for grading up by magnetic separation. Galena ore of good grade is being shipped from the Hope, a neighbouring property, also owned by the Ruth Mines, Ltd.

A news paragraph in the *Yukon World*, of Dawson, Yukon Territory, gives the information that a Mr. Livingstone, working on the claim at the rear of the old Hillside roadhouse, on Hunker Creek, on June 4,

took out one pan that contained more than 6 oz. of gold.

Finance Minister Fielding, in his annual financial speech in the Canadian Parliament May 22, announced that the exemption from duty of machinery for use in alluvial gold mining, which expires June 30, would be continued for six months longer.

It is stated that the Spokane Mining Exchange has been reorganised at Spokane, Washington, after having been inactive for two years. The interest in stocks in that city is reported to be stronger now than for several years last past, and brokers all report good business.

The average price of silver during last month (May) was 2.211 cents higher than that of the previous month. In April it averaged 64.765 cents per fine oz., while in May this was advanced to 66.976 cents. At this highest average price an advance of 10.379 cents per ounce results from the low point of last year, which was 56.600 cents.

The Consolidated Mining and Smelting Co. of Canada is doing development work on the Eureka-Richmond group of mineral claims, adjoining the Sloan Star mine, near Sandon. There are five claims in the group, which formerly belonged to the War Eagle Co., now merged in the Consolidated M. and S. Co. Some 400 ft. of work, principally tunnelling, had previously been done.

The Kamloops *Inland Sentinel* recently published the following: George MacDonald has returned from Cobalt, Ontario, where he has been for some months. While recognising the vast richness of the new mining field, he prefers British Columbia, the mining laws of which province are, in his opinion, superior to those of Ontario and far more in the interests of the miner and prospector.

General Manager Lindsey, of the Crow's Nest Pass Coal Co., says: "Our coke business keeps on increasing very rapidly. We recently signed a contract for the next three years for the exclusive supply of the Trail smelter. The prices in the metal markets make smelting everywhere very active now, and our foresight in providing ovens to burn the coke in enables us to meet all demands and give a steady supply."

The Granby Consolidated Mining, Smelting, and Power Co., Ltd., now has three vice-presidents instead of one, as heretofore. Mr. Jay P. Graves' new colleagues in that office are Messrs. George Martin Luther, secretary of the Nichols Chemical Co., and Geo. Crawford Clark, of Clark, Dodge, & Co. Both gentlemen are of New York and were on the company's directorate before receiving their new appointment.

From the London *Critic* of June 23 it is learned that Le Roi No. 2 shares have been in favour at £2 6s. 3d.

Ymirs, after having been weak on the forced sale of a large block shares, have recovered to 7s. 6d., and a better price may be looked for, having regard to the favourable nature of Mr. Gilman Brown's recent report on the mine. Closing price for Le Roi on June 21 was £1 10s. and for Tyee 15s.

The Nicola branch of the Canadian Pacific railway is expected to be in running order early in July. This line is about 60 miles long, running from Spence's Bridge, on the main line of the C. P. R., up the Nicola River to Coutlee. It is the intention to at once proceed with construction as far as Nicola. Ultimately the line is to be extended by way of Princeton, Similkameen, to Midway, in the Boundary district, and on the International Boundary line.

In the Supreme Court Mr. Justice Duff has upheld the 8-hour law and the interpretation placed upon it some months ago by Police Magistrate W. J. Nelson at Rossland, when two mining companies were fined for employing engineers at their mines for more than 8 hours in 24. The hiring of men for 12-hour shifts was admitted, but the defence raised was wholly technical and not deemed sufficient to exonerate the companies, so the decision of the police magistrate was confirmed.

It is announced that the Le Roi No. 2, Ltd., intends paying quarterly dividends, and that early in July a dividend of one shilling per share will be declared. Calculated at \$4.86 per £ this last distribution will amount to \$29,200, and will bring the company's total of divided profits on its 120,000 £5 shares up to 21s. per share, or 21 per cent on its issued capital of £600,000. The company's mine at Rossland is reported to have large reserves of high-grade ore in sight, sufficient to ensure the payment of dividends for two years, even should no new discoveries of ore be made within that period.

The ninth annual meeting of the American Mining Congress is to be opened at Denver, Colorado, U.S.A., on November 13, and continued over five days—to 17th, inclusive. Messrs. David H. Moffat and Simon Guggenheim have each offered to give \$50,000 towards the cost of erection of the proposed mining temple, conditionally that the remaining \$150,000 to \$200,000 required for this purpose be subscribed by others. The executive of the American Mining Congress expects to raise the money by direct subscription.

The Dawson directors of the Alaska-Yukon Exposition are offering a first prize of \$200 and a second prize of \$75 for an essay on "The Resources and Advantages of the Yukon," and similar prizes for "Collection of Yukon Flowers, Ferns, Leaves, Grain on the Stem, and Mosses (mounted)." The competition is open to Yukon residents. Entries for the former close July 1 and the latter December 1, 1906. The

winning essays are to be printed for distribution as soon as practicable after the awards shall have been made. The prize collections of flowers, etc., are to be exhibited at the Alaska-Yukon exposition, to advertise the Yukon.

A Reuter despatch from Ottawa to London, England, under date June 13, states that "Dr. Thompson, representing Yukon in the Dominion House of Commons, that day "drew attention of the House to the troubles between American and Canadian miners working in the vicinity of the border owing to the difficulty of determining the Yukon-Alaska boundary from Mt. St. Elias to the Yukon River. Sir Wilfred Laurier replied that the boundary, which was the 141st meridian, was marked years ago by Canadian surveyors, but was not accepted by the Americans who disputed the possession of a considerable tract of country. Negotiations were in progress, but the matter was no nearer settlement than it was months ago."

In Southeast Kootenay, at the St. Eugene, which is the largest lead-silver mine in Canada, there is now more ore in sight than at any previous time since the mine was opened. Mr. Jas. Cronin, general manager for the Consolidated Mining and Smelting Co. of Canada, now owning this mine, lately informed the *Moyie Leader* of this fact, and added: "We are cutting down the grade and shipping ore and concentrates of lower value than we did some time ago, but this is made feasible by the company owning its own smelter plant. Heretofore we have been shipping only higher grade material, but now we are putting through the concentrating mill all stuff carrying values." A recent week's shipments to the company's smelter at Trail totalled 1,264 tons—an unusually large output for one week.

The following comments on the prospects of the Ymir mine appeared in the London *Critic* of June 2: I understand that Mr. Gilman Brown, the Californian mining expert, arrived at the Ymir mine a few days ago. Having had an opportunity of inspecting the work accomplished in the rise between the tenth and seventh levels since his last visit, Mr. Gilman Brown has expressed the opinion that a very fine body of ore will be developed in that part of the mine. It may be recalled that the ore body for a distance of 100 ft. in the rise averages 5 ft. in width, of \$23 in value. The mill restarted crushing this week, and there is sufficient ore available for a month's run without touching the ore in the stopes. I hear, further, that arrangements have been completed for providing the company with fresh capital without calling upon the shareholders. With good developments in the mine and with adequate working capital the prospects of the company are brighter than for some considerable time.

The *Engineering and Mining Journal* of New York, lately made the following comment on the question of

"Sunday Work in Mines": The question of Sunday work in the mines is now to the front in Western Australia. Some companies have adopted the short-sighted policy of attempting to increase their production by working seven days, instead of the customary six. We say short-sighted policy, because aside from religious scruples and sentimental grounds, it has been the experience of the world that the workman requires something more than one free day out of seven to obtain the necessary relaxation; the additional time is provided in occasional holidays. Any attempt to depart from this custom, which has been established by the workers of the world, will lose more than it will gain. So far as any legislation is required, it is a sound principle to restrict Sunday work to that which is strictly necessary. Even in smelting plants, where the work must go on continuously, the men will lay off the number of days in the year that the demands of nature require.

The progress of the mining industry of British Columbia during fifteen years, 1891-1905, is exhibited in the following table, which shows, as well, the substantial increase made in each successive period of five years:

	Value.
Mineral production in five years 1891-1895	\$19,956,804
Mineral production in five years 1896-1900	56,607,967
Mineral production in five years 1901-1905	96,507,968

Total for fifteen years \$173,072,739

The approximate proportions of this total were: placer gold, \$11,500,000; lode minerals, \$102,000,000; coal and coke, \$57,000,000; and other minerals, \$2,500,000. The total mineral production for all previous years—to 1890, inclusive—was valued at \$74,590,437, making a grand total to the end of 1905 of \$248,663,176.

Reports from the Ymir mine are decidedly favourable. The raise from the 1,000-ft. level has warranted the consulting engineer, Mr. Gilman Brown, of San Francisco, in cabling to London that it gives every appearance of developing a good body of ore. Later the manager, Mr. E. M. Hand, cabled that a drift east and west on the strike of the vein was opening up a fine body of ore. By letter he reported: "The vein is certainly a fine one, fully 5 ft. wide, and it may be much wider, as we are not breaking into the foot and so do not yet know its full width. It is safe to say that the ore we have taken from the raise and are now mining will much more than pay for the cost of the raise." Since June 6 the mill has been operated with 30 stamps dropping, crushing between 600 and 700 tons of ore per week, with good results. A shortage of men has prevented additional batteries being used, but it is hoped that next month more will be available.

The Tyee continues to be the only mine in the Mount Sicker district, Vancouver Island, at which important development work is in progress. From the time, in 1902, the shipment of ore was commenced, up to the present, about 150,000 tons of ore have been sent to the Tyee Copper Co.'s smelter at Ladysmith. The metal contents of this quantity of ore were, approximately, 13,700,000 lb. of copper, 427,400 oz. of silver, and 22,000 oz. of gold. The main shaft in this mine is now down between 1,100 and 1,200 ft. When the latter depth shall be reached levels will be opened simultaneously at both 1,100 and 1,200 ft. Indications for the discovery at depth of permanent ore bodies are considered good, a body of low-grade baritic copper ore having been encountered at the 1,000-ft. level, and the formation thence down being favourable to the deposition of ore. To the west of the Tyee shaft, on the N. L. claim, also owned by the Tyee Copper Co., a shaft is being sunk to a depth of between 500 and 600 ft. Owing to the fall of hill this depth will be about equivalent to the 1,000-ft. level in the Tyee. Indications here are stated to be excellent, pointing to the close proximity of ore.

The Toronto, Ontario, special correspondent of the *Mining and Scientific Press*, on June 15, wrote: "In the House of Commons at Ottawa on June 12, Dr. Thompson, representative of the Yukon Territory, presented the claims of his constituents for a greater measure of self-government. He said he had the authority of experienced mining men for the opinion that more gold would be produced in the future than in the past. There were miles of auriferous gravel which capital would develop. Capital was coming in. The Guggenheim people were spending \$2,000,000 on hydraulic and other machinery, and English capitalists were building a railway from Dawson into the gold district. In the southern part of the district, a quartz camp was being established. The Government should help in the way of securing water, an aqueduct was required to bring water to the gold-bearing deposits and provide means for their being worked. He presented figures to show that this would be a paying proposition." In this connection it may be mentioned that the Dominion Government is giving the question of water supply its attention; that the Klondike Water Supply Co. has been incorporated with the object of establishing a system for the supply of water for hydraulicking purposes on several creeks in the Dawson district, and that early in July the first passenger train will be run to Grand Forks.

It is to be hoped that the iron ore resources of British Columbia, as well as those of Ontario, Quebec and Nova Scotia, will be investigated under the direction of the Dominion superintendent of mines, when the official investigation, brief particulars of which are printed on another page, shall take place. The provincial bureau of mines some time since published an illustrated pamphlet which contained much valuable information relative to occurrences of iron ore in this Province, gathered chiefly by Mr. Herbert Car-

michael, provincial assayer and assistant to the provincial mineralogist. In view, however, of the increased attention now being given to the utilisation of the iron ores of Canada it is particularly desirable that British Columbia shall share in the benefits expected from the wide dissemination of official information on this important subject. The Dominion Government is already doing British Columbia excellent service in the prominence being given under its auspices to the mineral resources of the Province, notably in connection with its zinc ores and the geological and topographical conditions of the Rossland mining district, yet, this notwithstanding, it is permissible to urge that the Province be permitted to share in the general advantage that may be expected to result from the extensive distribution of a report by experts on the iron ore resources of Canada, which report would of necessity be incomplete were those of British Columbia not taken full cognizance of. Further, the probability of there soon being iron furnaces established at some suitable point or points on the northern Pacific coast makes it all the more important that additional official information concerning British Columbia iron ores shall be available as soon as shall be practicable.

COAL IN THE WEST.

MOST Canadians are aware that we have in this Dominion supplies of coal, to express the amount of which our language falls lamentably short. "Enormous," "tremendous"—such words as these only feebly express the tonnage of lignite lying beneath the thousands of square miles in the western provinces. Unlimited is perhaps the correct word, for the supply is certainly "unlimited" for many hundreds of years. A billion, to the ordinary person, is little more than a figure of speech, but the tons of coal in Alberta alone are probably represented by hundreds of billions.

Though the presence of this coal is well known, and has been known for some time, the fact that it is only "lignite" has been sufficient to induce most people to believe that its economic use is comparatively small.

An invention has, however, been patented which has all the possibilities of rendering this lignite quite as useful as hard Welsh anthracite. This invention, known as a gas producer, has been put to very severe tests, and has proved that coal similar to our western lignite can be made to produce, by its aid, an amount of power equal to that produced in the ordinary way by best Welsh.

Mr. D. B. Dowling, of the Geological Survey of Canada, lately read, before the Mining Institute, a paper in which he gave some remarkable figures. These show that in an ordinary steam plant the amount of coal (similar to that found at Medicine Hat) required to produce one horse-power per hour is 6 lb., whereas in the gas producer a similar result is obtained from less than 2½ lb. This test was made on what is known as "wet" coal, but if the coal be dry, the vari-

ation is equally startling. These extraordinary results open up a field whose limits are practically boundless.

The Geological Survey has recognised the tremendous possibilities and its reports on the Western coal areas will be read with more than usual interest.—Geological Survey "Press Bulletin."

CANADIAN IRON ORE DEPOSITS.

FOLLOWING the successful experiments in electric smelting of iron ores which attracted attention throughout the world, and have led to many complimentary references to Canada as an enterprising and up-to-date country, says the Ottawa correspondent of the *Toronto Globe*, the Minister of the Interior, upon recommendation of Dr. Eugene Haanel, Dominion superintendent of mines, has authorised an investigation of the iron ore resources of the Dominion. This cannot be undertaken any too soon. In the past few years there have been numerous inquiries as to the extent of Canada's iron ore deposits, and of late requests for information on the same subject, possibly with a view to investment, have come from several other countries. The work to be done this summer will be divided into three sections.

The field work in Eastern Ontario and Quebec will be in charge of Mr. Fritz Cirkel, M.E.; that in Western Ontario of Mr. Shele, M.E., and that in Nova Scotia, of Prof. Woodman. The completed report will treat the economical side of the question rather than the geological, as it is desired to meet the wants of the practical miner and investor. Such geological data, however, as are necessary for a complete understanding of the ore formations, etc., will be given. Magnetic surveys will be made of those deposits, or portions of deposits, which appear to be the most promising, and samples will be collected for analysis. In view of the constant inquiries sent to the mines office respecting water power near different iron ore deposits available for electric smelting, the approximate horse-power of different water-powers met with during the progress of the examination will be ascertained whenever possible. Timber available for mining purposes and for the manufacture of charcoal will also be described. Magnetic surveys will be made independently of the field parties.

PROFESSOR BROCK'S REPORT ON ROSSLAND MINING DISTRICT.

LODE MINING in British Columbia has made a relatively larger advance in the value of its products since 1892 than any other branch of the mining industry of the Province. In that year the proportion lode mining contributed to the total mineral production was barely \$100,000 out of a total value of \$2,978,530, while placer gold was four times as much, and coal the comparatively large value of \$2,479,000. Five years later—in 1897—the total production from lode mining was \$7,052,431, placer gold \$513,520, and coal and coke \$1,737,717. Last

year the respective proportions of the year's total of \$22,461,325 were: From lode mining \$15,319,364, placer gold \$969,300, coal and coke \$5,511,861, and miscellaneous \$660,800.

The foregoing figures will serve to show that lode mining has become by far the most important branch of the mining industry of the Province. It is, therefore, a matter for congratulation that the Rossland mining district, which has produced during the last twelve years a total value of nearly \$34,000,000, with an average yearly production for the last five years of rather better than \$4,250,000, is being systematically examined by members of the Geological Survey of Canada, with Professor R. W. Brock in charge of the investigations. In the belief that the information contained in Mr. Brock's "Preliminary Report" will be of more than ordinary interest to many readers of the *B. C. MINING RECORD* who would not otherwise have this valuable publication brought to their notice, it is reprinted in this month's issue.

As a much more complete report is to be published later, by the Geological Survey, the pamphlet under notice partakes more of the nature of a progress report or summary, based upon the results of the field work done at Rossland in 1905, consequently it deals with only a few features of the complex questions requiring elucidation. It is noted that two questions in particular are having attention in the investigation still being carried out. These are (1) do the ore bodies now being worked extend to greater depths? and (2) is it likely valuable ore bodies occur outside the area already being worked? The examination of existing mines and surrounding territory is being made exhaustive and thorough, so that the conclusions that shall be arrived at when this investigation shall be completed should be of great assistance and value to those interested in the development of the mineral resources of Rossland camp.

While no comprehensive review of Mr. Brock's observations in his preliminary report is here attempted, there are a few points to which it is desired to call particular attention. They are briefly summarised in the following sentences:

(1.) The difference between the value of ores shipped during the earlier and later years of the camp, respectively, represents only in part a lowering of the grade of the ore in depth. Mining and smelting costs now being considerably lower, much more ore can be profitably mined and shipped than was the case years ago, consequently ore sorting is not nearly so close as formerly.

(2.) While it cannot be predicted with full assurance of profitable results to what depth pay ore will be found, it may be said that prospects for deep mining at Rossland were never before so favourable as at present, consequently prospecting operations to deeper levels are quite justified by the present outlook.

(3.) Concentration, while still presenting difficulties, will probably yet be found practicable and profitable, prolonged experiments having indicated

the directions in which it may be used to advantage.

(4.) A production of \$34,000,000 to the end of 1905 is convincing evidence of the substantial worth of the camp. While the profits of this production have not in the past been as large as could have been wished, the larger mines are to-day operating at a profit.

(5.) Costs generally being lower and prices of metals high, the prospect is that dividends aggregating a considerable sum may reasonably be looked for in the future.

The more complete report, with maps and other illustrations, now in course of preparation, will doubtless prove still more useful than that already published, and will serve to further demonstrate the value of the investigations made. It may be added that owing to Mr. Brock having previously had occasion to carefully examine the Le Roi, War Eagle and Centre Star mines, his services in directing the investigations are of especial value.

TREATMENT OF LEAD-ZINC TAILINGS IN AUSTRALIA.

SEVERAL processes for the treatment of lead-zinc ore tailings in use in Australia have recently been briefly reported on to the Department of Trade and Commerce of Canada, by Mr. D. H. Ross, commercial agent for Victoria, South Australia, Western Australia and Tasmania. Writing from Melbourne under date March 19, 1906, Mr. Ross reported as follows:

Purchase of Old Tailings in Australia—While the old tailings dumps of the Australian gold mines have been purchased by cyanide operators, there still remain very large old dump heaps from the zinc-lead silver mines, these ores having been treated for the lead and silver the residues carrying 6 per cent lead, 6.3 oz. silver per ton, and 20 per cent zinc. Australian metallurgists now claim to have successfully tackled the problem of treating zinciferous tailings of which many millions of tons have accumulated, hitherto practically worthless, but now representing a value of millions of pounds sterling.

Concentration Treatment of Ores.—Canadian mining men, particularly those interested in the investigations being made upon zinc deposits in British Columbia, should carefully ascertain the relative values of the various processes now in operation in Australia in the treatment of zinc residues which have been left after treating the lead-zinc ores from the mines. The general process of taking out the lead, which all the mines—at Broken Hill, New South Wales—have previously been taking out of the ore, is one of concentration by means of jigs and various types of concentrators, such as the Frue vanner, Wilfley table, and other concentrators of this description.

Previously no satisfactory process had been brought forward for extracting the zinc from the ore, and this zinc-bearing residue has been put to one side for a number of years until now there are probably 5,000,000 tons of material carrying on an average about 20 per

cent zinc and 6 per cent lead. There are also at Broken Hill immense quantities of residues carrying a lower percentage of zinc which will probably be treated later on.

Purchase and Treatment of Ores.—A company was formed a few months ago in Melbourne—with a capital of £350,000—for the purpose of purchasing large quantities of tailings from the different mines and treating them by what is known as the "Potter" process. This company has purchased and secured the option on about 4,000,000 tons of tailings, estimated to produce 269,000 tons of lead, 20,638,000 oz. of silver and 738,000 tons of zinc. The preliminary plant has just been completed and is giving excellent results on a treatment of about 50 tons of tailings per day, but a plant is now being designed in Melbourne capable of treating 2,000 tons of material per day, and later it is intended to increase the daily capacity to 4,000 tons.

The "Potter" Process.—After some years of experimenting the inventor of the process—Mr. Potter—discovered a cheap and effective method of extracting the zinc from the huge dumps of Broken Hill tailings by use of sulphuric acid in a dilute form, the effect of which—when added hot to the tailings—is to float the zinc to the surface, when it can easily be run off. It is a strange thing about this process that the heavier portion of the tailings, viz., the metallic, rises to the surface, being ballooned up by the gaseous bubbles formed by the action of the acid, leaving the lighter substance, the gangue, at the bottom.

The procedure adopted in the working of the Potter process is that the material from the dump is thrown continuously, by means of a belt conveyor, into a spitzkasten. At the bottom of the spitzkasten is introduced a pipe by means of which boiling sulphuric acid of about 1½ per cent strength is pumped in—the ore being thrown on top of this liquid with a fall of about a foot. There is a certain amount of carbonate in the material which is attached by the acid and forms carbonic acid gas. This gas rising from the solution leaves the gangue, but forms on all metallic particles a coating which raises the metallic particles to the surface of the liquid and they are allowed to flow over the edge of the spitzkasten. The gangue falls to the bottom and is drawn off by the ordinary spigot. The particles of gas seem to be detached from the mineral by striking the bottom of the launder, leaving the mineral to be carried by the solution to the settling pits. The solution is then decanted and sent back to the boiling vats, after being cleared and brought back to the proper strength. The concentrates are sent direct to the smelters. The process is thus continuous and the concentrate obtained, so far, averages about 45 per cent of zinc and 5 to 6 per cent of lead, but it is possible that further experience will perfect the method of working, so that the concentrate will be obtained of perhaps 60 per cent of zinc.

The "Cattermole" Process.—Another process—known as the "Cattermole"—is also being used at Broken Hill in the extraction of zinc from tailings.

This process is worked on much the same lines as the Potter process, with the exception that a certain amount of mineral oil is used with the sulphuric acid solution of about the same strength— $\frac{1}{2}$ per cent. The material to be treated—the oil and the acid solution—are passed through six centrifugal mixers by which the oil, acid and material are thoroughly mixed, and then passed into a spitzkasten. The cold acid having cleaned the mineral particles, the oil—which has an affinity for mineral—floats it to the surface, and it is collected as before. The percentage of extraction in this process is said to be about the same as that obtained by the Potter process.

The "Delprat Salt Cake" Process.—The third process in use at Broken Hill obtaining zinc from tailings is the "Delprat salt cake" process, which followed the Potter process, and is almost identical with the latter except that a small amount of salt is added to the acid solution. The proprietors of the Potter process, however, are now engaged in a legal action against the Delprat people for infringement of patent rights.

Acid Used and Improved Machinery.—In connection with the treatment of the tailings it may be stated that the sulphuric acid used is made by the local Carmichael-Bradford Co., owing to its cheapness and efficiency. A concentrator, made by the Gillies Co., has been designed to provide an improved mechanical means of producing zinc concentrates by the use of the Potter process.

CHANGE OF SUPERINTENDENTS AT TYEE MINE.

AFTER having been six years in the service of the Tyee Copper Co., Ltd., as superintendent of its Tyee mine at Mt. Sicker, Vancouver Island, B.C., Mr. Edward C. Musgrave leaves that company's employ on July 1, prox., to commence business on his own account as a consulting engineer, with office at Victoria.

Following his graduating at the Kingston School of Mines in Ontario, Mr. Musgrave commenced his active association with the mining industry in British Columbia in 1894, which was about the time lode mining in the Province began to assume important proportions. He first entered the employ of the Hall Mining and Smelting Co. of Nelson, and afterwards was with the Columbian Mining Co. In July, 1900, he was appointed superintendent of the Tyee Copper Co.'s mine, and during the six years that have since elapsed that property has, under his direction, been developed from little more than a promising prospect into one of the paying mines of the Province.

During the period above mentioned the main shaft of the Tyee mine has been sunk to a depth of 1,100 ft.; other shafts aggregating more than 1,000 ft. have also been sunk on the property; several miles of underground workings, in drifts and cross-cuts, have been driven; and upwards of 150,000 tons of ore have been extracted and shipped to the company's smelting works at Ladysmith. Practically the whole of this

work was planned and carried out by Mr. Musgrave in a thorough and efficient manner. While nothing has lately been given out for publication it is known that the indications in the deepest workings of the mine are so favourable as to give promise of leading to results, when the development work now in hand shall have been completed, that will be further testimony to the grasp Mr. Musgrave has of local conditions, and fully justify his confidence that ore of payable grade occurs at depth in quantity.

While looking closely after the interests of the company employing him, Mr. Musgrave has at the



Mr. E. C. Musgrave, C. E. and M. E.

same time assiduously cultivated such friendly relations with the men employed under him in and about the Tyee mine as to have gained their respect and goodwill. The kindly feeling existing found happy expression in the presentation of a valuable gold watch by the mine employees to Mr. Musgrave on the occasion of the valedictory dinner given to him on the termination of his period of service with the company.

It is gratifying to know that, although Mr. Musgrave has voluntarily retired from the superintendence of the Tyee mine, his knowledge and experience of mining conditions in the Province will be available in his new sphere as a consulting mining engineer.

A few words in conclusion relative to Mr. Musgrave's successor—Mr. J. W. Bryant, who recently arrived at Mt. Sicker. Mr. Bryant is a graduate of the Camborne School of Mines, Cornwall, England, after leaving which he was engaged in both Cornwall and Wales, afterwards going to Nicaragua, Central America. Later he was for four years and until his

recent resignation, in the employ of the Namaqua Copper Co., Ltd., having mines and concentrating plants in Little Namaqualand, Cape Colony, South Africa. These mines have large reserves of ore, which is high-grade chalcopyrite, occurring with intrusive greenstone traversing granite. The company has been in existence since April, 1888; has issued capital of about \$940,000; has the reputation of being conservatively and ably managed; has a surplus fund of about \$200,000 invested in British consols, and has, since its organisation, returned profits equal to double the amount of its capital. Mr. Bryant was cordially received by the men at the dinner to Mr. Musgrave, and his brief remarks made an excellent impression.

THE PASSING OF THE MINING BOOM.

MINING BOOMS must pass, is the conclusion arrived at by the *Daily Mining Record*, of Denver, Colorado, U.S.A. After stating that though Colorado, "premier gold state of the Union, does not partake of booms, there are finds every day in Colorado, in which as rich ore is uncovered as any that was ever discovered in outside camps," and contrasting the quiet yet very substantial progress in mineral production of that State with the excitements of recent years in Nevada, the *Record* says:

This leads us to ask a question. It is this: When a state or a district settles down to steady production, is not a boom an impossibility as associated with that region?

Men with money do not wish to boom anything that is good. They want to invest and not be disturbed about it. The capitalists of Colorado do not object because Nevada has one boom after another. They know that many sections of Colorado produce as rich ore. But they are not after the exciting things that attend a boom. These men prefer cosy corners in clubs, the golf links, or their homes. They have had all the adventure their natures craved, in the getting of their wealth.

* * * * *

No matter what camp has a boom, soon or late, it must settle down to the quiet life. It is not unlike a champion in any line of athletic sports. His hey-day passes and he is forgotten.

Investors who have followed booms for years, would do well to stop and think—a long serious thought at that. Let us count the booms, and see what has become of them. There was an Arizona copper boom a few years back. It passed and steady development and production took its place. Alaska was the flame that awoke the country after the echoes of Cripple Creek had died, but the glamor of Alaskan gold days passed, and that country has settled down to steady production. Idaho set the world aflame. Now the operations of Idaho are serious. Money going into its camps, goes there for returns and not for red head lines. Oregon took on the breath of startling values. To-day, the Cracker Creek region can produce specimen ore with values of hundreds

of thousands of tons, but the world does not hear. Men with money and intentions of mining are in Oregon and are going there without cessation. California is doing a great deal of real, unsensational mining. The residents of California, for the most part, never think of investing in California mining propositions, preferring Nevada.

Montana is too busy with real mining to think of booms. Utah is doing development and it is progressing and will continue to progress. But its sensations are as cold ash that has fallen from the days when the boom fires burned brightly.

Wyoming is so intent on real mining that it set an embargo on advertisements that misrepresented, as did also Washington. All good states—but *sans* booms.

Thus the story progresses. And the booms come and go. The excitement that attends them passes. A little while and the large operators of the Nevada camps will tire of the booms. They will want rest and profit. They have witnessed that course already in Tonopah. That district evinces small desire to burst forth in print.

All of this editorial comment is not intended to cast reflections on any boom camp. It is the temper of the people that makes booms possible. At the very instant a concerted attempt to boom Searchlight was on foot, Manhattan came in with a rush. And now Fairview is holding the boards.

There is coming a time when the West will have no more mineral booms. Maybe that time is far distant, but the clarion call to steady production brings one camp after another into line. And when that time comes, the sensation seekers will have to cease their quest. Investment then will be different from what it is now. It will bear a stamp that is peculiarly its own. And the results, too, will be different.

The few hundred thousand men and women who are financing the boom camps, are building for better days. But the months that are fitting now are the halcyon days of boom-time mining. Never in the future will times like these prevail. Mining is a business and it must get on a purely business basis. Then the heightened spirits will not distort one's ideas, nor will the glare of printers' ink startle the world. It will be a story told in "6-point" somewhere on the market page.

It is true that gold will ever possess a certain charm but the problems of commercial paper and the system of credit have come to be of almost equal importance.

America is big and young, and the mineral West has many undiscovered camps that will prove marvels. And the years as yet unborn are many and the chances of booms are not restricted. But they must pass. It is not such a far cry back to the days of "Forty-nine," when the world marveled at the daring of the pioneers who crossed the treacherous plains. But schools and churches and factories dot the line, and railways have made a checker board of all that vast region. And so, in a short while, the very disposition of the public will have passed and booms will be no more.

PRELIMINARY REPORT ON THE ROSSLAND
MINING DISTRICT.

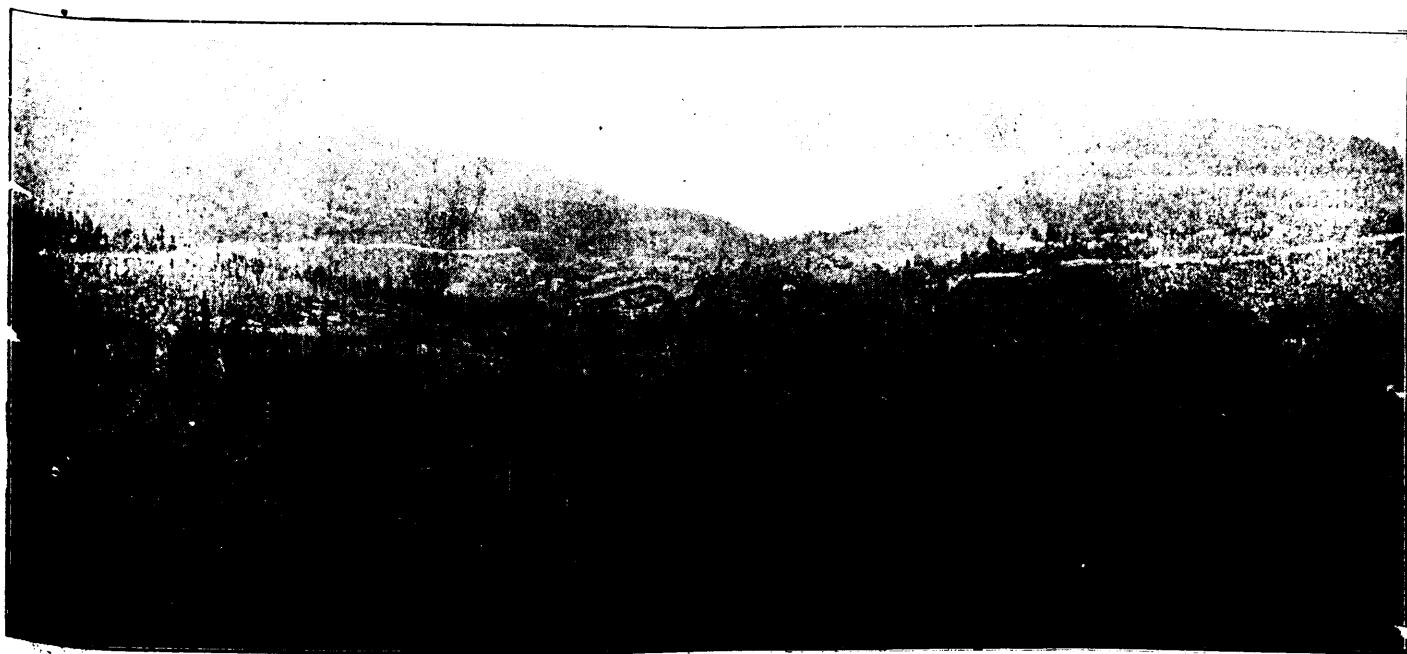
By R. W. Brock.

MENTION was made in last month's issue of the B. C. MINING RECORD of the publication by the Geological Survey Department, Ottawa, of Professor R. W. Brock's "Preliminary Report on the Rossland, B.C., Mining District." This is, as designated, simply a preliminary report; it gives a general review of the investigations conducted by Mr. Brock last year, throughout the field-work season of which he was in charge of a Geological Survey party engaged in the first important investigation of a detailed char-

acter was largely occupied in a study of the underground and economic geology of the camp. Mr. James Denny was engaged during the season in preparing thin sections of rocks and ores. During part of the season Dr. Young had a field assistant and, for a time, I was assisted in underground work by Mr. D. F. McEwen.

TOPOGRAPHICAL WORK.

The area embraced in the map sheet, as planned, extends from east of Columbia-Kootenay Mountain westward to the west slope of Little Sheep Creek Valley, embracing the summits of Monte Christo and Red Mountains, and southward to the south slope of Trail Creek, beyond the Canadian Pacific railway. It thus includes all the important mines, many of the



Bird's Eye View of Rossland in 1896.

acter undertaken by the Survey of a mining camp in British Columbia, with results that it is authoritatively stated "will surely call for similar investigation of other important camps in that great mining province." A more complete report is being prepared and meanwhile the investigations are being continued, with the intention of completing them this summer. The underground geology of the Rossland area is having Mr. Brock's particular attention; the intricate surface geology is being carefully traced by Dr. G. A. Young; the topographical work is being carried out by Mr. W. H. Boyd, who will make an accurate topographical map on a large scale. This season's work may, therefore, be expected to further justify the undertaking. Mr. Brock's preliminary report, with the exception of two excisions of a few lines each, follows:

On June 14, 1905, I left Ottawa for Rossland, accompanied by Dr. G. A. Young and Mr. W. H. Boyd of this Survey. Mr. Boyd took charge of the topographical work, with Messrs. S. King and G. Galt as assistants, while Dr. Young made a special study of the rocks and their areal distribution. My own atten-

claims that have attracted attention, and most of the extraordinarily numerous rock types of the district. Owing to the want of a detailed topographical map, little progress in areal geology could be made during this season, and this part of the work has for the most part been postponed until Mr. Boyd's results are available.

After establishing a base line in Rossland and erecting signals at suitable points, Mr. Boyd made a triangulation survey, giving a skeleton map of the area. Between the stations thus fixed, transit-stadia traverses, including those of railways, streets, roads, trails, etc., are run, and from stations on these traverses, subordinate traverses are made and points of topographical importance are fixed. A scale has been adopted large enough to show all surface improvements and the principal geological features. Contour lines at 20-ft. intervals indicate the salient features of the topography. Every care is being exercised to insure accuracy, and the resulting map should prove of general use and value. Mr. Boyd also attended to the construction of the map. The topographical work

of the season includes the triangulation, surveying and mapping of the complicated area occupied by the town and principal mines.

GEOLOGICAL WORK.

The conclusions drawn from Dr. Young's work have been incorporated in the following pages.

The writer spent the first week in a general survey of the area included in the map sheet, and then commenced the underground work. As he was already somewhat familiar with the geology and ore deposits of the three larger mines, typical of the central and developed part of the camp, he commenced work on the outlying workings, in the hope of discovering differences of conditions that would throw some light on the causes of mineralisation, and thus afford a clue that might be of service in prospecting for ore bodies in the district. Where plans existed of the mine workings, these were used; where none were procurable, surveys were made. On these plans the underground geological features were plotted. This necessitated tedious, detailed work, all the rock surfaces being dirt-covered. The following properties were examined:—White Bear, California, Spitzee, Gertrude, Mascot, Columbia-Kootenay, Giant, Novelty, Homestake, Monte Christo, Colonna, Jumbo, Cliff, St. Elmo, Le Roi No. 2 (partly): a few days were spent in the larger mines—Le Roi, War Eagle, and Centre Star.

As it is the intention to publish a separate pamphlet on the Rossland camp, only a few features need be mentioned in this summary of the season's operations. The geological problems presented in this camp are of extreme complexity: moreover, the unfavourable natural conditions render some of them, for the present at least, insolvable. The few stratified rocks have, through intense metamorphism, lost all original characteristics of texture and structure: the greater part of the district consists of igneous rocks of both surface and deep-seated origin. It is, in fact, a section through an old volcano or volcanoes, which were active for long periods and which have therefore the most complex anatomy. The rocks, though often closely related in composition and period of formation, are of infinite number and variety. Many varieties closely resemble one another and are very difficult, in certain cases impossible, to distinguish by the naked eye: yet they may differ materially in age. The plutonic rocks, which have invaded the others, have altered their attitudes and obscured their original forms, while the plutonics themselves might have had any form, so that what their original outlines were, cannot be presaged. The rocks are traversed by, literally, thousands of dykes, too numerous or irregular to be of much use as keys to structure. The complexity of the whole is rendered more obscure by innumerable slips and faults. Moreover, the rocks on the surface are frequently so weathered as to lose individuality, and the widespread mineralisation has wrought profound changes in many of the rocks. The wash covers at least one-half the surface, so that in the absence of any key horizon, few geological features can be traced with certainty on the surface. With a dia-

bolical perverseness, wash almost always overlies crucial points.

The underground workings which, in some respects, escape the surface disadvantages, were certainly not located with the idea of elucidating the geological problems. Moreover, they are to a considerable extent in altered or mineralised rock. All these factors tend to make the study of the camp a disheartening undertaking. There are, however, two questions of the utmost economic importance, and so long as there is any possibility of the present work contributing at all towards their solution, it is well worth pursuing. These questions are, first, do the ore-bodies now being worked extend to greater depths? and, second, are there likely to be valuable ore-bodies outside of those already worked?

* * * * *

SITUATION AND TOPOGRAPHY.

Rossland is situated in the Trail Creek mining division of the West Kootenay district of British Columbia, about six miles west of the Columbia River, and five miles north of the International Boundary line. It lies in the central portion of the Western Cordillera, in what has been called its Gold, or Columbian, Range of mountains. To the east of the Columbia River, and separated from the Gold Range by the Columbia Valley, is the Selkirk system. The Gold Range, or Columbian Mountains, are, as a rule, less lofty and alpine than the Selkirks, and in the vicinity of Rossland rarely exceed 7,500 ft. in altitude. Here, all the hills below 6,000 ft. have easy, flowing outlines, the inequalities of detail having been erased by the Cordilleran ice-sheet.

The camp occupies the head waters of Trail Creek, which flows east to the Columbia, and the head-waters of Little Sheep Creek, which flows southward to join the Columbia below the boundary line. To the west of Little Sheep Creek is Record Mountain ridge, about 7,000 ft. in elevation, forming a local divide. On its slopes Trail Creek probably had its rise before these waters were captured by the headward growth of Little Sheep Creek. This creek has now notched the transverse ridge from Record Mountain, which separates Trail Creek from Stoney Creek on the north, thereby severing Red Mountain (5,150 ft.), from Mt. Roberts (6,450 ft.), a shoulder from Record Mountain. A second gulch to the east of Red Mountain cuts it off from Monte Christo and C. and K. Mountain, the continuation of this transverse ridge, and leaves Red Mountain as a prominent dome. South of Trail Creek are Lake Mountain (5,410 ft.) and Look-Out Mountain (4,420 ft.). As a rule, the slopes are gentle, rising, on an average, about 1,500 or 2,000 ft. in the mile. Roads may be run almost anywhere. The slopes were formerly well forested, but the demands of the mines and towns, and forest fires, have largely denuded the hill sides of their timber.

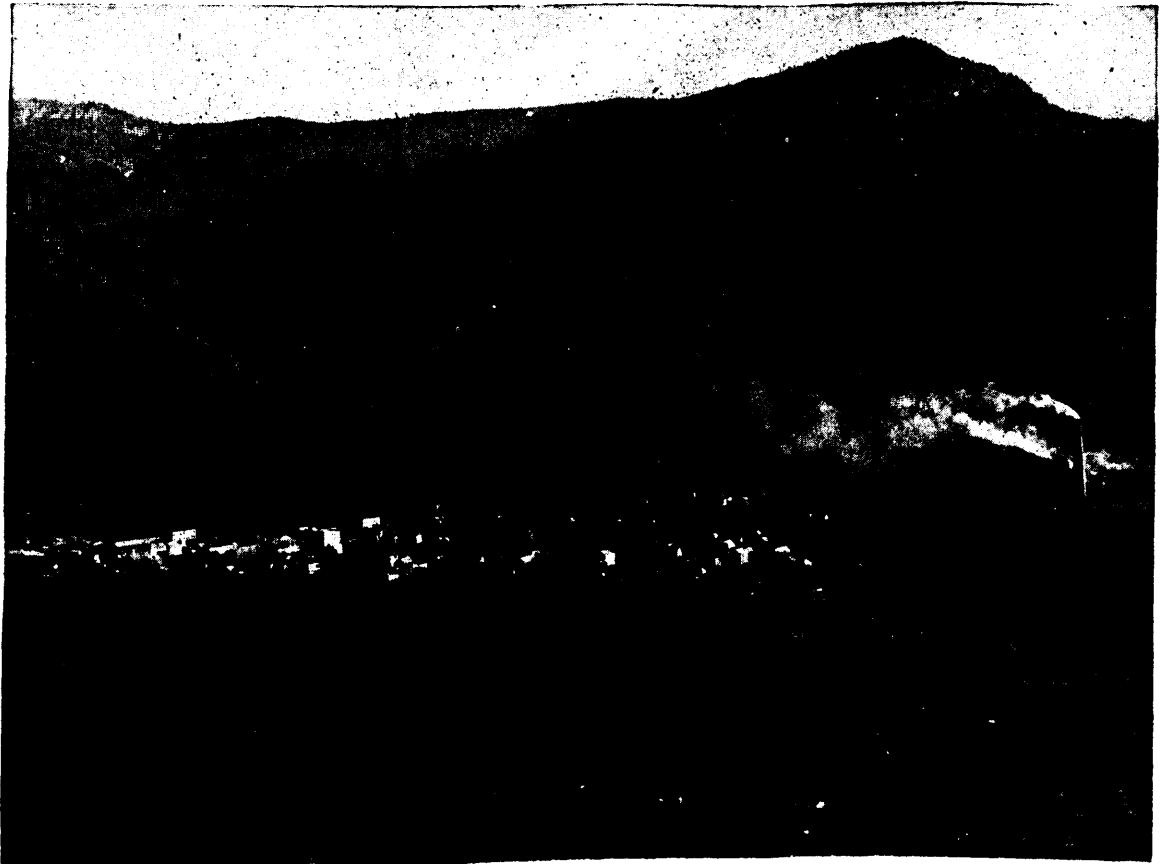
The climate is excellent. The summers are moderately warm and dry, with cool nights, and the winter climate is equable, the thermometer remaining remarkably steady, only a few degrees below freezing. The snowfall is heavy, but the clear air and sunshine and the absence of wind furnish an ideal winter.

On the north side of Trail Creek and almost at its head, perched on the slopes of Red and Monte Christo Mountains, is the substantial city of Rossland, which for natural situation and general characteristics will rival any mining camp in the west. It commands a view of Trail Creek Gulch and the Columbia Valley 2,000 ft. below, of the Selkirk Mountains beyond, and of the ranges in northern Washington and Idaho. The elevation of the main street, Columbia avenue, is about 3,410 ft. above the sea. The town is well built, and is provided with a complete system of water works and drainage, local and long distance telephone,

The Kootenay district is remarkably well adapted for gardening and fruit raising, and the camp is well supplied with fruit and vegetables.

HISTORY.

Although lead was discovered on Kootenay Lake (at the Blue Bell mine) in the early twenties and was used as a source of lead for bullets by the Hudson's Bay Co., mining in West Kootenay is of recent growth. In the early sixties, a few hardy prospectors came northward, attracted by the rich placers of the Cariboo, and tested and worked some of the local streams for gold. In 1865 the Dewdney trail was com-



Town of Trail in 1896—Heinze Smelter (since developed into present Canadian Smelting Works) showing on the right.

telegraphs, express companies, churches, schools, daily newspaper, board of trade, banks, etc., and all the industries required in a mining and self-supporting community.

Ample power for all mining and industrial purposes and light is furnished by electricity, generated at Bonington Falls, on Kootenay River. Two lines of railways connect the camp with the outside world. The Columbia & Western railway joins it with the smelter town of Trail, on the Columbia River, and with Robson, Nelson and Boundary district points. At Robson connection is made with Arrow Lake steamers, for the Canadian Pacific railway main line, and at Nelson with the Crow's Nest branch. The Red Mountain railway unites Rossland with Northport, Wash., 18 miles distant, where the Le Roi smelter is located, which point the Spokane Falls and Northern railway connects with Spokane.

pleted, from Hope, on the Fraser River, to the placers of Wild Horse and other East Kootenay creeks, passing close by the site of Rossland, down Trail Creek. In the eighties, some claims were staked in the Boundary district; in 1883, at Ainsworth on Kootenay Lake; and in 1886, rich ore was discovered on Toad Mountain, near Nelson. In 1887 the news of this discovery had attracted prospectors, and a trading post was established at Nelson. These discoveries started prospectors along the Dewdney trail, on the lookout for lode ores. The first claim located was the Lily May, on the trail itself, near what is now Rossland. It was discovered in 1887 and re-located in 1889.

Although the gossan of Red Mountain had attracted the attention of the earlier travellers along the Dewdney trail, some of whom, as Nelse Demers, who had done a little work on it, the values were too low to warrant lode mining in a wilderness, with its costly

transportation and development; placer mining, naturally, absorbed their interest. It was not until 1890 that claims were located on the lodes which were to create the city of Rossland and to bring southern British Columbia prominently before the mining and commercial world.

In the summer of 1890, Bourjois and Morris, who were working on the Lily May, crossed over to Red Mountain and located in one day the Le Roi, Centre Star, War Eagle, Idaho and Virginia. These claims were recorded at Nelson, the Le Roi being given to E. S. Topping for paying the \$12.50 recording fees. He secured specimens and went to Spokane, interesting some business men of that town in the Le Roi, and the development of the camp began. The news of the strike brought prospectors, and the Josie and most of the other claims whose names became so familiar, were located shortly after the first discovery—many in the same month.

Development was for the first few years slow, and the prospects of the camp uncertain. Lack of transportation and the financial panic of 1893 were the chief deterrent factors that nearly wrecked the fortunes of the camp. The first ore sent out of the camp was a small lot in 1891, which was packed to the Columbia River and shipped thence to an American smelter. In 1893, a wagon road having been constructed to Trail, on the Columbia, about 700 tons were despatched. The results were sufficiently reassuring to justify the erection of machinery, and with improved facilities, 1,856 tons of ore shipped in 1894, returned \$75,510. During the summer the Geological Survey, through Mr. R. G. McConnell, made a reconnaissance survey of the camp. Several of the more important properties were bonded for considerable sums and development was begun in earnest. The following year, the young camp received marked attention. The population rose from 300 to 3,000; railroad and smelting facilities were projected, and from this time forward, developments were rapid. The smelter at Trail, and a tramway to connect it with Rossland and the mines, were begun in October, 1895, by Mr. F. Aug. Heinze, of Butte, and the first furnace was blown in in the following February. In 1896 the Red Mountain railway, connecting Rossland with the Spokane Falls and Northern railway at Northport, was completed. Then came the inevitable wild boom.

* * * * *

Rossland has been called on to pay in full all the penalties attaching to a boom. The phenomenal rise in the value of Le Roi stock, the dividends declared by this company and the War Eagle, and the sale of the latter, to Toronto capitalists, for the reported sum of \$700,000, produced a feeling of buoyancy that afforded every opportunity to the unprincipled boomster and the amateur mining magnate, the public for the time being cheerfully swallowing whatever was offered. The inevitable slump followed.

In 1897 Rossland had an estimated population of 6,000 and was incorporated as a city. A broad gauge railway was built from Trail to Robson, giving better connection with the Canadian Pacific railway than was

afforded by river navigation along this rapid stretch of the Columbia. Stronger companies were formed to take over and develop promising prospects. In particular, the British American Corporation purchased the Josie, Nickel Plate, Great Western, Poorman, West Le Roi, Josie No. 1, and Columbia-Kootenay mines. Development work had yielded most promising results. The Le Roi Co., having completed its contract for 75,000 tons with the Trail smelter, erected its own smelter at Northport. In 1898 the Canadian Pacific Railway Co. purchased the Trail smelter and railway from Mr. Heinze, and immediately made an important reduction in smelting charges. The British American Corporation secured the Le Roi mine and smelter by purchasing the stock at a price which was said to represent nearly \$4,000,000 for the property. The Centre Star was purchased by Toronto capitalists for \$2,000,000 cash.

The construction of the Crow's Nest branch of the Canadian Pacific, built through the Crow's Nest Pass coal fields to Kootenay Lake was an important event for the camp. It meant cheaper and better fuel and coke, and a consequent reduction in cost of ore production and treatment. These reductions brought about a considerable increase in ore tonnage, with a corresponding diminution in the grade of ore mined. Large plants, with the most approved machinery for the economical working of the mines, were installed or planned, and operations on an extensive scale were projected. The construction of the West Kootenay Power Co.'s plant at Bonnington Falls, 32 miles distant, was another important event. Electric power was now available for the Trail smelter and the Rossland mines, although full use has not been made by the mines of this most convenient and economical form of power.

At the close of 1899, the reputation of Rossland suffered from the sudden collapse in the price of War Eagle stock. This stock had been run up to a wholly unwarranted point, and was held in the hope that new machinery would permit an increased output, with a resultant advance in the stock. Unfortunately the machinery proved a failure, and the stock dropped. A general desire to realise followed and brought about a collapse, with a consequent loss of faith in the camp. In 1901, Rossland again received a set-back, this time in the form of labour troubles, which closed up the mines for a part of the year. These difficulties were amicably adjusted, but the evil effects of such troubles in discouraging investments are not quickly effaced. By 1902 the mines had resumed their normal operations and on a more business-like basis than before.

Although the great number, size, and value of the ore shoots in these mines have been proved, and it is known that much lower grade ore can now be profitably worked, this has so far not had the effect that might be expected in encouraging the search for other pay shoots and new veins outside the area already developed. Experiments in concentration were commenced in 1903 and are still being made, and serious efforts are being made to obtain the greatest possible profit per ton of ore.

The development and progress of mining is reflected in the following table of production.

	Tons.	Smelter returns.	Value per ton.
1894	1,856	\$ 75,510	\$40 69
1895	19,693	702,457	35 67
1896	38,075	1,243,360	32 65
1897	68,804	2,097,280	30 48
1898	111,282	2,470,811	22 20
1899	172,665	3,229,036	18 70
1900	217,636	2,739,300	12 59
1901	283,360	4,621,299	16 31
1902	329,534	4,893,395	14 85
1903	360,786	4,255,958	11 80
1904	312,991	3,760,866	12 01
*1905 (estimated)	295,589	3,750,000	12 70
Total	2,212,271	\$33,839,322	\$15 25

The development work in the four leading mines is now in the neighbourhood of 24 miles, and is at present advancing at the rate of about four miles per annum.

OUTLINE OF GEOLOGICAL HISTORY.

The geological history of Rossland is largely a record of volcanic activity, of which, for an unusually great portion of geological time, it has been a centre. So far as understood the chief events have been as follows:

In the Carboniferous period, stratified rocks, consisting of clays, limestones, and perhaps quartzites, were laid down in an early ocean. Some volcanic outbursts occurred during this time, whose tuffs, ash beds, and lava flows were included in the stratified



Columbia Avenue—Rossland's Principal Business Street—in 1896.



Le Roi Hotel—One of the First Buildings Erected by Original Operators of the LeRoi Mine, Rossland.

Shipments by mines to December 31, 1905 (estimated):

Le Roi	1,220,475
Centre Star	417,529
War Eagle	357,814
Le Roi No. 2	173,035
Jumbo	28,422
Iron Mask	17,655
Rossland-Kootenay	12,878
Rossland-Great Western	12,331
Velvet-Portland	7,751
Spitzee	6,709
White Bear	5,973
Giant	4,344
I. X. L.	3,500
Evening Star	1,500
Monte Christo	400
Miscellaneous	1,200

*NOTE.—The official returns for 1905, as given in the Annual Report of the Minister of Mines for British Columbia, are: 330,618 tons; total value, \$3,672,828. This gives an average of \$11.10 per ton.—Editor B. C. MINING RECORD.

series. These rocks are now found very much disturbed and altered west of the Josie Gulch, and on Red Mountain and at various points about the outskirts of the camp. Succeeding the formation of these rocks, probably in Mesozoic times, came a period of heavy vulcanism. Beds of volcanic agglomerates and conglomerates were formed and thick flows of lava were poured out over this sedimentary basement. The remains of these are represented by the agglomerates and augite porphyrites found near the mines. The volcanic centre was probably the area occupied in the centre of the camp by the main mass of monzonite, which was intruded into the rocks already present, for notwithstanding the occasional apparent transition between the two rocks, the monzonite generally appears to cut the porphyrite. The surface of the ground must then have been above its present position, for the mass of molten rock matter certainly cooled well below the surface in depth. Later intrusions of closely related rocks invaded the monzonite and some of the older formations, near its contact.

From the voluminous magma of the Nelson granodiorite, tongues were sent out, one of which, now exposed on the Little Sheep Creek slope, cuts the monzonite mass.

No doubt some of these great eruptions accompanied mountain building processes, which disturbed and fractured the rocks. Some of these fractures were filled with magma from the eruptives, which may now be seen in the older system of dykes. The exact geological dates of these events, and the time interval between them, have not yet been made out, but the eruptions probably extended into Tertiary times. In this period, surface flows of lava again took place. Andesites and tuffs of Beaver Mountain and certain andesites and agglomerates of Record Mountain, probably belong here. In an interval of quiescence, streams formed beds of gravel over some parts of the neighbourhood. Remnants of these are to be seen in the conglomerates on Sophie and Lake Mountains. But tranquil conditions were not lasting, for vulcanism burst out afresh on a more extensive scale than ever. Ash beds, tuffs, and great thicknesses of lava flows were probably piled up as a thick mantle, connecting with other lava fields to the westward, and with the Columbia lava field of Washington and Idaho. Erosion has laid bare, in the neighbourhood of Rosslund, large stocks of pink alkali syenite with some basic facies that have intruded and sent dykes into all the previous rocks. The main mass lies on Granite Mountain and westward over Sheep Creek, but a tongue of it runs south towards Little Sheep Creek, crossing the Jumbo claim. A small neck of it comes up north of Columbia Avenue and west of Centre Star gulch, and a small boss on the Spitzee and southwest of it. These stocks no doubt represent channels by which the later lavas reached the surface.

The centre of volcanic activity had now shifted a little to the west of its original position in the camp. Following the intrusion of this rock—to some extent, perhaps, concurrently, and as a result of it—came a period of intense fracturing of the country rocks, accompanied by much, but generally minor, faulting. Certain beds were minutely sheared or fractured. The main directions of fissuring were a little west of north and south of west, but irregularities in direction and branching of the fissures were common. The rocks became impregnated with "mineral" matter, brought in by heated waters, chiefly along and near the fissures in sheared zones with an easterly trend, but to some extent in those with a northwesterly direction. The fracturing and faulting of the rocks, some of them now holding veins, continued, fissures with a northerly trend predominating.

A very large number of these were filled with dykes, in which various rocks are represented. A great number of the dykes, including some of the largest, are mica lamprophyres (basic dykes in which mica is the conspicuous mineral). Others are non-micaceous, some basic and some acidic.

In the mines the dykes are usually classed as "mica dykes" and "non-mica dykes." These are not all of precisely the same age, their formation having continued over an interval of time, and later injections

crossed earlier injections, or came up alongside or within them, forming compound or mixed dykes. Dykes belonging to these dates cut—and in many cases fault—the ore bodies. Dykes of the earlier eruptions are also pierced by them. Faulting continued after the later injection of dykes, displacing such as were not parallel to the faults. Indeed, much of the displacement of the veins by dykes is in reality due to faults in or along the dykes. Subsequently, the agents of erosion attacked the old surface, cut away the topographical features produced by the volcanic eruptions, and sculptured out the present surface relief. The streams have been the chief factors in this, but a great deal of the present aspect of the district is due to the action of the Cordilleran glacier which, at the close of the Tertiary period, bore down upon the district from the north, burying all the valleys and the lower hills and ridges under a thick ice-mantle. The ridges and peaks above 6,400 ft. stood out like islands above the sea of ice. The ice-sheet swept away the loose and rotted rocks, scoured and polished the underlying live rock, and erased rugged and outstanding shoulders. In favourable localities ground-moraine was left by the glacier. Some of this may be seen in excavations in the town of Rosslund.

At the close of the period of intense glaciation, the Columbia, like other valleys of Southern British Columbia, was filled with water, in this section at least, to the height of Rosslund. Whether this was due to the sinking of the land, or damming of the valley by a lobe of ice, is not clear. These waters worked over a large amount of the glacial debris, and redeposited it as clays, sands, and gravels, terraces of such material marking successive stages in its retreat. Much of this material has since been carried away by erosion, but in favourable localities, as between Rosslund and the Columbia, it still remains. During the period of erosion, surface water, descending through the fissures and pores of the rocks, rearranged to some extent the minerals of the ore deposits, concentrating certain minerals in what are now the upper portions of the deposits. Underground waters, either from the surface or given off by the cooling rock magmas, also concentrated ore in the deposits against many of the dykes which cut the veins, in a few cases these waters made rich deposits that extend for a short distance from the veins in fault planes which intersect them. Surface oxidation only extends to a depth of a very few feet.

ORES.

The ore deposits occur as follows:

(1) In fissure veins, with or without replacement of the country rock.

(2) In lodes or zones of fissuring or shearing, with the ore minerals forming a network of veinlets in the fractures, and eating into and replacing in whole or in part the intervening fragments of the country rock, replacing the wall rock, or developing along particular fractures.

(3) As irregular impregnations of country rock.

What have, so far, proved the most important ores occur in (1) and (2).

On the basis of mineral contents the deposits may

be classified as:—

(a) Massive pyrrhotite and chalcopyrite ores with some pyrite and occasionally a little arsenopyrite, massive or mixed with rock matter and gangue. Free gold occurs, but it is seldom to be seen with the naked eye, although the proportion of free gold runs from 10 per cent. to 50 per cent. of the total gold contents. Rarely, some molybdenite and magnetite are found in this, the typical ore of the camp. Galena and blende have been found at one or two points. The pyrrhotite at times contains up to 0.65 per cent nickel and 0.59 cobalt.

(b) Massive coarse-grained pyrrhotite carrying very little copper and little gold.

(c) Gold bearing quartz veins (O.K. and I.X.L. mines).

The gangue is principally country rock, with some quartz and, in places, calcite. This country rock is frequently altered. In addition to its impregnation or replacement by the sulphide minerals, the formation of biotite and silica (sometimes in separate layers, constituting a banded brown and white rock), is the principal change, but chlorite and hornblende are also extensively formed in places, and muscovite, tourmaline, garnet and wollastonite also occur. Zeolites (chiefly anthophyllite and chabazite) are frequently found where alteration by thermal solutions is marked. Epidote was observed in the Jumbo (**), where



First Power Plant at Le Roi Mine, Rossland, in course of erection in 1896.

(c) Veins of pyrite and marcasite with arsenopyrite and perhaps galena and blende. (South Belt.) Silver may form an important part of the values in such veins.

(d) Impregnations of arsenopyrite, pyrrhotite, pyrite, molybdenite, a little chalcopyrite, bismuthinite and native gold, particularly in and around small pegmatitic or aplitic alkali syenite dykes. (Giant and Jumbo mines.)*

(*) The arsenopyrite in this camp is frequently if not always cobaltiferous.

(**) Telluride of gold is said to occur in Jumbo ore, but the specimens we have so far examined have failed to respond to tellurium tests.

molybdenite and bismuthinite are uncommonly prevalent. The ore varies considerably in appearance and composition in different parts of the same mine.

Typically, it consists of more or less altered rock matter, although in places fresh-looking rock is seen, with reticulating veins or irregular masses and impregnations of pyrrhotite and varying amounts of chalcopyrite and perhaps a little quartz, the sulphides forming 50 to 75 per cent of the mass. The chalcopyrite is frequently later in forming than the pyrrhotite, occurring in veins and impregnations in it. Sometimes arsenopyrite and pyrite occur with the chalcopyrite. From this typical ore all transitions occur, on the one hand, to solid sulphides, forming larger masses or shoots; on the other to rock matter

or gangue with little apparent mineralisation, but carrying pay values, and sometimes a high percentage of gold. Consequently, constant assaying is necessary to distinguish ore from waste. In places, the ore is quartzose, and calcite is occasionally abundant as gangue.

The values in typical ores of the camp are largely in gold, with some copper and a little silver. In the Giant and Jumbo the quantity of copper is negligible.

The ores mined from near the surface were, on an average, much richer, the first 128,428 tons shipped averaging 1.46 oz. of gold per ton, 1.96 oz. of silver per ton, and 1.73 per cent. of copper (after smelter deduction of 1.3 per cent.). But the proportion of *free* gold does not appear to diminish in depth, and some of the ore recently encountered in the lowest levels compares favourably with that of the earliest shipments. The gold values do not appear to be dependent upon the presence of any one mineral, although in many cases ore richer in chalcopyrite is also richer in gold, but exceptions are frequent. Pyrrhotite, which, in some instances, is gold bearing, is, in general, very low grade.

The following average analyses may be taken as typical of the ores now being mined in the larger producers:—

Au. oz.	Ag. oz.	Cu. %	Fe. %	SiO ₂ %	S. %	CaO.%	Al ₂ O ₃ %
0.441	0.5	1.15	19.8	43	7.25	8.7	15
0.5	0.3	0.9	22	37	10.8	4.2	14.9
0.4	0.54	0.7	15.5	42.1	6.8	17.6	....
1.18	2.318	3.62	....	....	....	....	....

LODES.

The ore is usually found in well defined lodes or veins, of which there are a considerable number in the camp. The general trend of these is for the most part easterly.

The chief lodes of the camp, the Le Roi-Centre Star, Main and South and the Josie lodes have a direction of about N. 60° E. The Le Roi North, War Eagle and Centre Star North veins have a trend of N. 70° W., and these seem to be offshoots from the "main" lode. The St. Elmo-Cliff-Monte Christo vein has an almost easterly direction. The dips are uniformly north, usually at an angle of from about 60° to 70°, although sometimes flattening, as in the War Eagle below the 8th level, where the vein dips away at an angle of 10° to 15°, though straightening up again at a lower level. Some of the veins show great persistence. The main Le Roi-Centre Star lode can be followed from the fault at the Josie dyke through the Le Roi, Centre Star, and Idaho claims, and probably extends through to the Kootenay claim.

As is to be expected from the nature of these lodes, sharply defined walls are frequently lacking, the mineralisation of the country rock gradually becoming less. Sometimes a fissure or fault plane bounds the ore, but often where this is the case, the slip has been formed after the mineralisation. The transition from

pay ore to what is—from a commercial standpoint—waste rock, is generally rapid, but such change is not proof that pay ore does not exist beyond the poor material. The pay ore is localised in shoots distributed within the lodes. These shoots vary greatly in size and shape. Lenticular bodies are commonest, but some terminate abruptly against a dyke or fault, sometimes swelling to an enormous width or becoming L-shaped against the dyke. In width, they vary from 1 ft. to, in exceptional cases, 130 ft.; in length, from 50 to 500 ft. or more, and the vertical dimension is, on an average, the greatest. Stopes, 250 ft. long by 20 to 30 ft. wide, are by no means uncommon. One shoot of ore that has been followed down nearly 500 ft. vertically, has averaged at least 150 ft. long by 56 ft. wide, and this is not the largest shoot that has been developed. The pitch of the shoots in the lodes varies from vertical to pronounced easterly or westerly, and seems dependent upon purely local conditions. In the shoots themselves, the better grade ore is often confined to particular bands, which are generally parallel to the vein, but which may lie along either wall or within the shoot; more than one such band may be encountered in running a cut across a shoot. The position of such rich bands in the lode may suddenly change, owing to the mineralisation forsaking one set of planes for another.

In the Le Roi and Centre Star, where there are two important parallel lodes—the "Main" and "South" veins—it would seem, in the light of present developments, that where important shoots occur in the one vein, heavy mineralisation is lacking at the corresponding point in the other. It is sometimes difficult to trace the vein from shoot to shoot, particularly where its continuity is interrupted by faults and dykes. In the Le Roi-Centre Star Main vein, a seam of calcite extends almost uninterruptedly along the vein, and occasionally forms a useful indicator where mineralisation is slight.

Until it is more fully known what were the determining factors in localising the ores into shoots, no certain rules for their discovery can be formulated. Apparently several causes were operative. The contact of the lode with a fault having an impervious wall, or with an important dyke—particularly the underside of the dyke—so frequently marks the position of an ore shoot, that all such contacts are worth prospecting. The physical character of the ground was of importance. Where the shearing of the rock was such that the mineralising solutions were restricted within a zone of reasonable width, but had free movement, within that zone—that is, where the rock within that zone was thoroughly fractured while the wall rock as a whole is characterised by solidity—conditions were favourable, and other things being equal, a shoot would be formed. Cross fractures in the otherwise solid wall rock are frequently a noticeable feature where ore shoots occur. In the Le Roi the ore shoots are generally, but not always, found along the contacts between the augite porphyrite (greenstone) and a rather coarse gray monzonite, and between the former and granodiorite porphyry. In some cases at least, the Main lode lies along the north contact and

the South lode along the south contact of a belt of lines of a vein deposit, but is of very irregular form. the latter rocks in the porphyrite. In the lowest It lies in the highly altered stratified rocks against a



Rosslund in 1899—War Eagle Hoist on Hill in Background.

vels the whole of the country rock is the granitoid variety.

The main ore body of the Jumbo has not the out-

tongue of alkali syenite, and consists of altered country rock, traversed by numerous dykes from the syenite, many of them dipping at only slight angles from

the horizontal. The rock is impregnated with iron sulphide, chiefly pyrrhotite, and in places is almost entirely replaced by it. Pyrite, molybdenite, a little arsenopyrite and chalcopyrite are found. In the mineralised ground, bismuthinite with free gold is found in the dykes, and in the country rock, close to the contact, or in joint planes. The greater dimension of the mineralised area seems to conform to the direction of the syenite contact.

The Giant also lies in the stratified rocks, and is in some respects similar to the Jumbo, but the main minerals of the ore are arsenopyrite and molybdenite. Syenite is found in the mineralised ground. The country rock over a wide area from the Giant workings northward, is spotted with arsenopyrite impregnations. In the South Belt few of the workings could be entered. The Homestake shows a persistent, but much faulted E. and W. vein, mineralised with pyrite, some pyrrhotite and a little chalcopyrite.

COUNTRY ROCKS OF THE VEINS.

All the rocks, with the exception of the later dykes, may be mineralised. The alkali syenite rarely shows any signs of mineralisation except in the slight impregnation of little dykes in the Jumbo, and a few stringers near the Spitzee vein. Augite porphyrite and the coarser gray granitoid rocks are the ore-bearing rocks of the North Belt mines—the producing mines of the camp. These lie on the complex, north-west border of the large monzonite area, and near the contact of the porphyrites with the stratified rocks. A strong tongue of alkali-syenite (Pulaskite) lies just west of the Jumbo; mineralisation occurs here; signs of this syenite occur in the Giant ore body, a small pipe of it is exposed a little below the Le Roi and Centre Star mines, and a larger mass of the syenite is to be found a little farther south, adjoining the Spitzee. Thus, the ground which, up to the present, has been proved to be productive, is situated either near or within a limited distance of the alkali syenite and lies between the exposures of the latter. The greater part of the ground so situated is made up of the stratified rocks. Except from the Jumbo and Giant, however, no important shipments have been made from claims located on these rocks. This is not because these stratified rocks do not show signs of mineralisation, for, in the aggregate, they have probably received more ore than the porphyrite, but because of their physical character. Under the great dynamic stresses to which the rocks of this camp were subjected, they were completely shattered and minutely faulted, and consequently they did not, to the same extent, confine the mineralising solutions to particular channels, but allowed them to deploy over wide areas. The mineral deposited in these stratified rocks, therefore, while occasionally in small veins or bodies, is usually found diffused over great stretches of the rock. Crystals, patches and veinlets of arsenopyrite and the other sulphides are scattered a few inches apart over quite extended tracts. The characteristic colour of Red Mountain is due to the oxidation of such impregnations. The physical character of the stratified rock

was, therefore, not so favourable for the formation of lodes as that of the coarse monzonite and porphyrite, and in so far as the physical character was a controlling factor in the formation of ore, workable ore bodies were, to that extent, less likely to be formed. The chemical character of these rocks as a whole may have also been less favourable, so that replacement and precipitation of the ores occurred only at small isolated points. In the White Bear, the workings to the 500-ft. level are in the stratified rocks, and it was not until the underlying crystalline rocks were reached that anything like a lode was found. In the Columbia-Kootenay the ore for a considerable distance follows the contact between a granitic rock and the stratified rocks. In the South Belt, the Homestake and a number of other claims are in the complex altered rock outside the monzonite area.

GENESIS OF THE ORES.

From the way in which the ore occurs in veins and lodes and replacing the minerals of the various country rocks, it is evident that the deposits were formed through the agency of aqueous, mineral-laden solutions. Any doubts on this point are removed by an examination of thin sections of the ore under the microscope, which shows the secondary origin of all the ore minerals, and the gradual replacement of the original components of the rocks, particularly the feldspar, by them. In the polished hand specimen, veinlets of the sulphides are seen to cut through individual crystals, such as augite, of the country rock. From the character and relationship of the minerals formed, it may fairly be concluded that these solutions were at a high temperature—hydrothermal solutions. The temperature of the solutions, the fact that the lodes at times branch or give out going upward, the concentration of ore on the under side of dykes, the strongly reducing conditions shown, and the general character of the minerals, all tend to prove that these were ascending solutions. The source of these solutions and that of their mineral contents must be largely a matter of speculation, although the facts point strongly to their connection with the last stages of vulcanism in this district. The material was not derived from the immediate country rock, for the ore occurs in various rocks, and the materials of the lodes are found in these rocks only along the contacts of such lodes, except in the case of the stratified rocks, where the dissemination is accounted for by the physical character of the rock. The deposits were formed later than the rocks, excepting only the last formed dykes which are clearly newer than, and cut, the lodes, but are probably connected with the alkali-syenite intrusion. Consequently, the lodes were formed after the extensive intrusion of the alkali-syenite, but before the close of vulcanism.

The occurrence of ore at the Jumbo, described above, closely connected with the syenite contact, and with its dykelets, as well as its mineralogical composition (pyrrhotite, pyrite, arsenopyrite, molybdenite, bismuthinite, etc.), strongly suggests the causative influence of the syenite eruption—that the gases and aqueous solutions liberated by the solidifying syenite magma had much to do with the formation of this ore

body, but they were not altogether responsible for it. The ores of the lodes and vein systems differ from those of the Jumbo, not in the variety of minerals contained, but only in their relative proportion. Since they also were formed during this period of vulcanism, it seems probable that they were formed by solutions from a similar source, but in composition somewhat different, possibly on account of having travelled a greater distance. Even if it were not evident that the deposits were formed during a period of vulcanism, the connection of the deposits with igneous intrusion would be suggested by the assemblage of minerals.

Of the minerals characteristic of contact metamorphic deposits the following have already been recognised here—garnet, wollastonite, epidote, amphibole, pyroxene, quartz, calcite, magnetite, chalcopryrite, pyrite, galena and blende. These minerals do not occur in the same relative proportions as in typical contact

phate coating may occur. As might be inferred, no zone of rich copper sulphides occurs below the oxidised surface. The average copper percentage of the ores in the upper levels of the mines was appreciably higher than in the lower levels; the same is true of the gold values. It must be remembered, however, that the difference between the values of ore shipped in the early days and that shipped at present, only in part represents a lowering of the grade of ore in depth. In part, it is the result of mining a lower grade material that formerly would not pay, but which, under present conditions, is profitable ore. There is a strongly marked tendency for the ore shoots to widen and become more important against dykes (especially along the under side) that cut and displace the lodes. In a few instances, fault planes, subsequent to the ore, are mineralised for a short distance from the lode; chalcopryrite is found in points and veinlets in the pyrrhotite. Several hypotheses may be advanced to



Part of Le Roi Mining Co's Surface Works at Rossland.

metamorphic deposits, but their occurrence is suggestive of transitional type between such deposits and ordinary vein or lode deposits. Going westward to the Boundary district, various transitional forms and typical contact deposits are found. Of the minerals characteristic of hydrothermal action, there are tourmaline, muscovite, chlorite, zeolites, molybdenite (occasionally in large amount), arsenopyrite, bismuthinite and sulphides holding nickel and cobalt. The formation of the lodes was no doubt a long continued operation. Some pyrrhotite was formed before chalcopryrite, for the latter is found in veinlets in the former, but in other cases it is probable that the formation was also contemporaneous. There is good ground for believing that the formative period of the lodes lasted until after the injection of the last dykes.

There is little surface oxidation, except along some few fractures, the iron and copper sulphides remaining unchanged within a few feet of the surface. If deep weathering took place, all trace of it has been swept away by glaciation. The actual outcrop is a brown iron gossan, if the ore is solid sulphides, or an iron-stained rotted rock if the ore is mixed. Slight copper stains of coppercarbonates and silicate may be sparingly present, and in protected places an iron sul-

phate coating may occur.

(1st.) They may be regarded as evidence of secondary enrichment from above. The minerals formed by hydrothermal solutions may have been rearranged and concentrated by the ordinary underground waters working downward. In some veins this method of enrichment seems to have obtained for a limited depth, but on the whole it seems to have been a superficial phenomenon. The compressed state of the rocks does not favour the circulation of waters.

(2nd.) The dyking and faulting may have occurred during the process of lode formation, and ascending solutions, after their formation, were deflected and accumulated by the barriers thus produced. The precipitation of mineral was more abundant along these barriers, and copper and gold found more favourable conditions of precipitation at the higher levels. Well authenticated instances of original differences in veins at different elevations are on record.*

(3rd.) After the first deposition of the ore, water heated by recently injected igneous rocks, or given off by the still solidifying magma, might continue to ascend, though no longer of the original composition,

*A. I. M. E. Genesis of Ore Deposits, p. 670.

and these waters might deposit new minerals in the ores, or might rearrange and concentrate the ore minerals already present. Conclusive evidence on these points has not yet been obtained. Such as there is, seems to disfavour the first and support the second or third hypothesis.

Denudation has been heavy, so that the present surface is probably far below what was the surface when the lodes were formed; a large amount of this denudation was no doubt accomplished by the Cordilleran glacier. The source of the solutions was deep-seated. It is reasonable to suppose that, in ascending, there was a level where precipitation commenced, another where it reached a maximum, and possibly, approaching the surface, still another where, on account of the waters having been largely robbed of their treasure, precipitation diminished. Ascending currents would be more likely to follow the underside of the dykes. One of the latest actions to be discovered in the lodes is the solfataric-like alteration of the rock and the formation of zeolites at certain points in the mines. Recent sinking to deeper levels (1,550 ft.), in the Le Roi and Centre Star, and prospect work on the lowest level of the War Eagle, have disclosed ore that compares favourably with any from the surface workings. Silica, however, appears to be increasing. In the Centre Star South lode, near the shaft, the sulphides are disseminated on the 7th level. On the 8th, there is a tendency toward concentration into shoots; on the 9th, the minerals are sufficiently assembled to constitute ore that continues with some improvement to the lowest workings, 200 ft. below the 9th level. In the Le Roi a similar condition is met with. The 1,350 ft. level (corresponding in elevation to the Centre Star 9th) shows the top of an ore shoot that improves in value to the 1,450-ft. level, and which has now been followed to the 1,550-ft. level, at present the bottom of the mine. These facts indicate either that there were original differences in the vertical distribution of values—just as there are horizontally, as shown by the difference in the grades of various stopes on the same lodes—or that, if secondary enrichment has taken place, it was produced by ascending solutions.

It is nevertheless true that outcropping veins often show some surface enrichment, in some cases to a considerable distance below the weathered surface. It is evident, from the discussion on the distribution of ore in shoots in the vein, that this does not mean that the ore of deeper workings will necessarily be of lower grade than that near the surface, but only that the grade of the ore of that particular part of the vein has been raised, perhaps very materially, by surface concentration. A better ore shoot at a deeper level, unaffected by surface action, might contain a still higher grade ore. Consequently, great care, and a close study of the conditions in any given case, are necessary, before drawing conclusions as to the probable grade of ore to be expected below.

FUTURE PROSPECTS.

Since enrichment by descending waters does not seem to have been of great consequence in these lodes, except in some cases superficially, and since the mineralisation has been accomplished by ascending hydro-

thermal solutions, there is, as yet, no apparent reason why pay ore should not continue in depth. The shoots followed on the main Le Roi-Centre Star lode give out between 800 and 1,050 ft., and have, so far, not reappeared below. Ore was lost in the War Eagle at about the same depth, so that for a time it appeared as if ore bodies might not occur at deeper horizons. But work on the South lode shows extensive mineralisation which improves in successively lower levels, and in the lowest levels, shoots with pay ore have now been located. As noted above, there are facts suggesting that where the Main lode is not heavily mineralised, the solutions may have followed the South lode, i.e., that the main highway for the mineralisers was, in part of their course, the South lode, and, in part, the Main lode. Recently, Superintendent R. H. Stewart of the Centre Star-War Eagle mines, has found that below the 8th level, the War Eagle vein flattens to 10° or 15°, which throws the vein away to the north and accounts for the earlier failure to discover ore in the lower workings. Diamond drilling on these lower levels shows that the vein again straightens and that ore is continuous to the 11th and lowest level of the mine. A cross-cut on this level to the vein is said to have revealed good ore for a width of 20 ft.

Though it cannot be predicted to what depth pay ore will extend, it may be said that the prospects for deep mining in Rossland were never before so favourable as they are at present, and that operating companies are justified in pushing prospecting to deeper levels.

Notwithstanding the heavy shipments from the mines and the extensive prospecting done, there is still a considerable amount of promising ground above 900-ft. levels as yet insufficiently prospected, or even untouched. The mode of occurrence of ore shoots, already described, and the past experience of the mines, that following poor parts of the vein, horizontally and vertically and cross-cutting for parallel ore bodies, will often disclose good ore bodies, render it more than probable that certain portions of such areas contain ore. It should be remembered that little indication of pay ore may be found until the shoot itself is encountered. In one instance, two good stopes were separated by an interval of vein, which was indicated to be low grade by neighbouring ends of the two stopes, and by drill holes from the connecting drift (which was off the vein), yet a subsequent drift on the vein showed that a whole stretch between the two stopes was pay ore, except a couple of feet at the ends of the stopes and the points pierced by the drill holes. A large stope was opened up as the result of this discovery.

Somewhat similar discoveries have been and are yet frequently made; ground thought to be valueless has proved valuable, and this will no doubt continue for some time. Mineralisation has been so heavy and so complicated that all the ground near the highly productive shoots is worth bold though judicious prospecting. Outside the producing ground, there are points that are worth exploration. For instance, the Le Roi-Centre Star vein east of the Centre Star gulch should certainly receive attention. Ore of good grade was shipped from the Iron Mask vein. The well

marked vein of the St. Elmo-Cliff-Monte Christo has produced several hundred tons of ore that averages about \$20, and a considerable tonnage of low grade ore that has an excess of iron over silica, such as is desired by some of the smelters; small quantities of good grade ore have come from other properties. To the north of the camp and in the South Belt, bodies of low grade ore have been exposed. There are large numbers of claims that have a considerable amount of work done on them. Many have proved to be of little worth. In other cases the result of the work, while not absolutely conclusive, has been discouraging. Some may have had ore that, while too low grade to be worked some time ago, would be payable today. It must, however, be remarked that the work done in a

extracted. Where geological conditions are dissimilar to those in the productive area, and where no pay ore is exposed on the surface or elsewhere in the vicinity, the possibilities of the presence of ore are meagre. Considerable stretches of the surface are drift-covered, and of these, if the area be considerable, little certain knowledge is to be had, for changes in the formations in this camp are too numerous and irregular to make interpolations thoroughly reliable.

Judging from the surrounding rocks, and from what few exposures are to be seen, the ground between the Annie, Le Roi, and Centre Star, and a line a little west of south from the Spitzee should, in certain portions at least, resemble closely, in its geology, the ore-producing ground, and might very well con-



Hauling Ore to Trail from Rosslund Mines in the Early Days of the Camp.

surprisingly large number of cases has been of such a nature as to furnish little evidence regarding the value of the veins. In more than one instance it seems to have been a matter of unusual good fortune if the vein was touched once or twice in the whole extent of the workings. It is evident that the nature of the ore bodies, and the effects of dykes and faults were not understood when the earlier work in the camp was carried out.

From the remarks made concerning the occurrence of pay shoots in the productive ground, it follows that a vein or claim should not be condemned simply because a limited amount of prospect work has failed to reveal pay ore. Occasionally, a productive vein, or the productive part of a vein, has an insignificant outcrop, or none at all. Where, however, the ground is excessively dyked and broken by numerous fractures and faults into small blocks, it would seem to have little chance of containing ore shoots that can be profitably

tain important ore bodies.

The contact of the alkali-syenite (Pulaskite) at the Spitzee and at the Jumbo, is ore-bearing, and might be at other points as well. The South Belt, along the southern edge of the monzonite area, has a number of veins, from some of which good values have been reported. The only shipments of importance were from the Crown Point, near the southeastern edge of the monzonite area. This claim is reported to have had a good shoot of ore, until a fault was encountered, below which nothing has been found. It has shown, however, that at least at one point in this belt, shipping ore occurs. All but a very small fraction of the ore so far produced has come from an area covering scarcely 100 acres on the northwest corner of the monzonite area, which was the first ground staked on the Red Mountain. When it is remembered that many of the good ore shoots did not outcrop and that mineralisation is heavy over a very large area in the

camp, it is unreasonable to suppose that pay shoots are confined to the few earliest locations. While development work has shown that ore in workable quantities is much more restricted than was expected during the exciting days of the boom, it has by no means exploded all possibility of further discoveries.

The stratified rock in places are impregnated with arsenopyrite and other sulphides. The rock matter is usually very siliceous. Such material, if it contained values, could be very cheaply mined or quarried, and might be amenable to a cheap process of treatment. Samples were taken from the surface of such an impregnated band, running north from the Giant workings, through the west end of the Novelty. The exposures were laid off into blocks, and chip samples, systematically taken from the surface, were pulverised and reduced to convenient bulk for assay. While such samples are not absolutely representative they should afford some indication of the contents of the rock. Of twenty-three lots taken, twelve gave the following results per ton in gold: Two went \$1.20, four \$1.60, one \$1.80, two \$2, two \$2.40, one \$3.60, and one \$4; five gave results under \$1, and six yielded only traces of gold. A large sample averaging \$2.30 was taken, and is undergoing concentration tests by Prof. J. C. Gwillim at the School of Mining, Kingston, Ontario. It would appear from the foregoing that the more heavily impregnated areas of these stratified rocks are deserving of more careful tests as to values and amenableness to concentration or cyaniding. If the values are distributed throughout a considerable mass of such rock, so as to ensure a large tonnage, and concentration, or cyaniding is successful, \$2.50 or \$3., or perhaps an even lower grade rock, might be profitable.

It is to be emphasised that the present conditions are much more favourable for cheap mining and smelting than formerly, as a glance over the section of this report on "Costs of Operation" will show.

While it is conceivable that costs may be still further reduced, it is uncertain, and it might easily happen that future conditions would be less favourable for operating than the present; so that the present seems to afford the most favourable opportunity for any projected prospecting, development and mining. That this is the case, is shown by the leasing of old claims by practical miners, which was a marked feature in the past year's operations.

There are a large number of prospects now idle, equipped with serviceable compressors and hoisting gear, which machinery could probably be secured at a reasonable price for such development work. Prospecting in this camp requires the best technical skill, bold and courageous persistence, cool judgment and ample capital. With the knowledge that has been gained regarding the character and modes of occurrence of the ore bodies in this camp, with the present low cost of treatment, and with operations on a sane and business-like basis, the chances for success are vastly greater than in the earlier days.

A production of \$34,000,000 in the first decade of a camp's development is a tribute to its substantial

worth. While the profits on this ore have not been what might have been wished, the mines have been and are operating at a profit. Had all the ore been treated at the present cost, after allowing for all the past expenditure in development, equipment, fixed charges, etc., the net profit would probably considerably exceed \$8,000,000. All these costs have now been lessened, and there are further economies projected to secure the maximum profit on each ton, and to bring lower grade material into the workable class.

METHODS OF MINING.

The first development has usually been surface stripping, tunnelling along the vein, or cross-cutting to it. A few of the mines—as the Jumbo and Columbia-Kootenay—are so situated that they have been wholly or largely developed by tunnelling. When the positions of the vein and ore-shoots have been satisfactorily determined, shafts are generally sunk on the dip of the vein. At convenient intervals, formerly about 100 ft., but now usually about 150 ft., stations are cut out and horizontal drifts run along the strike of the vein, following it as closely as possible. The rock is firm, and timbering has not often to be resorted to in stations and drives, except occasionally when fissure zones are encountered. The numerous dykes and zones of fracture cause interruptions in, and often displacements of, the vein, so that after passing through them, cross-cutting or boring has often to be resorted to in order to locate the vein. Systematic cross-cutting and boring are also necessitated by vein branchings, shifting of pay shoots from one set of planes to another, and the possible occurrences of parallel ore-bodies. The extent to which diamond-drilling is utilised is shown by the expenditure by one mine alone of \$75,414.68 on this work up to December, 1904. Accurate geological maps of the levels showing the positions of the veins, ore shoots, faults, dykes, etc., are valuable aids in development, indicating, as they do, what may be expected on a new level and the direction of displacement, etc. Such maps are kept up and constantly utilised in planning prospective work in most of the larger mines. Raises are put in between levels where needed, as man-ways or chutes or to prospect the veins or for purposes of ventilation. When an ore shoot is located, a sill-floor is excavated, and, if the shoot is wide, sills and square sets are put in position. The ore is then extracted by overhead stoping, the timbering advancing by successive floors with the stoping, till the level above is reached. If the shoot is 15 ft. wide or less, stulls are generally used instead of square sets. The ground stands well in most places, timbering being necessary only for convenience in mining, and to prevent the infall of loose blocks and slabs. In some cases—where the ground is not subject to slabbing—only one floor is timbered for tramways and chutes, the stoping above being done from the top of broken-down ore, enough being drawn to keep the broken ore a convenient distance below the backs. When stoping is finished, the ore is drawn. The large chambers thus left may afterwards be filled with waste, or used as store-rooms for material too low

grade for present use. The mine cars are loaded from chutes below the stopes and trammed, usually by hand, to the shaft, where the ore is dumped either into a pocket or directly into a skip. Most of the shafts have three compartments, one for a manway, pipes, electric wires, etc., and two for the skips. The Le Roi main shaft has five compartments, the two additional ones being used for cages for men, timber, and cars.

MINING MACHINERY.

The mines are extensively equipped with modern mining machinery. Compressed air is used to operate all the drills and most of the pumps. A brief des-

Maximum capacity 14,500 lb. unbalanced load, raised 2,000 ft. per min. with a 100 lb. steam pressure. The drums may be run singly or in counterbalance. Compressed air is used for the signals. The 5-ton skips, which bring the ore up from the mine, deliver it automatically to crushers, and from these it is delivered to sorting belts (in the Centre Star and Le Roi No. 2 sorting tables are used), from which it falls through the sampler to a storage bin, whence an aerial tram conveys it to a railway bin. The timber for square sets, etc., is framed by mechanical saws. The blacksmith and machine shops are furnished with modern forges, power hammers, lathes, shears, etc.



Mill and Concentration Plant at Le Roi No. 2 Mine, Rossland.

cription of the Le Roi plant will serve for illustration. The Le Roi has two Canadian Rand Drill Co.'s compressors, with a combined capacity of 8,000 cu. ft. of free air per min., at sea level, compressed to 95 lb. gauge pressure. These are operated by steam. The steam plant consists of two Heine safety water-tube boilers set in one battery, and three batteries of three each h.r.t. steel shell high-pressure boilers. This plant has a nominal capacity of 2,000 h.p., and is used to operate all the engines about the mine. The hoisting plant consists of two modern, first-motion, winding engines, one of 1,000 and the other of 500 nom. h.p.; the larger consists of two 24 by 60-in. Corliss engines with two drums 10 ft. in diameter by 5 ft. face, mounted directly on crank shaft. Each drum is equipped with a powerful band friction-clutch; and a strong post brake, operated by steam. It has a special valve gear for hoisting-engine work, and is controlled by link reversing gear, operated by an auxiliary engine.

An air-driven, mechanical drill sharpener is operated in the mine. The Centre Star uses electric locomotives for handling the ore and waste on the surface, and will probably use them for haulage on the longer levels underground; electricity is used as the motive power for the 5-cylinder mine pump, which handles most of the mine water. Electricity is used for lighting buildings, stations and mine levels. Telephones connect the mine levels with the surface, and all the mine buildings are connected by telephone. Electricity is also used for a number of mine hoists and air compressors in the camp, and its use is being extended.

PROCESSES OF TREATMENT.

The shipping ore is loaded in 30-ton bottom-dumping railway cars and taken to the smelter. Heretofore, the Le Roi ore has been shipped to the Le Roi smelter at Northport. The Northport plant consists of sampling mill, six rectangular copper furnaces, with blowers, dust-chambers and stacks, steam power

plant, three Holthoff-Wethey calcining furnaces, two briquetting plants, a good roast yard, assay office, water supply, etc.

At present almost all the Rossland ore is treated at the Canadian Smelting Works at Trail.

The Trail smelter is a combination copper-lead plant, with a lead-silver-gold refinery. If, as is planned, a copper converting plant be added, it will be one of the most self-contained copper-lead reduction plants on the continent. In addition to Rossland ores, it treats high-grade Boundary, Kamloops, Slocan, Lardau and East Kootenay ores, together with some small amounts from the adjoining States. Besides ores and concentrates the works can handle mattes, bullion, cyanide, and mill products. The refined gold is sold to the United States assay office, pending the establishment of a mint in Canada. The greater part of the silver is disposed of in China. The lead, which is an exceptionally pure product, finds a market in Canada, China and Japan, and, to a limited extent, in Australia. Copper sulphate, which is produced as a by-product, is sold in the Northwest provinces. The copper matte is sold to refineries in the United States.

The plant is operated by electricity obtained from Bonnington Falls. It consists of copper and lead sampling mills, roast yard, two buildings with hand roasting furnaces, one with six Bruckner roasting cylinders, and one with two double-hearth mechanical roasting furnaces. The blast furnace building contains four rectangular copper furnaces with a capacity of about 1,500 tons of charge; a large furnace 22 ft. by 42 in., is being added to treat the high grade matte. There are also two lead furnaces and a third one is ordered. There are two briquetting machines, a well equipped blower-room, with motors and an auxiliary Corliss engine, a power and lighting plant, assay laboratory, machine and boiler shops, water supply, electric locomotives for handling the materials, etc. In all, there are forty buildings connected with the smelter, and in addition five belonging to the refinery.

The refinery is the first electrolytic lead refinery in the world. It contains a lead melting room with two 30-ton melting pots—one for the base bullion, which is cast into anodes, and one for the refined lead. There is a tank room with 180 tanks, in which the base lead of the anode is dissolved in an electrolyte of hydro-fluosilicic acid and lead fluosilicate, and deposited on the cathode, a thin, starting sheet of pure lead. This room has a capacity of 51 tons of refined lead per day. The slimes left from the anode go to the silver building, where they are melted in a reverberatory furnace to dore bars, and then parted with sulphuric acid and the silver is precipitated and cast into bars, .999 fine. The gold left in the parting kettles is melted into bars .995 fine. The solution of copper sulphate resulting from the precipitation of the silver goes to the copper sulphate building where it is crystallised.

The process of copper smelting as conducted in Northport and Trail differs but slightly. In the Trail smelter the present practice is to mix the crude ore

with limestone and coke and to smelt to a low grade matte; this is granulated, roasted in the mechanical furnaces and briquetted with 5 per cent of lime as a binder; the briquetted matte, together with certain ores, is re-smelted to a high grade matte, which is shipped to the refineries. For the initial smelt the charge is about 1,500 lb. Rossland ore, 500 lb. limestone and 275 lb. coke. The matte-fall is from 10 to 14 per cent, and the matte contains about:

6 to 8% Cu, 24% S, 50% FeO. The slag runs 42 to 44% SiO₂, 17½% FeO, 17½% CaO, 15 to 16% Al₂O₃, 0.15 to 0.20 oz. Au, 0.01 to 0.04% Cu.

For the high grade smelt the charge is 1,000 lb. roasted and briquetted matte, 400 lb. of crude Rossland ore, 300 lb. heap-roasted Rossland ore, and 300 lb. siliceous ore. The matte-fall of about 8 per cent gives a matte of about 42 per cent copper and 16 to 20 oz. gold. The slag runs:

50.07% FeO, 38% SiO₂, 4.7% CaO, 0.02 oz. Au, 0.1 oz. Ag, and 0.4% Cu.

This practice was adopted after experiments along the lines followed at Mount Lyell, Tennessee Copper Co., and other points, of concentrating first to a high grade matte, say 20 per cent, and then re-smelting with siliceous ore, low in sulphur, and, if possible, high in copper, by this means avoiding the danger of loss in granulation, and the costs of roasting and briquetting.

With the Rossland ores, which are so low in copper, high in gold (which prevents running too siliceous a slag), low in sulphur (which is in the form of pyrrhotite), and high in silica and alumina, it was found impracticable to run the low grade matte to a high without roasting, or to produce a high grade matte on the first concentration.

CONCENTRATION.

The problem of concentration has received considerable attention during the last three years, and five mills have been erected in or near the camp.

(a.) There is a large amount of ore in and about Rossland that is too low in grade for profitable handling even with the present low cost of smelting, but which, if some cheaper method of extracting the values were found, would greatly increase the output of the camp and help many properties that, under present conditions, do not promise immediate success. For such ores, concentration has been proposed.

(b.) In the operating mines the ore in a stope frequently becomes lower in value or spotty. This poorer material, which is broken down with the good ore and which may be too low grade to send to the smelter, amounts in some cases to a considerable tonnage.

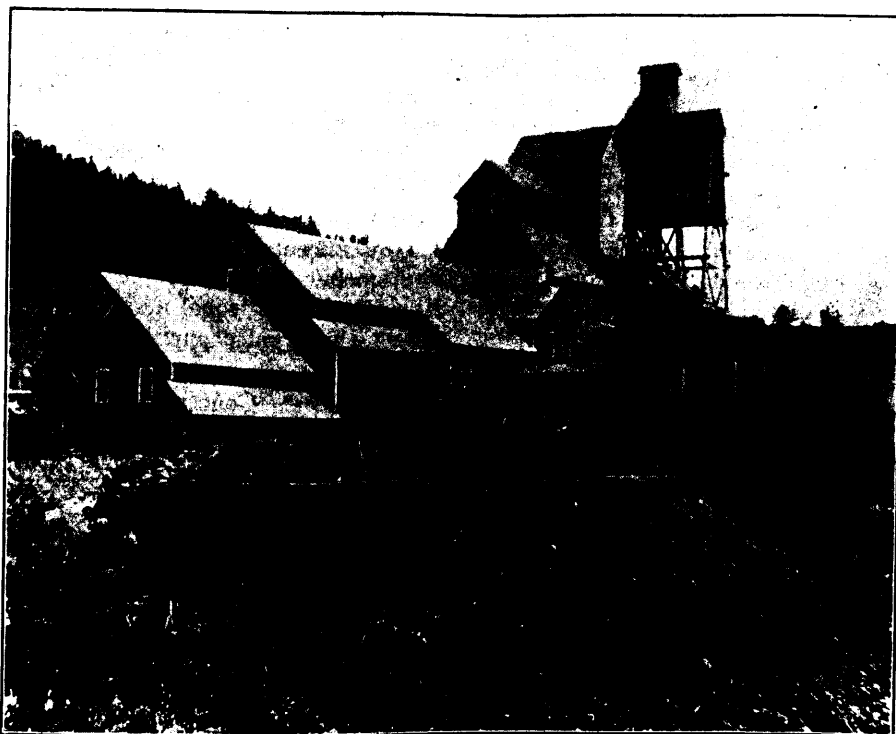
(c.) The vein may contain poor material, which, if it could be made to pay costs of extraction, would be mined in the hopes of good grade material being encountered, for, in the same way as good material may suddenly become poor, this poorer material may suddenly become rich, and the mining of such matter would undoubtedly lead to the discovery of good pay shoots. It has been mainly for the purpose of meeting cases (b) and (c) that experiments have been

conducted and mills have been built. The processes of concentration experimented with in these mills are water concentration, the Elmore oil process (succeeding a water concentration), and a water concentration followed by cyaniding.

Le Roi No. 2 Mill.—This mill, which was built in 1903 and has been in almost continual operation ever since, is a 50-ton mill (42-ton actual). It is operated by a 3-phase alternating current. The ore is reduced to first-size by a Blake crusher and then to $\frac{1}{2}$ -in. by a Gates crusher which discharges into a storage bin. From this the ore is fed to two Trent (Chilian) mills (one is sufficient to handle the feed), where it is crushed to 30 mesh. From these mills the pulp is led into

tons of concentrates averaging 2.542 oz. gold, 2.48 oz. silver, and 2.613 per cent copper. On material running \$5 per ton, taken out in the ordinary process of mining, and consequently with no mining costs to be charged against it, a good profit is said to be made.

In connection with this mill is a 2-unit Elmore oil plant (50-ton), built to handle the tailings from the Wilfley tables (a brief description of an Elmore plant will be given in connection with the White Bear mill). After a short trial the Elmore plant was closed down, for while demonstrating the efficiency of the oil process in recovering metallic minerals, the tailings from the Wilfley tables were so low-grade that what could be extracted from them would not pay for operating



Stamp Mill and Concentration Plant at White Bear Mine Rossland.

three Jenckes sizers, the underflow goes to three Wilfley tables, and the overflow from the third sizer to a canvas slime table. There are two No. 4 Wilfley tables and one No. 5; the latter is found to do better work when proper attention is given to it. The mill feed is material sorted from the shipping ore at the head-works and some obtained from the dump. It runs about 0.4 or 0.5 per cent of copper. The copper loss is 0.3 per cent., so that with this grade of material the copper loss makes a large percentage. The gold saving is from 56 to 60 per cent, and the copper 20 per cent or thereabouts. From September, 1903, to September, 1904, the mill treated 11,600 tons of ore producing 523 tons of concentrates running 1.77 oz. gold, 1.44 oz. silver and 1.86 per cent copper. From September, 1904, to September, 1905, according to a published report in the *Engineering and Mining Journal*, the mill treated 10,678 tons of low grade ore (0.117 gold, 0.306 silver, 0.545 copper), saving 424

the oil plant. During its run 4,578 tons of tailings were treated, yielding 137 tons of concentrates containing 1.11 oz. gold, 3.8 oz. silver, and 6.42 per cent copper. The final tailings ran about 0.076 oz. gold, 0.135 oz. silver, and 0.206 per cent copper. It has been pointed out by the Canadian Ore Concentration, Ltd., owners of the oil process, that in addition to the low grade of the material to be treated, conditions for economic operating were not present in this mill.

Rossland Power Co's Mill.—This is a 200-ton mill, erected on the terrace flat above Trail. The mill was designed to concentrate the ordinary shipping ore of the War Eagle and Centre Star mines. The process was a coarse concentration with jigs, the tailings from which were pulverised in Trent mills, and cyanided. The results were not very satisfactory. The jig concentrates, while clean, contained large amounts of pyrrhotite which does not carry much of the values, and this part of the process did not extract the

values expected; to save these, concentrating tables would have to be added. The lowering of the cost of smelting about this time made concentrating ordinary ore unprofitable, so that nothing further has been done with this mill.

White Bear Mill.—The distinctive features of this 100-ton mill are the crushing of the ore by means of six 5-stamp batteries fitted with 20-mesh screens, sizing to two products, a concentration on six Wilfley tables (three for fines and three for coarse), and the treatment of the tailings, which are pumped from the tailings tank by two centrifugal pumps, in an oil plant. This plant consists of four units; the tailings are led into the mixers, of which there are three, one below the other, in each unit. These mixers are long iron cylinders, with inside baffle plates, which slowly revolve, thoroughly mixing the charge with water and a constant feed of oil from the oil storage tank. The oil, which has the property of picking up and retaining free gold and metallic sulphides, escapes through a pipe, while the tailings, wormed to the lower end, are discharged into the second mixer below, and similarly to the third. The tailings go to two settling tanks, where any oil may float off and be recovered, while the tailings escape through the bottom. The heads (mineral charged oil) and oil from the settling tanks are pumped to a tank (where a steam pipe warms the oil), and dropped into the first oil extractor. This is a centrifugal machine revolving at a high speed, which separates the water and oil from the concentrates, the former flowing into an oil settling tank from which the oil is returned to the storage tank. The concentrates, both Wilfley and oil, are sent to the smelter. The oil mill had been in operation only a short time when the White Bear mine was closed down, and it has not yet resumed operations. While operating, the mill had very low grade feed, but it is claimed, effected a saving of 80 per cent of the values. The oil consumption was about 1½ gallons per ton.

Le Roi Mill.—In the early part of 1905, this 45-ton experimental mill was erected. The process is somewhat hampered by the limited water supply (20 miners' in. under 6-in head). The ore from the crude ore bin passes over a grizzly, the coarse material through a Blake crusher, and on to the supply bin. An automatic arm feeder loads an elevator discharging into a trommel, which divides the material into four sizes. The first size goes to hydraulic classifiers, the next two, 8 mm. and 16 mm. respectively, go to two Hartz jigs, the concentrates go to concentrate bin and the tailings from jigs to a fine set of rolls, from which they go again to the elevator and join the natural process. The fourth size, 26 mm., goes to a Hartz jig; concentrates to concentrate bin, and tailings from jigs to coarse rolls, from which they go to the elevator and join the natural process. Product discharged from the end of the trommel goes to one Hartz jig, concentrates to bin, tailings of jig to a 7-in. by 10-in. Blake crusher, which discharges them to elevator of the natural pro-

cess. The hydraulic classifier makes four sizes, which go to four Hartz jigs, concentrates to bins, and tailings of first two jigs to a 5-ft. Huntington mill, then to sand pump and to hydraulic classifier; tailings of third and fourth jigs to a 5-ft. Huntington mill, which is fitted with fine screens, product to centrifugal pump and then to classifier. The overflow of the classifier is led into V-settling tanks. On account of shortage of water, the clear water of settling tanks is returned to the Hartz jigs. Sediments of settling tanks go to Wilfley tables, that from the first two plugs of the settling tanks to one table, and from the third and fourth to another, and that from the remaining four to a third. The concentrates of the Wilfleys go to a drying floor, the tailings to a lower Wilfley table, the tailings from which go into a tail race. All the overflow waters from concentrate boxes and bins pass through a system of settling tanks. The sediment goes to dry floor, the water back to V-tank and Hartz jigs. All the concentrates are shipped to smelter.

The test-runs for two months gave the following results:—

First test.—694.9 tons of low grade ore gave 116.116 tons of concentrates, or a concentration ratio of 6 to 1. The smelter returns, which always run higher than the mill samples, equal a saving of 65.5 per cent gold and 51.4 per cent copper, or a total saving of 58.8 per cent.

Second test.—Concentration ratio 4.5 to 1. Saving as per smelter return, gold, 62 per cent; silver, 64.5 per cent; copper, 57.5 per cent, total saving, 60.3 per cent. The tailings run about 0.3 per cent copper, or practically the same as the waste rock, without visible mineralisation, of the mine. This mill has been closed down, the reason given being that the system of sizing and classifying is faulty.

The experiments in concentration, while not very successful, tend to show that some of the low grade material mined with the shipping ore and sorted from it can be concentrated at a profit, and that with some material it is profitable to sort out the better grade and concentrate the remainder. Those who have experimented are confident that a certain class of the low grade ores can be successfully treated, in a properly designed mill, by water concentration.

The oil process, in the experiments made, has effected a good saving of values, particularly in copper, but, so far, the material which it has had to treat has been too low in grade to pay. The following results of oil tests on Rosslund ores have been kindly furnished by Mr. H. H. Claudet, representative in Rosslund of the Elmore process:

	Gold.	Silver.	Copper.	Gross Assay Value.
Feed	0.09	....	0.6%	\$ 3.60
Wilfley concentrates.. . . .	0.72	1.50	2.9	24.00
Wilfley tails and oil plant feed	0.03	....	05	2.10
Oil concentrates	0.27	3.50	10.3	48.40
Oil tails	0.01	....	0.2	0.80

(NOTE.—About 2½ times as much concentrates produced by the Wilfley as by the oil. Although the tailings the oil plant had to treat ran only \$2.10, the oil concentrates were twice as rich as the Wilfley concentrates, produced from \$3.60 feed.)

	Parts.	Gold.	Copper.
Ore	1,000	0.57	0.91
Concentrates—water	42	11.0	4.5
Concentrates—oil	84	0.7	4.
Tailings	964	0.095	0.1
Loss	110	.....	.....
Recovery . . . . .	.....	87.3%	91.6%

Ratio of concentration 8-1; ground to 60 mesh.

Sizing Test.

	Sizing Test.	Gold.	Copper.
Left on 20 mesh screen ..	45.4% assay value.	0.41	0.65
Left on 30 mesh screen ..	11.5 "	0.73	0.83
Left on 60 mesh screen ..	18.7 "	0.62	0.88
Finer than 60 mesh screen	24.4 "	0.59	1.52
Slimes	9.5 "	0.17	1.27

Average result of water and oil concentration on seven samples, in 16 different tests made, samples crushed to 30 or 60 mesh.

	Gold	Copper.	Gross Assay Value.
Average assay of seven different samples	0.278	1.0%	\$8.56
Average assay of tailings of 16 different tests on these samples	0.06	0.35	....
Ratio of concentration 10:1; extraction	0.81%	0.78%	....
Average of seven final tailings of best tests	0.044 oz.	0.27%	....

Some of the difficulties in the way of greater success in concentration are:—The low value of the material to be treated, (from what is now shipping grade the values drop suddenly to about \$5 per ton, and very little material of intermediate grade has been found); the wide difference in the nature of the low grade material of the camp and even of the same mine; and the values distributed through the rock are in a finely divided state. Some of the low grade material is siliceous and therefore amenable to water and oil concentration. It appears probable that in the deeper workings siliceous ore may be more abundant, and water and perhaps oil concentration may become more important. But much of the low grade material is highly ferruginous (pyrrhotite, etc., 40 to 80 per cent). With such material the ratio of concentration by gravity methods of oil must be too small to make it a practical treatment. For this material pyritic smelting, and the Hendryx electrocyanide process has been suggested. The pyrrhotite as a rule contains very little gold. Mr. P. S. Couldrey, manager of the Le Roi No. 2 mine, obtained the following results in an experiment on typical ore. The sample assayed 12 oz.

in gold and 4.80 per cent copper. Crushed to 50 mesh and separated by a magnet, the magnetic portion, pyrrhotite, contained 5.9 oz. gold and 2 per cent copper, the non-magnetic portion (chalcopyrite) contained 34 oz. gold and 10.6 per cent copper, or for every pound of copper there were 34.212 oz. of gold. If the gold in the pyrrhotite was held by the copper and was present in the same ratio, the 40 lb. of copper in the ton of pyrrhotite would contain 6.15 oz. of gold, which is almost the amount actually held (5.9 oz.). So that it appears probable that what gold is found in pyrrhotite is held by the copper also present.

In a number of cases, assays of pyrrhotite showed little or no gold or copper to be therein.

In the above experiment, of the 34 oz. of gold in the chalcopyrite, 13 oz. are free, or recoverable by amalgamation. In one series of mill tests 11.4 per cent of the gold contents were caught on amalgamation plates. It is stated by one mill superintendent that while 12½ per cent of the gold is free, the plates corrode too fast for successful amalgamation. In some



Josie Mine, Rossland, in 1896.

tests by amalgamation in a mortar as much as 50 per cent of the gold was recovered. In a microscopic examination of 50 mesh pulp, a small flake of gold was detected, also a few scales of a white silvery mineral that is probably bismuthinite or tellurides, but these were too small to collect or to analyse. The metallic minerals as far as could be seen, seemed to be freed entirely from rock matter, and none of the grains of the silicate minerals or rock matter showed any adhering particles of metallic minerals. From this it would seem that not all the values left in the tailings are locked up in the silicate grains, in the form of sulphides, or if so they must be in an extremely fine state of division.

When gold and copper values in the pyrrhotite are low, magnetic separation in water, or some other form of magnetic separation might perhaps be feasible.

COSTS OF MINING AND TREATMENT.

The costs of mining and treatment in the early days rendered \$40 ore barely profitable. With the

improvements in the roads, \$25 became the limit. With the advent of railways and local smelters costs were still further reduced, and there has been an almost continual decline till the present. Costs of supplies are now about 15 per cent to 20 per cent less than in 1897. Wages have remained stationary. In 1899, an 8-hour day for workers underground was instituted, which it is claimed added to the cost of mining. In the case of the Le Roi it was estimated by Mr. R. E. Parmer to add 72 cents to the costs per ton of the ore produced, but in spite of this, costs of mining

interest in the smelter and the contract. In 1897 the War Eagle's smelting rate was \$9.96 direct or \$14.29 direct and indirect charges. During the past year the direct and indirect charges on the shipping ore of the camp were about \$6. The direct charges for freight and treatment are now from about \$3.25 to \$4 per ton, according to the character of the ore. The following table of costs, compiled from the published reports of the mines, and from the paper referred to below (2) illustrates some of the reductions in costs.

In quoting the costs from the published reports of

	*Le Roi.			War Eagle.				Centre Star.		
	1897.	1899	1904-5.	1897.	1899.	1904.	1905.	1900.	1904.	1905.
Mining.....		\$ 5.55	\$ 2.78	\$ 3.24	\$ 3.92	\$ 2.54	.....	\$ 3.59	\$ 2.31	.....
Development			0.90	10.67	1.74	0.76	.....	6.73	0.74	.....
Smelting direct	\$11.00	8.75	5.88	9.96	4.91	4.46	.....	6.00	4.09	.....
Smelting indirect	5.00	5.00	5.88	4.33	6.25	2.60	6.12	3.57	1.72	5.89
Raising			27.58	30.33	36.81	28.08	.....	56.01	38.60	.....
Winzing.....			48.96	.....	44.42	36.15	.....	59.01	.....	.....
Drifting.....			14.80	20.11	23.81	17.77	.....	26.82	18.19	.....
Diamond drilling			2.98	.....	.....	.....	.....	.....	.....	.....

*Le Roi costs for 1897 and 1899 taken from paper of Bernard Macdonald, already referred to.

(1) and (2). Hoisting and Haulage in Mining Operations, by Bernard Macdonald. Journal Canadian Mining Institute 1902, page 311.

Ore Extraction—Cost Per Ton.

	1897.	1899.	1901.	1902.	1903.	1904.
Drilling.....	\$0.94	\$1.53	\$0.43	\$0.73	\$0.64	\$0.46
Blasting.....	.....	.....	0.04	0.06	0.05	0.05
Explosives	0.27	0.25	0.13	0.26	0.22	0.16
General mine supplies.....	0.14 ¹ / ₄	0.06	0.08	0.10	0.05	0.04
Mine lighting, candles	0.03	0.03	0.02	0.02	0.02	0.02
Mine lighting, electric.....	.....	0.03	0.03	0.03	0.03	0.02
Smithing	0.10 ¹ / ₄	0.15	0.07	0.14	0.03	0.04
Tramming and shovelling, direct	0.44 ¹ / ₂	.....	0.28	0.29	0.27	0.28
Tramming and shovelling, apportioned .....	.....	0.53	0.11	0.12	0.14	0.12
Timbering, labour	0.31 ¹ / ₂	.....	0.18	0.28	0.25	0.29
Timbering material .....	.....	0.29	0.11	0.15	0.14	0.12
Machine drill, fitting and repairs.....	0.23 ¹ / ₄	0.05	0.07	0.14	0.07	0.08
General mine labour .....	.....	0.30	0.28	0.22	0.16	0.13
Hoisting, underground .....	.....	.....	.....	.....	.....	0.01
Hoisting shaft	0.18	0.13	0.23	0.16	0.23	0.24
Compressed air .....	.....	0.21	0.09	0.15	0.18	0.11
Ventilation	0.07	.....	0.06	0.03	0.02	0.02
Assaying .....	.....	0.05	0.07	0.05	0.05	0.05
Surveying	0.26 ¹ / ₂	0.02	0.04	0.02	0.02	0.02
General.....	0.25 ¹ / ₄	0.31	0.49	0.25	0.28	0.27
	\$3.24 ¹ / ₂	\$3.94	\$2.81	\$3.20	\$2.90	\$2.53
Stopping figured on tons .....	.....	45,810	17,910	20,327	58,683	53,084

are now much lower. It is, however, in smelting that the reduction in costs has been most marked. In 1897 the Le Roi was shipping to Trail on a contract which called for 75,000 tons of ore, at a rate for freight and treatment of \$11 per ton, direct, or \$16 direct and indirect charges. In 1897 the Northport smelter was built, the Le Roi Co. owning a three-quarter interest in it. According to agreement between the mine and the smelter (1), the smelter was to treat the Le Roi ore for a period of five years at a direct rate of \$8.75 per ton, or about \$13.75 direct and indirect charges (the Le Roi Co. owning three-quarters of the smelter received three-quarters of the profits). In 1900 the Le Roi Co. bought out the remaining one-quarter in-

the companies, ore from development work, dumps, or ore already stoped, is not included, as the amounts vary from year to year and would not afford a basis for comparison. The lowering of indirect smelting costs is not altogether due to the lower grade of ore; the scale of deductions has been greatly lowered.

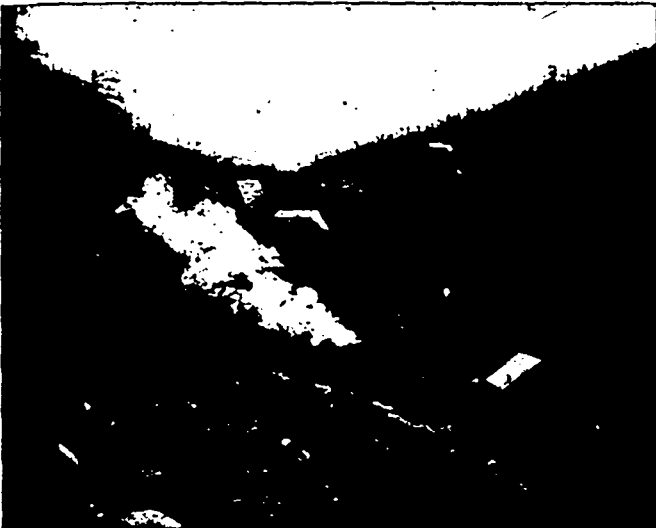
The mine from which these costs were taken was under the same management for the whole period, except during 1897.

The total costs, including all expenses connected with mining, smelting, depreciation, etc., are now probably under \$10 per ton. Ore running about \$7.50, against which general and similar expenses have not to be charged, can be profitably handled.

PROFITS.

The net profits on the operations of the leading mines for the last financial year, according to published statements, should be about \$775,000. There have been paid in dividends to the end of 1903, \$2,377,050. The Le Roi No. 2 has since paid substantial dividends—£18,900 in 1904 and £25,200 in 1905—and the other mines have creditable cash balances.

While the amount paid in dividends is not large in comparison to the value of the ore produced, it is to be remembered that the mines started with little or no working capital, and that the extensive development, the expense of machinery and plants, had to be met by profits from the ore extracted. Until recently, smelting costs have been heavy. The costs of development, especially in the early days when less was known regarding the occurrence of ore, the effects of faulting and dyking, were high. In the case of one



Centre Star Gulch, Rossland, in 1898.

mine, these costs have been \$1.58 per ton of ore exposed, and in a second, \$2.60. The present costs for development, per ton of ore, are much less. The following extract from a general manager's report is quoted in Bulletin 19, Bureau of Information, British Columbia, "The whole of our plant, surface improvement, and buildings, both at the mine and smelter, representing an expenditure of over \$1,000,000, and in addition, the mine itself, on which there has been spent, apart altogether from the purchase price, a sum of \$500,000, is absolutely free and unencumbered. As working capital was not provided, the \$1,500,000 represents profits on ore extracted. Until the mines had paid for these improvements, interest as well, had to be met out of profits." This hand to mouth existence of the mines has affected the profits in another direction, through the lack of extensive development work, ahead of mining. The Rossland ores have kept two smelters in operation. With a smelter dependent on one mine, or holding a contract for a certain tonnage from a mine, when, as happens, a number of the working faces suddenly became poor, the mine has had to ship material below grade in order to keep up

the tonnage demanded. The Le Roi No. 2, which for the last few years has shipped only carefully selected ore, has maintained regular dividends, although the tonnage produced has been small. At present the mines give promise of adding materially to their record of dividends.

NOTE.—Since the above was written the Le Roi Mining Co. has declared a dividend of about \$75,000, and the Consolidated Mining and Smelting Co., which includes the Centre Star and War Eagle mines and the Trail smelter, as well as the St. Eugene mine in Southeast Kootenay, has declared a quarterly dividend of 2½%, amounting to \$117,000.

YUKON RIVER IMPROVEMENTS — UNITED STATES' DO-NOTHING POLICY.

FROM being a "graveyard of navigators" the Upper Yukon River has become practically as safe as a canal, observes *The Engineering and Mining Journal* of New York. Continuing, it remarks: During the open season steamers, barges, scows, canoes in great number ply its waters, and accidents of any description are extremely rare. The Yukon forms a convenient highway through the central portions of this great Northwest. Its traffic is divided between the White Pass and Yukon route (railroad and steamers) from Skagway to Dawson and the American route *via* St. Michael. Generally speaking, Yukon Territory and the Forty-Mile district in Alaska are served by the Canadian route, while the American route supplies the wants of the lower river points, including the Tanana, Koyukuk, and Rampart mining district. Fairbanks alone, during the present winter, required as large stores of provisions as Dawson. In its solicitude for the welfare of Yukon Territory the Canadian Government has annually voted grants, not only for the construction and maintenance of roads and trails—about \$200,000 for the fiscal year ending June 30, 1905, or \$1,386,400 altogether from 1899 to January 31, 1906—but also for the improvement of the Yukon River and its tributaries. The programme for the current year provides for an expenditure of \$15,000, to be distributed as follows: \$8,000 for rock blasting at Hell's Gate, \$1,500 for the Forty-Mile River, \$3,000 for the upper Yukon reaches, including Thirty-Mile River, and \$2,500 not yet placed. Since the opening up of this country a few years ago Canada has appropriated about \$175,000 for Yukon River improvements. On the American side of the line, in Alaska, improvements have not even been started. The Yukon flats are still there to endanger and retard American shipping, and so are the obstructions at the mouth of the river, which were fully described and explained to the senatorial sub-committee who personally, in 1903, investigated conditions in Alaska. It should be thoroughly understood, in this relation, that transportation is the chief problem in this wonderful northland. It is the paramount question in the development of Alaska.

THE BRITISH COLUMBIA COPPER CO. AND
THE B. C. MINE.

By E. Jacobs.

STEADY expansion has been, and continues to be, a prominent feature in the operations of the three mining and smelting companies that have contributed so largely to the marked and substantial progress of the Boundary district of British Columbia. In the extensive development of the copper mining and smelting industries of that district (which, by the way, produces more copper than all

smallest capitalisation, its authorised capital being \$2,000,000, as compared with Granby \$15,000,000 (\$13,500,000 issued), and Dominion \$5,000,000. Up to the close of its last financial year, November 30, 1905, the company had issued \$1,765,000 of its stock, but since then mining property purchased has been paid for in stock, so that it is probable there remains but little, if any, unissued stock.

The mining operations of the Boundary Mines Syndicate that early in 1898 developed into the British Columbia Copper Co. were commenced in the summer of 1896 on the Mother Lode, with Mr. Frederic Keffer, M.E., in charge. During the ten years that have



Big Stope in B. C. Mine, Boundary District.

other parts of the Dominion combined, as exhibited by the following statistics of value of copper production in 1905: Boundary district, \$4,313,853; remainder of British Columbia, \$1,562,369; all other parts of the Dominion, \$1,544,229; total, \$7,420,451), the Granby Consolidated Mining Smelting, and Power Co. has taken the leading place, with the British Columbia Copper Co. and the Dominion Copper Co. each sharing in an important degree the task and credit of earning for the Boundary this momentous distinction. It is especially noteworthy, though, that of these three companies, the British Columbia Copper Co. has the

since elapsed Mr. Keffer, who, in the capacity of engineer, still supervises the company's mining work, has had the satisfaction of seeing the Mother Lode developed from a mere prospect into a big mine with between two and three miles of underground workings, extensive ore quarries, a total production to date of more than 800,000 tons of ore, and further development and equipment well forward for a daily output of 800 to 1,000 tons.

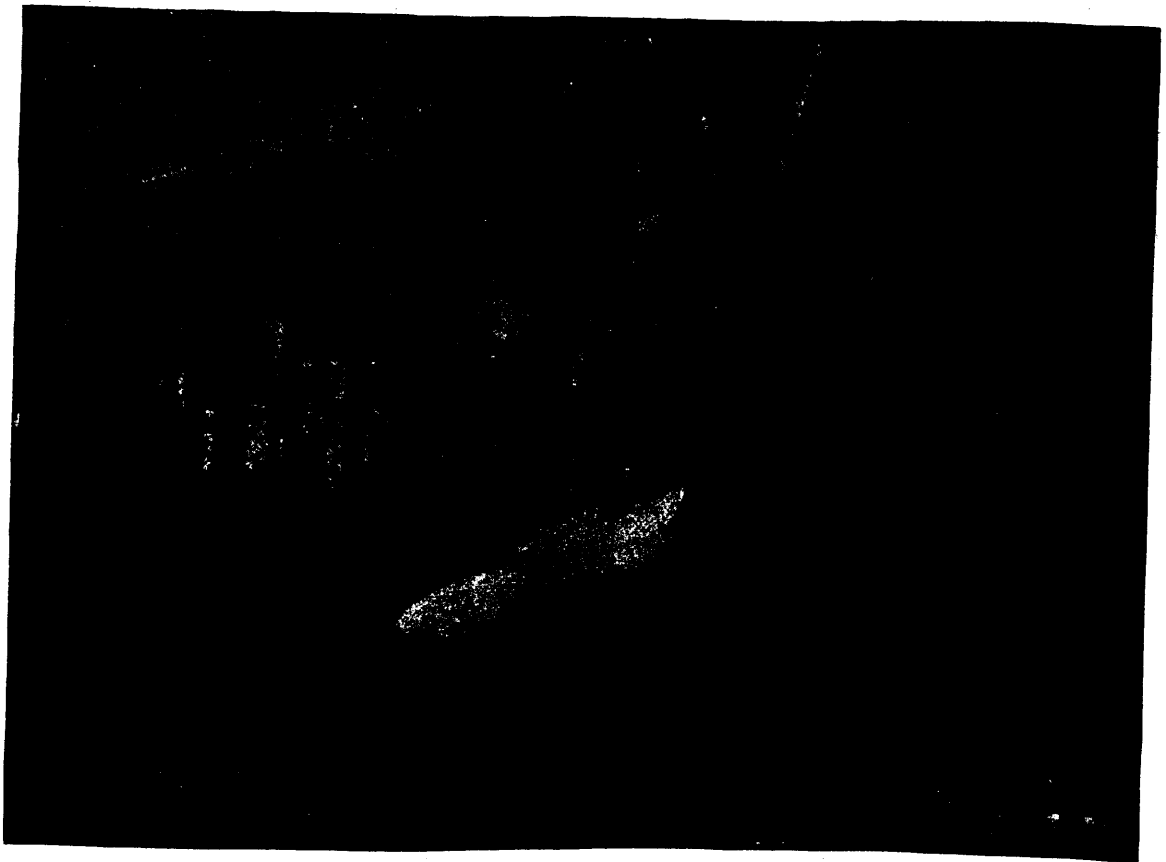
For the reduction of the product of its mines and of custom ores the company built a smelter at which, since its first furnace was blown in on February 17,

1901, some 930,000 tons of ore have been treated. Commencing with one 350-ton blast furnace, a second was added in 1902, and by June, 1904, the company was also operating a two-stand copper converting plant. Now the smelting works are being remodelled and equipped with a modern plant, designed by the company's manager, Mr. J. E. McAllister, the daily treatment capacity to be about 1,500 tons.

During the last two or three years the company has extended its mining operations both in the immediate neighbourhood of its provincial headquarters at Greenwood, and in parts of the large Boundary district farther afield. On Copper Mountain, near

properties have large reserves of ore and are favourably situated for transportation purposes, the Eholt-Phoenix branch of the Canadian Pacific Railway Co.'s Columbia and Western railway crossing them and giving railway connection with the Boundary smelters. Now the announcement is made that the British Columbia Copper Co. has taken under a working bond the B. C. mine, which is situated about a mile from the Emma and Oro Denoro mines. It is understood the transaction includes the whole of the group of claims of which the B. C. is the one heretofore worked.

The B. C. mine was the first in the district to send



Surface Works at B. C. Mine, Boundary District—Showing Shaft and Power Houses.

Princeton, and in the vicinity of Hedley, both in the Similkameen; in the southern part of Osoyoos mining division; and still farther south, across the International Boundary line, both in the Chesaw and Marcus districts, mining properties have had its active attention. But, apart from the Mother Lode, it is in Summit camp, in the Greenwood and Grand Forks mining divisions of the Boundary district, that the company is operating most extensively to supplement the ore supply available for the enlarging requirements of its smelting works. First it secured a three-fourths interest in the Emma group, and for about two years it has been developing this property which to date has shipped nearly 90,000 tons of ore. Then, early in the current year, it obtained an option on the Oro Denoro, which adjoins the Emma mine and the aggregate production of which is about 41,000 tons. Both these

ore in quantity to a smelter. It is owned by the B. C. Chartered Co., of Montreal, Quebec. It was closed down in the summer of 1903 after having shipped an aggregate of 99,580 tons of ore during the four years it ranked as one of the important producing mines of the Boundary district. For eight months during 1902 operations were suspended at this mine on account of the low price of copper, its owners not caring to sell its product at so low a price as then prevailed. The average value of the ore was throughout higher than that of the larger mines of the district. To the end of 1901 the total production was 67,136 tons, having an average assay value per ton of 0.015 oz. gold, 2.45 oz. silver, and 5.8 per cent copper, wet assay. When operations were resumed in 1902 local smelters treated the ore instead of its having to be shipped more than 100 miles to Trail, and the conse-

quent considerable reduction in freight and treatment rates admitted of ore sorting at the mine being discontinued, with the result that the value of the ore shipped in 1902 was lower—averaging 1.75 oz. silver per ton and 4.1 per cent copper.

Mr. S. F. Parrish, M.E., late general manager for the Le Roi Mining Co., Rosslund, B.C., and now of Los Angeles, California, U.S.A., who was manager of the B. C. mine for several years, thus described the ore: "The ore itself is chalcopyrite, pyrrhotite, and some pyrite, with a small quantity of gold and silver. On the edges of the main ore body bunches of specular iron and zinc blende occasionally occur, but never in

ore to result from systematic and extensive prospecting, especially as good showings of ore have been found on neighbouring claims.

The B. C. mine is equipped with a power plant sufficient to break and hoist 200 tons of ore a day through the present working shaft. This plant includes four steam boilers, together about 225 h.p.; a Rand straight-line 4-drill air compressor and half of an Ingersoll-Sergeant compressor, rated at 10 drills; one large and two small hoisting engines, two Cameron sinking pumps, etc. An electric light engine and dynamo have also been installed. The mine buildings are substantial and comfortable, and up to 115 men



Surface Works at B. C. Mine, Boundary District—Showing Covered Tramway to Shipping Ore Bins.

the ore mass. The specific gravity of the ore is 3.65 to 4.00. Garnet rock is the mineral most intimately associated with the ore, occurring round the edges of the ore body and occasionally in masses in the midst of it. A noticeable feature is the entire absence of oxidation of the ore body, at the outcrop or elsewhere."

Practically all the important development work done on the group is on the B. C. The deepest shaft is down about 400 ft. Of the 7,000 lin. ft. of work about 1,500 ft. consists of sinking and raising and 5,500 ft. of drifting and cross-cutting. The group comprises eleven adjoining mineral claims, with but little of the total area of 268 acres thoroughly prospected, so that it is quite reasonable to look for new discoveries of

have been employed on the property at one time. A spur to the mine from the Canadian Pacific Railway Co's Eholt-Phoenix branch of the Columbia and Western railway provides transportation facilities.

The American Institute of Mining Engineers will meet in London, England, in July in joint session with the Iron and Steel Institute of England.

A discovery of anthracite coal was recently announced by the minister of mines for Ontario. The report is that extensive beds of anthracite exist on the Hudson Bay slope in the neighbourhood of Albany River, which forms the dividing line between Ontario and the Northwest Territories.

GRIBBELL ISLAND—ITS GEOLOGY AND MINING OPERATIONS.

By W. M. Brewer, M.E.

NOT much information relative to mining on Gribbell Island, which is situated about 150 miles north of the northern end of Vancouver Island, is usually obtainable, so the article Mr. W. M. Brewer, M.E.,—whose business connection with the Tyee Copper Co. necessitates his familiarising himself with all mining operations on a commercial scale along the northern coast of British Columbia and Southeast Alaska—kindly contributed for the use of the provincial mineralogist in preparing the Annual Report of the Minister of Mines for 1905 is of interest. Gribbell Island is in the Skeena mining division of Cassiar district. It has been visited several times during the last year or two by Mr. Brewer, who writes thus of its geology, mines, etc.:—

Near the southern entrance of Granville Channel, about 400 miles north-westerly from Victoria, is located a group of islands, the largest of which is Princess Royal Island. Immediately to the north of the northerly end of this island, and separated from it by a narrow channel, lies Gribbell Island, comprising an area of some 50 sq. miles.

This island has received more attention from prospectors during the past seven or eight years than any other one of the group, excepting Princess Royal. Syndicates composed of residents of Bellingham, in the State of Washington, have been operating on Gribbell Island on two groups of mineral claims since 1899, and a total of about \$60,000 has up to the present time been expended for development work by the two companies. One of these is designated as the Canadian-American Copper Mining Co., and the other as the Gribbell Island Copper Company.

Geology.—The island may be considered as one enormous mountain, the summit of which reaches an elevation of some 4,000 ft. above the sea. The evidences of glaciation are very pronounced, there being several exposures of bare rocks, covering areas of variable extent even to five or six acres, which show plainly the groovings and channelling produced by erosion, which invariably record the effects following the movements of the enormous glaciers which passed over this portion of the continent during the Ice Age. In this particular locality this work of erosion is still going on, for there is hardly a winter during which snow and ice slides of great extent do not occur on these bare mountain sides.

Except on these spots, however, the island is heavily timbered with cedar, spruce, hemlock, and some Douglas fir. The underbrush, which is principally devil's club and sallal, is practically impenetrable, while the fallen timber and precipitous mountain sides render anything like thorough prospecting difficult and hazardous.

So well is this fact illustrated on the claims of the Gribbell Island Copper Co. that the miners, when constructing trails from the beach to the workings, about

2,000 ft. in elevation, built ladders by felling trees side by side and nailing cleats across from one to the other. In this way the visitor to these claims finds himself climbing a series of ladders for about half a mile in distance by horizontal measurement and nearly 2,000 ft. by vertical.

The similarity of the geological formations on Gribbell Island as compared with those on Texada Island, nearly 400 miles to the southeast, or at Whitehorse, in Yukon Territory, is very striking, especially with regard to the occurrence and character of the ore bodies, but the geology cannot be said to be exactly similar, for on Gribbell Island the granitoid rocks, especially in the vicinity of the ore bodies, have a decided gneissic structure, which is certainly absent in the two other districts mentioned.

Another feature of dissimilarity which is noticeable is the fact that, so far as at present exposed, the ore bodies, instead of occurring at the contact of crystalline limestone and igneous rocks, as is the case both at Whitehorse and on Texada Island, occur between a gneissic granitoid rock on the footwall side, and a diorite on the hanging wall side; but with regard to the hanging wall this is merely a conjecture based from the conditions on the outcroppings and not from any underground exposure, because sufficient cross-cutting has not been done in any place to determine either the character of the permanent hanging wall or the width of the main ore body.

A well-defined diorite dyke is noticeable on the beach at the landing place used by the Canadian-American Mining Co. This dyke, according to the most reliable information the writer could obtain, forms a prominent landmark through the island. Its average width is about 12 ft., and its line of strike about N. 20° E. On the easterly side of this dyke no occurrence of minerals has yet been discovered.

The country rock on the west side of the diorite dyke referred to has always been classed as a granite, but a closer examination with an ordinary lens caused the writer to be of the opinion that this rock is composed of hornblende and feldspar, and should therefore be classed as syenite. A very noticeable feature connected with it is observed in a tunnel 600 ft. in length, which has been driven for the purpose of intersecting the ore body which outcrops on the surface. This feature is the change of structure and grain of the rock from a coarse-grained with well-defined large crystals to a fine-grain rock with gneissic structure, but so far as can be observed with an ordinary lens, composed of the same hornblende and feldspar, and apparently having no other minerals associated with these.

Characteristics of Ore Bodies.—The ore bodies, so far as they have been exposed by open cuts on the outcrop, by tunnels, and by a shaft, are masses of considerable extent made up of crystals of variable size of bornite, shot through a matrix of garnetite and feldspar; the latter occurring in particularly large crystals of a pinkish colour. Much of the garnetite is made up of large sized garnets almost perfect in their crystallisation, and of such beauty as would

make them treasured specimens in the cabinet of a mineralogist.

There is one peculiarity with regard to the foot-wall of some of the ore bodies, which is that it resembles for about a foot in thickness a sandstone, and in this can be seen grains of chalcopryrite, but whether in sufficient quantity to give it any commercial value I should consider quite doubtful.

From the greenish colour of the ledge matter, there is evidently considerable epidote associated with the other minerals which make up the matrix.

Canadian-American Co.—Southerly from the point where the main outcrop on the Canadian-American Co's property has been exposed by open cut work, there occurs a steep bluff which has all the appearance of being a continuation of outcroppings capping an ore body, but no work has been done to establish this fact. The development work performed on this property consists of some open cuts made on the outcrop, a short tunnel situated about 30 or 40 ft. below the outcrop, which was apparently started with the intention of cross-cutting the ore body, but instead of doing so, the tunnel was merely run until at the face about three ft. of ore was exposed, when a shaft was started and sunk about 37 ft. in ore. At that depth the water interfered with sinking to such an extent that, having no pump at hand, it was concluded by the management to drive a cross-cut tunnel, starting from a point on the mountain side about 200 ft. lower elevation than the short tunnel referred to. At the time of the writer's visit this tunnel had been driven 600 ft., but had not yet intersected the ore body on which the shaft had been sunk, and is really a waste of money.

About 425 ft. from the mouth of the tunnel a lens of ore has been cross-cut and drifted on for about 30 ft. The ledge matter in this is made up of the same minerals as are found in the main ore body, that is to say, large crystals of calcspars, feldspar and garnets, also some epidote with masses and crystals of variable size and bornite occurring as impregnations, distributed with variable regularity through the matrix.

The line of strike of this ore body is almost parallel to that which outcrops higher up the mountain, nearly due north, but the dip is at an angle of about 60 degrees towards the west, while the dip of the main ore body is about 65 degrees towards the east.

From a survey made, it will be necessary to continue the long cross-cut tunnel for probably 100 ft., and also to turn its course northerly, in order to make an upraise connect with the shaft referred to, and to determine the conditions of the ore body below the bottom of that shaft.

Judging from the extent of the outcrop, the fact that the shaft has been sunk 37 ft. all in ore, and the continuity of the outcrop along the line of strike of the main ore body, it certainly appears as though this property, if development is continued on the proper lines, should, in the near future, be placed in a position to ship a considerable tonnage of ore. The tonnage, of course, would depend largely on the cost of transportation, and the necessity for more or less close

sorting. Judging from the dumps which have already been accumulated, the writer is of the opinion that it will be found more profitable in the end to consider the ore bodies as low-grade propositions, rather than to attempt close sorting to secure a high-grade product.

Gribbell Island Mining Co.—About two miles north-westerly from the property of the Canadian-American Mining Co. is situated the property of the Gribbell Island Mining Co. This consists of a large group of claims located in a block. The work done consists of one tunnel 354 ft. long, driven in granite along the line of fault, and several shorter tunnels, shallow pits and open cuts. The surface outcroppings show indications of mineralisation to a considerable extent. In fact, there is felsite, garnetite, epidote and sometimes limestone, through which is disseminated particles and masses of bornite and occasionally chalcopryrite. This fissured zone containing the mineralised material is picked up at intervals along a general north-westerly line of strike for a distance of about 3,000 ft. In this distance work has been done to a limited extent at six different points where this mineralised material outcrops, but nowhere has enough work been done to demonstrate sufficient facts to warrant any opinion other than that there is a possibility of the occurrence of an ore body.

The long tunnel demonstrates nothing, and, in my opinion, should never have been driven, because the same amount of money and labour expended at some other point would have demonstrated the value of the property, especially if such had been done at a point about 1,500 ft. to the northwest, and at some 500 ft. higher elevation, where the outcrop shows greater mineralisation than elsewhere, and a typical sample assayed 1.79 per cent copper, 19 oz. gold, and 0.70 oz. silver per ton.

Shipping Facilities.—There are but very few propositions located more advantageously, when the question of shipping is under consideration, than are those on Gribbell Island. The mountain side, from the points where permanent workings would naturally be located at the properties of both the Canadian-American Co. and the Gribbell Island Co. to a deep-water harbour, in a cove well sheltered, has quite a precipitous incline, rising about 80 ft. in a distance of 2,600 ft. to the former company's property, while the proposition owned by the last-mentioned company, although at a higher elevation, is not much farther distant from the shore line. At the present time connection between the landing at the beach and the property owned by the Canadian-American Co. is made by a well-constructed "tubbed" road, about three-quarters of a mile in length.

Timber and Water Supply.—With regard to the supply of timber on Gribbell Island, it is noticeable that the trees have a scrubby growth as compared with those farther down the coast, but the supply is ample for mining and fuel purposes. Cedar, hemlock, spruce and some fir are the varieties of timber noticeable on this and the adjacent islands.

When the water supply is taken into consideration

the writer found that right there is a condition which, if properly utilised, will minimise the cost of mining, for the reason that a magnificent power can be developed from a stream which flows from a lake situated some 400 or 500 ft. higher elevation than the outcroppings on the Canadian-American Co's property, and any machinery required for mining plant can be run by water-power instead of steam.

DAWSON, YUKON TERRITORY.

DURING May royalty was paid at the office of the comptroller, Dawson, on gold valued at nearly \$960,000, which was the highest value entered for royalty payments in any corresponding month since 1903. The values of gold so entered in May of three years was as follows:

May, 1904	\$836,606.10
May, 1905	485,603.55
May, 1906	959,422.50

It is estimated that a similar increase over last year will be maintained throughout the season. The present season opened early and the spring proved unusually favourable for sluicing. June of this year is considered certain to show a considerable increase over the corresponding month of last year, for the large mining plants installed last summer did not operate to any extent last month, but this month entered upon their summer work on dumps that had been accumulated during the winter.

The steamer "T. C. Powers" recently made a record run between Dawson on Yukon River and Chena on Tanana River. From dock to dock the recorded time taken was 5 days, 8 hours, and 30 min. The steamer had in front of her a barge carrying 80 tons.

There are now four dredges operating in the Yukon. Morley Ogilvie's dredge is now doing good work near the Ogilvie bridge, after having been improved by putting in a new conveyor and elevating it so that no trouble is now experienced with the tailings. The new dredge that was being taken to Forty-Mile and which broke adrift in the canyon is being repaired, and another start up stream will shortly be made.

The Yukon *World* states that at Dawson on June 14 two foreign incorporations were granted a licence to transact business in Yukon Territory. These were the Northwest Hydraulic Mining Co. and the Yukon Consolidated Gold Fields Co., both incorporated in the State of Delaware, U.S.A. Chester A. Thomas has been designated as attorney within Yukon Territory for both. The Guggenheim interests are said to be at the head of these companies. In this connection it may be mentioned that the transfer of some 24 claims on Bunker Hill, Magnet Hill and Gulch, and Bonanza Creek, with all water rights, ditches, hydraulic machinery, etc., has been recorded. These were the Fuller-Norwood properties, and it is understood that they have been transferred to representatives of the Guggenheim companies.

Mr. Thos. Hinton, mining recorder for the Stewart and Mayo district, when in Dawson early in June,

stated that in his district "on Hiatt Creek, on the frozen rim, the pay is running from \$1.50 to \$2 to the foot. From the mouth of Stewart River to the end of the district, up in the Mayo and Duncan, there is plenty of rich ground. The ground has not yet been thoroughly prospected. Men have gone in there time and again, but have gone broke because they could not stand the pressure. Now that the Government is putting in roads (this season's appropriation for roads on Duncan and Hiatt Creeks is \$10,000) and has provided large pumps for assisting in properly testing the grave's on the Duncan, the district will be even better than the Klondike."

The transfer has been made of the Elwell group of 26 claims, all at the mouth of Gold Bottom, to M. Leon de Blegier, who came to the Yukon from Paris. He was for a time with the Syndicat Lyonnais du Klondike, and returned to Paris for last winter. Whilst in France he interested other capitalists and on his return acquired the above mentioned property. The claims are described as all bench ground particularly suitable for hydraulicking. M. de Blegier has obtained water rights from Gold Bottom and Soda Creeks, and will, it is understood, begin operations on a large scale without delay.

Mr. Emil Weinheim, engineer for the Bonanza Creek Gold Mining Co., formerly the Matson & Doyle concession, has 24 men at work on Adams Creek building a dam some 60 ft. high. The site of the dam is 2 1/2 miles up Adams Creek.

The development along new lines of the Five Fingers coal mine, situated between Dawson and Whitehorse, is reported as being steadily proceeded with. After Mr. George J. Milton took charge he arranged for the use of the Government diamond drill for prospecting purposes, but owing to the broken nature of the formation and the lack of sufficient casings for the drill it was decided to open up the property without first using the drill. Accordingly a prospecting shaft was sunk, and at 30 ft. depth it entered a seam between 5 and 6 ft. in thickness, of better quality coal than any previously found on the property. A slope was then driven into the hillside, connecting with the shaft at 125 ft. and thence in the coal to a distance of about 300 ft. From the entrance to the slope a wharf has been built out 100 ft. and on this have been constructed bunkers, screens, and loading and shipping facilities for placing the coal on the steamers and barges. It is stated that fully 1,000 tons of merchantable coal from this mine will be delivered in Dawson this summer and that next year the available supply will be fully equal to all demands.

The Ontario Bureau of Mines has announced that for the three months ending March 31 last 360 tons of ore were shipped from the Cobalt district to the smelters. The silver contents aggregated 580.825 oz., an average of 1.613 oz. to the ton, valued at \$362.248. The cobalt contents amounted to 10 tons, worth \$10,360. Since the latter part of 1904 ore has been shipped from Cobalt to the value of about \$2,250,000.

COMPANY MEETINGS AND REPORTS.

GUGGENHEIM EXPLORATION CO.

A special meeting of the Guggenheim Exploration Co., says the *Engineering and Mining Journal*, will be held on July 2 for the purpose of increasing the capital stock of the company from \$17,000,000 to \$22,000,000. President Guggenheim says that the company has acquired, during the year, or has entered into contracts for purchase of large interests in important mining properties in Utah, Alaska, Yukon Territory, and British Columbia. In so doing obligations of upward of \$10,000,000 have been incurred. More purchases are contemplated, involving further outlays. The company's capital authorised is \$17,000,000, of which \$13,554,000 has actually been issued, and \$14,090,000 issued and contracted for. The subscriptions for the new stock are payable as follows. \$100, Aug. 1, 1906; \$50, Oct. 1, 1906; \$50, Dec. 1, 1906. No subscriptions will be received for fractional shares. Each holder of record will be entitled to subscribe to 50 per cent of present holdings at \$200 per share. All unsubscribed stock may be sold at discretion of the directors at not less than \$200 per share.

BOUNDARY-ELKHORN MINING CO., LTD.

On June 5 the annual meeting of the Boundary-Elkhorn Mining Co., Ltd., was held at Greenwood. Those present expressed satisfaction with the development now being carried on at the mine. The directors elected were: President, Phil. McDonald; vice-president, James Sutherland; secretary-treasurer, H. V. Fuller; managing director, Dr. J. E. Spankie; and Charles Kenney, H. C. Wilson, and James McCreath. It was decided to continue the main shaft, now down to the 275-ft. level, to 300 ft. depth, and then drift and stope ore. The secretary stated that 132,350 shares of stock had been issued by the company.

ALBION MINING CO.

The annual meeting of the Albion Mining Co. was held in Spokane, Washington, U.S.A., on June 2. Mr. Thos. Hooker was elected president. The company's mining property, which has not been worked for years, is situated at Ainsworth, B.C. Recently the company was able to make a contract with the Highlander Mill and Mining Co. to continue its Black Diamond tunnel through to the south line of the Albion property, a distance of 230 ft., and to permit the Albion Co. to use this tunnel. The manager of the Highlander Co. last year reported to the provincial mineralogist that the Black Diamond tunnel had been extended, and that at 2,520 ft. in it had cut a 20-ft. vein, and at 2,610 ft. a 6-ft. vein. The Albion Co. will have to drive from its south boundary line a distance of about 1,800 ft. to cut its lode, which, if done, will give a depth of more than 1,000 ft. Spokane stockholders in the Albion Co. are stated to be much elated over the improved prospects of their company.

CANADA WESTERN OIL COMPANY, LTD.

The first annual meeting of the recently organised Canada Western Oil Co., Ltd., was held in Greenwood, Boundary district, on June 5.

The report of the provisional directors was received. It reviewed the work of organisation and pointed out that the company holds ten licenses and one lease for oil and coal prospecting in Southeast Kootenay. It also showed that all preliminary expenses had been paid from the sale of stock, and a small balance remained in the bank. Dr. Spankie, Dr. Gordon, Hugh McCutcheon, E. R. Redpath, and S. Barry Yuill were re-elected directors, and James McCreath and Angus Cameron were added to the board.

After the close of the shareholders' meeting, a meeting of the directors was held. Dr. Spankie was elected president, Dr. Gordon vice-president, and E. R. Redpath secretary-treasurer. It was decided to send an expert to the oil fields in Southeast Kootenay, who will make a thorough examination of the company's property with a view to placing a drilling rig in operation as soon as possible.

BLACK-MACKAY MINING CO., LTD.

A meeting of shareholders in the Black-Mackay Mining Co., Ltd., was held at Nelson on June 8, when the following directors were duly elected: William Spurck, Seattle; Robert Campbell, Moyie; Leander Shaw, Vancouver; George M. Gunn, and Charles A. Mackay, Nelson. The directors will meet shortly and elect the officers.

The two claims located by C. A. Mackay and partner, to acquire and mine which the company was formed, were formally acquired and taken over by the directors. Two building lots near the shore of Moyie lake were also taken over.

YMR GOLD MINES, LTD.

In a circular to the shareholders the secretary of the Ymir Gold Mines, Ltd., states: The ore bins being now full it is necessary to start the mill and the manager cabled that this would be done on June 6. Mr. Gilman Brown has again visited the mine and reports by cable that "1,000-ft. level raise has every appearance of becoming a good body of ore. The average height is 35 ft. as far as developed; have not yet developed along strike." Since the date of this cable 22 ft. of drifting has been done east and west on the strike of the vein, the manager in his last weekly cabled report stating that it is opening up a "fine body of ore." In a recent letter he states: "The vein is certainly a very fine one, fully 5 ft. wide, and it may be much wider, as we are not breaking into the foot, and so do not know its width yet. The blasts today noon made the ore body appear better than ever. It is safe to say that the ore from the raise that we have taken out and are now mining, will much more than pay for the cost of the raise." With reference to the new vein, Mr. Gilman Brown cables as follows: "I have every hope that the result of the present work will be satisfactory in the course of the next 30 days." In this connection the latest advices from the manager, Mr. E. M. Hand, report that rich pieces of float ore have already been encountered in driving this cross-cut, which convinces him that there is a vein in the immediate vicinity, carrying good values. On the recommendation of Mr. Hand an option has been secured on some claims adjoining the Ymir group to the southwest, the value of which he advised could be tested quickly and at small cost. Mr. Gilman Brown cables with regard to these claims that the "prospects are decidedly encouraging." The ores can be treated with great advantage at the Ymir mill, and if the developments continue to show values equal to those already reported, the property should afford a further important source of supply for the company's 80-stamp mill.

DOMINION COPPER CO., LTD.

Under date June 9, a circular letter was sent to shareholders in the Dominion Copper Co., Ltd., in which the following appears:

At a meeting of the shareholders of your company, held on May 12, 1906, the following resolution was adopted:

"Resolved. That the proposition and plan of the directors of the company to issue and sell \$300,000 par value of the company's first mortgage bonds, and about 228,000 shares of its stock of the par value of \$10 each, substantially in the manner and upon the terms and subject to the conditions set forth in a notice to the shareholders dated April 25, 1906, which is hereby referred to, be and the same time is in all things approved; and the directors and officers of the company are hereby authorised and directed to execute on behalf of the company an underwriting agreement of the general form and tenor of the draft agreement submitted and read at the shareholders' meeting, with such modification as to details as may be approved by the company's counsel; and all or any of the directors of the company are hereby authorised to sign such underwriting agreement as underwriters, and personally to participate in any profits or benefits that may accrue therefrom, notwithstanding their positions as directors; and the directors and officers of the company are further authorised and directed to execute any other instru-

ments, and to do any and all other acts, necessary or appropriate fully to carry out the purposes of this resolution."

At a meeting of the directors of the company held on May 15, 1906, resolutions were passed, pursuant to said action of the shareholders, whereby the issuances of the bonds referred to was fully authorized, and the issue will be made as follows:

The prior right of subscription is reserved to the stockholders. The bonds and stocks are to be sold together. Each bond of the par value of \$100 will be sold with 76 shares of the capital stock of the par value of \$10 each. It is impossible to offer any less amount of these securities to any one individual because the unit of subscription must be based on the ratio of the amount of bonds to the amount of stock to be sold. The lowest denomination of the bonds being \$100, the corresponding aliquot portion of stock is 76 shares.

The price of a bond of the par value of \$100 and 76 shares of accompanying stock is \$229.80, as of June 1, 1906. The interest coupons maturing June 1, 1906, annexed to the bonds, will be detached, and the interest accruing between that date and the time for final payment of subscriptions will be adjusted and paid at the time of the final payment.

The outstanding stock amounts to about 270,000 shares of the par value of \$10 each. The amount of the proposed issue is 228,000 shares. For the sake of convenience, and in order to offer to each of the other shareholders entitled to participate share for share of his recent holdings, some of the large shareholders have consented to waive their right to subscribe for their full proportion of these securities. Accordingly, every holder of 76 shares (par value \$10 each) desiring to do so will be entitled to subscribe for one bond of \$100 and 76 shares accompanying it. The holder of twice that amount of shares may subscribe for twice that amount of bonds and accompanying stock; and so on.

While any holder of less than 76 shares of stock (par value \$10 each) cannot be definitely assured that he will receive an allotment, all shareholders are invited to subscribe, if they see fit, and will receive an allotment, if practicable, the matter of allotment having been left by the action of the shareholders and directors in the unrestricted discretion of the board.

The bonds are payable June 1, 1915, but are redeemable earlier by the company in the manner provided therein. The total authorized issue is \$1,000,000, of which \$700,000 are now outstanding.

Pursuant to authority of the shareholders and directors the proposed issue has been underwritten by a syndicate which has agreed to take all of the bonds and stock which shall not be taken by the shareholders.

COMPANY CABLES AND NOTES.

CABLES.

British Columbia.

Le Roi—May: Shipments amount to 12,017 tons containing 4,887 oz. gold, 6,734 oz. silver, 270,000 lb. copper. Estimated profit on this ore, after deducting cost of mining, smelting, realisation and depreciation, \$50,000. Expenditure on development work during the month, \$13,500.

Le Roi No. 2—May: Shipped 2,100 tons. The net receipts are \$33,517, being payment for 2,126 tons shipped, and \$1,800 being payment for 52 tons concentrates shipped; in all, \$35,317.

Tyce—May: Smelter ran 13 days, and smelted—Tyce ore, 1,915 tons; custom ore, 748 tons; total, 2,663 tons. Matte produced from same, 266 tons. Gross value of contents (copper, silver, and gold) after deducting costs of refining and purchase of custom ore, \$38,177.

U. S. A.

Alaska Consolidated—Mr. John R. Mitchell, superintendent at the mines, Juneau, Alaska, reports by cable. "Developments made in mine last week are as follows:—Alexander tunnel, No. 3 east drift—No. 5 chute upraised 10 ft.; average assay value, \$2.70 per ton. No. 3 west drift—No. 3 upraise risen

20 ft.; average assay value, \$4.50. No. 3 west drift—No. 1 cross-cut driven 28 ft. across footwall ore body, of which 10 ft. averages \$8.35; the whole 28 ft. averages \$5 per ton."

Alaska Mexican—May: 120-stamp mill 29½ days, 20,074 tons ore; estimated realisable value of bullion, \$41,337. Saved 429 tons sulphur; estimated realisable value, \$40,467. Working expenses, \$30,785.—Note by London office: The San Francisco office states that a letter has been mailed explaining the extra large yield.

Alaska Treadwell—May: 240-stamp mill 29½ days, 300-stamp mill 29½ days—89,055 tons ore; estimated realisable value of bullion, \$93,250. Saved 1,671 tons sulphur; estimated realisable value, \$85,406. Working expenses, \$55,201.—Note: The San Francisco office advises that the expenses are unusually low, owing to large credits on mining account.

Alaska United—May: Ready Bullion claim—120-stamp mill 29½ days; 20,260 tons ore; estimated realisable value of bullion, \$26,477. Saved 428 tons sulphur; estimated realisable value, \$16,961. Working expenses, \$26,815.

NOTES.

The Prince Mining and Development Co.'s Standard mine, in the Big Bend district, has been shut down for a short time until the snow is sufficiently gone to enable work to be started on a lower level. The annual meeting of shareholders will be held at the company's office, at Revelstoke, on July 18, prox.

Louis Pratt, of Sandon, Slocan, has been appointed official liquidator of the Last Chance Mining Co. The company has been reorganised, and operation of the mine will be resumed shortly.

The Consolidated Mining and Smelting Co. of Canada, has put five men to work on its Eureka-Richmond group of mineral claims near Sandon. The group is situated in the vicinity of the Slocan Star mine.

The Klondike Water Supply Co. has been incorporated with a capital of \$6,000,000 to establish a system by which water from the Klondike Creek, Yukon, may be brought to Bonanza, Hunker, Eldorado, Gold Run, Sulphur and other creeks for hydraulic mining. The incorporators are Alex. McDonald, Dr. Wm. Barrett and A. B. Patmer, of Dawson; Robert Kelly, of Vancouver, and Alfred Hitchcock, of London, England.

The *London Critic* states that the secretary of the Yukon Corporation has issued the following:—"At a meeting of directors of the corporation held on February 27 last the financial position was fully discussed, and the board came to the conclusion that it was impossible to continue operations. They therefore recommend to the shareholders that the company be put into voluntary liquidation." In accordance with this decision notice is given of an extra-ordinary meeting for the purpose of passing the necessary resolution, to be held on June 26.

The annual general meeting of the Rambler-Cariboo Mines, Ltd., was held in the company's offices, Kaslo, recently. The members of the former board of directors were all re-elected.

Mr. James Cronin, of Moyie, East Kootenay, and Mr. J. C. Hodgson, of Hodgson, Sumner & Co., Montreal, have been elected on the board of directors of the Consolidated Mining and Smelting Co. of Canada, Ltd., owning the St. Eugene mine at Moyie, War Eagle and Centre Star mines at Rossland, Canadian Smelting Works at Trail, and other properties. Mr. Cronin is manager of the company's mines.

The Consolidated Mining and Smelting Co., of Canada, Ltd., is inviting tenders for the supply of 40,000 ft. peeled stull timbers to be delivered at the St. Eugene mine works, lower Moyie Lake.

Mr. Geo. P. Payer, of Nelson, liquidator of the B. C. Standard Mining Co., Ltd., owning mining property in Ymir district, has been advertising requiring creditors of that company to prove their debts or claims on or before June 30, so as to entitle them to participate in any distribution that shall be made.

The newly incorporated Britannia West Copper Co. will acquire the Twentieth Century group of mineral claims on

Howe Sound, B.C., from Mr. E. Cowper-Thwaite, who is proceeding to Mexico. Mr. Thos. Gibson, formerly of South Africa, is to superintend the company's mining operations, which are to be proceeded with after his arrival from Cananea, Mexico.

The name of the Skeena Development Syndicate, Ltd., which was on March 1, 1905, incorporated under the "Companies' Act, 1897," has been changed to the Prince Rupert Development Syndicate, Ltd.

The Pontiac Copper Mines, Ltd., has had a notice gazetted of its intention to make application to have its name changed to that of the Keremeos-Pontiac Mines, Ltd.

Mr. Sidney Stockton Taylor, of Nelson, British Columbia, barrister, has been appointed the attorney for the Dundee Gold Mining and Milling Co., Ltd., in the place of Mr. Joseph Duhamel, whose appointment has been revoked.

M. Tade Obalski, of Atlin, British Columbia, has been appointed attorney for the Societe Miniere de la Colombie Britannique, in place of M. Henri Maluin.

On June 16 the British Columbia Copper Co. took up its bond on the Oro Denoro mine in Summit Camp, which mine it has been prospecting with the diamond drill for some time past. During the years 1903-1906 some 41,000 tons of chalcopryite and magnetite ore, of similar grade to the general run of Boundary copper ores, have been shipped to district smelters from this mine.

The Canadian Metal Co., Ltd., has sent the MINING RECORD the following notice: We beg to notify you that Mr. C. Fernau is no longer general manager of this company, nor in any way connected with it. All letters and communications should be addressed "Canadian Metal Company, Nelson, B.C."

CERTIFICATES OF INCORPORATION.

- Britannia West Copper Co., Ltd.*, with a capital of \$500,000, divided into 100,000 shares of \$5 each.
- Boundary Mining and Exploration Co., Ltd.*, with a capital of \$200,000, divided into 200,000 shares of \$1 each.
- Thomas-Gasaway Co., Ltd.*, with a capital of \$1,000, divided into 1,000 shares of \$1 each.
- Northern Ventures, Ltd.*, with a capital of \$10,000, divided into 100 shares of \$100 each.

REGISTRATION OF EXTRA-PROVINCIAL COMPANIES.

- Cariboo Gold Mining Co.*—Head office at Wilmington, Delaware, U.S.A. Capital, \$1,000,000, divided into 10,000 shares of \$100 each. Head office in British Columbia at Bullion. Attorney, J. B. Hobson, Bullion.
- Otter Creek Development Co.*—Head office at Toledo, Ohio, U.S.A. Capital, \$20,000, divided into 20,000 shares of \$1 each. Head office in British Columbia at Atlin. Attorney, Alfred Carmichael, Atlin.
- Cornell Operating Co.*—Head office at Seattle, Washington, U.S.A. Capital, \$14,000, divided into 14,000 shares of \$1 each. Head office in British Columbia at Van Arda, Texada Island. Attorney, A. G. Deighton, Van Arda, Texada Island.
- Bullion Hydraulic Mining Co.*—Head office at Wilmington, Delaware, U.S.A. Capital, \$250,000, divided into 250,000 shares of \$100 each. Head office in British Columbia at Bullion. Attorney, J. B. Hobson, Bullion.

NEW REGISTRATION IN ENGLAND.

- Western Dominion Collieries, Ltd.*—Registered May 23, by Herbert Smith & Co., Ltd., 62 London Wall, E.C. Capital £200,000, in £1 shares. Objects: To acquire certain collieries in Saskatchewan, Canada, with the fixed and movable plant, surface and other rights, etc., appertaining thereto, and to carry on the business of coal and

general miners, etc. No initial public issue. The first directors (to number not less than two nor more than seven) are: Frank Harcastle, J.P., D.L. (director of Thomas Fletcher & Sons, Ltd., colliery proprietors), 87 Lancaster Gate, W.; A. G. Pollock (managing director London & New York Investment Corporation, Ltd), 18 St. Helen's Place, E.C.; C. G. Ross, J.P. (director Gresham Life Assurance Society, Ltd., 38 Beaufort Gardens, S.W.); and J. R. Tennant (director Western Canada Land Co., Ltd., 19 Hanover Square, W. Qualification, 100 shares. Remuneration, £100 each per annum and £100 extra for the chairman. Registered office, 6 Old Jewry, E.C.

COAL NOTES.

The Canadian Pacific Railway Co. has a gang of men clearing up a townsite at Hosmer, in the Crow's Nest Pass. A coal seam will also be opened, a tunnel on which is to be commenced at once.

The Nicola *Herald* states that Mr. Paul Bockmier, of Palouse, Wash., manager of the Nicola Coal Mines, Ltd., which owns about 5,000 acres of coal lands in the vicinity of Lindley Creek, near Lower Nicola, was at Nicola lately. He stated that work would be commenced shortly on the property and tenders were now being called for driving the present tunnel, which is in about 30 ft., 100 ft farther in. Other work will be done on different parts of the property.

Lundbreck, the new town being built around the collieries of the Breckenridge and Lund Coal Co. in Southwest Alberta, is making much progress. The development of the coal mine is proceeding in a most satisfactory manner. Coal shipments now average 150 tons a day. There is general contentment with the situation; the town is building up, and with the numerous improvements now planned under way, the end of the season should see the importance of the place as a town much enhanced.

A press despatch from Nanaimo states that President Howard, of the Western Fuel Co., recently arrived from San Francisco. After consultation with the local management, the company decide to close the Brechin mine down for an indefinite period. Mr. Howard says that business in San Francisco has been completely paralyzed by the earthquake and the consumption of coal has been curtailed to such an extent that with the bunkers and yards of the company in that city running over with coal this step has been found necessary. In the meantime No. 1 mine will be kept working full time as the sale of enough coal has been obtained to guarantee this. There are 800 men working in No. 1 now and in addition to this work will be found almost immediately for about 150 men from Brechin, leaving about 200 men out of employment. Nanaimo is not the only coal centre to suffer by the San Francisco disaster, as the Coos Bay mines, Oregon, have been shut down. The Washington mines, having little direct business with San Francisco, are not affected to any great extent. Asked how long the Brechin mines would remain closed, no definite answer was given, but it was considered possible that it would be until the end of the year.

The West Canadian Collieries, Ltd., Blairmore, Southwest Alberta, is now shipping from its collieries at Lille and Bellevue 1,100 tons of coal per day beside producing about 100 tons of coke. At the No. 1 mine at Lille, where is situated the big tippie, the work of gradually increasing the capacity of the plant and extending the development of the mine is being steadily carried out and between the sawmill, railway and mine, this company is now giving employment to over 275 men at Lille. A large addition is being built to the boiler house so as to provide for the increased work at the coal washery. At the Bellevue mines four seams are being developed and worked through the main entry, which is a cross-cut tunnel that cuts all four seams in a distance of about 350 ft.

MACHINERY AND CONSTRUCTION NOTES.

An order received by the Jenckes Machine Co., Ltd., of Sherbrooke, Quebec, through its Vancouver, B.C., office, for a 100-h.p. tubular steam boiler for the Brown-Alaska Co., of New York, has lately been executed, the boiler having been delivered at Vancouver, for shipment thence to Portland Canal. Beside this boiler the Brown-Alaska Mining Co. lately also shipped from Vancouver an air compressor, cable etc., for an aerial tramway; 110,000 ft. of lumber for wharf and ore bunkers; and other plant and materials for two mines which it is developing near Portland Canal. This company has copper mines and (in conjunction with the Alaska Smelting and Refining Co.) smelting works on Prince of Wales Island, Southeast Alaska.

The Jenckes Machine Co., Ltd., through its Rosslund office, has closed a contract with the Dominion Copper Co., Ltd., operating copper mines and smelting works in the Boundary district of British Columbia, for the supply of two Farrel-Bacon crushers—one 42 by 30 in. and the other 16 by 10 in. The shipping weight of the larger machine is 125,000 lb. and its capacity is 1,500 tons crushed to not larger than a 6-in. cube in a day of 10 hours. It is stated to be the largest pattern jaw crusher so far made anywhere. Several of the Jenckes Farrel-Bacon pattern crushers have, during the last three or four years, been installed at the mines of the British Columbia Copper Co. and Granby Consolidated M. S. and P. Co., Boundary district, and have been found well suited to the continuous and heavy ore-crushing work connected with the large output steadily maintained by those mines. Another order recently received by the Jenckes Co.'s representative at Rosslund was for a 36 by 24 in. Farrel-Bacon crusher for the Centre Star mine at Rosslund, owned by the Consolidated Mining and Smelting Co., of Canada, Ltd. This crusher is to have a capacity of 1,000 tons crushed to 6-in. cube every 10 hours; its shipping weight will be 60,000 lb.

The Alberta Portland Cement Co., Ltd., of Calgary, Alberta, has obtained from the Jenckes Machine Co., Ltd., a hoisting plant, consisting of 40-h.p. locomotive boiler, 7 by 10 hoisting engine, rope, steam piping, etc.

The Hamilton Powder Co. this month purchased from the Western Fuel Co. 90 acres of land situated near Nanaimo, Vancouver Island, and adjoining that on which the former company's powder factory stands. This land has been acquired to admit of necessary extensions to the factory buildings and plant being made, the increasing demand for the Hamilton explosives, which find a large and ready sale in the Pacific Northwest, making it imperative that provision be made without further delay for the expansion of business already experienced and further developing.

The Crow's Nest Pass Coal Co., Ltd., is installing at its No. 9 mine, Coal Creek colliery, near Fernie, Southeast Kootenay, a Wilson fan, similar to that supplying air to Nos. 2 and 3 mines, which is 12 ft. face and 16 ft. diameter, capacity 250,000 cu. ft. of air per min. and discharging about 150,000 ft. at water gauge 09 in. The output of No. 9 mine being now about 600 tons per diem, the fan in use during development operations is now too small to properly ventilate this mine. A new tunnel is being driven in No. 9, to be completed by the time the new fan shall be ready for operation—about the end of July.

The Granby Consolidated M. S. and P. Co., Ltd., is adding to its smelting plant at its works at Grand Forks, Boundary district, two Connersville "Jumbo" blowers, to meet additional blast requirements following the enlargement of several of its copper blast furnaces, and four 150-h.p. induction motors to drive these blowers. The "Jumbo" blower installed late last year has a capacity of 30,000 cu. ft. of air per min., and has a double drive, being operated by two 100-h.p. induction motors. It is the largest blower in Canada. Those about to be installed are of similar make and capacity. Three more electric motors, for furnace automatic charging purposes, are being obtained, and another power pump, having a capacity of 750,000 gal. per diem. The work

of putting in a third converter stand, of the horizontal barrel type, is already well advanced.

Additional machinery is being received at the Ottawa mine, Slocan City mining division, including air compressor, hoist, pumps, etc. An electric light plant is also to be installed. It is intended to sink a shaft from the 500-ft. level of the mine. The Ottawa is owned by Mr. Thos. A. Noble and others, of Pittsburg, Pa., who are stated to have made money out of operating it during the last two years. Mr. R. J. McPhee is manager.

The International Coal and Coke Co. has let a contract for building 90 additional beehive coke ovens at its colliery, Coleman, Alberta. The company is already using about 100 similar ovens.

A wharf with coal bunkers to have a storage capacity of about 600 tons is to be built at Coal Harbour, Vancouver, Macdonald, Marpole, & Co. having let a contract to Ironside, Rennie & Campbell, the work to be completed by the end of July. The *Province* states that Macdonald, Marpole & Co. have secured a water frontage of 295 ft. 6 in. immediately west of Jarvis Street, and that the bunkers will be 160 ft. in length, with an extension for a travelling crane to unload the coal from the scows in which it will be conveyed from Vancouver Island shipping ports, the total length of the structure to be about 200 ft.

TRADE NOTES AND CATALOGUES.

Mr. N. S. Braden, sales manager for the Canadian Westinghouse Co., Ltd., has returned to headquarters at Hamilton, Ontario, from a business trip through the West, in the course of which he visited the chief cities in Alberta and British Columbia and went thence to Seattle, Wash., and San Francisco, California.

The *Mining and Scientific Press* states that the C. T. Carahan Co., of Denver, Colorado, has given a Murphy air-hammer rock-drill and dust-layer to the College of Mining of the University of California. This is a useful addition to the apparatus at the college, and it does credit alike to the enterprise and the generosity of the company mentioned.

The Colorado Iron Works Co., of Denver, Colorado, frequently receives shipments of ore to be treated at its ore-testing works. These shipments vary from small parcels of 25 lb. up to lots of a carload or more. Recently a 500-lb. shipment was received from Japan others have come from Mexico, South America, the Philippines, Australia, and from points scattered over the western half of North America. The company's testing plant provides facilities for stamp-milling, amalgamation, concentration and cyanidation, with all modern accessories for each process.

Canadian Westinghouse Co.'s Circular No. 1130 describes and illustrates that company's Electro-Static Voltmeter, for measuring high voltages, the advantages of which are outlined and compared with the disadvantages of the more familiar of other methods.

Among the May circulars of the Westinghouse Electric and Manufacturing Co. are the following: No. 1,129, Westinghouse No. 119 Railway Motor for Direct-Current Service; No. 1,132, Westinghouse Protective Apparatus and No. 1,134 Electrical and Mechanical Brakes for Westinghouse Type K Motors. Each is freely illustrated and gives much useful information on its subject.

The Westinghouse Electric and Mfg. Co. is doing a large business in equipping mines with electric locomotives, to replace the older forms of haulage, whether animal or mechanical. Electric mine haulage, whether considered from the point of efficiency or economy, has so many advantages as compared with the older practice, that it is believed the time is not far distant when any other method of mine haulage will be the exception.

The tippie being erected at Frank, Alberta, for the Canadian-American Coal and Coke Co. is well under way.

BOOKS, ETC., RECEIVED.

United States Geological Survey.—

Water Powers of Northern Wisconsin. By Leonard S. Smith. Pages 137; illustrated by half-tones, diagrams and map.

Oil Fields of the Texas-Louisiana Gulf Coastal Plain. By N. M. Fenneman. Pages 139; illustrated by half-tones, diagrams and maps.

Results of Spirit Leveling in Pennsylvania for the years 1899 to 1905, inclusive. By S. S. Gannett and D. H. Baldwin. Pages 54.

Results of Spirit Leveling in the State of New York for the years 1896 to 1905, inclusive. By S. S. Gannett and D. H. Baldwin. Pages 100.

The Rampart Gold Placer Region, Alaska. By L. M. Pringle and Frank L. Hess. Pages 50; illustrated by half-tones and maps.

Geography and Geology of Alaska. A summary of existing knowledge by Alfred H. Brooks, with a section on Climate by Cleveland Abbe, Jr., and a topographic map and description thereof by R. U. Good. Pages 308; illustrated by numerous half-tones, diagrams and maps.

The Tertiary and Quaternary Pectens of California. By Ralph Arnold. Pages 250; illustrated by numerous half-tones.

Underground Water Resources of Long Island, New York. By A. C. Veatch, C. S. Slichter, Isaiah Bowman, W. O. Crosby, and R. E. Horton. Pages 385; illustrated by half-tones, diagrams and accompanying maps.

Geology and Mineral Resources of part of the Cumberland Gap Coal Field, Kentucky. By George Hall Ashley and Leonidas Chalmers Glenn. Pages 225; illustrated by half-tones, diagrams and accompanying maps.

KETCHIKAN, SOUTHEAST ALASKA.

From the *Ketchikan Mining Journal*.

Information has reached here that the bill providing for the extension of the Government cable to Ketchikan and Wrangell was signed by President Roosevelt on June 13. The amount of the appropriation for this work is given as \$179,000. Mr. T. J. Patterson, in charge of the cable office at Juneau, has been instructed to inform the department whether suitable buildings for cable offices are available at Wrangell, Petersburg, Ketchikan and Hadley. As Hadley is on Prince of Wales Island, it appears that its mining and smelting interests, which would use the cable to a considerable extent, are likely to also benefit by the extension. It is announced to be the intention of the department to proceed without delay with the laying of the cable, and to have it in working order by September 30 next.

Mr. J. M. Miller, president of the Cymru Copper Co., has returned to his home at Tacoma, Wash., after having paid his first visit to his company's Cymru mine at Moira Sound. The wharf at the camp was recently completed, in time for the landing thereon of about 100 tons of steel rails, tram cars, and other plant for use in the mine. The construction of ore bunkers, to have a capacity of about 1,200 tons, has been commenced. The company is making small shipments of ore to smelters at Hadley and Coppermount, both on Prince of Wales Island; Ladysmith, on Vancouver Island, B.C.; and Tacoma, Puget Sound, Wash., for test purposes, with a view to determining where to arrange for the regular treatment of ore from its mine.

Hon. W. B. Hoggatt, the newly appointed governor of the District of Alaska, was banquetted at Ketchikan on June 16, some 70 men resident in Ketchikan district attending to do him honour. The toast of "Mining" was done justice to by Mr. G. L. Parker, superintendent of the Brown-Alaska Co.'s several mines. While in the Ketchikan district Governor Hoggatt visited the mines on Prince of Wales Island of the Brown-Alaska and Hadley Consolidated Copper companies, also the Alaska Smelting and Refining Co.'s smelting works

at Hadley, which were designed and erected by Mr. Paul Johnson, who has been successfully operating them during several months of the current year.

The tug John C. Potter, which brought in from Union, B.C., coke for the Hadley smelter, will have for return freight marble from the Alaska Marble Co's quarries at Marble Creek, Shakan Bay. These quarries are extensive and some very fine marble has been excavated from them. A shipment of 1,100 tons has already been made to Chicago, Ill., and now 1,600 tons are being loaded for the same market.

The Red Wing mine lately shipped 140 tons of ore to the Tacoma smelter. The Wellington took another shipment of copper matte from the Hadley smelter to the Britannia Smelting Co.'s works at Crofton, Vancouver Island, to be there converted into blister copper for shipment to New York.

J. R. Heckman & Co. having obtained judgment against the Golden Fleece Mining Co., it has been ordered that the property rights and interests of the defendant company shall be sold to satisfy such judgment. The sale has been announced to take place at Dolomi on Friday, July 27. The property levied on by the U. S. Marshal for Division No. 1, District of Alaska, includes several mining claims in the Ketchikan Precinct, Port Johnson mining district, Prince of Wales Island; tramway, 10,000 ft.; buildings, consisting of wharf, office, warehouse, dwelling house, boarding house, bunk house machinery and plant, including 2-stamp mill, ore crusher, concentrator, and steam engine and boiler.

The tug "Mary D. Hume," recently purchased by General Manager F.W. Hale for the Alaska Copper Co., is on her way north from Seattle with a barge in tow. On her up trip she is bringing a shipment of siliceous ore for the Hadley smelter. After unloading at Hadley she will proceed to Karta Bay for ore for the Coppermount smelter, the furnace of which will be blown in after her arrival at the latter place.

Mr. Harry P. Stow, assistant superintendent of the Alaska-Treadwell gold mine, Douglas Island, Alaska, has been revisiting his old haunts at Oroville, and Forbestown, in Butte county, California, U. S. A.

The loss entailed by the dynamite explosion and subsequent fire at Cobalt on May 18 is estimated at \$25,000. About 20 houses were destroyed by the explosion and 50 burned. In future all powder and dynamite will be stored a considerable distance outside the town limits.

Mr. John L. Howard, of San Francisco, Cal., president of the Western Fuel Co., operating coal mines at Nanaimo, Vancouver Island, was at Nanaimo during the latter part of June. The company has closed its Brechin mine, at Departure Bay, consequent upon a considerable falling off in the demand for coal in San Francisco, which is the chief market for Vancouver Island coal.

Mr. A. N. C. Treadgold, of London, England, was in Vancouver towards the end of June en route to Seattle and thence to Dawson, Yukon, where he will attend to the interests of English capitalists he represents. Mr. Treadgold's name is familiar to all interested in Yukon matters, by reason of his connection with the Treadgold Concession, of which so much has been heard during recent years.

From the *Revelstoke Mail-Herald* it is learned that Mr. E. A. Haggen, M.E., is severing his connection with the Interior Publishing Co., Ltd., which publishes that newspaper, and intends opening a real estate, insurance, share-broking and financial agency in Revelstoke, having been appointed agent for an Eastern company investing in British Columbia lands, mines and timber. Mr. Haggen has done much useful work in visiting and publishing descriptions of mining properties in Revelstoke and Northern Lardeau districts during several recent years.

MINING MEN AND AFFAIRS.

Mr. W. D. McGregor, M.E., has returned to Victoria from a business trip to the Similkameen.

Mr. H. Pim, Vancouver, local manager for the Canadian General Electric Co., has been visiting Toronto, Ontario.

Mr. Elfric Drew Ingall, mining engineer to the Geological Survey of Canada, recently paid a brief visit to New York.

Dr. Robert Chalmers, of the Geological Survey Department, is making a tour of Western Canada with a view to locating clay suitable for the manufacture of fire-brick.

Mr. F. C. Laird, manager of the Willow River Mining Co., Cariboo, returned to Barkerville about the third week in June from a business visit to the Coast.

Mr. R. H. Anderson, superintendent of the Sullivan Group Mining Co's mines near Kimberley, East Kootenay, visited Rossland during the month, reaching that camp on 21st.

Mr. O. B. Smith, Jun., superintendent of the Granby Co's mines at Phoenix, has been visiting at his old home at Spencer, Massachusetts, U.S.A.

Mr. Phil. Holliday, mining recorder at Kluane, Yukon Territory, when in Whitehorse last month reported much activity in the Kluane district this spring.

Mr. E. Conway left Ladysmith during June for Prince of Wales Island, Southeast Alaska, where he will be assayer and assistant manager for the Omar Mining Co. at Kiam.

Mr. L. C. Wynne, of Claudet & Wynne, assayers, recently visited the Similkameen. He has announced that it is his intention to open an assay office at Princeton.

Mr. H. L. Manley, assistant engineer for the Crow's Nest

Pass Coal Co., was married at Fernie on June 18. A honeymoon trip was spent visiting the Coast cities.

The Whitehorse *Star* says: F. E. G. Berry, mining engineer for the Bullion Hydraulic Co., is in town and reports everything as being favourable to a busy season for his company.

Mr. Jas. D. Sword reached Victoria from Seattle late in June *en route* to Alberni, to examine a mining property on the west coast of Vancouver Island.

Mr. Charles A. Bramble is now editor of the *Canadian Mining Review*, having succeeded Mr. H. Mortimer Lamb, who resigned several months ago on account of ill health.

Mr. Paul S. Couldrey, manager of the Le Roi No. 2 mine at Rossland, is now also in charge of the Velvet-Portland mine, situated on Sophie Mountain, in the same district.

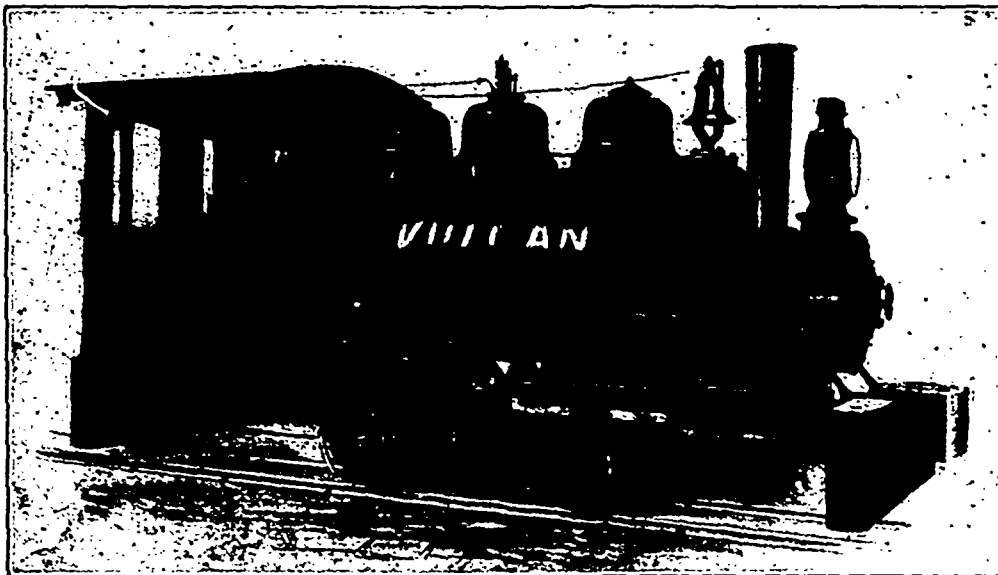
Mr. J. P. Rogers, manager of the Conrad Consolidated mines, at Windy Arm, Yukon Territory, was in Seattle, Wash., lately buying mining machinery.

Mr. John W. Bell, M.E., was in the Nicola district during June, examining mining properties in which Mr. R. P. Inglis, of Montreal, Quebec, who accompanied him, is largely interested.

Mr. Wm. White has arrived at Moyie, East Kootenay, to succeed Mr. Geo. Clothier as superintendent of the Consolidated Mining and Smelting Co. of Canada's St. Eugene mine on Moyie Lake.

Mr. R. G. McConnell, of the Geological Survey of Canada, left Vancouver on June 9 by the "Princess Beatrice" for Skagway, *en route* to Dawson to take up the season's field work in Yukon Territory.

Mr. Albert I. Goodell, superintendent of the Le Roi Min-



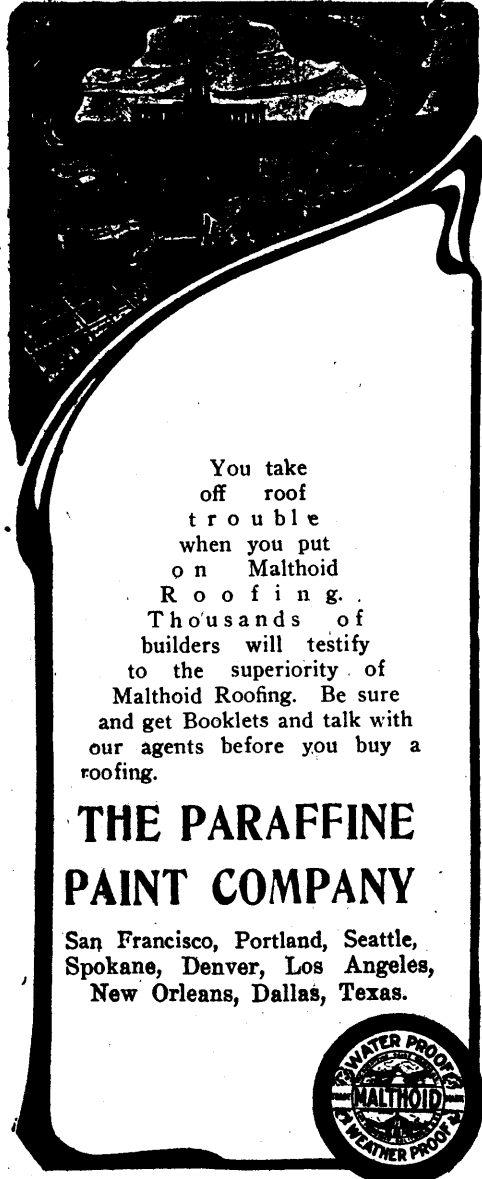
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AGENT N. W. T.—

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ing Co's smelter at Northport, Washington, has returned from a visit to the East which extended over five or six weeks.

Mr. Frank Robbins of Los Angeles, Cal., formerly manager of the North Star mine, East Kootenay, has been appointed to the charge of the property of the Midnight Sun Mining Co., on Solomon River, Alaska.

Mr. Robert Musgrave, for some time past with the Copper Queen Consolidated Mining Co., at Bisbee, Arizona, has been appointed general superintendent for the El Tigre Mining Co., Yzabel, Sonora, Mexico.

Mr. G. G. S. Lindsey, general manager of the Crow's Nest Pass Coal Co., Ltd., with coal mines at Coal Creek, Michel and Carbonado, Southeast Kootenay, has returned to Fernie after spending a week at Victoria.

Hon. W. B. Hoggatt, governor of the District of Alaska, is expected to during July pay a visit to Dawson, Yukon, where he will be the guest of Hon. W. W. B. McInnes, Commissioner of Yukon Territory.

Mr. Jules Labarthe, superintendent of the Trail smelter, on June 18 paid a visit to the Canadian Metal Co's Blue Bell mine, on Kootenay Lake, afterwards proceeding to East Kootenay.

Mr. Geo. H. Grant, who is in charge of development work at the June group, Quatsino Sound, West Coast of Vancouver Island, was married recently. After a honeymoon trip Mr. Grant returned to Quatsino accompanied by his bride.

Mr. J. J. Constant Fernau, late general manager for the Canadian Metal Co., has brought action against that company for \$1,234 for balance of salary and other amounts claimed, and for unstated damages for wrongful dismissal.

The *Engineering and Mining Journal* states that Mr. W. M. Brewer, M.E., of Victoria, B. C., has gone to Kodiak Island, off the Alaskan Peninsula, where he will be engaged in professional work during the summer.

Mr. R. G. Drinnan, of Fernie, Southeast Kootenay, general superintendent for the Crow's Nest Pass Coal Co., was a recent visitor to the Coast. He attended a meeting of the Board of Examiners for Coal Mine Officials held at Nanaimo on June 23.

Mr. C. W. McMeekin, mining engineer for the Britannia Copper Syndicate, operating the Britannia mine on Howe Sound, lately returned from another visit to the Mt. Andrews mine on Prince of Wales Island, Ketchikan district, Southeast Alaska.

J. H. Patterson has been gazetted a deputy mining recorder for the Omineca mining division with office at Skeena Canyon, and John Simpson of Poplar to be acting mining recorder at Trout Lake during the absence on leave of F. C. Campbell.

Mr. W. Bromfield Brough, for the last three years resident manager of the hydraulic gold mining property on Williams Creek, Cariboo, the Cariboo Gold Fields, Ltd., of London, has been operating, recently left Barkerville on his return to England.

The *Rossland Miner* states that Mr. A. Kaye, for several recent months assistant assayer at the Le Roi mine, has been appointed to the charge of the Dominion Assay Office, Vancouver. Mr. Kaye was for several years employed by banks having branches at Atlin to assay the gold bought by them in that camp.

The Vancouver Island Mining and Development Co., of which Mr. Clermont Livingston of Duncans is manager, has made its first shipment of ore from its Koksilah property. Some 300 tons of ore have been won from surface workings on the company's Bluebell claim, and this is being shipped to the Tye Coper Co's smelter at Ladysmith.

Mr. Chas. Camsell, of the Geological Survey of Canada, has been outfitting at Hedley and Princeton preparatory to entering upon the work of examining the Similkameen coun-