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RECENT MINING LEGISLATION.

THE volume of legislation relating directly to mining, passed at the last session of the Legislature, was not great. Taking the several acts up in the order of their introduction we have first a bill to amend the "Coal Mines Regulation Act," which provides that no Chinese, Japanese or person unable to speak English shall be employed as a bankman, onsetter, signalman, brakesman, pointsman, furnace man or underground or at the windlass of a sinking pit. There is another amendment to the same act providing for the payment of "check weighers" employed by miners, and also requiring a reasonable supply of timber to be kept in or near each working place.

A brief act provides for trial by jury of cases under "the Mineral Act," and for the determination of the respective right of persons who have certificates of work for the whole or portion of the same claim. The latter provision is purely of a technical character.

The most important measure of the session, as far as mining is concerned, is one making provision for the extraction of iron from magnetic sand. In introducing this bill the Minister of Mines said that it was to enable a new process to be employed in this

province. The act provides for the issuing of twenty-year leases for gold commissioners, with the sanction of the Lieutenant-Governor-in-Council of any unoccupied or unreserved Crown land for iron placer mining. The land may be staked by a free miner, who must place a post at each corner, and put a notice "on the post nearest to the iron placer leaseholds then being worked and also in the office of the Mining Recorder." The notice must give the name of the applicant, describe the location, and specify the area applied for and the terms for which the lease is desired. He must within thirty days after staking make his application to the Gold Commissioner in duplicate, specifying in addition to what the notice contains, the number of the applicant's free miner's certificate and the rent proposed to be paid, and there must be a plan of the ground on the back of the application. He must also file three plans of the land with the Mining Recorder, and deposit \$10.00 with the Gold Commissioner, to be applied on the first year's rent, if the application is granted, otherwise to be returned to the applicant. The balance of the first year's rent must be paid within sixty days after the lease is granted. The deposit is forfeited if the applicant does not fulfill his part of the application. The maximum area permitted in a single application is 80 acres, and the same person may not have two leases in the same locality. Agricultural land may not be leased nor any ground already occupied by free miners, except with their consent. The act provides certain covenants as to public rights of way and water, for the proper mining of the deposit and the like, and the lease may be terminated by the Gold Commissioner, subject to the sanction of the Minister of Mines, in the event of failure to perform the covenants. The leases will authorize iron placer mining only. Extensions of leases are provided for, also the consolidation of leases held as creek claims. A royalty of ten cents a ton on all iron produced is imposed. An amendment to the original act declares that none of its provisions shall interfere with the locations under the "Placer Mining Act."

A short act was passed in amendment of the "Companies Act, 1897"; one to amend the "Companies Act, 1897, Amendment Act of 1901," and one to amend the "Companies Clauses Act, 1897." The first relates to penalties to which companies may render themselves liable under the "Companies Act" or the other acts relating to such organizations. It pro-

vides that the right of action for these penalties shall belong wholly within the province, that the prosecution for the penalty must be brought within three months from the act or measure complained of, and that the penalty may be wholly or in part remitted by the Minister of Finance. It also provides that prosecutions for a penalty for failure to file the list of members with the registrar of joint stock companies must be brought by the registrar only. The act is made retroactive, except as to costs in actions already begun. This measure is intended to put an end to the numerous suits for penalties begun against incorporated penalties. Similar legislation has, we understand, been passed at Ottawa. These prosecutions were for the most part vexatious, and if allowed to be continued would have worked great injustice to many innocent people without producing any corresponding advantage.

The amendment to the act of 1901 consists in the repeal of sections 2, 3 and 4, which relate to extra provincial companies, and this leaves the law of the province in regard to these in precisely the same position as it was upon the passage of the "Companies Act, 1897." The amendment to the "Companies' Clauses Act" relates to penalties and is along the same lines as that above mentioned.

COAL DUST AND EXPLOSIONS IN MINES.

IT IS a somewhat curious coincidence that the disaster at the Fernie Colliery should have occurred on the same day of the month, and also under precisely similar conditions to a disastrous accident which took place last year at the Universal mine, in Wales, resulting in an almost equal loss of life. According to a report issued by the Home Office on this explosion, the Union pit was a new one, the colliery was well laid out, the ventilation good, and the engines and equipment generally were of a first-class description. The system of watering was probably superior to that to be found in many mines: pipes were laid along the main haulage-roads for an aggregate distance of 1,450 yards on either side of the shaft, in which water-cocks were inserted every 40 yards, from which the roads were sprayed by means of hoses. In spite of these appliances, it is generally agreed that the whole of the workings at the Universal were dry and dusty when the explosion occurred. From the report of Professor Galloway, based on an exhaustive examination of the workings, the *Mining Journal* (London) points out that two circumstances are clear—first, that the ex-

plosion followed the course of the intake workings used for haulage, where there was dust and no fire-damp, scarcely touching the return-air ways; and, second, that the explosion failed to affect those parts of the workings which were permanently wet from natural causes. Our contemporary proceeds to remark: The fact that coal-dust is far more dangerous in a mine than fire-damp has been more widely recognised of late than when Professor Galloway, in 1875, demonstrated that fine coal-dust plays the part of a quasi-gas when intimately mixed with air, and, as was apparently the case here, itself initiates and carries on the explosion. In the present instance nothing can be known as to the cause of the explosion, the whole of the evidence being circumstantial in character. But, whether the originating cause was shot-firing or an explosion of fire-damp from a blower in some way ignited, it depended for its power on the presence of dust throughout the mine. When once an explosion has occurred in a confined space, the increased pressure and consequent rise in temperature greatly increases the intensity of combustion, so that coal requires wetting more thoroughly than would be the case in the open air. For instance, Mr. Hughes, in his text-book on coal-mining, states that only the smallest amounts of moisture are needed to prevent ignition, a conclusion hardly borne out by the present case. It follows from the knowledge we now possess—that a mixture of coal-dust and air alone is capable of producing an explosion—that the practical question is how to eliminate dust. The use of dust-tight wagons would greatly minimise it, and, supplemented by thorough watering, would no doubt be adequate. Professor Galloway, however, considers, as the result of long experience in the South Wales collieries, that thorough watering suffices to prevent the settling of dust upon walls, roof, and timbering, which, if once allowed to accumulate there, renders watering of the roadways alone of but little effect, as the present case shows. The main difficulty lies in insuring that the wetting is done regularly, though a more systematic inspection for dust on the roof and sides of the workings might correct laxness in this regard. If it were generally recognized by the miners themselves that the real danger of explosion, at any rate on a large scale, is due to dust, and not to fire-damp, greater progress would be made towards the fulfilment of Professor Galloway's hope that, with a better understanding of their cause, great colliery explosions will soon disappear from the record of disastrous events.

It is meanwhile satisfactory to learn that the Department of Mines is making very full enquiries, with a view to ascertaining the best methods of preventing the occurrence of accidents in coal mines in this Province resulting from the accumulation of dust in the workings.

BRITISH COLUMBIA IRON AND THE POSSIBILITIES OF LOCAL MANUFACTURE.

THE deposits of iron ore in British Columbia are numerous, and some of them are of ascertained value. There is sufficient evidence that the supply is extensive enough to enable the province to take the leading place among iron producing countries in which respect it stands, as far as is known, alone in the Pacific Northwest. The companies, which now are or contemplate being engaged in iron smelting in the State of Washington, look to British Columbia for their chief supply of ore, and the consumption already amounts to a very considerable figure, and it will certainly increase. A not unnatural feeling has arisen in some quarters in favor of taking steps to complete the utilization of our ores at home by the erection of furnaces to manufacture pig iron at home and the establishment of plants for the production of steel. It is pointed out with much justice that extensive industries would certainly follow in the wake of the production of pig iron, and also that the markets of the Orient and Australasia are just as open to British Columbia products as to those of the United States. Necessarily the domestic consumption of iron would be smaller than that which furnaces in the United States would supply, but even allowing for this it is contended that British Columbia offers such facilities for the production of iron that the industry could be profitably carried on here.

While much that has been said and written on this subject is necessarily more or less speculative, there is probably a solid basis for this claim. It is an economic principle that a country, which is content to export raw material, makes the least of its natural wealth. The manufacture of finished products is what insures a full measure of industrial prosperity. Everyone will concede that it is not desirable that our iron ore deposits should pass into the hands of American companies, who will export the raw material and manufacture the finished products elsewhere. The policy, which stopped the export of pulp wood from Ontario and has prohibited the exportation of cedar cut on Crown lands in this province, is based upon a sound principle, and the time seems to have come when it should be applied to our iron ores. The question was brought up by Captain Cox in a letter written a short time ago to the Victoria Board of Trade. Captain Cox advocated an export duty on iron ore. The board did not see its way clear to take any action upon the matter, and the opinion was expressed by some of the members that the most which could properly be done just now is to let it be understood that such a policy might be put in force in the near future, thus giving notice to com-

panies, contemplating investment in iron and steel plants in Washington, to work up British Columbia ores, that they might find this source of supply cut off. There is no sentiment in trade, of course, and any person investing his money in such enterprises would do so with the full knowledge that such a contingency might arise. An American iron smelter would require no vested right to export our iron ores free of an export duty or to handle them on the same basis as a Canadian concern. Yet it, perhaps, is only neighbourly to let it be known that the demand for a policy, which will keep our iron ores at home, is likely to arise in the near future.

Whether or not an export duty is the best way to deal with the matter is another question. Possibly a better plan would be to impose a tax on all iron ore mined with a rebate upon that smelted in the province. There can be no doubt that the legislature has full power to deal with the subject in this way, and it would be as effectual a method as could be devised.

Under present arrangements we are getting very little out of our iron deposits. A mine is being worked on Barkley Sound, the ore being shipped to Irondale, Wash., and the most of the work is done by Chinamen, and everyone knows how very little their labour contributes to business prosperity. If they are objectionable when producing wealth in the country, they are doubly so when all they are doing is to enable foreigners to carry our native wealth out of the country. The statement is made on good authority that iron ore is mined on Texada for \$1.00 per ton. This is very cheap, and if it can be done elsewhere for the same price there would seem to be no substantial reason why the iron industry cannot be established in British Columbia on a profitable basis. The subject is one which the department of mines might very profitably investigate, so that at the next session of the Legislature some definite plan may be submitted for consideration. At present the great lack is of definite information bearing on the subject. One thing is clear, namely, that if it is possible to devise a policy which will ensure the smelting of British Columbia ores at home the public will hardly indorse it.

This subject has recently been discussed at meetings of the Victoria Board of Trade and the Voters' League, and the fact most clearly demonstrated was that intelligent treatment of it is impossible, from a public point of view, until more information is available than is at present within reach. Mr. Carmichael, the Provincial Assayer, properly pointed out that without data having official sanction it would be extremely difficult to interest outside capitalists. As he said, private information may be just as complete and just as trustworthy as that officially compiled, but it

will not carry the same amount of weight. It would not have been consistent with Mr. Carmichael's official position for him to have followed this up with any recommendation, publicly at least, whatever he may do in conversations with the head of his department. Persons who have had occasion to discuss the iron industry with prospective investors, have felt the lack of just such information as Mr. Carmichael speaks of. It might be well if the government would direct special attention to the compilation of definite matter bearing on this subject. This would call for the assignment of the duty compiling it to some individual with a knowledge of the subject matter, but there can be no doubt as to the value of the report made by such a person. The Department of Mines cannot, in our opinion, address itself to a subject from which more immediate or more valuable results are likely to be derived.

In connection with the production of iron in British Columbia for export to countries beyond seas, mention may be made of an advantage which a British Columbia smelter, properly located, would have over one in the State of Washington, using British Columbia ores. Take the case of the Irondale smelter, which uses ore from Texada. The ore costs the company for mining and delivery \$1.00, and a royalty of 50cts. per ton is paid to the owners of the mine, the freight to the smelter is \$1.00, the cost of unloading is 15cts., the duty is 40cts., making the cost of the ore delivered at Irondale \$3.10. Two tons of ore are required to produce one ton of pig iron, which makes the cost of the raw material for a ton of pig iron at Irondale \$6.10. If a smelter were erected on Texada, the cost of the ore would be \$1.00 per ton, or \$2.00 per ton of pig iron, making a difference of \$4.10 in favor of the Texada product. Add to this the royalty of \$2.00 per ton on pig iron and we have a difference in favor of the Canadian product of \$6.10, that is to say, the Canadian smelter would get its raw material for nothing. These figures are given for purposes of comparison only, because they might not hold true in their entirety in respect to other iron deposits on the Coast, but they show a very satisfactory margin in favour of the British Columbia product as compared with the output of a smelter in the State of Washington, dependent chiefly upon this province for its ore supply.

THE LE ROI SCANDAL.

IN appointing a committee to investigate all matters affecting the past and present management of the Le Roi mine, and also to ascertain the true inwardness of the alleged manipulation of the company's shares, the shareholders at the extraordinary meeting held in London this month took the only sen-

sible course open to them, and until a report is forthcoming there is not much to be gained by further comment on our part. There can be no doubt, however, that important information, as contained in the cabled advices, from the mine manager, found its way to the stock exchange before it was communicated to shareholders and was used for market manipulation purposes. It will be the duty of the committee to prove these charges and place the responsibility where it belongs. We are, meanwhile, glad to note that so impartial and intelligent an observer as the *London Critic* shares our view, that the attack on Mr. Mackenzie, the mine manager, is unjust. Thus our contemporary remarks:

"If the affairs of the mine and smelter were in such a state of chaos as Mr. Frecheville described in his report of December, Mr. Mackenzie may easily have been led into an error in his method of estimating, which he was only able to discover after working for several months. It is common practice in these days to make a scapegoat of a mine manager, when the directors and their following of market-mongers in London desire to be screened; and the sinister insinuations regarding Mr. Mackenzie, which have recently been put in circulation, ought not to be too readily believed by the shareholders, until that gentleman has been heard. The evidence at present available points to the office of the company in London as the source of the early information which was acted upon by the market-mongering clique."

Meanwhile, in view of the report issued by Mr. Frecheville last November, the fact that the mine has not since been operated at a profit is not after all particularly astonishing, if the decline in metal values is considered, and if as may be shrewdly suspected, the change in the smelter practice as inaugurated by Mr. Scntag, proved somewhat disastrous. In the last month the price of copper has risen slightly, the advance being somewhat about a half to three-quarters of a cent per pound. Even this small favourable difference made, however, the considerable difference of \$32,000 on last month's operation of the mine. It is now also stated that upon the completion of the branch line of the Northern Pacific Railway into Fernie, coke will be delivered to the Northport smelter for \$6.80, which will reduce treatment costs by eighty cents a ton. Even then if oil concentration or some other cheaper method of saving values is not resorted to, there can be no doubt but that ere long the Le Roi will again be placed upon a profitable footing.

Great stress has been laid on the fact that so well-known an engineer as Mr. Wayne Darlington had consented to act in a consulting capacity for the now notorious Olalla company. Mr. Darlington, however,

has written to say that the publication of his name on the prospectus, and in the advertisements of that concern was entirely unauthorized, and without his knowledge or consent. Mr. Darlington was asked, it appears, to report on the company's claims some time ago, but he failed to do so, and has no connection whatever with the undertaking. As we previously stated the only expert opinion the company obtained was that supplied by Mr. A. A. Watson, B.Sc., of Vernon, whose report, however, was only relatively favourable, in that it testified to the promising surface showings on several of the prospects owned by the company in the Keremeos Valley, but described in the prospectus as "big mines." If the public had been invited to subscribe for shares on the strength of Mr. Watson's report there would have been no occasion for criticism, for Mr. Watson is, as everyone is aware, a trained geologist and well qualified to give an authoritative opinion on the value of mineral prospects, and in criticising the company's methods we certainly did not, as some seem to have imagined, intend for a moment to cast any slur upon Mr. Watson's professional attainments. Mr. Watson does not call himself a mining engineer, but he has made a special study of geology. In this connection the remarks made by Dr. Wolcott, at the fourteenth annual meeting of the Geological Society in the course of a discussion on the relation of geology to mining, is interesting. He said: "Nowadays the larger interests are not without a mining geologist, who is consulted on the larger affairs pertaining to the mine, while the technical work, measuring drifts, surveying the properties, etc., is done by the mining engineer, who receives smaller pay, and has less power than the mining geologist."

All signs point to a considerable revival of mining in the Cariboo district. The recent intelligence that the Slough Creek Limited, a British company engaged in deep level mining in this section, has at length tapped what is believed to be the ancient channel gravel bed at a depth of 385 feet from the surface, from which a drive of 1,000 feet was carried, is of great interest and importance, and news of the value of the deposits is naturally impatiently awaited, although confidence in the result is strongly expressed by those acquainted with Cariboo conditions. The Cariboo Gold Fields at Barkerville is operating this season on a very large scale, and great quantities of gravel are now being raised by means of hydraulic elevators. All the other mines in the vicinity of Barkerville and Stanley are said to be doing well, while a new territory is being opened up with promising results at Moffat Creek, between Harper camp and Beaver Lake. On the Upper

Horsefly a number of men are engaged in opening up and prospecting work, while sluicing is also in progress on some few properties.

The construction of the Kootenay & Arrowhead Railway, a branch of the Canadian Pacific system, having been at length completed, the Lardeau District, which is thus afforded satisfactory transportation facilities, may now be expected to become an important contributor to the mineral production of the Province. The district is unquestionably the richest silver-lead camp in British Columbia, while in one locality free milling gold quartz of exceptionally high grade character has been discovered. None of the mines have yet been proved at great depth, but all indications point to the permanence and continuity of the deposits. In the last few weeks probably on account of the more favourable conditions, consequent upon the opening up of the district by railway communication, a large number of mining transactions are reported to have been consummated, and in the next few months a large amount of capital will undoubtedly be expended in the exploitation of the many exceedingly promising claims and prospects, in the vicinities of Trout Lake, Ferguson and Fish River.

ROSSLAND ORES AND THE ELMORE PROCESS.

At a public function at Rossland this month, Mr. Mackenzie, manager of the Le Roi mine, in the course of an interesting speech, pointed out that probably the longevity and future prosperity of the Rossland District now depended on the success or failure of the application of some new process of concentration to the ores of Rossland. The Le Roi mine, he remarked, with its large bodies of low grade ores containing an excess of silica and an insufficiency of copper for successful and profitable smelting, exemplifies the need of a new and cheap method of extracting the metal values from the ore. But owing to the brittle character of the chalcopyrite in the ore, other concentration has not been found applicable. Mr. Mackenzie, however, believed that by the utilizing the new Elmore process of concentrating mineral values from the ores by means of oil, a solution to the problem would be found. Thus, he shows that the total cost of mining and delivering ore on cars during April was \$2.62 per ton. This includes all charges, with exception of depreciation of plant. Out of the total product mined one-fifth was sorted out and thrown into the second-class dump, while the remaining four-fifths had to bear all the mining charges and costs of sorting this material, which is worthless under present methods of treatment. If the oil process were successfully applied, however, instead of only four-fifths of the mine output being treated, the whole would

be turned to commercial account, the operating expenses being thus distributed over a greater number of tons and reducing the cost of mining to \$2 per ton, while the costs of crushing and concentrating should not exceed 50 cents and the loss of oil about 15 cents. Taking Le Roi ores containing values of \$4.75 per ton, at present market rates, a saving of 80 per cent. and a concentration of 10 into 1 would give one ton of the concentrate product worth \$38, the charges against this single ton being ten times the cost of mining and concentration, or about \$26.50, plus freight, smelting, metallurgical losses, interest and refiner's charges and deductions which amount to \$11 per ton, making a total charge of \$37.50 per ton, leaving a profit of 50 cents on the ten tons mined, although this does not include depreciation of plant or royalties to the inventor, yet it is safe to say that \$5 ore will clear expenses, and a profit can be made upon all ores above that value.

Meanwhile a small quantity of the Le Roi ores has already been tested by this process, but not on a large enough scale to demonstrate beyond a doubt that it will be a financial success; however, the test indicated a saving of 80 per cent., which is certainly ground for hope and encouragement.

Mr. Mackenzie concluded his speech as follows:

"Although we may not live to see as was once predicted, a continuous line of concentrates between Rossland and Trail, we may reasonably expect the mines of Rossland to produce an unbroken line of dividends to the pockets of some of the now discouraged shareholders, convincing the most skeptical that dividends can be produced from the low grade ores of the camp."

Another speaker in the course of the evening, Mr. Bernard McDonald, manager of the Le Roi No. 2, was equally optimistic and hopeful—only rather more so. After expressing in general terms his confidence in the future of all Rossland mines, he then referred to the great possibilities in the way of economic treatment of Rossland ores by oil concentration:

"Exhaustive tests made of the ores of this camp show that the Elmore process can concentrate what is now considered waste rock, that is, ore running $\frac{1}{2}$ per cent. copper, or, to be accurate, 52 per cent.—12 tons into 1, making a product containing 6 per cent. copper, and eliminating at the same time a large percentage of the silica and aluminum, that now constitutes the chief expense and difficulty in smelting these ores. The resulting product, that is, the concentrates, will require less than one-half of the fluxes and not more than one-half of the coke now required to smelt a ton of the crude ore. All the costs of concentration by this process should not exceed \$1.00 per ton, including freight to the works. So you can see at a glance, without any further figures, the favourable position the mines of this camp occupy at the present time, and how silly and foundationless are the rumors which have recently gained circulation about them. The mines of Rossland have produced in the past precious metals and useful metals having a value of \$15,000,000, and as yet the surface has hardly been scratched. This production is only an earnest of the results to be obtained in the future."

But for the cyanide process, the Rand mines could not have been made to pay, and it may be, therefore,

that through the introduction of oil concentration, the British Columbia mines will work out their salvation. So far as the big Rossland mines are concerned, however, where it becomes a question of treating 1,000 tons daily, the initial expense of installing plant will naturally be very heavy, and as the Le Roi, for example, has already an indebtedness largely in excess of its assets, the reconstruction of the company reducing the capitalization and at the same time providing adequately for future working expenses would seem to be not only an inevitable but a judicious step.

COPPER SMELTING ON VANCOUVER ISLAND.

THE establishment of a custom smelting plant of large capacity on the Pacific Coast in British Columbia has been "under discussion" for some years past. Various proposals, to each of which a bonus requisition was attached, have been presented for the consideration of the City Councils of both Victoria and Vancouver, but since last January the supplying of this need was decided upon and arrangements immediately entered into in a practical way by practical smelter men without any flourish of trumpets or requests for financial assistance. Messrs. Breen & Bellinger, than whom there are no better known metallurgists in the West, after thoroughly investigating conditions and ascertaining the amount of ore supplies available, proceeded to select a suitable site and at once started the constructive work with a view to the commencement of smelting operations about the 1st of July of the present year. As a base for ore supplies a contract was entered into with the Lenora Mining Co., of Mount Sicker, and the location selected was the new townsite of Crofton, which had been acquired by Mr. Henry Croft, for the ocean terminus of his ore railroad.

The prospects for obtaining a sufficient supply of ore to keep a smelter of a large enough capacity in continuous operation to produce satisfactory commercial results were also investigated, with the result that apparently when the claims and prospects in course of development on the East and West Coasts of Vancouver Island and in the adjacent Mainland districts, were taken into consideration, it was determined to build a smelter with a capacity to treat about 800 tons of ore per day.

In deciding upon the erection of works of so large a capacity as those projected, the promoters of this enterprise were influenced by the following favourable conditions:

(1) The geographical situation is such that not only the mines of British Columbia can be reached, but also the rapidly developing portions of Alaska to the extreme northern limit, as well as the entire Pacific Coast to the southern portion of South America.

(2) The deep water harbour at Osborne Bay on the shore of which Crofton is located, with the channels which lead into that harbour, and which are navigable for the largest vessels afloat, provided for the transportation of ores and fuel at the lowest possible cost for freight.

(3) The fact that in the past the very large ma-

majority of the vessels which have come from either the North or the South to load with coal, coke or lumber have usually arrived at the Island ports in ballast, offered an opportunity to promote not only the smelting interests but also the shipping interests, because in future it will be possible for vessels to load from their home ports with ore instead of ballast, and thereby obtain paying freight on both voyages, and at the same time admit of the freight cost on ore being sufficiently low to induce many of the producing mines in California, Mexico and South America to ship their ore to the Crofton Smelter in cases where high railway freights to interior points would prohibit shipments.

(4) The close proximity of the Vancouver Island Washington and Queen Charlotte Island coal mines, as well as the possibility, if necessary, of obtaining coke from the Crow's Nest Pass Coal Field via the Great Northern Railroad Co.'s newly constructed line from Morrisey Creek in the Crow's Nest Pass, insuring a fuel supply at exceptionally low cost.

(5) The presence in the immediate neighbourhood of suitable fluxes, such as limestone and iron ore, in large quantity, both of which are obtainable from several points on the east coast of Vancouver Island.

(6) The ample supply of timber obtainable in the smelter's vicinity for calcining purposes if required in the case of certain classes of refractory ores.

(7) The fact that labour conditions are favourable, there being less likelihood of strike troubles so common in many of the smelting centres of the United States.

(8) And the fact that the location of the smelter on the Coast would admit of the product being consigned direct to the English markets by water transportation and thus avoid the excessive all-rail freight rate across the continent to the New York market.

These then were the reasons duly considered, together with the circumstance that the ore in sight in the Lenora mine at Mount Sicker was sufficient to guarantee a base for supply, that influenced such practical smelter operators as Messrs. Breen & Bellingier in their decision to inaugurate this important enterprise at Crofton. Meanwhile construction had hardly been commenced on the smelter at Crofton before the Tyee Copper Co., which owns the Tyee mine on Mount Sicker, also gave practical assurance that they had sufficient confidence in their property and the future growth of the mineral resources of the Island by making arrangements to build a smelter at Ladysmith, situated on Oyster Bay on the East Coast of Vancouver Island and about ten miles northerly from Crofton. The plant at present being installed by this company will have a capacity to treat about 100 tons of ore a day, and the company estimate that they have sufficient ore in sight in their own mine to keep the smelter running continuously for at least two years, and they anticipate that as the development work progresses further reserves of ore will be exposed. This smelter is being erected under the superintendence of Mr. Thos. Kiddie, a thoroughly competent and practical metallurgist.

While it is almost certain that the results from smelting on this portion of Vancouver Island will prove satisfactory and profitable to the smelter com-

panies, there is another feature in connection with the establishment of these enterprises, which is important.

The establishment of the Crofton smelter will, as has already been pointed out, have a strong tendency to promote the shipping industry here by inducing the construction of vessels for the carrying of ore not only from the coast mines of British Columbia, but from those situated in countries to the North and South.

For the reason just given the lumber and coal trades, which are so important to Vancouver Island and the Coast of the Mainland, will likely develop far beyond their present limits. The establishment of the smelter, moreover, should furthermore prove an incentive to owners of the many promising claims in the immediate neighborhood to put forth greater effort in the direction of developing these properties and placing them upon a productive footing. Meanwhile the immediate effect of Messrs. Breen & Bellingier's enterprise has been to stimulate enquiry on part of both American and British investors for partially developed properties in this section of the country, and there can be no doubt but that capital in large amounts will be invested in the near future in mining on Vancouver Island and the adjacent islands in consequence. The mineral resources of Vancouver Island, so far as metalliferous ores are concerned, have not been developed in the past as they should have been, and it is not likely that a repetition of past mistakes will be witnessed.

MINES AND METALLURGY BUILDING AT THE EXPOSITION TO BE HELD SHORTLY AT ST. LOUIS.

THE Mines and Metallurgy Building of the Exposition to be held shortly at St. Louis forms part of the east wing of the fan-like general ground plan of the Exposition, and is the last building on the south side of the esplanade leading to the group of Government Buildings, which are to stand on a higher level. It will have a rich background of hillside foliage toward the southeast.

Considered as part of the general scheme, it plays a very unimportant role in the spectacular display of the Fair, and for this reason no attempt has been made to force attention to it by such means as towers, domes or similar architectural devices.

The outside dimensions are 55x750 feet. The building is divided into eight oblong parts almost equal in area. The division is accomplished with glass covered and ventilated arcades, from 30 to 50 feet wide, which makes it possible that each one of the eight divisions shall receive abundant light from every side and that no skylights shall be necessary directly over any of the exhibition spaces. At the intersection of the two principal arcades through the main axis a colonnaded rotunda is shown with an appropriate monument.

The ground floor will furnish an exhibition space of about 265,000 square feet, and about 150,000 square feet may be gained by the introduction of galleries. A sub-division of the exhibit space into numerous alcoves for each classification is suggested.

The walls of the building are set back from the facade 18 or 20 feet, forming a covered loggia, which surrounds the entire building.

The facade of the Mines and Metallurgy Building may be likened to a screen bearing the same relation to this structure as do the colonnades of the adjoining buildings to their structures.

The base of this screen consists of sculptured panels illustrating in bold relief mining and metallurgical operations in symbolical representations, the background to the sculptured figures being of a rough, golden colored glass, which will be illuminated at night and show the figures in silhouette. The figures are more than life size. As a building for housing Exposition exhibits it was argued that it should express externally as much friendly dignity as would be compatible with its ephemeral character; that it would be incongruous, however, to disguise its ephemeral character by the garb of severe and classic forms which we associate with the most lasting architectural monuments of antiquity; and that, furthermore—being a part of the greatest "show" ever attempted—it undoubtedly should be novel, striking and full of life.

The style of architecture which it represents has been a source of much speculation.

"Some have attempted to classify it as an example of the 'nouveau art,'" said Mr. Theo. C. Link, the architect of the building, "but when I recently noticed an English art critic say, in protesting against its invasion of Great Britain, that this 'nouveau art' is 'a malady, the pernicious virus of which becomes more acute the further it travels,' I feel a strong personal solicitude for a properly conducted baptismal ceremony.

"Let us, therefore, name it Secession Architecture. Perhaps I will have to explain what Secession Architecture is, if the name should not make it quite clear. It means architectural liberty and emancipation with a strong plea for individuality. It is a breaking away from conventionality in design; it is more an architecture of feeling than of formula"

RECENT LEGAL DECISIONS AFFECTING THE MINING INDUSTRY.

STAR Mining & Milling Co., Ltd. Ly., v. Byron N. White Co., recently reported.

This was an appeal to the Full Court upon the form of order providing for inspection of underground workings. The plaintiffs, the owners of the Heber Fraction and Rabbit Paw mineral claims, brought an action for damages for trespass against the defendants, owners of adjoining mineral claims, the Slocan Star and the Silversmith, located and recorded in October, 1891.

The defendants alleged that in carrying on mining operations upon their claims they discovered a vein

with its apex on their claims, and which in its downward course extended outside the limits of their claims into the ground comprised within the surface location of the plaintiff's claims, and that it was in following this vein that they had entered underneath the plaintiff's claims (which they said they had a lawful right to do) and that was the alleged trespass.

The plaintiffs alleged that the defendants were allowing their workings to cave in, etc., and were causing damage to the plaintiffs, and upon their application the late Chief Justice made the inspection order complained of.

In this order the plaintiffs undertook by their counsel to be responsible for any damage they might be liable for by reason of the inspection, and that the information obtained would be used for the purposes of the action only.

It granted leave to the plaintiffs, by their representatives to the number of 10, to enter into the mineral claims and to inspect and make plans of the workings, so far as necessary to ascertain whether defendants



had worked or were working under the plaintiffs' claims, the nature of the working and the quantity of ore removed; also to ascertain the apex, and location thereof, as to veins mined by defendants under plaintiffs' ground.

For those purposes they might inspect and copy the workings or mining plans of defendants, take samples, make observations and try experiments.

The defendants in their appeal urged that plaintiffs should give security as to damages, other than counsels' undertaking, and that they should not be allowed to copy plans, etc., and that for business reasons one company's business should not be disclosed to another. That taking of samples should be limited to a reasonable amount, and experiments not allowed at all.

The court, however, dismissed the appeal with costs, but struck out the phrase "try experiments," that being assented to by the plaintiffs. CATO.

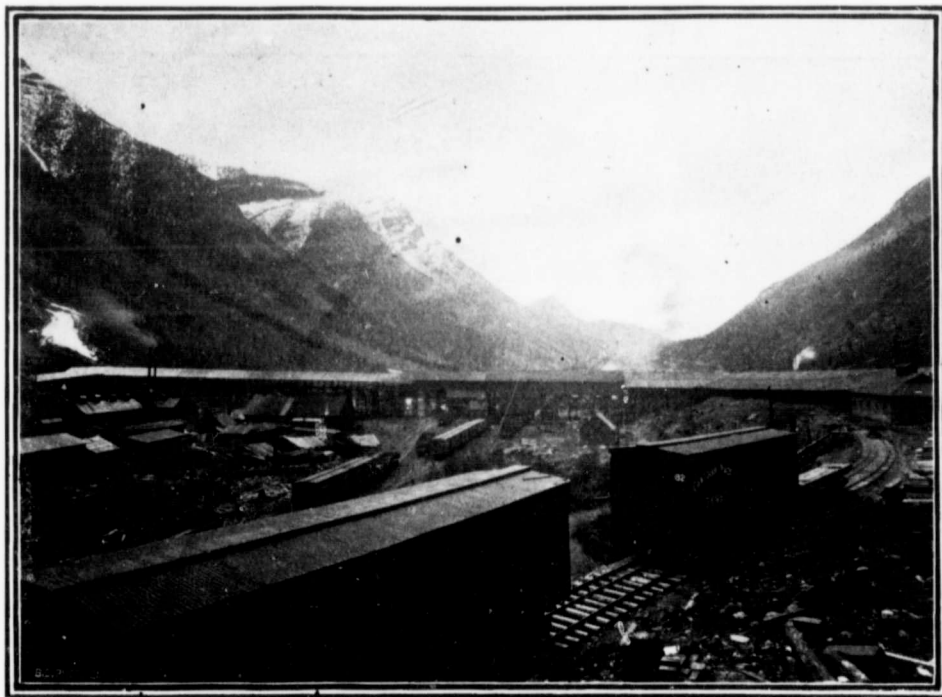
THE FERNIE COLLIERY DISASTER.

By C. H. Gibbons.

THE strange fatality which apparently attaches to festive occasions throughout British Columbia found further illustration in the colliery town of Fernie, not far from the summit of the Crow's Nest Pass, on the eve of the intended celebration of Victoria Day. I refer to the disastrous explosion, which took place last month in the workings in slopes 2 and 3 at Coal Creek, four miles distant from the town, bringing immediate death to

It had been intended to mark Victoria Day (the 24th of May) with sports, parades and band music, the Friday as well as the Saturday being devoted to the celebration; instead, it saw a horror-stricken community, dumb with sorrow, at the mine entrances, while heroic parties of volunteers staked their lives in the restoration of ventilation in the mine, and the recovery of the bodies of their unfortunate companions from the mine workings.

The disaster occurred shortly after seven in the evening, and fifteen minutes later a relief train had arrived from Fernie and the call of volunteers had



Coal Creek Mines, Overground, shewing across the centre of the picture the long trestle connecting No. 1 Mine to Nos. 2 and 3. Entrance to the ill-fated workings marked by snow spot low down on the hillside.

almost all of those employed in the ill-fated shift. The collapse of the Point Ellice bridge at Victoria just seven years before, resulted in the death of 76 persons; the disaster at the Extension mine, Vancouver Island, during the recent visit of the Duke and Duchess of Cornwall and York, cost the lives of 57 workers; in the Fernie explosion the fatalities numbered 151. Investigation of the primary cause of the disaster is now proceeding; directly, the explosion is declared by authorities to have been due to the ignition of dust from the flare of a shot in the machine section, the mine being of the class technically rated "dry and dusty," and insufficiently provided with systematic watering appliances for the guarantee of perfect safety against the accumulation of dust in the workings and the roadways.

been responded to by half a hundred men. Among these were none but Anglo-Saxons, for although Slavs and Hungarians composed quite one-half of the company's working force, it was noted with indignation in the emergency that not one "foreigner" responded to the call of duty and humanity.

It has been remarked that always on the occasion of such a crisis necessity and opportunity for action proclaim the hero. In this case, the man of the hour was a miner named Trueman Weatherby. In the first moments of partial mental paralysis among the official leaders, he took the initiative, and placing himself at the head of the first rescue party, led the way in forcing an entrance to the reeking mine, and during the twenty-four terrible hours that followed worked with tireless activity, directing operations

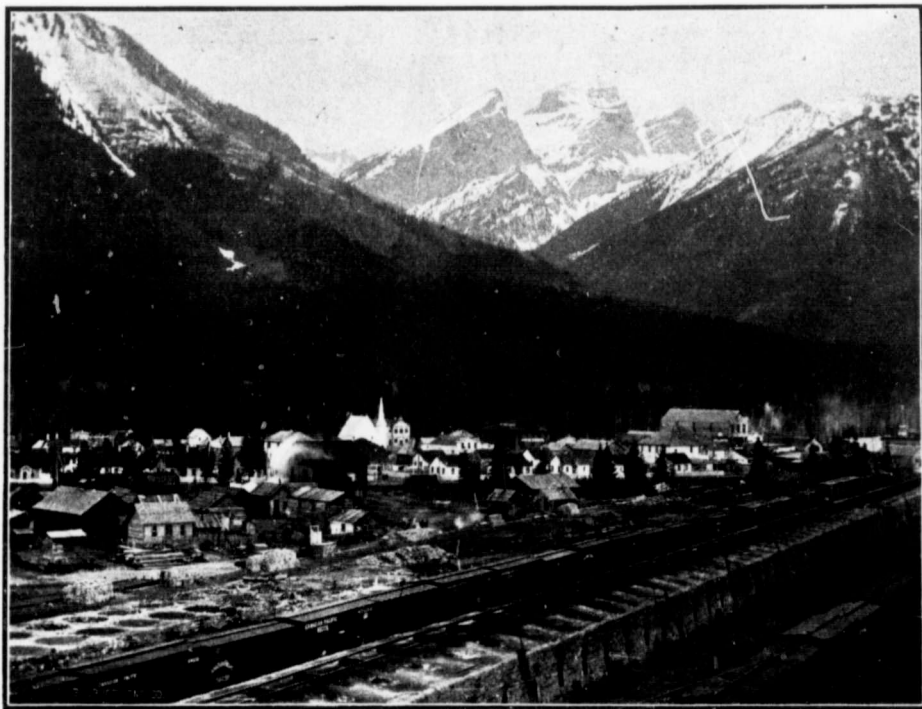
and taking upon himself the larger share of the danger and labour. Time and again he fell gasping, insensible, to be dragged forth by his fresher working mates; each time he would return to duty, directly consciousness was restored. It was he who was on hand to support Manager Drinnan when he fell unconscious, forcing his way through the choke damp—the manager's inert body in his arms—by sheer force of will and determination; it was he who bore out the first recovered body, that of the young lad Robertson; it was he who instantly perceived and did aright all things that such occasions demand of the man who rises nobly to great emergencies.

Fortunately the explosion was not followed by

dred and fifty graves provided in anticipation of the recovery of the bodies.

Victoria Day, instead of witnessing mirth and festivity in the town of Fernie, was given to successive funerals; while during the week ensuing scarcely an hour passed that did not see the going to the little hillside graveyard of the mourners with their mutilated dead—half-masted flags in evidence everywhere—coffins and crape wherever one might look. Nor were the days sufficient for the work of burial. Far into the dusk of evening could be seen the slow-moving processions of black-burdened mourners, toiling laboriously up the mountain side.

It is very greatly to be doubted if any similar dis-



Town of Fernie, in which few families escaped the loss of some members by the disaster of May 22nd. Coke Ovens in the immediate foreground.

fire, nor was the mine wrecked to any appreciable extent—the roof of the fan house blown off and a few planks dislodged at the pit head constituted the sole external evidence of the disaster—and the recovery of the bodies was therefore greatly expedited. Within the twenty-four hours, effective system ruled the rescue operations, and soon the bruised bodies were being sent to the sorrowing town by train loads, and few of the homes in Fernie but bore the significant badge of black upon the door. Coincidentally the opening of a new cemetery was begun upon the hillside overlooking the desolated town, the site being cleared as though by magic, and one hun-

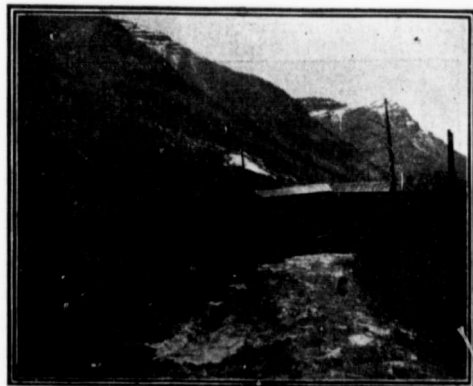
aster in Canada has been productive of so many dramatic incidents as are associated with the Fernie horror. Among the most remarkable of these is that in which a Scottish miner, Donald McMillan, is the central figure. McMillan worked for a time at Fernie, and on the removal of James R. Wilson from the mine management, followed his former chief down to the newer collieries at Frank, his son remaining, however, in the works at Coal Creek. On the night of the 21st of May, in his boarding house at Frank, this Donald McMillan dreamed a curious dream. It was, as dreams are, vague and incoherent, but it concerned his son, and seemed to forewarn

him that some calamity threatened the lad. McMillan awoke in a fright and so impressed was he by the vividness of the vision that dressing hurriedly he hastened to the railway station. Here ascertaining that on account of washouts all traffic might be stopped for perhaps a week, his strangely-aroused anxiety became increased. He started back to his room,



Placing the Bodies on the Funeral Train

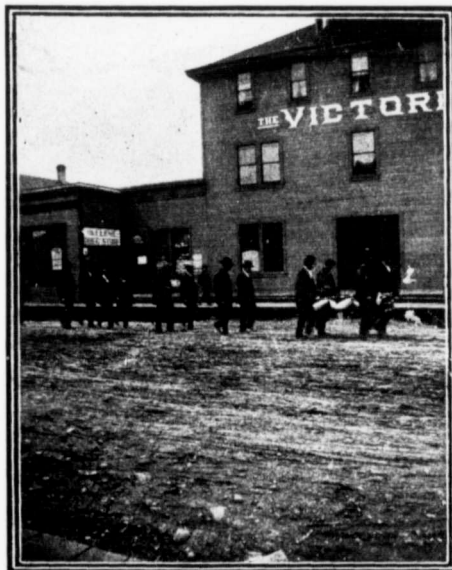
but could not rid himself of his presentment. He awakened his working partner and told him of his feeling, and finally he determined, as trains were not running, to walk to Fernie, fifty-five miles away, to join his son. And walk he did, arriving footsore and haggard at the mining camp, but just in time to receive the body of his boy, brought bruised and bleeding from the tunnel mouth.



Entrances to the ill-fated workings as seen from Coal Creek.

Here is another most pathetic incident. John Stewart and John McLeod, two Nova Scotian miners, had both labored formerly in the Springhill mines, and came unscathed through the disaster there. Both men were engaged to be married. Three or four weeks ago John Stewart had a brilliant inspiration.

Both he and his friend and partner were steady, saving fellows, and both had money saved, to which additions were made each pay day. Two men intent on a common object, can naturally, however, save more money than one, and the idea of which John Stewart became possessed was to pool the savings for the benefit first of one and then the other. The tossing up of a coin would quickly decide which was first to be made happy. The coin declared for McLeod, and so Stewart loyally turned over his savings to his friend until a sufficient sum had been accumulated to admit of his marriage taking place. On the 12th of May the girl whom McLeod was to make his wife started from her home in Halifax for Fernie, the plan providing that the wedding take place on the 24th, as a little special personal celebration of



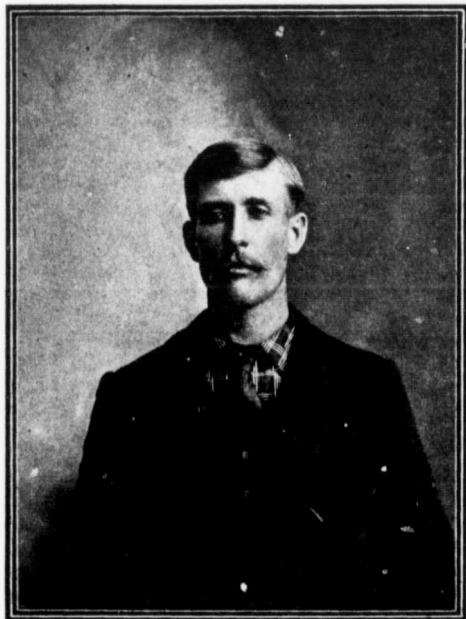
An almost hourly incident in the days following the accident. Miners bearing the body of a fellow worker to the grave.

the holiday. Mudslides hindered the progress of the prospective bride by the direct route via Crow's Nest, and being sent the round-about way, she first had news of the explosion somewhere near Revelstoke. Tortured by cruellest anxiety, but hoping still that at least her lover would be saved, the girl bravely proceeded to the trysting place.

She arrived in Fernie Monday afternoon. That morning the body of John McLeod was borne for burial to the hillside cemetery. On Tuesday his friend and comrade, John Stewart, was laid in a grave beside him.

Another pathetic story is woven about the aged mother of a young Slav miner named Bakas, from Pincher Creek, Alberta. So soon as the first reports reached there of the explosion at the mine, Hedrig Bakas, the mother, took the train for Fernie. The

slides detained the train, and at Blairmore the anguished mother was told she would have to wait—the gumbo piles could not be cleared away in many hours, and till they were, traffic was at a standstill.



Trueman Weatherby, a miner who distinguished himself on the day of the accident.

But could a mother idly wait while her heart was breaking? Hedrig Bakas could not. And so two days later—lame and worn and weary—she walked

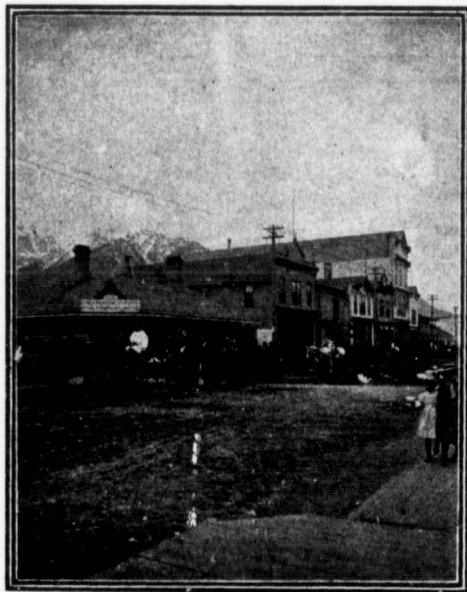


Funeral train making journeys every four hours to carry bodies of victims to Fernie.

into Fernie, to be met accidentally by Dr. Corsan and taken to his hospital. Thence two hours afterwards she was escorted to the mine, in time to receive

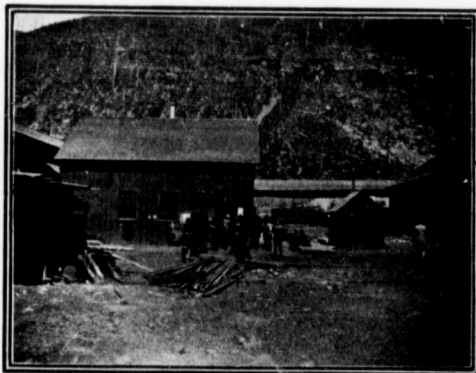
the battered body of her son, and with tender hands prepare it for its last cradling.

There was another hero among the Slavs—seemingly the only one of the Fernie miners of his race.



A funeral at which 28 victims of the disaster were buried at the same time.

He was hastening from the mine, his head and shoulder hurt by a fall of coal when the explosion came. He sank exhausted on the tunnel floor, and



Lamphouse No. 2. Miners endeavouring to ascertain by checking the list of lamps issued who were in the mines.

Duke Dano, a white miner, passing him, breathed a hurried word of pity for one for whom hope had fled. A moment later Dano, his right leg broken

and helpless, himself dropped senseless from a whiff of after-damp. He can just remember the coming of the Slav to save him; how he got him upon his back and desperately fought with air for the lives of both. He won the unequal battle, too, and now Dano is looking among all of the many Slavs of Fernie to find the man who saved him, and whose name even he has no knowledge of.

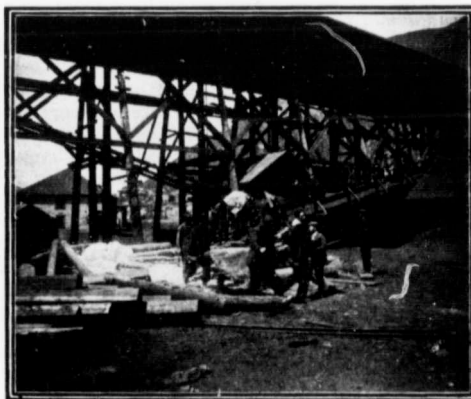
At a coroner's inquest held on June the 20th to in-



Cemetery on the hillside in which the victims of the Fernie disaster were buried.

Throughout the inquest the chief effort has been to locate the point in No. 2 mine, at which the explosion occurred. The miners and their committee have been almost unanimous in their opinion that the explosion originated in the No. 1 machine room, while against this the officials of the company give it as their opinion that the explosion first occurred in McDonald's level.

All of the bodies have been recovered with the exception of three or possibly four. These have been



Carrying the bodies from the mine entrance.

quire into the circumstances attending the deaths of three of the victims, the jury brought in the following verdict:

"That the said Steven Morgan, Joseph Sangalla and Wm. Robinson came to their deaths on Thursday, the 22nd day of May, 1902, at or about the hour of 7:30 o'clock in the afternoon, in what is known as numbers two and three mines, situated on Coal Creek, near the town of Fernie, in the province of British Columbia, the property of and worked by the Crow's Nest Pass Coal Company, Ltd.

"That we, the said jury, find the initial cause of the explosion being at a point in number two mine aforesaid, not clearly defined, and that said initial cause extended from the said undefined point throughout the greater portion of number two and three mines, coal dust being the conveying medium; and we find in consequence that the inadequate method of watering and removing of the dust left the mine in such a condition to be dangerous, and thereby providing a medium whereby the initial cause was augmented and intensified; that we, the said jury, recommend the government to take such steps to enforce:

"1st.—The immediate installation of the most approved system of watering for allaying dust in coal mines.

"2nd.—That a more thorough inspection be adopted at these mines, throughout the old workings and rooms contiguous to the air channel, that are not being worked.

"3rd.—That the safest explosives and most approved safety lamps be used."

buried in the mine and may possibly never be recovered.

MINE SURVEYING.†

A FEW years ago a paper with this title, no matter how faultless in style or complete and explicit in subject matter, would have possessed a merely academic interest to all but a few of the members of our association. With the rapid increase in the development of the various mineral resources of our province during recent years, however, this branch of the profession is engaging more or less of the time and attention of a constantly increasing number of our members. Just as the surveyor in the southwestern part of Ontario develops, sooner or later, into a drainage engineer, so the surveyor in New Ontario finds himself compelled to become familiarized with mining work.

The average "mining expert," as far as he is in evidence in this part of the world at least, is brought to a sudden halt when confronted with any instrument work. Thus the mining engineer who is also an O. L. S., and therefore thoroughly conversant with all kinds of instrument practice, has a long advantage over the "mining expert;" and the mining companies in this vicinity are becoming educated up to the point where they expect the man who does their engineer-

†Paper presented at the Annual Meeting of the Association of Ontario Land Surveyors, by Messrs. DeMorest and Silvester, Sudbury.

ing and underground work to be able, also, to do whatever surface surveying may be necessary in connection with the property.

The importance of obtaining complete and accurate surface plans of any mining property, before development work is commenced, cannot be over-estimated. Instances could be quoted in this district, where expensive shafts have been sunk and other development work done, completely outside the limits of the property upon which the owners supposed they were working.

When the prospector attempts to develop his own "find" he is usually somewhat short of funds, and naturally wishes to spend every dollar towards showing the property for sale. When, however, the man or company takes hold, who intends to go into legitimate development for mining, a careful topographical survey of the outcrop and the vicinity should be made, and the location of probable buildings and plant decided upon, so that any development work may be done intelligently and with a definite end in view from the commencement. The position of a happy-go-lucky shaft, which might just as easily have been sunk elsewhere, but which, after completion, is thought too valuable to abandon, may often spoil the convenient and economical arrangement of the subsequent hoisting and mining plant.

Frequently, however, the system of developing by shafts, drifts and crosscuts, or by diamond drill, or by a combination of these, may reveal the ore body in an entirely different form from what was anticipated by the surface showing and formation. In these cases, the most complete plans and surveys possible should be made of all work done, to enable one to decide upon the probable shape and extent of the ore deposits, and the proper location and direction of the working shaft or shafts. We do not recollect any instance where the incline of a shaft has been fixed to suit the convenience of the surveyor. We may say, however, that we have found the most convenient angle to be about 45 or 50 degrees, and the most inconvenient, just less than 90 degrees.

In vertical shafts plumb-bobs are used, hung as far apart as the space between the timbers will permit. Where the shafts are deep, heavy bobs should be used suspended with fine wire or woven cord. A twisted cord will continue to untwist and stretch for hours. If the bob is allowed to hang in a pail of water it will come to rest much more quickly, and be less easily disturbed by air currents.

When the line of the shaft is established at top and bottom, whether by transit, if inclined, or by plumb-bobs if vertical, intermediate points should be marked on the shaft timbers, a few feet above the floor of each level, where there will be least probability of their being disturbed. For aligning inclined shafts, a diagonal eye-piece on an ordinary transit will suffice in almost every case. For producing the line of the shaft downwards for timbering, etc., the instrument can be set up on the downward production of two points on line higher up. About the only cases where an eccentrically mounted telescope is really necessary, are where a shaft changes its incline, and where a downward production of the shaft line

has to be made through a small aperture in a platform or pentice. We have found the most convenient instrument to be one with the extra telescope mounted vertically over the other. This places the eccentricity in the vertical plane, and obviates all trouble with offsets, except in the rare cases where such an instrument is used for vertical traverses.

Permanent traverse points should be established on every level, and the traverse connected with the line of the shaft. A traverse point is usually marked by drilling a hole in the roof of the drift, say four or five inches deep, and driving in a dry wooden plug, which will swell with the moisture and fit very tight. Into this plug is driven a small screw eye from which a plumb-bob may be suspended. Once these points are established on a plan, it is never necessary to get up the line of the shaft for any further work on that level. Everything possible is done to prevent the necessity of having recourse to the shaft, as that means the cessation of all hoisting operations while the work is in progress.

There are many contrivances in the way of plummet lamps, discs or cards with slits, etc., for use as sighting points underground; but we have found that a common candle is quite satisfactory for all ordinary work. For short sights it can be held a few inches above the plumb-bob string, the latter forming a dark line across the flame. For longer sights the open page of a field book may be held behind the plumb-bob string, and when illuminated by a candle held in front and slightly away from the line of sight, forms a white background.

For illuminating the cross hairs in the instrument, also a candle is all that is necessary. When the transit is not provided with hollow axis and reflector, the cradle may be held at arm's length in front of the objective and slightly to one side. The neat lantern with supporting bracket, should be left in the office to adorn a shelf, together with the short-focus reading glasses, which are usually attached to surveyors' instruments, and all other attachments which are not absolutely necessary. The most convenient reading glass is a jeweller's eyeglass, which leaves both hands free, one for holding the candle, and the other for manipulating the clamp and tangent screw. The use of the very short-focused reading glasses attached renders one very liable to get his hair and eyebrows singed with the flame of the candle.

For ordinary work the drifts are usually considered level from the shafts to the stopes; but where extreme accuracy is required, levels are run along the drifts, and bench marks established, the plugs at the traverse station serving admirably for this purpose. The different levels of the mine are connected vertically by measurements down the shaft, checks being made wherever possible through winzes.

The nickel-copper ores of this vicinity do not occur in regular veins, but in columnar or lenticular masses, frequently assuming a somewhat spiral form; and a rapid survey of a large stope of this character frequently calls for the exercise of some thought and ingenuity. There are usually a number of drillers and muckers working in the stope, frequently by contract, and all work must be suspended during the

survey, as the operation of climbing up and down the steep incline is apt to dislodge loose material, which would endanger the life of anyone working below. So it is highly desirable that the most expeditious methods possible be used.

Any accessible point along the walls or sloping floor of the stope is defined by placing a candle and reading the horizontal and vertical angles, and measuring the incline distance. The best tape for mine work is a light steel one, 5-16 inches wide, 100 feet long, in closed case and nickel-plated to prevent corrosion from the highly mineralized mine water.

For inaccessible points in the roof we have designed an extension rod, capable of measuring heights of sixty feet or over. This rod is made of weed in sections, and varies from three-quarters of an inch square at the top to about two inches square at the bottom. The different sections connect with dowel pins, and a candle is attached near the top. The method used is much the reverse of that of taking soundings in water.

Various refinements of method suggest themselves readily after some experience, when very accurate results are required.

When a proper system of points has been established in a mine, the projection of new work, such as the sinking of new shafts, connecting different points by drifts, winzes, etc., becomes a simple matter. In sinking a new working shaft it is frequently possible to carry on the work simultaneously from different points, sinking and raising to meet, thus saving a great deal of valuable time. It is simply a case for the exercise of the greatest care and caution, and every possible means should be taken of checking the results, as the work usually involves the expenditure of many thousands of dollars.

Too much care for one's personal safety cannot be taken when working underground. One should always be accompanied by a mine foreman or other experienced miner when going into unfamiliar workings in the mine. On the other hand, when working around a shaft or in other perfectly familiar yet dangerous places, one should be constantly on the alert against that condition of mind so aptly described by the old proverb, "Familiarity breeds contempt."

Fire damp is never encountered in mines in this formation (archæan), owing to the total absence of all carbonaceous matter; choke damp very rarely, and only in unused workings. Care should be exercised, however, on venturing into poorly ventilated stopes too soon after blasting. The gases from the explosion are apt to cause violent headache and nausea, especially to one unaccustomed to them.

A system of examination called "magnetic surveying," is coming into practice in connection with the magnetic ores of this vicinity. It is used as a means of determining the size and shape, both horizontal and vertical, of ore bodies. The instrument used is called a magnetometer. It consists essentially of a sensitive magnetic needle, swinging between pivots, and mounted somewhat similarly to a ship's binnacle, so that it can be used either in the horizontal or vertical plane. An adjustable magnet, to compensate for the normal magnetic attraction of the earth, is

attached to the arm carrying the sights; and the normal magnetic variation in azimuth for the vicinity is obtained. The surface over the ore deposit, and in the vicinity, is then staked out in squares of 50 feet or less, the lines run astronomically in the cardinal directions. The magnetometer is set to read zero both horizontally and vertically, when pointing horizontally in the meridian. Horizontal and vertical readings are then taken with the magnetometer at each intersection. From these readings isomagnetic curves are platted, somewhat resembling contours on a topographical map. A separate plan is made for each set of readings, one called "Plan of Horizontal Intensity;" the other "Plan of Vertical Intensity." From these plans the probable magnetic poles are defined, giving the major axis of the ore lenses. The magnetometer is also used as a means of prospecting for ore; but we believe its usefulness in this respect is confined to localities where the surface of the rock is covered with shallow swamps or earthy deposits, and the outcrop cannot be seen.

To obtain the full benefit from mine plans, they should be revised to date every month. When this is done systematically from the start, such plans form a complete record of progress, showing the extent of any particular working at the end of any specified month, and the amount of work done in such working during any number of months. An original plan should be made on strong detail paper of each level separately, showing all traverse points. These can be extended each month as the work progresses. For very small workings, a scale of 10 feet to an inch may be used, but for the average mine 20 feet to the inch is the most convenient scale. From these separate plans a common tracing is made showing all the levels. This plan is really a series of horizontal projections of the various levels upon a plane assumed below the deepest workings. The out-lines of the different levels may be distinguished by different colored inks up to a certain number, say five or six; but coloured inks blueprint very poorly, and it is much better to reserve all colours for rock and ore distinctions. We have adopted another system which seems to be quite satisfactory. The lines consist of long dashes with groups of dots between, the number of dots indicating the number of the level. Thus the first level is indicated as follows —. —. —., fourth level —. . . . —. . . . , etc. Beyond the fourth or fifth level this becomes too cumbersome, and the dots are replaced by small figures, thus, ninth level, —9—9—9; twelfth level, —12—12—12. Notwithstanding any attempt at distinguishing marks for the different levels, any plan showing more than three or four levels where the ore body is sufficiently nearly vertical that the projections encroach on each other, becomes very complicated and confusing to one not thoroughly conversant with the workings in the mine. So, it is, if not absolutely necessary, at least highly expedient to have a series of plans, showing the levels in pairs, thus, "Surface and First Level," "First and Second Levels," etc., in addition to the general plan of all the levels. It is seldom necessary to examine any level relatively to any other, except that immediately

above or below it. In such cases the general plan may be consulted. The extension each month may be shown by fine dotted lines with the date written on. The general plan need not be revised oftener than twice a year.

It is usual to have two vertical plans or sections, taken in directions at right angles to each other. For some purposes it may be necessary to show an actual section along some given plane, even if such plane does not intersect all the workings. It is more usual, however, to make a series of projections of vertical sections taken in parallel planes. The strike of the planes should be chosen so as to intersect the ore bodies as much as possible along their greatest length; and the position of each plane of section shown on the plan of the corresponding level. Any number of levels can be shown in section on one sheet, of course, as the lines do not overlap, as in the horizontal projections.

Where the shape of the ore body becomes very irregular, as in the case of a spiral, for instance, it is very difficult to give an adequate representation with two sections at angles. In such cases, the most feasible scheme is to show, in addition to the others, a developed section, along a series of planes following the spiral.

Red and blue may be used in general to distinguish ore and rock, or as many colours as may be desired for different kinds of rock and varieties or qualities of ore. Surfaces may be tinted on tracings to be sent away, accompanying reports, etc.; but coloured dotted lines only, denoting boundaries between ore and rock, should be used on the original tracings, as ore surfaces of one month may become rock surfaces at the next revision.

All diamond drill holes should be shown on the plans and sections, as they form a valuable aid in projecting new development work in the mine. Negative results from diamond drilling, however, should not be allowed to override positive indications from actual workings; for diamond drills have a peculiar faculty for following thin seams of rock between bodies of ore, and vice versa also. Nor need a surveyor be surprised to find the actual intersection of a diamond drill hole with some working several levels below the surface, several feet from the projected intersection on his plan, for these holes frequently describe curves, the drill having been deflected by seams or other inequalities in the ground.

A complete set of blue prints, showing the latest revision, should always be on file at the mine office, for the daily inspection of the mine captain and the shift bosses. In this way these men become familiar with the workings as they actually are, rather than as they were; and have a much more intelligent grasp of the work. Without plans, the work must be carried on more or less at random; and we have seen instances, in mines where no regular systematic surveys and plans were made, of sufficiently absolutely useless work being done in a month, to pay for regular surveys for a year.

BEASLEY COPPER CAMP.

By Ronald C. Campbell-Johnston, M.I.M.E.

BEASLEY is at present a siding on the Canadian Pacific Railway, lying seven miles west of Nelson, and like the bear cub has its future and troubles ahead. It was named after an official on the railway, is situated on the north bank of Kootenay river, and has magnificent water power at its doors. From the railway the mountains rise at a steep elevation towards the north to an altitude of 2,000 feet.



Smelter Site at Beasley.

facilities for open cast working without going underground are unexcelled. The show mine of the camp is the "Queen Victoria," standing horizontally 1,500 feet from the railway and vertically 1,000 feet above. As the copper ore deposits run up diagonally along the face of the mountains, and are of great width, the feet from the railway and vertically 1,000 feet above. Here is a bluff of copper ore standing out in bold re-



Queen Victoria Copper Bluff. The only rock showing is entirely copper ore.

lief from the country rock, measuring along the face, that is the strike of the deposit, for over 400 feet in length. Across the deposit horizontally the width is 300 feet, and ore also shows vertically for 150 feet, with a westerly dip. The specific gravity of the ore

gives 200 pounds to the cubic foot, the same as the Le Roi, or ten cubic feet in place to the ton. By multiplying these dimensions together and dividing the product by ten, gives ore in sight 1,800,000 (one million, eight hundred thousands) tons, or six years supply of ore at an output of 1,000 tons daily for 300 days each year. The character of the deposits are somewhat similar to the Boundary mines, being a zone of lime rock flanked by apparently rhyolite walls, changing to gabbros and diorites.

The ore is richest in the rhyolite (this nomenclature will have to be authenticated by microscopic examination) then shading off in values to the centre of the lime zone and also into the outer country rock. In estimating the value of the mass of ore in the bluff a complete cross section will have to be made, there only at present being a tunnel 100 feet long, started in the lime zone and not exposing either walls. Sampling this present tunnel by systematic chipping will, therefore, rather underestimate the true values than over-estimate them. Of three engineers all have arrived at different conclusions regarding values per ton, viz.: \$9.37; \$10.50; and \$12.

The ore can be quarried, concentrated, smelted and refined on the spot for \$4 (four dollars) per ton. Writing off thirty-seven cents per ton for mineral tax, office and brokerage expenses, taking the lowest estimate of the three, gives a profit of \$5 per ton, or nine millions on the total contents of the bluff. Surely this is one of the largest natural exposures of ore extant, even surpassing the Britannia mines, at Howe Sound.

The estimate is based on three per cent. copper, the balance of values in silver and gold. Below this bluff lies the "Orinoco," "Copper King" and "Copper Prince" claims. Here the gravel wash is very deep, only exposing ore in places near the railway. All the wash is heavily studded with float ore, and a smelter return of a shipment made gave total gross values per ton of \$17.85, of which copper contents were 6 7-10 (six and seven-tenths) per cent. per ton. This fact is most encouraging as warranting expectations of richer ore at depth below the bluff. It may be pointed out that although the proportions of the metals differ, the estimated values of this bluff, and the estimated values of the "Le Roi" ore chutes in place are very similar, with the advantage of cheaper mining from open cast working in favour of the "Queen Victoria." On apparently the same zone to the northeast, an open cut on the "Rio Tinto" seventy feet across and not reaching either walls yet, exhibits the apex of a copper deposit, which by sampling the full length averages \$10.25.

To the west along the mountain side on the far side of Garritty Creek on the "Monarch Elk" group is a fine exposure of good copper ore eighty feet wide. This is seemingly distinct from the other deposits, and gives several hundred feet depth for open cast workings. To the north of Bear Creek is another immense showing of ore on the "Samson" group, an estimate of the values of which is impossible until more sections are made. The deposit is in the shape of a cone like the "Mother Lode" mine in Boundary, giving great opportunity for "glory holes" to remove the whole top, and also getting good depth for open work from Bear Creek.

To the west of Falls Creek is a very extensive ex-

posure of magnetic iron ore. What ore, future development will prove, remains to be seen. Whether a second iron deposit like the Kitchener one, or the capping of a copper deposit, since magnetite occurs in parts with copper on the mountain. Over the first range up Bear Creek are more copper showings.

An account of the copper on the south up 49 and Rover Creeks must be given another time. Comparing the values on the "Queen Victoria" with other British Columbia mines, and also in size, prove that Beasley has a great future before it with its natural facilities for water power, and the situation of the deposits. In far Tasmania £900,000 was invested in mining on Mount Lyell before dividends were paid, which have been continuous since; the value of the best grade of ore they treat from the mine is only 2.35 (two point thirty-five) per cent. copper; two ounces of silver, and one and one-third ($1\frac{1}{3}$) dwt. of gold per ton, of a gross value of \$10.34. Their fuel is shipped in and their matte shipped out to America for refining. The deep level mines of Montana only yield from three to four per cent. copper. Boundary ores are lower grade, all of which facts demonstrate the immense prospective value of the Beasley camp with ample working capital to erect their own concentration, smelting and refining plants.

HOISTING AND HAULAGE IN MINING OPERATIONS—A DESCRIPTION OF THE PLANT ON THE LE ROI MINE, ROSSLAND, B. C.*

By Bernard MacDonald, M.E., Rossland, B.C.

PROGRESS in everything is marked by continual change and continual growth. Whatever survives the present must change or grow to meet the demands of the future. What was the nearest approach to perfection in the economic arts and sciences a few years ago is antiquated to-day. The truth of these aphorisms is nowhere more clearly demonstrated than the progress made in the art of mining, especially in more recent years.

In the early history of mining on this continent, during the 16th and 17th centuries, when the Spaniards were skimming the cream of the phenomenal deposits of silver ores found in Mexico and South America the Indian peons, climbing notched poles, carried the ore out of the mines on their backs. From the mouth of the mines, donkey pack trains carried it to the reduction works, more or less distant. If water was encountered in the workings, it was filled into leather bags and dragged to the surface by mules or horses. The Indians and the donkeys, moving slowly with loads of from 50 to 200 pounds, and the mules and horses hoisting the sacked water, constituted the hoisting and haulage system used in the mining operations of those days.

While the ores were rich, near the surface, and the mines were comparatively dry, these methods served very well, that is, the mines operated in this way left

*From a paper read before the Canadian Mining Institute.

a margin of profit for the Spanish owner and a living for his peons. But when the ores became poorer, or the mines were exhausted to even inconsiderable depths, or water was encountered, the limit of profitable operations was reached and the mines were abandoned. Thus, human and animal labor, unaided by mechanical appliances, reached their limitation, to use the Western phrase, "very early in the game."

From this time, history shows that the limitations of successful mining have widened continually as progress has been made in the perfection and adaptability of machinery suitable for the work done by manual labor. It may now be asserted that the economies effected by the use of machinery in mining operations are more prominent in the work of hoisting and haulage than in that of any other department. And although it is true that special mechanical appliances have invaded all departments of mining, it must be admitted that hoisting and haulage, on account of this prominence, are entitled to distinction as the mechanical department.

Of course, the introduction of machinery in mining, as in other branches of industry, presumes the certainty of abundance of work, suitability for the work, and proper installation. Without these prerequisites, no installation would be warranted, or the results profitable. Nor does the fact that occasionally it is good business to install auxiliary units of machinery in a large plant to stand guard, as it were, in like manner as insurance is placed, alter this as a general rule.

The economic results obtained from the modern hoisting and haulage plant erected on the Le Roi under the design and supervision of the writer, goes to corroborate what has been said, and as this plant has many novel features, both of design and application, it is hoped that a description of it and the economies affected by its operation will prove interesting. In this description which follows, many incidental circumstances, apparently extraneous to the subject matter proper of this paper, will have to be narrated, in order to give a comprehensive grasp of the economic exigencies which created the necessity for this plant. It is also hoped that such extraneous matter will not be uninteresting, inasmuch as it constitutes a chapter in the history of one of the most prominent mines in this province, and deals with many of the peculiar conditions which are, to a more or less degree, characteristic of all mining enterprises.

Historical.—The Le Roi was located in the summer of 1890, and in November of the same year it was bonded to a syndicate of Spokane business men. This syndicate completed the purchase of the mine, and on the 23rd June, 1891, conveyed it to the Le Roi Mining Company, which they organized for the purpose of operating the mine. Under the auspices of this company the mine was developed into a paying property, and the company realized from its operations \$975,000.00 in dividends before selling it in 1898.

The ore which yielded these dividends was extracted from workings comparatively near the surface, where, owing to the concentrating action of meteoric agencies, the values, originally existing in the entire vein, were concentrated into a streak of varying width. The ore mined was sold to custom

smelters, which made a direct charge of \$11.00 per ton for freight and treatment, besides making certain deductions from the metal values, which amounted to approximately \$5.00 per ton. Thus, the aggregate of the direct and indirect smelting charges was \$16.00 per ton.

But as depth was attained on the vein, it was found that the values were becoming more uniformly disseminated throughout the great width of vein matter, instead of being, as near the surface, concentrated into a comparatively narrow streak.

Thus, as the work of mining progressed in depth, the ore became too low-grade to stand the cost of freight and treatment formerly paid to the smelters and leave a satisfactory margin of profit.

This change in the character of the ore induced the company to build its own smelter, so that the profit of smelting the ore might be added to that of mining it.

A favorable site was selected at Northport, in the State of Washington, and a smelting plant of the capacity of 250 tons per day was built there in the fall of 1897.

In this enterprise the company associated with it to the extent of one-quarter interest, Mr. James Breen, a man of extensive experience in copper smelting. Mr. Breen's ownership of this interest made it necessary to operate the mine and smelter as separate concerns.

The smelter was operated under terms of an agreement made between Breen and the Le Roi Mining Company, which provided that all the ores produced by the Le Roi mine for a period of five years should be sold to the smelter on the following terms:—The gross values of the metals contained in the ore was to be paid for at New York market quotations, less \$8.75 per ton as direct charge for freight and treatment, and certain specified deductions from the gross metal values in the ore, which amounted to \$5.00 per ton additional. Thus the total charges, direct and indirect, for smelting the ore at the Northport smelter, amounted to \$13.75 per ton, a reduction of \$2.25 per ton under the price charged by outside smelters. This contract was, nevertheless, very profitable for the smelter, the profits earned being distributed, three-quarters to the company and one-quarter to Breen.

About this time the president of the Le Roi Mining Company (Col. I. N. Peyton) went to London for the purpose of selling the mining and smelting property of the company. The negotiations which Col. Peyton began, finally resulted in the purchase of all the assets of the company by the British America Corporation, Ltd. This corporation conveyed the property to the "Le Roi Mining Company, Limited," a new company, organized in London to take over and operate the mining and smelting property of the old Le Roi Company.

The mining and smelting operations of the new company were then conducted under the management of the new (London) company, Mr. W. A. Carlyle being local manager until December, 1899, when that gentleman severed his connection with the company to accept the management of the Rio Tinto Copper Mines, in Spain.

At this time—on the 10th December, 1899—the

writer was appointed general manager to fill the position made vacant by Carlyle's resignation. On accepting this position I was informed by the directors that no profit had been made by the company's operations and was instructed to examine the company's property and report as to what would be the probable results of future operation.

I immediately began the examination of the mine, the compilation of records of previous production and working costs, and a study of the commercial problems involved in the mining and smelting operations of the company.

The mine records showed that for the eight months ended June 30th, 1899 (the first eight months after the mine was taken over from the old company) there were 45,167 tons of ore shipped, having an average gross value of \$17.33 per ton; and that for the subsequent six months ended December 31st, 1899, there were 51,448 tons of ore shipped, having an average gross value of \$13.66 per ton, making a total of 96,615 tons of ore shipped during this period, having a total gross value of \$1,485,423.19. This made the average daily shipment about 250 tons, which, upon investigation, I found was the maximum which could possibly be obtained from the mine with the equipment and facilities it then possessed. To maintain even this, the miners were obliged to climb into and out of the mine to depths ranging to 900 feet so as not to interrupt the production, instead of being, as is usual, hoisted and lowered by the winding engine.

The general details of the costs of realization of the gross values per ton of ore for the period under review showed, without making deduction for depreciation of mine or plant, as under:

Costs of mining and development	\$5.55 per ton.
Railway transportation to smelter . . . .	.75 "
Cost of smelting to matte	5.59 "
Refining tolls and charges, and freight .	1.25 "
Breen's profit on smelting contract . . .	2.00 "
	—————
	\$15.14

Subtracting the costs of realization from the average gross value of the ore, the first eight months operations showed a profit of \$2.19 per ton on the production for that period, or a total of \$98,915.73, while the last six months showed a deficit of \$1.48 per ton, or a total deficit of \$76,202.24 on the production of that period, which brought the profits for the 14 months down to \$22,713.49.

It should be noted as of particular significance, the general lowering of the average grade of the ore produced, and further, that the production of the last three months of the period under review, that is October, November and December, had an average gross value of only \$12.50 per ton, which made a working deficit to the company of \$2.64 per ton for the ore produced during these months, notwithstanding the profits derived from the three-quarters interest in the smelter.

Such were the statistics furnished by the com-

pany's records for the first fourteen months of its existence. From these it was quite apparent that no profit could be earned unless the conditions under which operations were carried on were modified.

The Conditions.—At this time the mine was worked through a three-compartment incline shaft, sunk near the easterly end of the property on the variable dips of the vein, to a depth of 940 feet. In this shaft, at approximately 100 feet distant from each other, stations were cut and level drives run easterly and westerly in the vein. Along these drives stopes were opened and worked upwards in the ore bodies. The exhausted stopes were timbered by the square set system. The ore was stoped by drilling with machines run by compressed air, and by blasting with dynamite. The ore when blasted was shovelled into chutes, down which it gravitated to the levels, the larger pieces being sledged into sizes not exceeding 10 inches in diameter. From these chutes it was drawn off into steel push-cars having a holding capacity of from 18 to 22 cubic feet (about one ton of broken ore). These cars were pushed by the trammers to the shaft stations and their contents dumped into the storage pockets cut under the stations. The storage pockets had a holding capacity of from 700 to 900 cubic feet, that is to say, 40 or 50 tons of ore each. From these pockets the ore was loaded into the hoisting skips and lifted to the surface by a double drum, direct acting hoisting engine, cylinders 20x42 inches. These skips dumped automatically at the surface, running in counter balance, the empty skip being lowered as the loaded one is hoisted.

On being dumped at the surface, the ore gravitated into a receiving car which was pushed along to the various distributing stations over the sorting floor, where it was dumped before the squads of ore sorters, whose duty it was to pick out the second-class ore from the shipping ore and shovel the two classes into separate bins.

From these bins the ore was trammed in the receiving bins at the head of the tramway, and the second-class ore was trammed to the second-class ore dump. From the receiving bins the ore was loaded into four-ton cars and run over a surface gravity tramway, 700 feet in length, with a fall of 250 feet, to the lower or loading terminal, where it dumped through a chute into the railway cars.

As each of the railway cars was loaded, it was moved by men and an empty one substituted, until a train of from ten to twenty 30-ton cars was made up. When, as often happened, there were no empty cars, all the men at the various stages in the passage of the ore from the stopes to railway cars, were thrown idle because there were no intermediate storages of sufficient capacity to hold the ore accumulating in the interval.

Under these conditions, and with the facilities and equipment briefly described above, the average output (250 tons per day) for the fourteen months under review, was hoisted from the mine, sorted and loaded on the railway cars.

The details of the cost per ton of hoisting, sorting and trampling to and loading on the railway cars is given in the following table:—

TABLE I.

Hoisting—		
Fuel	8 tons @ \$6 00	= \$48 00 or \$0.192 per ton
Engineers	3 @ 4 00	= 12 00 or 0.048 "
Firemen	2 @ 3 00	= 6 00 or 0.024 "
Skip-tenders	4 @ 3 50	= 14 00 or 0.056 "
Int., depreciation & renewals	1 50	or 0.006 "
Oils and waste	50 or	0.002 "
\$0.328 per ton		
Sorting—		
Foremen	2 @ \$3 00	= \$6 00 or \$0.024 per ton
Topmen	4 @ 2 50	= 10 00 or 0.040 "
Waste trammers	4 @ 2 50	= 10 00 or 0.040 "
Ore trammers	12 @ 2 50	= 30 00 or 0.120 "
Sorters	32 @ 2 50	= 80 00 or 0.320 "
Int., depreciation, renewals and tools	1 50	or 0.006 "
\$0.550 per ton		
Tramming to Railway—		
Brakemen	1 @ \$4 00	= \$4 00 or \$0.016 per ton
Carmen	5 @ 2 50	= 12 50 or 0.050 "
Carmen at railway	3 @ 2 50	= 7 50 or 0.030 "
Int., depreciation, renewals and tools	2 00	or 0.008 "
\$0.104 per ton		
Total cost		\$0.982 "

After the mechanical handling of the ore produced as above described, the next item of cost attaching was 75 cts. per ton for railway freight between the mine and the smelter. This was the contract price made with the railway some three years before for all the ore to be produced by the mine for the term of five years.

On arrival at the smelter yards, the ore was dumped from the (bottom-dumping) railway cars into the receiving bins. From these it was loaded into push-cars and trammed to the roast yard and dumped over the roast heaps being built there, into which it was fed by shovelling—six men being required for this work. The crushed ore was elevated and put through the sampling mill. When sampled, the ore was again elevated to the "high line" bins. From these it was loaded into push-cars and trammed to the roast yard, and there on trestles over the roast heaps being built.

Table II. following gives an itemized statement of the cost of the different handlings of the ore as above described, between the mine and the roast heaps, including the railway freight.

TABLE II.

Railway Freight—		
Under contract		\$0.750
Unloading and Crushing—		
2 Dumpmen	@ \$2 40	= \$4 80 or \$0.019
6 Trammers to crushers	@ 2 50	= 15 00 or 0.060
2 Crusher feeders	@ 2 50	= 5 00 or 0.020
Repairs and renewals		0.050
\$0.149		
Sampling—		
1 Foreman	@ \$5 00	= \$5 00 or 0.020
1 Sampler	@ 3 50	= 3 50 or 0.014
1 Topman	@ 3 00	= 3 00 or 0.012
1 Binman	@ 3 00	= 3 00 or 0.012
Interest, depreciation and renewals		0.100
Power		0.125
\$0.283		
Tramming to Roast Yard—		
6 Trammers to roast	@ \$3 00	= \$18 00 or \$0.072
Depreciation and renewals		0.010
\$0.082		
Total cost		\$1.264

TABLE III.

Giving Summary of the Per Tonnage Costs attaching to the Ore for Hoisting; Sorting; Tramming to Railway; Loading on Cars; Railway Freight to Smelter; Unloading and Crushing at Smelter; Sampling and Elevating at High Line; Tramming to Roast Heaps. 250 tons possible.

Hoisting	Table I.	\$0.328
Sorting	" I.	0.550
Tramming to railway	" I.	0.104
Railway freight to smelter, contract	" II.	0.750
Unloading and crushing at smelter	" II.	0.149
Sampling and elevating to high line bins	" II.	0.283
Tramming to roast heaps	" II.	0.082
Total		\$2.246

The costs of stoping, timbering and development work will not be considered here, although they were also indirectly and unfavourably affected to a considerable extent as to cost.

Extraneous Conditions.—While my investigation of the economical factors affecting the operation of the Le Roi was proceeding, that is, during the first two months of 1900, new conditions were commencing to affect the mining industry of the Province unfavourably. The burdens of the eight-hour law passed by the Provincial Legislature during its session of 1899 were beginning to be seriously felt in Rosslund, which was the only important district that continued mining work after the law became effective, paying the same wages for eight hours' work as was formerly paid for ten hours' work. The law had been in operation for the last eight months of 1899 and the returns were coming in a way that there was no mistaking the result. Careful calculations made by Mr. R. E. Palmer, chief engineer of the Le Roi mine during 1899 and part of 1900, and now assistant to Mr. W. A. Carlyle at the Rio Tinto mine, showed that the additional cost of operating the Le Roi since the eight-hour law became effective, amounted to a sum which added \$0.72 per ton on the ore produced (250 tons per day).

During the same year (1899), contract work in the mines had been prohibited by the Miners' Union, and statistics showed that the mine costs during that year reached higher figures in the Rosslund mines than in any other camp in the Rocky Mountain regions.

The Provincial Legislature during its session in 1900 passed a law doubling the tax which had previously been imposed on the gross output of metalliferous mines. Prior to this time the Provincial tax had been 1 per cent. on the gross value of the ore produced, less freight and treatment charges. This tax was raised to 2 per cent. on the same basis by the new law just passed.

It will, perhaps, be pardonable to digress for a moment, to say that the Mine Owners' Association protested vigorously against the passage of this law, pointing out that the regular annual addition of the new laws passed by the Provincial Legislature oppressive to the mining industry could only result in driving capital from seeking investment in the Province.

The law was passed, however, in disregard to the mine owners' protest and representations, and, I regret to say, the results then pointed out have come to pass. The mining industry, vigorously commenced in the early '90's in a new undeveloped mineral region of exceptional promise, should have ad-

vanced by leaps and bounds, but it has barely held its ground, and while the tonnage produced has increased in some instances, the dividends are few and far between.

Thus stood the economical conditions affecting the operations of the Le Roi mine in February, 1900, two months after the writer had assumed its management. The prospect was not very bright; in fact, it was very gloomy. All the per tonnage expense of mining, development, depreciation, renewals, hoisting and delivering the ore to the roast heaps at the smelter, government taxes, smelting ore to matte, loss in smelting operations, freight charges on matte to Eastern refineries, refiners' tolls and charges, interest and discounts, and Breen's profits of \$2.00, amounting to \$15.15, had to be paid from the gross values in the ore, which had fallen to an average of \$12.50 per ton during the last quarter of 1899, and the balance was expected to be—profit, to pay dividends to shareholders.

Facts to be Determined.—It could not be expected that the metals in the vein would reverse the persistent and natural tendency they manifested from the surface to the 800-ft. level already noticed, and become concentrated into smaller and richer streaks such as were found near the surface.

The average character and grade of the ore in the vein already found to exist below the circulation of surface waters was the best that could reasonably be hoped for in the deeper levels, that is the metals would be found distributed more or less uniformly throughout the entire width of the vein-filling in the deeper levels, which meant a larger tonnage and a lower-grade ore. Future operations would have to deal with these facts intelligently if they would be profitable.

The experience of the previous fourteen months, wherein 96,000 tons of ore were mined and smelted, leaving practically no profit, showed how futile it would have been to continue operations on the same scale in the face of a lower average grade of ore than was dealt with during that time. Could existing conditions be modified so as to make operations profitable? This was the problem which had to be solved affirmatively or the mine abandoned, for the company could not be expected to continue operations while making a loss of from \$2.00 to \$3.00 per ton of ore produced.

Of the numerous factors required for the solution of this problem, the main one was the determination of the quantity and grade of the ore in the mine, and the probability of its downward continuation. This was the one which had to be more or less accurately determined before it was worth while to consider the others.

In due course it was ascertained that there were approximately 1,000,000 tons of ore in sight in the mine, having an average gross assay value of \$12.50 per ton, and it was considered probable that the ore bodies would extend indefinitely downward. The problem, thus simplified, then appeared as follows:—

Can the costs of realization, now \$15.14, be so reduced as to leave profit on the \$12.50 ore; and if so, what profit can be reasonably expected?

Contingent Calculations.—Proposed Plans.—Careful

calculations showed that the costs of realization might be reduced to \$8.00 per ton providing an expenditure of about \$1,250,000.00 was made on new development and equipment of the mine, and increase of the capacity of the smelting plant. This expenditure provided for:

1. Freedom of the company from dictation of the Miners' Union so that, by re-establishment of the contract system, the company could contract its work to the best workmen, and would have to pay only for the work actually done, instead of the time spent in doing it.

2. The purchase of Breen's one-fourth interest in the smelter, and his contract for smelting the ore.

3. The sinking of a five-compartment shaft on the mine, and the erection of a modern plant of hoisting machinery and handling facilities at its head, of adequate capacity for an output of 1,000 tons per day of 10 hours.

4. To enlarge the Northport smelter so as to have a marginal capacity of from 400 to 500 tons daily for custom ore, in addition to that required for smelting the increased production of the Le Roi, viz., a total capacity of 1,500 tons per day.

Difficulties Overcome.—When the position of the company, as above described, was fully understood by its directors, I was authorized to carry out these plans if the necessary financial arrangements could be provided for from the operation of the property.

The difficulty of making satisfactory arrangements for financing the company seemed, at first, almost insurmountable—the chartered banks of the Dominion being compelled by law to lend money to mining companies only on the security of liquid assets such as ore on dump or in stock in smelter yards or furnace products in transit. This required a margin of production over and above that required to finance the normal mining and smelting operations, sufficient to meet the cost of the new work.

Fortunately, however, this difficulty was soon solved. A two-compartment winze sunk on the vein from the Black Bear tunnel to the mine workings on the 700-ft. level was equipped with a 150 h.p. electric hoist and pressed into service as an auxiliary shaft. All mining timbers and supplies, the general mining traffic and the miners going to and from their work, passed through this new outlet. This relieved the congestion at the old shaft so that it was soon possible to almost double the ore production. The output was immediately increased to an average of 443 tons per day, and later on to 600 tons per day, which gave the desired margin of unincumbered ore available for security for the funds required for the proposed improvements, which could now proceed as rapidly as desirable.

The option previously obtained to purchase Breen's interest in the smelter for \$300,000.00 was exercised, this sum being borrowed from the bank. This left the company the complete owner of the smelter and all the profits on the smelting operations, which reduced to it the costs of realization to \$13.14 per ton, except the deduction for interest on the \$300,000.00 borrowed.

The proposition to introduce the contract system in the mine was next tackled. This was vigorously

opposed by the Miners' Union, who refused to allow their members to work by contract. The mine was, in consequence, closed down for a period of 66 days. At the end of which time the Union consented to allow their members to work by contract, as proposed, and the mine was re-opened under freedom to utilize this system.

The results proved very satisfactory to the company and to its employees as well. The possibility of earning wages commensurate with skill and experience attracted the best miners from surrounding camps. In the hands of skillful miners, the maximum capacity of the machine drills was soon reached, and with the increase of output came a general lowering of costs, although the miners continued to earn more than the standard scale of wages.

A suitable location for the five-compartment shaft had been selected and its construction commenced. Simultaneously, the excavation for the foundations of the several units of the proposed new plant was begun, as was also the preliminary work for increasing the capacity of the smelter. During the latter part of March, or the early part of April, all the necessary preparations were made, and the work of constructing the new plan commenced.

Inasmuch as a detailed description of the several units comprising this plant would be very lengthy and, perhaps, too tedious, I will content myself with the following brief description of them, referring only to their more prominent features.

Boiler Plant.—This plant consists of nine horizontal, return tubular, steel shell, high pressure boilers, set in three batteries of three boilers each; and two Heine Safety Water Tube boilers set in one battery.

In the aggregate, this plant has about 2,000 nominal horse power—sufficient to supply the steam necessary to operate all the machinery connected with the mine and have one of the four batteries out of service. The spare battery is always held ready for steaming when any of the others in service require cleaning or repairs. This plant is modern and complete in all its details, and is equipped with all the most improved devices (except mechanical stokers) to provide for safety and continuity of operation at the lowest cost for attendance and maintenance.

The selection of the site chosen for this plant was suggested, (1) by its accessibility from the high line spur of the railway from which the coal is delivered to the storage bunkers behind the building; (2) because of its safe distance from the other units, in the event of fire originating in it; (3) convenience to the large cooling reservoir, where the steam pumps for fire protection and pumping back the water for condensing purposes, are located.

Steam is transmitted from this plant to all the steam engines through a series of insulated steam lines. A 9-inch steam line, carrying steam at 140 pounds pressure, connects with the two air compressors. Two additional steam lines run through the Black Bear tunnel and connect with the hoisting engines at the head works of the combination shaft. One of these is an 8-inch and the other a 6-inch line, the 8-inch line being the one generally used, the 6-inch being held in reserve in case of accident to the 8-inch line.

Each of these lines is insulated by two layers of cellular asbestos covering, and provided with the requisite number of steam traps and expansion joints. This arrangement of concentrating the boilers into one suitable location and transmitting the steam to the separate units of the plant, gives greater economy, satisfaction and security from fire than could be obtained if separate boiler plants were installed adjacent to the engines requiring the steam.

Air Compressing Plant.—This plant consists of two compressors, one having 22x36x48 inch cross compound condensing steam cylinders, with 22x36x48 inch two stage air cylinders; the other, 22x36x48 inch, with cross compound condensing steam cylinders, with 22x38x48 inch two stage air cylinders. The combined capacity of these two machines is 8,000 cubic feet of free air per minute at sea level, compressed to 95 lbs. gauge pressure.

One of these compressors was installed during my management, and the other installed by the old company in 1896, but this latter was remodelled in some essential details at the time of the newer installation. Both compressors were built by the Canadian Rand Drill Co., and both have given entire satisfaction, although in economy and efficiency there is a very marked difference in favor of the latter installation. It is very interesting to notice the improvements made in the manufacture of this class of machinery in the four years that transpired between the building of the first and second of these machines.

The operation of this plant has proven very economical, a working test extending over a period of thirty days during ordinary working conditions showed a coal consumption of 1.9 pounds per horse power per hour, and that air was being compressed to 95 pounds per square inch at the low cost of \$1.59 per each 100,000 cubic feet of free air compressed. This calculation did not include the interest on the investment or depreciation, but all other costs.

The air compressed by this machinery is transmitted into the mine workings through a series of air receivers and two pipe lines. The air receivers consist of boilers rejected from the old steam plant and erected in the open air immediately outside the compressor room. The two pipe lines leading from these receivers extend to the bottom of the mine workings, and consist one of 8-inch and the other of 6-inch pipe, with branch lines leading off, carrying the compressed air to the workings on the various levels.

The extensive cooling surface afforded by the number of tubes in the boilers thus converted into receivers, permits of the condensation of the moisture contained in the condensed air; besides, the long, ample pipe lines in themselves serve as a second series of receivers, passing through which most of the moisture contained in the air is condensed and precipitated, to be blown off as it accumulates in the receivers placed on every working level in the mine. The air, thus drained of its contained moisture, goes to the drills and the pumps in the best condition for service, and freezing of the machines driven by it is unknown.

Hoisting Plant.—This plant, installed at the head works of the combination shaft, consists of two modern types of first motion winding engines, one of

1,000 and the other of 500 nominal horse power. The larger hoist is the standard Allis-Chalmers design, with some special features incorporated to meet our views. This engine is used exclusively for hoisting ore, and is not called upon to do any of the general traffic of the mine. Devoted to this specialty, its efficiency and capacity is increased, as the engineer has only this special work to perform and is not confused by the call signals for other purposes.

The smaller hoisting engine consists of a pair of 20x30 high pressure engines, and is equipped with four auxiliary engines, with which the clutches, reversing gear and brakes are handled.

This engine was especially designed for the rapid and safe hoisting and lowering of men, and the general traffic incidental to the mining operations, and is exclusively used for these purposes.

Heating Plant.—This consists of a Sturtevant fan heater, and heats the headworks and sorting room by heat generated from the exhaust steam of the hoisting engines.

Combination Shaft.— This shaft, having dimensions of 27½x6 feet clear of outside timbers, is sunk on the average dip of vein, 69° from the horizontal, to a depth of 1,125 feet (June 30th, 1901).

It is divided into five compartments, two of which are used exclusively as roadways through which the ore is hoisted from the pockets at the stations on the various mine levels and delivered to the crushing machinery at the headworks; the two adjoining ones being used for the general mine traffic, that is, hoisting and lowering men, timber, tools and mining supplies; the fifth compartment being used as a manway and for the compressed air and water pipes, and electric wires.

From the hanging wall side of the shaft at the various levels, stations have been cut to accommodate the general traffic of the mine. Underneath the floor of these stations, pockets are excavated having a holding capacity of about 500 tons each. These pockets are used to receive and store the ore trammed from the stopes until it is suitable to hoist it.

At the 900-ft. level, a large catch basin or water tank having a holding capacity of 50,000 gallons, has been excavated in the solid rock in the footwall side of the shaft. This tank receives all the water flowing from the various parts of the mine. Over it the mine pumping plant is installed, and the accumulated water is lifted a height of 600 feet to the Black Bear tunnel, through which it flows to the surface.

The four hoisting compartments in the shaft are tracked with 36-lb. "T" rails and provided with timber guides, to prevent the hoisting skips from leaving the track.

Head Frame at Shaft.—This is 85 feet high from the collar of shaft to the bearings of the sheaves, and is built of Douglas fir in a very substantial manner, calculated to withstand the strains due to the rapid lifting of heavy loads from a state of rest by the two hoisting engines.

The ore hoisted is dumped automatically on grizzlies set in the head frame at a height 65 feet above the collar of the shaft. The delivery of the ore at this height provides sufficient elevation for its auto-

matic passage by gravity over the grizzlies and through the crusher into the storage bins beneath, from which it is delivered, by automatic feeders, to the Sorting Tables.

Crushing, Sorting and Sampling Plant.—This plant occupies in part the building enclosing the head frame at the combination shaft, and continues into a wing extending from it 100 feet in length by 30 feet in width and three stories high.

The machinery of this plant was especially designed for the crushing, sampling and sorting of ore in continuous operation as comes from the mine, completely preparing it for smelting operations.

The transportation and handling of the ore from the time it is broken in the stopes to its delivery in the smelter yards, is briefly described as follows:—

The ore, when blasted down in the stopes, is broken into pieces of suitable size, say 10 inches in diameter, shovelled into chutes, and from them trammed to the storage pockets at the combination shaft.

From these pockets it is drawn off into the hoisting skips through chutes opened and closed by steel gates, actuated by compressed air cylinders. By these means the ore is loaded rapidly and cheaply, it only requiring a few seconds to fill a four-ton skip.

The loaded skips, holding 4 tons, are hoisted to the surface and dumped automatically over the grizzlies, which are arranged to divide the ore into three classifications. The size too large to fall through the grizzly bars, gravitates over them to Comet crusher, set to crush to 4-inch sizes, the largest size suitable for the subsequent sampling and the smelting furnaces. The fines falling through the grizzly bars pass directly to the "fines" receiving bin, from which it is automatically fed to a conveying belt and carried to the sampling machinery without sorting.

The ore passing through the Comet crusher falls into the "coarse" receiving bin, from which it is fed automatically to two endless conveying belts. These belts, including the belt carrying the fine ore, are each 100 feet in length between centres, and adjusted to travel at the rate of 45 feet per minute. On either side of the two belts carrying the coarse ore the sorters are stationed, who pick out the waste and second-class ore, allowing the shipping ore to be conveyed past them to the sampling machinery.

On falling from the conveying belts, the ore passes through the sampling machinery, consisting of three Constandt cone samplers, a Blake crusher, Cornish rolls, Bridgeman sampler, small Comet crusher and small Bridgeman sampler, where a uniformly proportional sample for assay is "cut out" and quartered, ready for the assay office.

The sorted ore, after passing through the sampling machinery, falls into a storage bin, having a holding capacity of 1,000 tons. This bin was intended to hold in storage the production of the mine for 24 hours, in case of accident or repairs needed for the aerial tramway, which could be stopped for 24 hours without interfering with the mining operations.

All the operations of hoisting, screening, crushing, conveying and sampling the ore in its passage from the pockets at the shaft stations in the mine to the railway cars, is automatically conducted, and the

cost of this work, as may be seen from Table IV., is reduced to a very low figure.

Electricity is the motive power used for driving this plant, one 150 horse power induction motor driving the Comet crusher and one 125 horse power synchronous motor driving all the rest of the machinery. This power is supplemented by a 250 horse power Corliss engine, to be used as the motive power for driving the machinery in case of accident to the electric motors. The electric motive power has given very satisfactory and economical results.

Ore Bins and Aerial Tramway.—When the ore is crushed, sorted and sampled, it falls into a bin having a holding capacity of 1,000 tons. This bin is situated under the sampling mill, and is equipped with a delivery chute, which is opened and closed by a steel gate attached to the piston of an air cylinder, embodying the same principle of construction as the chutes from the pockets in the combination shaft.

The ore is fed through this chute into an automatic loading device, which loads the buckets of the aerial tramway while in motion. This device is operated by one man, who easily loads and controls the travel speed of the tramway, so as to deliver 120 tons per hour at the terminal bin at the railway.

The *Aerial Tramway* is of the two rope system—one stationary, carrying the sheave wheels from which the buckets are suspended; the other hauling them and controlling their speed. It was built by Mr. B. C. Riblet, and has numerous patent devices owned by that gentleman. The attachment of the compressed air cylinder for operating the loading chute was designed by the writer, and is said to be the only tramway equipped with that device. There are 26 buckets attached on the moving rope and spaced on it 65 feet apart. This rope has a speed travel of 268 feet per minute. The buckets have a holding capacity of 10 cubic feet, or 1,000 pounds of crushed ore, and are arranged to dump automatically at the railway terminal bin. Only the one man who operates the automatic loading device and the brake at the loading terminal is required to operate this tramway to its full capacity.

As the ore dumps in the terminal bin at the railway, it falls on grizzlies, the bars of which are spaced $1\frac{1}{2}$ inches apart, and set at an angle of 40° over the centre compartment of the bin.

In passing over the grizzlies, the ore is screened into two classes, coarse and fines. The fines, passing through the grizzlies, fall into the centre compartment of the bin, the coarse, gravitating over the grizzle, goes to the outside compartments. This separation gives the classification desirable for building the heaps for roasting at the smelter. This bin has a holding capacity of 1,600 tons of crushed ore, and, as above indicated, is divided into three compartments, the centre compartment holding the fines, the two outside compartments the coarse ore.

The ore from these compartments is loaded into the railway cars through triple chutes, one triple-mouthed chute leading from each compartment. These chutes are opened and closed by compressed air lifts, and operated by one man.

A train of from 20 to 25 empty cars, each of which has a holding capacity of from 30 to 40 tons of ore,

are "spotted" at these bins by the engine, which also moves each car of the train under the spouting apron of the chutes as required. It requires less than a minute to fill a car from this bin.

It may be explained here that when the plans for increasing the output of the mine were made known to the officials of the Great Northern Railway, they consented to modify the contract existing with the company by reducing the freight rate to 40 cents per ton, on an output of 1,000 tons per day being maintained.

The ore is hauled to the smelter in bottom dump cars, which empty their contents into the ore bins set under the spur track recently built. This spur track and the ore bins built under it are part of the recent construction for increasing the smelter's capacity and cheapening the handling of the ore there. From these bins the ore is drawn off into push-cars and trammed directly to the roast heaps. The repeated handlings of crushing, sampling and elevating formerly required to be done at the smelter being unnecessary now since all that work is done at the head works of the mine automatically by the machinery installed there. Thus it will be seen that the ore is taken from the pockets of the mine, hoisted and conveyed through the crushing and sorting processes, trammed to the railway, loaded on to trains and then hauled to the smelter yards, all by machinery and with the least possible handling in transit.

It is hypothetically possible for the ore to pass from the pockets at the 900-ft. level of the mine to the roast heaps at the smelter, 18 miles distant, in 1 hour 41 minutes 8 seconds, this time being occupied between the various stages of passage as follows:—

	H.	M.	S.
Loading in skip at 900-ft. level.....	05
Hoisting and dumping at surface.....	30
Crushing and feeding to travelling belts.....	10
Passing over travelling belts before sorters.....	..	2	18
Gravitating through sampling mill machinery to bins beneath.....	05
Loading buckets of tram and delivering to bins at railway.....	..	3	..
Loading on railway cars.....	..	1	..
By rail to smelter, 18 miles.....	1	30	..
From smelter ore bins to roast heaps.....	..	4	..
Total.....	1	41	8

In ordinary operations this speed is modified by the length of time any given quantity of ore rests in the bin storages provided between the different stages of progress from the 900-ft. level of the mine to the roast yards at the smelter. In fact the pockets at the various levels in the mine or the storage bins underneath the crusher or at both terminals of the aerial tramway are seldom empty, a condition that would be necessary to effect the travel speed given in the above table.

The costs of hoisting, crushing, sorting, sampling, aerial tram to railway, loading on railway cars, railway haulage to smelter and distribution to roast heaps, of 1,000 tons of ore daily between the pockets in the mine and the roast yards at the smelter, as above described, is given in Table IV. following:—

TABLE IV.

Hoisting—

		Per Ton
Fuel, 10 tons.....	@ \$5.75 per ton=\$57.50 per day or	\$0.0575
Foremen.....	2 @ 3.00 per day= 6.00 " "	0.0060
Engineers.....	2 @ 4.50 " = 9.00 " "	0.0090
Wipers.....	1 @ 3.50 " = 3.50 " "	0.0035
Skip tenders.....	2 @ 3.00 " = 6.00 " "	0.0060
Interest, depreciation and renewals..	4.40 " "	0.0045
	\$86.50	\$0.0865

Crushing, Sorting, Sampling—

Foreman.....	1 @ \$5.00 per day=\$5.00 per day or	\$0.0050
Crushermen.....	1 @ 3.00 " = 3.00 " "	0.0030
Sampler.....	1 @ 3.50 " = 3.50 " "	0.0035
Oilers.....	1 @ 3.00 " = 3.00 " "	0.0030
Sorters.....	30 @ 2.50 " =75.00 " "	0.0750
Oil and waste.....	1.00 " "	0.0010
Electric power.....	10.00 " "	0.0100
Interest, depreciation and renewals..	2.00 " "	0.0020
	\$102.50	\$0.1025

Aerial Tram to Railway—

Tram runners... 1 @ \$4.00 per day=\$4.00 per day or	\$0.0040
Interest, depreciation and renewals..	5.00 " " 0.0050
	\$9.00 \$0.0090

Loading on Railway Cars—

Spouting into cars, attendance.....	\$0.50 per day or	\$0.0005
	\$0.50	\$0.0005

Haulage—

Railway to smelter.....	\$400.00 per day or	\$0.4000
	\$400.00	\$0.4000

Distribution to Roast Heaps—

Foreman.....	1 @ \$4.00 per day=\$4.00 per day or	\$0.0040
Trammers.....	15 @ 3.00 " =45.00 " "	0.0450
Interest, depreciation and renewals..	11.00 " "	0.0110
	\$60.00	\$0.0600

Totals.....	\$658.50	\$0.6585
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In Table V. following, is given a comparison of the Per Tonnage Cost of hoisting, sorting, crushing, sampling, tramping to railway and loading on cars, railway haulage to smelter and distribution of ore to the roast heaps, as done with the old machinery and facilities, and that done by the new plant.

TABLE V.

	Old machinery.	New machinery	Difference in favor of new machinery
Hoisting—Tables I, III, IV.....	\$0.3280	\$0.0865	\$0.2415
Crushing, sorting, sampling—			
Tables II, III, IV.....	0.9820	0.1025	0.8795
Aerial tram to railway.....	\$0.0005		
Loading (spouting) r'y cars... 0.1040	0.0090		
Tables I, IV.....		0.0095	0.0945
Haulage, railway to smelter..			
Tables II, IV.....	0.7500	0.4000	0.3500
Tramping to roast heaps—			
Tables II, III, IV.....	0.0800	0.0600	0.0220
Totals.....	\$2.2460	\$0.6585	\$1.5875

From this Table the following deductions may be made:—

Daily.....	Saving effected on output of 1,000 tons.	\$ 1,587.50
Monthly (25 days) " " "		39,687.50
Yearly (300 days) " " "		476,250.00

In connection with the installation of the hoisting and haulage plants above described, various accessory facilities, including railway spurs, have been

constructed, which have materially cheapened the costs of realization that have previously prevailed. A general description of some of these follow, but the economies effected are not given, as the main object of the paper is to describe the new system of hoisting and haulage at the Le Roi mine and the economies effected by it, as compared with the old system.

Carpenter Shop and Framing Shed.—Here all the mine timbers are delivered from the railway cars, and are framed to square sets by machine saws, of which there are two sets, each complete in itself. The high line spur of railway is on a level with this plant, so that the timbers roll directly from the cars to the framing saws. When framed the timbers are loaded on the timber trucks, run through the Black Bear tunnel to the station at the combination shaft, there loaded on the cages and lowered to the different levels in the mine. The mining timbers are thus handled and framed in a most economical manner, and a very material saving is effected on the cost of wagon haulage and hand labor by which this work was formerly done.

Blacksmith and Machine Shops.—These adjoin each other, and are furnished with modern designs of forges, power hammers, lathes, shears and the general equipment necessary for the repairs and maintenance of a plant of this character. The forges and machinery for these shops, as well as for the carpenter shop and framing shed, are run by compressed air or steam. These shops are on a level with the railway, and all supplies used are delivered directly from the railway cars.

Powder Magazine.—A new fire-proof powder magazine has been built of stone and brick, alongside the high line spur that passes the portal of the Black Bear tunnel, blacksmith shops, etc., at a convenient though reasonably safe distance from the works.

Thawing House.—On the same track, and midway between the Black Bear tunnel and the powder magazine, a thawing house, equipped with steam heat, has been built. This is reached by the mine cars, which carry the thawed powder directly to the Black Bear station in the combination shaft, from which it is sent to the various levels as required. These arrangements do away with the cartage and consequent risk incidental to the extra handling of the powder, the importance of which will be recognized when it is known that the amount used daily in the mine approximates 2,000 pounds.

Water Supply and Fire Protection Systems.—A complete system of water supply for the machinery and for protection against fire has been installed, and, as a consequence, a very material reduction in the rates of insurance has been effected. The systems are a combination of the gravity and pumping systems, each supplementing the other. The gravity system operates under a head of 300 feet, and the pumping is done by two Standard Underwriter's pumps having a capacity of 500 gallons per minute each against a 400-ft. head.

The arrangement of these systems, which includes 31 hydrants strategically located around the various buildings, is such that a very efficient fire service can be maintained with very little cost to the company,

and the safety of the plant from fire may be considered assured if ordinary precautions are taken.

On the completion of this plant, the insurance companies made a reduction of 40 per cent. in the premiums previously paid for insurance.

The construction of the entire plant as above described was not finished until the month of May, 1901, although many of its units had been completed and utilized in the mining operations several months before. Owing to the industrial activity that prevailed during the period of construction, it was almost impossible to close a contract for the delivery of machinery of any considerable size short of nine or ten months from date of signing contract. This and other factors prolonged the time occupied in construction to double what would have been sufficient under favorable conditions.

The working of the completed plant was successful from the start, and the results shown in the preceding tables have been taken from actual operations.

Smelting Plant.—The enlargement of this plant had kept pace with the facilities provided at the mine for the increased extraction of ore, and in the month of May, 1901, five furnaces, having a total capacity of 1,250 tons per day, were erected. The sixth furnace was on the ground ready to erect, which would have brought the total daily capacity of the smelter up to about 1,500 tons.

For the purposes of this paper it will not be necessary to give a description of the smelting plant, except to mention its increased capacity and facilities afforded for handling the increased output of the mine. In the installation of the mining and smelting plants, great care was exercised in the choice of such machinery as was best adapted for the work to be done, while every portion of the plant was constructed with a view of obtaining the highest possible efficiency and economy in operation at the lowest cost.

The saving effected in the hoisting and haulage operations of this plant is worthy of the attention of mining engineers, for, as shown in Table V., this alone would make a very considerable profit on the mining operations, if conducted on a large scale.

All the cost of installation of the mining and smelting plants, and the purchase of Breen's quarter interest in the smelter was paid from the profits of the mining operation for the eighteen months ended June 30th, 1901, besides leaving a balance of \$135,132.79 unencumbered product at the smelter.

The following statement, Table VI., shows the cost of these plants, and hence the profits earned during the period named:—

TABLE VI.

<i>Smelter</i> —	
Cost of James Breen's smelting contract and one-quarter interest in smelter.....	\$300,000 00
Cost of interest paid on this amount.....	10,785 75
Cost of new smelter additions and handling facilities.....	185,442 00
<hr/>	
The total cost of the smelting plant....	\$496,227 75
<i>Mine</i> —	
Cost of 1,125 feet combination shaft, mine development and exploration.....	\$292,426 40
Cost of new mining machinery.....	210,086 05
Cost of new buildings enclosing the plants.....	99,311 13
Cost of underground machinery and equipment....	64,453 45

The total cost of mine development, machinery and equipment.....

\$666,277 03

The total cost of mining and smelting plants. \$1,162,504 78
On hand at smelter, ore and furnace products,
unencumbered as security to Bank.....

135,132 79

The total net earnings for 18 months.....

\$1,297,637 57

Economies Effected.—As indicating the extent to which the costs of realization of the gross values in the ore may be reduced under full operations of the new mining and smelting plants, Table VII., giving the costs for the fiscal year ended June 30th, 1901, follows:—

TABLE VII.

<i>Mining</i> —	
Stopping.....	\$3.362 per ton
Exploration.....	.138 "
Equipment.....	.094 "
Depreciation of buildings.....	.030 "
Depreciation of machinery.....	.106 "
Freight on ores.....	.510 "
<hr/>	
	\$4.420 "
<i>Smelting</i> —	
Matting ores.....	\$4.252 per ton
Depreciation smelting plant.....	.100 "
<hr/>	
	\$4.352
<i>Realization of Smelter Product</i> —	
Interest and discount.....	\$0.145 per ton
Eastern representative.....	0.027 "
Sacking and crushing matte.....	0.044 "
Freight on matte.....	0.536 "
<hr/>	
	\$0.752 "
<hr/>	
Making the total cost of realization.....	\$9.344

In the foregoing table, the costs of realization show a reduction of \$5.80 per ton under the costs prevailing while Breen owned the quarter interest in the smelter, or \$3.80 per ton not counting Breen's profit of \$2.00 per ton of ore smelted.

For the year reviewed, in Table VII., the mining operations had comparatively little benefit from the completed plant, although it must be acknowledged the saving effected by the several units of it completed earlier in the year, was very material.

Nevertheless, with the full benefit of the completed plant, a still further reduction in the costs of realization may be confidently expected and while the direct saving effected by the new hoisting and haulage plant is only \$1.5875 per ton over that of the old machinery, it will be readily seen that the saving effected in the other departments on account of the high capacity and efficiency of this plant is solely, though perhaps indirectly, attributable to it. In other words, the hoisting and haulage plant and the incidental facilities installed on the Le Roi mine have made possible whatever reduction under \$13.14 can be made in the costs of realization. It has been shown that with only part of the plant in operation during the year 1900-'01, the reduction amounted to \$3.80 per ton. And it is reasonable to expect that with the larger output now possible, the operations will show a still further reduction of costs in all departments.

Concluding Remarks.—The data collected in this paper show that for effecting the highest economy in mining operations where a large output can be

maintained, the following equipment and facilities should be provided:—

1. An efficient and up-to-date system of hoisting and haulage.

2. Such incidental facilities as will ensure, as nearly as may be, the continuous operation of every plant comprising this system.

3. Intermediate storages of ample capacity for ore, in the mine and between the different sections of the plant, to provide against the stopping of the entire plant if an accident to any one section occurs.

4. Separate hoisting compartments for the ore, and for the general traffic of the mine.

5. All loading from the storage bins to be done through chutes opened and closed by compressed air.

6. Where hand sorting of ore is advisable, it is to be done on travelling tables of steel or rubber passing before the sorters at a speed not exceeding 45 feet per minute.

7. The waste and second grade ore to be picked out and dropped into bins underneath the sorting floor, the sorted ore to be allowed to be delivered to the sampling machinery automatically.

8. The boiler plant to be installed not nearer than 200 feet to any of the other units of the system and at a point, if possible, where the storage of a reasonable quantity of whatever fuel is used can best be effected.

9. A convenient grouping of the various units of the surface plant adjacent to the entrance of the mine, which should be accessible by railway, or by an easy system of wagon roads.

10. An efficient system of fire protection operating preferably by gravity, or a combination of gravity and pumping. If the latter is used sufficient tank storage should be provided, so that, in case of fire breaking out, water under sufficient pressure will be available at once while the pumps are being started.

These features, so far as possible, have been kept in sight in the design and construction of the plant, herein described.

Before closing this paper, I feel it my duty to state that in the design and construction of this plant, I was ably assisted by Mr. William Thompson, who occupied the position of Assistant Manager with the company.

COMPANY MEETINGS AND REPORTS.

ABSTRACT OF ENGINEER'S REPORT OF OPERATIONS AT YMIR MINE AND MILL FOR THE YEAR 1901.

MINE DEVELOPMENT WORK.

THE shaft was sunk during the year 116 feet, and at 31st December had reached a depth of 30 feet below No. 6 Level, or 655 feet below the apex. Between No. 4 and No. 5 Levels the quartz broken from the shaft had assayed 0.33 ounces gold and 1.68 ounces silver, which, on the whole, are higher results than were obtained from above from the quartz lying nearest the footwall. At No. 5 station, however, where a general average can be had, the assays of ore gave 0.52 ounces gold and 2.12

ounces silver. Below No. 5 the shaft is either intersected by a transverse dyke several feet wide or is mainly in the footwall country, on account of the vein having flattened slightly. At No. 6 station the car sample assays, on account of the presence of the dyke, are low, viz., 0.17 ounces gold, but against this hand samples have given 1.32 ounces gold and 7.20 ounces silver. The station and crosscut here show the vein 19 feet wide, including the usual lean or barren streak on the hanging wall, but the balance is well mineralised. The progress of the shaft was annoyingly slow for the year, for various reasons, the chief of which were, hard rock, water, and inefficiency of pumping and hoisting by compressed air. In the latter part of the year, however, we carried a steam line into the shaft and discarded the use of air, with satisfactory results, and although the rock has not materially changed in character we are less troubled by water, which seems to be lessened in quantity by the gradual approach of No. 10 Adit, from which a considerable volume flows constantly. During January 1902, 44 feet were sunk, thus showing a much better rate, the depth being at 1st February, 74 feet below No. 6, or practically 700 feet from surface.

NO. 10 ADIT.

This was driven during the year 1,257½ feet. (since this report was issued the vein was encountered in this tunnel at a distance in of approximately 22,000.)

OTHER DEVELOPMENT.

This work underground was partly devoted to making several raises for facilitating stopping operations above No. 4 Level, cutting station at No. 6, and drifting on Nos. 4 and 5. The balance was in prospecting on the Mugwump claim, and driving a crosscut from No. 2 Level to explore the ground north of the main vein. The ore broken from various points covered by development, but not credited to that department of our operations amounted to 4,365 tons, and the total cost of the work, excluding No. 10 and the shaft proper, was \$17,099.71, or \$0.2459 per ton of ore milled, as compared with \$0.2995 per ton milled in 1900.

RESERVES.

For the purpose of calculating the tonnage of ore blocked out in previous years, we have assumed that twelve cubic feet in place were the equivalent of one ton. Now, however, with a better knowledge of the constituents of the ore at depth, it seems more near the truth to call this factor eleven cubic feet per ton. At this ratio we had at 31st December, 1901, approximately, 54,000 tons remaining above No. 3 Level. On No. 3 Level the ore body is at least 340 feet in length, and its average thickness is a little over 17 feet. So far as exposed in No. 4, the thickness is about 28 feet, while at the stations of No. 5 and 6 levels it is 17½ and 19 feet respectively. Practically no drifting has been done at No. 6, and thus, thorough conservatism limits the reserves below No. 3 to a triangle whose apex is at No. 6 station and whose base is 340 feet along No. 3. At 17½ feet thickness and eleven feet per ton this block contained as at 31st December, 80,000 tons, more or less, thus making the total reserve 134,000 tons, or approximately two years' run of the stamp mill at its present

rate of consumption. I feel compelled to add, however, that this is rather unfair to a mine, which, above No. 3 Level has produced an average of close on 700 tons for each foot in depth, and for purposes of rough calculation, this factor appears to be reasonably applicable to tonnage below No. 3, as far as No. 6. Below this point we cannot see at present, for the shaft is in the footwall, as stated above, and the vein will not be crosscut until we reach No. 7.

STOPING.

This operation has been carried on essentially as described in my last annual report, and the system of filling stopes with waste from the hanging-wall country at the surface has continued to prove a very successful and economical one. The total cost of filling and timbering stopes for the year amounted to about 32 cents per ton milled, whilst, inclusive of such of the general mining costs as are applicable to stoping, that operation cost us only \$1.52 per ton as compared with \$1.84 per ton during 1900.

The ground lying just under the surface, say for forty or fifty feet in depth was more or less difficult of winning and of dangerous nature because of the many fractures existing. I am glad to report, however, that nearly all of the ore from this bad ground is exhausted, and our mine foreman, Mr. Turner, deserves particular credit for having won this material without having had a single serious accident among his men. In fact only one serious accident has ever occurred at the property, and not one which has proved fatal.

There were sent from the mine to mill in 1901, 69,540 tons, of which 69,505 tons were stamped and 35 tons sorted out and shipped as crude ore. About 1,100 tons remained in tramway bins and in mine chutes, and thus the total ore broken was approximately 70,600 tons.

MILLING.

The following is a summary of the battery records by months for 1901—

	Running time 80 stamps.	Tons Crushed.
January.....	29 days 17 hours.....	5,500
February.....	25 " 2 ".....	4,390
March.....	29 " 18 ".....	6,450
April.....	28 " 12 ".....	6,030
May.....	27 " 9 ".....	5,800
June.....	26 " 14 ".....	5,610
July.....	30 " 9 ".....	5,993
August.....	29 " 10½ ".....	5,822
September.....	28 " 22½ ".....	6,210
October.....	29 " 8 ".....	6,370
November.....	26 " 3 ".....	5,480
December.....	28 " 10 ".....	5,850
Year.....	339 " 15 ".....	69,505
Average.....	28 " 7¼ ".....	5,792

Tons crushed per 24 hours run..... 204.65
Tons crushed per 24 hours per stamp..... 2.558

These figures compare favourably with corresponding ones for 1900, which were 197.10 and 2.464 respectively; and the increased duty of 1901 is accounted for partly by use of better shoes and dies, partly by the use of iron guides on several of the batteries, and finally, in part to using a courser screen on the batteries which supplied the experimental cyanide plant. We regard the result as a good one for 850 lb. stamps, with hard quartz, and No. 11 slot screens in three-quarters of the mortars.

The costs of operation and repairs per ton for 1901 and 1900 are compared below:—

	Operation.	Repairs.	Total.
1901.....	\$0.668.....	\$0.146.....	\$0.814
1900.....	0.66.....	0.24.....	0.90

There was thus a decided decrease in cost of repairs and a slight increase in operation. If, however, we omit from operating cost of both years the expense caused by firemen and fuel, the result would be found in favour of 1901 by ten cents per ton. The mill's share of expenses for fuel and firemen in 1901 was nearly \$11,500, or over 19 cents per ton. It should be remarked in this connection that there was only a slight snowfall in the winter of 1899-1900, and the volume of water available for purposes of driving stamps was consequently small during last summer. But, admitting abundant water, our power-flume was designed for 40 stamps, and we have had to rely on the other hand on very poor fuel, and power cost, therefore, is higher than I wish.

Omitting cost of power, our milling operation is shown to be \$.474 per ton, and this I think a very favourable result when we consider the high wage paid in this country, the heavy cost of supplies and the large amount of concentrate produced (7.2 per cent).

Several small economies were effected during the year, notably by the automatic discharge of concentrates to bins on the lower floor. This avoids nearly all the former expense of emptying the concentrate boxes, immediately under the vanners, which are now cleaned only once a month, whilst the concentrates are sacked directly from the bins into which they flow by gravity.

On the whole, our mill plant has been kept up to a good degree of mechanical efficiency, and watchfulness at every point has resulted in very good saving of values. I am glad to state in this connection that our net losses in tailings were, per ton of mill feed, only 0.088 ounces gold. This means an actual recovery of 79.35 per cent. of gold present in the original ore, and when one considers the complexity and baseness of the concentrate, a recovery of nearly 80 per cent. is a subject of congratulation.

TRAMWAY.

The wire ropeway from mine to mill has worked very satisfactorily, and although two new ropes were purchased during 1901 (one being still in reserve), the total cost was a shade under ten cents per ton. Of this the cost of operation was about six cents and of repairs and rope about four cents.

TRANSPORT.

This item of operating expenses continues to be a heavy one. It includes, sacking of concentrates, the sacks, and hauling the material about four miles by wagon to Ymir station. The cost was 21½ cents per ton of ore, or \$2.97 per ton dry product hauled. This is slightly (one cent per ton of ore) higher than in the previous year, because of increase of concentrate shipped. This cannot be materially reduced except by the presence of a light, narrow gauge railway of five miles length, the cost of which we believe should be a matter of consideration when we know what the No. 10 Adit shall reveal.

QUANTITIES AND GROSS VALUE OF PRODUCTS.

Product.	Weight.	Ozs. Gold.	Ozs. Silver.	Lbs. Lead.	Gross Value.
Bullion....	34,086.36	18,658.265	12,620.38	....	\$393,116.15
Tons.					
Concentrate...	5,002	4,567.181	61,463.49	2,156,317	*152,886.24
Tons.					
Crude Ore	35	55.007	660 61	19,622	*1,650.04
Ozs.					
Cyanide experiment.	1,850	257,903	1,001.19	....	\$5,887.72
Totals.....					
	23,538.356	75,745.67	2,175,939		\$553,540.15

‡100 per cent. gold at \$20.67; 100 per cent. silver at N. Y. quotation.

*95 per cent. gold at \$20.00; 95 per cent. silver at N. Y. quotation, and 90 per cent. of lead at London quotation less \$1.00 per 100 lbs.

The actual average net price received by us for our lead in 1900 was \$2.69 per 100 lbs., whereas in 1901

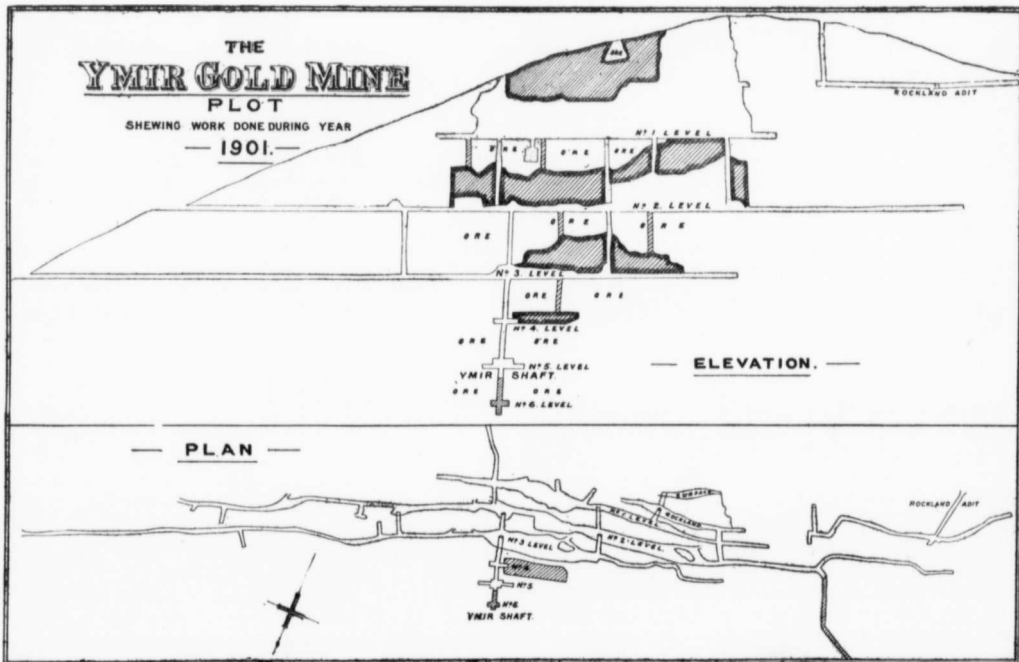
RECOVERIES AND VALUES PER TON TREATED.

Product.	Ozs. Gold.	Ozs. Silver.	Per ct. Lead.	\$
Bullion and Cyanide.....	.2721	0.196	....	5.7378
Concentrate and Crude.....	.0665	0.893	1.56	2.2222
Total, 1901.....				
	.3386	1.089	1.56	7.9600
Total, 1900.....				
	.3646	1.425	1.86	8.8813

Thus showing a decrease in gross value recovered of 92 cents per ton, of which 41 cents is due to price and 51 to grade.

OPERATING COSTS PER TON, 1901.

	MINING.		Totals.
	Labor.	Other Charges.	
Stopping.....	1 1652	.3554	1.5206
Development.....	0.1885	.0574	0.2459
Repairs.....	0.0283	.0194	0.0477
Total.....			
	1.3820	0.4322	1.8142
	MILLING.		Totals.
	Labor.	Other Charges.	
Operation.....	0.3138	0.3546	0.6684



we got only \$1.65 per 100 lbs. The difference, \$1.34 per 100, represents a decrease to us amounting to \$26,241.00 on the lead produced by us in 1901. For our silver we received in 1901, \$586 per ounce, as compared with \$.618 for 1900. This means a decrease of income for 1901 for our silver, amounting to \$2,302.00. Thus, had 1900 prices been maintained our gross value of produce would have been \$582,083, instead of as above, and the value per ton would have been \$8.37 instead of \$7.96.

Repairs.....	0.0826	0.0628	0.1454
Total.....			
	0.3964	0.4174	0.8138
TRAMWAY.			
Operation.....	0.0582	0.0013	0.0595
Repairs.....	0.0099	0.0285	0.0384
Total.....			
	0.0681	0.0298	0.0979
TRANSPORT.			
Total.....	0.0446	0.1705	0.2151
OFFICE.			
Salaries.....	0.1047	....	0.1047
Assaying.....	0.0019	0.0205	0.0224

Cables and Postage.....	0.0082	0.0082
Printing and Stationery.....	0.0043	0.0043
Travel.....	0.0099	0.0099
Total.....	0.1066	0.1495

CONTINGENT AND GENERAL.

Discount and Exchange.....	0.0093	
Taxes.....	0.1186	
Insurance.....	0.0393	
Legal Charges.....	0.0019	
Miscellaneous.....	0.1102	
Total.....	0.2793	
Expressage, freight and smelting of product.....	1.0626	

COSTS SUMMARY.

	Totals.	Per Ton.	Per Ton, 1900.
Mining.....	126,158.75	1.8142	2.1367
Milling.....	56,592.56	0.8138	0.8996
Tramway.....	6,815.76	0.0979	0.1076
Transport.....	14,959.53	0.2151	0.2027
Office & Management	10,394.59	0.1495	0.2198
Gen. & Contingent...	19,424.85	0.2793	0.2837
	234,346.04	3.3698	3.8501
Freight & Smelting..	73,892.68	1,0626	0.9901
Totals.....	308,238.72	4.4324	4.8402

The decreased cost per ton for 1901 as compared with the previous year thus amounts to 8½ per cent.

CYANIDE PLANT.

A year ago we were constructing an experimental cyanide plant under the direction of Mr. E. C. Holden, and the operation of this small installation of ten tons daily capacity was in that gentleman's charge until its taking down a short time ago.

During the period of operation 3,100 tons of tailings from the vanners were treated, and the actual recovery of metal sold averaged:—

Gold, 0.083 ozs. Silver, 0.323 ozs. per ton:

a saving of about 84 per cent. of the gold, and 30 per cent. of the silver from material treated. The actual extraction was considerably higher, but the losses are accounted for principally by absorption in the material of wooden vats used, and the necessary crudity of an experimental plant.

The general result of the work was such as to justify the Board in authorizing us to proceed with the construction of a plant designed to treat all of the tailings from the stamp mill, and ground was broken for this about 1st August last. The plant is now practically complete and should be in operation by 1st March. We have had to put up with several annoying delays on the part of the contractor for all the iron work, consequent on strikes, and these delays have not only prevented an earlier completion of the plant, but considerably increased its cost. My next annual report, I trust, will show that the entire expenditure incident to the construction will have been defrayed, and that a profit will have been made on the operation.

GENERAL.

I think that the Company has every reason to congratulate itself on the result of the year's operations, for although there has been a slight decrease in grade

this has practically been offset by reduced costs, and we are still endeavouring to decrease our expenses. Although our general and contingent expenses are somewhat less than for 1900, we hope to have them less still this year.

Taxes paid to provincial government amounted to \$8,246.62 for the year. This is equivalent to 3.36 per cent. of our operating profit, and is levied on the value of the ore at the mine, i.e., without deducting mining costs. We have looked in vain for some amelioration of this condition and a lessening of the burden, but any change is not yet in sight.

As previously stated, one of the heaviest of our charges is that of power supply, and the problem of how to secure it at lower cost is now the chief one before us. Our fuel is poor and expensive and the cost will increase somewhat during the current year. Depending to a great extent on the developments at No. 10 Level, I, therefore, must say that we shall soon be driven to serious consideration of a probable expenditure of \$30,000.00, or thereabouts, for power purposes, and if No. 10 proves the mine to be what we have every reason to think it, the above sum will be a small one, in view of the advantages to be gained.

We have spent in the aggregate considerable sums during the past year on capital accounts, but we hope to be able to cut these very materially from now on. During this year, however, the cost of connecting the No. 10 with upper workings, in at least two places, will be rather heavy, and we shall also have to establish a permanent traction system at this level. Expenditure for these purposes must, therefore, be anticipated. Nevertheless, with the cyanide plant running and the stamps continuing their present efficient work, I am confident that we may look forward to a highly prosperous year, and much increased profits.

In conclusion I wish to say that, in a large measure we owe our thanks to Mr. G. H. Barnhart, Superintendent, for his untiring energy in connection with our work, and for the success he has attained in reducing our costs.

SAMUEL S. FOWLER.

ROSSLAND AND SLOCAN SYNDICATE.

At the fifth ordinary general meeting of the Rossland and Slocan syndicate held in London, Eng., the directors reported that they as vendors of the Snowshoe mine at Phoenix to the Snowshoe Gold and Copper Mines, Ltd., have agreed to accept the purchase price of £150,000 in fully paid shares in the new company. The syndicate is therefore the largest shareholder in the Snowshoe, and two of the directors are also on the board of this promising new undertaking. The profit and loss account shows a net profit of £17,367 10s. 4d. for preliminary expenses, development work, office expenses, directors' and auditors' fees, etc. In addition 80,000 shares in the Snowshoe Gold and Copper Mines, Ltd., valued at £80,000, have been transferred to reserve account.

The nominal capital of the company is £100,000, and of this amount on December 31st last, 87,340 shares were issued. Of these 70,033 shares were fully paid and 17,307 were 12s. 6d paid up, leaving a balance of 12,660 shares to be issued.

PAYNE CONSOLIDATED.

At the annual general meeting of the Payne Consolidated Mining Company, which was held in Montreal last week, it was decided to acquire the adjoining well-known property, the St. Keverine. The Payne leads extend through the same. The Payne company now own a portion of the St. Keverine stock. The assets of the company, according to the annual report, are as follows: Mines, mineral claims and assets, \$2,609,433.82; permanent equipment, buildings, machinery, etc., \$42,108.52; office furniture, \$501.07; mine supplies and stores on hand, as per inventory, \$2,740.75; accounts receivable, \$3,303.53; cash on hand and in banks, \$53,544.82. The profit and loss accounts show the cost of mining and development to have been \$69,190.65; freight and treatment, \$12,608.95; ore tax, \$595.24; general expenses, \$576.88; Montreal office expenses, \$1,642.63; tools and appliances, etc., \$1,111.56; written off permanent equipment, \$1,881.81; repairs to machinery, buildings, tramways, etc., \$4,698.63, and directors' compensation, \$2,000. The retiring directors were re-elected.

THE IRON RESOURCES OF BRITISH COLUMBIA.

REPORT OF A SPECIAL COMMITTEE.

AT A MEETING of the Voters' League, held in the subject of the Iron Industry of the British Victoria on June 24th, the following report on Pacific Coast was presented:

We, your committee appointed to investigate the resources of this province in iron ores with a view of determining the economic value of the same, together with a comparison in cost of manufacture, and prospective markets should smelting and rolling mills be established, beg to make the following report:

ORE DEPOSITS.

Your committee find that very large deposits of magnetite ores are to be found within the districts of Victoria, Alberni coast, Nanaimo, Bella Coola, Cariboo, Silmilkameen, Kamloops and Queen Charlotte Islands. Hematite also exists, the extent of which remains as yet a matter of conjecture. Prospectors are now looking up these properties and fuller information will be available to your committee within a short time.

LOCATIONS.

Of the developed properties, upon which a value from an economic standpoint may be based, those of the Texada Island may be cited. It is here the Puget Sound Iron Company own 2,700 acres, situated on the southwest side of the Island. Sufficient development has taken place to expose an ore body estimated by experts as representing 8,000,000 tons of commercially valuable iron, which gives a detailed test of from 68 to 70 per cent. iron, and comparatively free from objectionable properties. Arrangements have been made to transport this ore by a gravity tramway 1,100 feet in length and 500 feet above sea level, with the intention of making regular shipments to the smelter at Irondale, Washington. Here the ore is subjected to a mixture of from 1-

to 3-10 of bog ore obtained near Hamilton, Skagit County. From this an excellent foundry pig is made, and was utilized in building the United States war vessels Olympia, Monterey, Charleston and Oregon, by the Union Iron Works Co., of San Francisco. Experts have pronounced this a superior article to the Eastern manufacture, and it is certainly a compliment to the British Columbia magnetite ores. Of other properties upon which development work has taken place, mention may be made of the Serata, with an ore body of 80 feet wide, a depth of 90 feet, with an easterly extension of considerable distance; over 800 feet has been crosscutted with excellent results. The Copper Island and Sheshart have each an ore width of over 100 feet, a tunnel has been made at the latter of 200 feet wide with a depth of 800, a very extensive body of limestone lying contiguous to this property. On the Copper Island a tunnel of 100 feet wide and of the same depth has exposed a vein from 15 to 20 feet, assaying 60 per cent. iron and no impurities. This has been traced for over half a mile, and described as one of unlimited supply. Hematite deposits lie in close proximity. These mines are situated in the Barkley District, and are bonded by an American syndicate who expect within a short time to expend three million dollars in the erection of smelter and rolling mills. The Redonda mine is situated on the north shore of West Redonda Island, the north shore of which rises abruptly from the sea to a height of over 3,000 feet. The ore outcrop is situated at an altitude of 450 feet, a foothold to this rapid rise being afforded only by the standing timber. In 1893, 623 tons of magnetite ore were shipped to the Oswego Iron & Steel Co.'s furnaces in Oregon. This work exposed an open face of solid magnetite 30 feet wide by 30 feet in height, assaying 66 per cent. per ton. No further work has been recorded, and owing to the peculiar situation little is known of the extent of this deposit.

The Glen iron mine at Cherry Bluff, near Kamloops, on the line of the C.P.R., is another which has produced in a small way. The product of this mine is of excellent quality, 66-83 per cent. metallic iron, and the annual output of from 500 to 2,000 tons being conveyed by aerial tramway to the C.P.R. tracks. This ore has been extensively used for flushing purposes by the smelters of Tacoma, Revelstoke and Nelson. The estimated ore in sight being given at 2,000,000 tons.

The Kootenay River deposits reported by Dr. Dawson are quite extensive, and are of a magnetite character, their situation renders them of little commercial value, lacking facilities for cheap transportation.

Another extensive deposit of a hematite formation was discovered by Mr. Ludloff, a German geologist, in the Cariboo District. This measures 500 feet in thickness, and, like the former mine, is of little value with the present means of communication.

At Port Renfrew a vein of 100 feet in width has been located, and this is situated some seven miles from tide water and assays 68.8 per cent. iron.

A tunnel at Rivers Inlet 100 feet wide with a corresponding depth has exposed a vein of 30 feet width, assaying some 69 per cent. iron. Little is known by record of the two latter deposits beyond that here stated.

In addition to the forementioned properties, deposits of a more or less extensive nature have been discovered at Sooke, Chemainus, Toba and Knight's Inlets, Comox, Nootka Sound, Bella Coola, Alberni, Graham and Moresby Islands, Similkameen and other points, showing conclusively that iron ore deposits are not confined to any particular locality. It is an undoubted fact that immense bodies of both magnetite and hermatite lay awaiting development the moment demand and favourable conditions exist for iron and steel production.

QUALITY.

The investigations of your committee show that while quantity is a prime factor in the distribution of iron deposits throughout the Province, the quality and commercial value of the same is of the highest order.

Numerous assays have been made and tests applied in England, Scotland, Pittsburg, and indeed many of the leading iron laboratories of the world, in which the iron ores of this Province have not only held their own, but have been proved superior to many now used in course of iron production. Space alone prevents your committee from giving a resume of analysis in this report, but they can be tabulated if it is the wish of this meeting, and filed for future reference.

SHIPPING CONDITIONS.

A peculiar feature of the iron distribution on the East and West Coasts lay in their accessibility to deep water shipment. Many of the deposits are situated at the very edge of ocean navigation, with sufficient grade for chuting the ore into bins at salt water. It is stated in some locations ore can be quarried at 20 cents per ton and delivered on board of steel scows for 30 cents or less. In this respect an advantage is possessed by the Coast properties over the inland deposits; another important factor is the abundance of timber for making charcoal. The immediate deposits of limestone and coal, together with magnificent water power stretches for generating light and motive powers all point that nature has destined this Province as the workshop of the world.

COST OF MANUFACTURE HERE AND ELSEWHERE.

This is a phase of the inquiry in which your committee have experienced difficulty. The short time allotted for report has not afforded us an opportunity of collecting data upon the subject, and in view of the comprehensive reports now being received by the Provincial Government from British consular agents residing within spheres of the iron industry, together with the increased rate of wages paid on the Coast to labour, we deem it advisable to leave this question subject to future investigation and report. We are satisfied, however, with the favourable conditions mentioned elsewhere, and that the abundance of raw materials other than iron will more than offset any difference arising from a wage comparison.

As showing the difference in point of supply and manufacture between the Irondale smelter in Washington and the Collingwood of Ontario, your committee submit the following as a probable estimate. It must be remembered that it requires two tons of iron ore to produce one ton of pig. At the Irondale smelter the Texada ores are laid down as undermen-

Mining and delivery of two tons of ore at \$1 per ton	\$2.00
Freight on same at \$1 per ton	2.00
Royalty, at 50c. per ton	1.00
Unloading .....	.30
Duty .....	.40

Total per ton of pig iron

Collingwood smelter: Ore supplied by the Superior Power Co., owned by the Helen mine, at \$1.30 per ton, 1 2-3 ton, \$2.16 per ton pig.

Estimated cost of manufacture, Collingwood smelter:

Ore, 1 2-3 tons at \$1.30 per ton	\$2.16
Fuel, 1,800 lbs. coke, at \$4 per ton	3.60
Lime .....	.15
Labor	1.05
Maintenance and interest, 10 per cent.	1.28
Power, oil, etc. ....	.25
Office .....	.25

Total

Probable estimate to Irondale smelter:

Ore, 2 tons at \$3.05	\$6.10
Fuel, 1,800 lbs. coke	3.60
Lime .....	.15
Labor, 100 per cent. additional	2.10
Maintenance and interest, 10 per cent.	1.28
Power, oil, etc. ....	.25
Office .....	.25

Total

Or a difference of about \$5 per ton.

The estimated cost of ore to the Irondale smelter would suffer a material reduction if smelted on the West Coast, owing to the abundance of raw materials on the spot, and a saving in the freighting, unloading and duty. If the Dominion bounty of \$3 per ton were taken from the cost, the local manufacture would be brought down to \$10.73 per ton or less. In establishing the iron industry on this side of the line an immediate demand would be created for lime, charcoal, coal, coke, and a dozen and one necessities, requiring the employment of large numbers of skilled and unskilled labourers. This would give a stimulus and lead to the establishment of many other industries little thought of at present. A permanency would be thus attained and a rapid development would take place, leaving the Pacific base of supply practically in our hands.

MARKETS.

This is a subject which might, in conjunction with the foregoing chapter, be referred for future report. In addition to observations on the cost of manufacturing, reliable information is now being received by the Bureau of Information on iron consumption. This should be disseminated as early as possible, for upon this question lies the immediate or future establishment of smelters and rolling mills. The incomplete returns in the hands of your committee are of small value to manufacturers or capitalists; but probable markets may be found to exist for a British Columbia product in Japan, a large consumer with little or no iron of her own; China, Mexico, Guate-

mala, San Salvador, Nicaragua, Costa Rica, Republic of Columbia, Philippine Islands, Venezuela, Ecuador, British East Indies, and possibly Australia. It is worthy of note that Japan alone imports from all countries iron and steel manufactures of \$16,000,000 value—an increase of 100 per cent. over the preceding year.

It will be seen at a glance that these markets, if supplied by Canada, must, owing to transcontinental railway charges, depend upon Pacific Coast mills and factories. With unhampered restrictions upon the raw material from British Columbia, it is possible that our energetic neighbors might arise to the occasion and become formidable competitors. Much depends at the present juncture on the uses made of our opportunities. Your committee are of the opinion that this question has not been entered upon too soon.

IMPORTS OF IRON AND STEEL.

As showing the extent of the home market, the following figures are taken from the Statistical Year Book on imported iron and steel manufactures, exception being taken on ship's boilers, fish hooks, printing presses, tin plate, sheets, etc.

Year ending 30th June.

	Dutiable.	Free.	Total.
1892	\$ 9,968,409	\$2,673,033	\$12,641,442
1893	10,113,177	3,080,340	13,199,223
1894	8,776,533	2,554,238	11,310,771
1895	7,405,923	1,843,826	9,249,749
1896	8,463,747	2,488,860	10,952,607
1897	8,666,497	1,947,133	10,613,630
1898	12,691,772	3,864,989	16,556,761
1899	15,621,346	4,147,379	19,768,725
1900	22,209,073	7,130,100	30,429,233
1901	18,738,135	8,042,323	26,780,458

Total 10 years: Dutiable, \$122,734,612; free, \$37,778,287; or a grand total of free and dutiable imports of \$160,512,899 for the past ten years.

DOMINION GOVERNMENT BOUNTY ON STEEL.

Recognizing the immense advantages accruing to the Dominion in being enabled to provide for the ever-increasing demand for iron and steel, the Dominion Government offers a bounty of \$3 per ton on pig iron made from Canadian ores, and \$2 per ton on foreign, and a further sum of \$3 per ton on steel ingots. This bounty is reduced 20 per cent. per annum after the 23rd day of April, 1902. It is possible, however, owing to the success attending its efforts, that an extension might be given for several years—until, perhaps, 1907. This aid has been supplemented by the Ontario Government, which has added \$1 per ton for pig iron manufactured in Ontario from Ontario ores. This provision, with other concessions, has led to the establishment of the steel industry upon a substantial basis, and a corresponding prosperity in the provinces wherein located.

Owing, however, to the rapidly increasing demand in consequence of internal development, it will be some time before any perceptible impression is made upon the imports, and a splendid field is afforded in this province for further extension in this direction.

LACK OF PROVINCIAL INFORMATION.

It is greatly to be regretted that so little information is forthcoming upon such an important subject

from official sources, and it is to be hoped the government will see its way clear to keep one or two practical men constantly in the field—thus enabling it to keep in closer touch with the development now going on—reporting upon fresh locations and supplying capitalists with reliable information as to our mineral wealth.

The question of re-staking claims demands immediate attention. Gross abuses of the present act exist, and many good locations are tied up, which greatly affects any attempt at development.

RETICENCE OF PROSPECTORS.

The best information obtainable on the character of magnetite and hematite deposits is at present in the possession of private prospectors. Your committee have interviewed a number of these gentlemen, and it would appear that considerable activity is going on at the present time in the interests of wealthy syndicates having in view the immediate establishment of smelters and rolling mills. It is owing to this fact that little can be gleaned from private prospectors. They represent to your committee that being under engagement to the companies referred to they are not at liberty at the present time to give out any information. When this has been presented to their principals, we are led to believe that the league will be placed in possession of information regarding a number of unreported properties.

IMPRESSIONS.

In pursuing the investigations called for, we have been particularly impressed with the immense distribution which has taken place by nature of the raw materials throughout this Province, and particularly so of the Island of Vancouver. At a period in our history when the various manufacturing interests of the world have been brought to such a perfected state and increasing at a rapid ratio each year, it would appear to us that the time must be necessarily short before world-wide attention is directed this way. From the manufacturing possibilities presented to us by the great wealth lying dormant in forest and sea, from a harnessing of electricity to the water powers of the West Coast to assist in bringing about a cheaper method of production in man's requirements, much is to be expected. The importance of such factors few appear to realize, and of the future that lies before us how much remains with ourselves in bringing it about in our own time, thus replacing present conditions with those of a happier nature.

SUGGESTIONS.

In suggesting to the league methods which we think would prove beneficial and tend toward the immediate development of the iron industry in this Province, your committee have written to the Bureau of Information for the Province of Ontario for all information showing the course pursued by that Government in giving encouragement to iron and steel smelting in that Province. This will be shortly forthcoming, and will be placed before you for consideration and action. We believe the iron and steel trade to be the foundation of all the industries of a country, and there is no reason why, with the advantages possessed by us, full enjoyment should not be taken of the privileges.

To bring forward debate, your committee make the following suggestions:

1. That the Minister of Mines be asked to have the various ore bodies reported upon, that accurate knowledge be forthcoming regarding: (a) The locality; (b) Quality of ore; (c) The extent of deposits, and commercial value of the same.

2. The preventing of re-staking of claims, and speedy punishment for false declaration in respect to improvements.

3. That a bill be brought down embodying the following legislation in addition to the mining laws of the province: (a) That a bonus of not less than \$—, nor more than \$—, be offered prospectors for each available body of magnetite or hematite ores discovered within the Province, the same being approved of by the proper officer as to quality, quantity, and availability for manufacturing purposes; (b) That all such deposits be reserved by the government in the interests of the owner to the intent that he be aided by the Government in obtaining full money value for his find. This prevents the owner locking up the raw materials of the Province against the industry; (c) That in cases where the owner is unable to prove his find the Government shall (if considered of value) reserve and prove the same, deducting the expenses from the amount of bonus or royalty thereafter paid; (d) The Government shall place the reserved properties in the hands of responsible parties who will deposit a bond with the Government covering a contract to mine such quantity of ore per year as shall be agreed upon. Smelting, or have the same smelted, within the Province. That for each ton of ore mined the discoverer shall be paid a royalty, the amount of which shall be determined according to quality, quantity and the availability of the ore, the Government at all times acting as arbitrator of values. In event of an arrangement being made for the sale or purchase of a deposit outright, the purchaser shall be required to deposit a bond with the Government covering an agreement (under the law of reserve) that the material taken from such mines shall be smelted within the Province.

THE POSITION AT ROSSLAND.

From our own Correspondent.

THE past month in this camp has been one of much unrest. No reference is intended to the labor troubles, which are practically concluded, at all events for the near future, but to the altered conditions of mining in this city. It is rather the fight that has been in progress between the mines, notably the Le Roi and the railways, for cheaper rates of freight and for cheaper coke. The shipments from the Le Roi for the past month have been of much higher grade than for some time past. This is in a measure due to a higher grade of ore, \$18, being discovered on the 900 level of the Le Roi, but it is principally due to a deliberate attempt to "gopher" the mine. That this "gophering" has been done with any wilful and mischievous intent is not true. It has been done as a temporary expedient to keep the mine open.

The drop in the price of copper, the discover-

that the values recovered at the smelter were not as high as had been estimated under previous managements, both of mine and smelter, have shown that the ordinary grade of ore shipped from the Le Roi right across the vein, practically without careful sorting, would not pay. Hence it was either necessary to produce an ore of higher grade, or by reducing the cost of treatment or freight, to make a higher profit on that low grade ore.

Negotiations have been in progress for some time past with the Great Northern railway having the latter object in view. The mine management has recently authoritatively declared that no deal "has been closed." Nevertheless your correspondent is positive that this statement, emanating from Mr. Mackenzie of the Le Roi, though true to the letter, is false as to its purport. The railway company is willing to grant the terms asked, which will make a difference of \$1 per ton profit on the ore.

There are certain reasons, which are based partly on the condition of affairs in the management of the mine (referring to London), and partly on the Elmore process, which is talked of as being certain to be adopted, both by the managers of the Le Roi and of the Le Roi No. 2, reducing the amount of the ore to be shipped, (being shipped as concentrates at a rate of 12 to 1), which have rendered it necessary for the present not to take advantage of this concession, or rather concessions, and to conclude a contract.

It is therefore necessary that the mine should only export its best ore from its best stopes, and from the hanging walls of the same. This will inevitably reduce the value of the remaining ore on the foot walls and in the stopes of lower value, inasmuch as the ore of higher grade will no longer be there to be a part of the same lot shipped, it is, however, considered that this will do no harm if the policy is not too long continued. It is possible that its discontinuance may be only a matter of a few weeks, but on the other hand it may be delayed until the autumn.

Such is the condition of the Le Roi. Before Christmas the mine should be producing at least 1,000 tons per day, and it is more than possible that if the Elmore process is by that time in full working order that the production may be considerably more.

I have dwelt at some length on this mine, as the position of the Le Roi is to a great extent the keynote of the camp. In much the same way the War Eagle and the Centre Star have been endeavoring to get rates from the Trail smelter. Up till now these mines have not succeeded in getting all they demand. The smelter people declare that the demand is too exigent. The mine people say that the Trail smelter, having a cheaper power and a much cheaper rate for coke, which is supplied it by the C.P.R., is able to reduce ore at least \$1 cheaper than can the Northport smelter, and demand that the rate made to the mine should be in accordance with these circumstances. Such in brief is the dispute. The manager of these mines, Mr. Kirby, is paying a visit to the East, it is understood, in this connection, and up to the present has not returned. He has, however, made a statement that within a very short period the conjoint mines will be shipping 300 to 400 tons daily.

It is likely that the concessions granted by the

Great Northern, which practically place the Northport smelter on the same basis as the Trail, will have some effect in the conclusion of negotiations. In this connection it may be stated that the War Eagle and Centre Star both possess vast quantities of low grade ore, which can only be made profitable supposing that low freight and treatment rates be accorded them. It is for this reason that such a strenuous protest has been made against certain classes of mining legislation, especially the two per cent. mineral tax.

In this interesting combat between mine and smelter and railway be it noted that whereas the debt owed by the War Eagle and Centre Star is one to the Bank of Toronto, a kindred concern; the debt of the Le Roi is owed to the Bank of Montreal, an utterly foreign though undoubtedly friendly body.

The third mine in Rossland which is of consequence is the Le Roi No. 2, consisting of the Poorman, Josie, No. 1 and Annie. The average value of ore shipped, gross, is \$18 per ton. It is principally sent away from the Josie, which means that it is hoisted through the Josie shaft. As a matter of fact the bulk comes from the Annie, the highest graded mine in the camp, and which is showing great values at a depth; and the Poorman on the other side, contiguous to the War Eagle, and whose pay shoot is partly in the War Eagle ground, but up to the present unworked by that company. On the Josie proper comparatively little work is being done, except on the 300 level. On the No. 1 work has developed some very good looking ore bodies of whose permanency Bernard Macdonald seems to have a favorable opinion. The trouble with these veins, which are the westernmost worked successfully in the camp, is that they have a tendency to widen and to split. A diamond drill has lately been introduced with success to counteract these difficulties, which often amount to local displacements.

The Rossland Great Western is practically closed down, and will so remain until the lowered prices of treatment goes into effect. This is expected early in July, when the Great Northern has completed its branch line into Fernie. To work this mine at present at a profit would simply mean to gouge the property of its best pay streaks.

Similar language may be used with regard to the Kootenay mine, which, despite all adverse reports, possesses probably the largest bodies of low grade ore in the camp. Under favorable circumstances this mine will probably become one of the standbys of the camp. Bernard Macdonald, the present general manager, may be regarded as unduly optimistic, but this verdict of the mine's possibilities and future is one that was also rendered by so conservative a judge as Manager Carlyle, now of the Rio Tinto.

The Giant is doing some work, and is shipping ore at a profit. With this mine it is apparently merely a question of capital, and this, it is thought, will be forthcoming very shortly.

Attempts are also being made to resuscitate the Homestake and Gopher, and under the favourable conditions, which are now likely to apply, there is little or no reason to doubt that this mine, in common with many others, which are not at the present mo-

ment being worked, will once again come to the front and become permanent and profitable shippers.

The Spitzee is also working steadily. There are various rumors in connection with this property, and the truth of the matter will doubtless come to light within the year.

The White Bear is still working steadily and is reported to have lately struck a paystreak of value at depth.

The Green Mountain is steadily prosecuting development with hopeful results.

THE LARDEAU.

From our own Correspondent.

RAILWAY communication for the Lardeau District is at last an assured fact, and should greatly stimulate the development of its resources during the present season.

The new line will be taken over from the contractors by the C.P.R. about the 1st of July, so that regular passenger traffic will not commence before that time, but an accommodation train already meets the steamers on Kootenay Lake thrice weekly, and a gradually increasing number of visitors are taking advantage of the ready means of access thus afforded.

C.P.R. surveyors are at work along the shores of Trout Lake, and it is possible that construction of a further section of the road may be begun in the near future, the intention being to eventually connect with the Arrow Lakes and the main line of the C. P.R. at Arrowhead.

The Fish Creek section has come into prominence lately owing to several important mining deals having been successfully carried through.

W. B. Pool and associates have bonded the Oyster and Rossland groups for \$50,000 and \$25,000 respectively, a considerable cash payment down being made in each case, while the Goldfinch claim has been sold outright for \$25,000 to Chicago investors. All these properties are free-milling and possess very good surface showings, but little development has yet been done on any of them.

On the adjoining Eva group, however, a depth of about 400 feet has been attained, and the ore is said to hold its values very well.

There seems no doubt but that a new free-milling camp of much promise is now being opened up at this point, and it is to be hoped that future developments will be satisfactory. The ores consist of white quartz carrying free gold, often coarse, with varying, but usually small quantities of oxide of iron, and in some cases a little zinc-blende and galena, and occur in metamorphic shists and slates, the veins as a rule following the general strike of the formation, but sometimes apparently cutting it at a slight angle.

The formation is identical with that found in the Trout Lake District, and it is probable that careful prospecting will prove the existence of similar free-milling ores here, as gold values are already known to be widely distributed and occur in many of the claims now being developed.

The section of the country at the foot of Trout

Lake, which is more particularly opened up by the new railway, is also receiving considerable attention from prospectors. On Canyon Creek, particularly, several promising silver properties are being opened up, while free-milling ores have been found on Tenderfoot and Poplar Creeks.

MINING AT KAMLOOPS.

From our own Correspondent.

A MONTH ago the dredge was moved from the North Thompson River to the mouth of Tranquille Creek at the head of Kamloops Lake. The Boyd Dredging Company have secured two half-mile dredging leases on the creek, extending from the lake to the mouth of the canyon. Promising returns are being obtained by the dredge in dredging its way into the creek.

At the Iron Mask development work is being done on the five hundred-foot level, where the ore body is reported favourable. A four drill air-compressor has been installed and is now in continuous operation. The Glen Iron has now been working continuously for four months, shipping thirty tons of iron ore per day, to the Hall Mines and Trail smelters for fluxing purposes. An extra force of men has been put on development work.

The Hardie Cinnabar Mines near Savonas have fifteen men employed. The property is being developed under the superintendence of Mr. Joseph Luce, M.E., of Utah, by a series of three tunnels to cut the ore body at depth. The property has a very extensive outcropping of cinnabar ore, and the tunnels are being run to deliver the ore near the place of treatment. The ore has been struck in the lower tunnel.

The Tenderfoot Mining Company have started operations, a small force of men being employed drifting on a body of high grade ore. The Copper King group of claims at Cheery Creek has changed hands, having been purchased outright by Eastern Canadian parties. The late owners by recent work on the property have proved the ore body to be several feet wider than previously anticipated.

RECENT PUBLICATIONS.

THE Gold Mines of the World (second edition), written after an inspection of the mines of the Transvaal, Rhodesia, India, Malay Peninsula, West Australia, Queensland, Victoria, New South Wales, Tasmania, New Zealand, British Columbia, the Klondike, United States, Alaska and Mexico; illustrated with plans and photographs; by J. H. Curle. London, Waterlow & Sons, Limited.; Simpkin, Marshall, Hamilton, Kent & Co., Limited. New York, Engineering and Mining Journal, Incorporated. Price, 10s. net.

We had reason to criticise and dispute some of the statements contained in the first edition of this book relating to the gold mining industry in British Columbia. In the second edition these statements have been withdrawn, but we still have to regret that we find ourselves at disagreement with Mr Curle in the opinions he has formed and the conclusions he has arrived at in respect to the condition of gold mining in this country. In the introductory portion of the work the following reference is made to Canadian mines. "British Columbia has not fulfilled expectations. Three years ago its gold mines looked more promising than they do at present. The Atlin hydraulic find may prove successful. . . The Klondike has passed its zenith. Its production in 1900 of over a million ozs. will never again be reached." It is this sort of dogmatic assertion, without a vestige of proof, that we object to, and one is almost inclined to ask, "Who, pray, is Mr. Curle?" Again, later, in a chapter dealing with the gold mines of the province, the author remarks on the "so far and almost complete failure" of effort in this direction, but he fails to explain how, notwithstanding this "almost complete failure," gold production has increased in the interval between the publication of the first and second edition of his book nearly a hundred per cent. But British Columbia is not and does not pretend to be a country of gold mines. Gold mines, by which we understood free milling quartz in which no other metal than gold is present, are the exceptions rather than the rule, and if it is fair for Mr. Curle to consider the Le Roi mine as a gold mine and describe it as a failure, why has he omitted to take into consideration the "gold mines" of the Boundary or of the coast districts, which are by no means failures. Even the Le Roi mine has paid a million and a half dollars since Mr. Curle visited it in 1898, and if this sum has been spent in mine equipment and developing instead of being distributed among shareholders, it is in line with the very policy Mr. Curle recommends should be followed by the Ymir company. The greater part of the chapter on British Columbia is taken up with a description of the Atlin camp, while the far more important field of Cariboo is dismissed in a couple of brief paragraphs, one of which states: "In the first edition I dealt with the English companies floated to work the alluvial gravels over a great area, of which Cariboo is the centre. These mines up to that time had all been failures, and I can see no reason to alter my opinion about them now." Should this remark be brought to the attention of Mr. Hobson and other eminent hydraulic mining engineers, who have the utmost confidence in the future of mining in Cariboo, it will doubtless cause them much uneasiness. The volume, however, contains much matter of interest and even of value, relating to gold mining in the different chief centres of this industry throughout the world, and up to a certain point should be of use to investors.

C. J. Walker, of 24 Coleman St., London, E.C., has just published a third edition of that very admirable work of reference the "Advertisers' Ready Reckoner," price 1s. in paper or 2s. in cloth binding. The third edition is in handier form than previous issues, while much valuable data has been added. Hints on the art of advertisement writing are given, followed by a short article on "How to Achieve Success in Advertising," by an expert. The book also contains a full list of changes for the insertion of advertisements in leading British and Colonial newspapers.

A CHANGE OF TITLE.

WE have received the following notification in the form of a circular from the Vancouver Agency, Limited: We beg to draw your attention to the change in the title of our Company, from "The Vancouver Agency, Ltd.," to "C. F. Jackson & Co., Ltd." The change is one in name only and in no way affects our constitution or the continuity of our business. We trust that with your assistance we may still further increase our rapidly growing business, and beg to call your at-

tention to the departments which we run in conjunction with our Liverpool office through whom we purchase our European supplies.

B. C. AND THE LONDON MARKET.

OUR special correspondent writes that the market has been very dull during the month, the only feature being the fall in Le Rois, which declined to £1, but since recovered somewhat. Ymirs have also suffered badly, having an offer at well under par. Hall Mining and Smelting is quoted at rubbish prices.

INSTITUTE MEETINGS.

A MEETING of the Canadian Mining Institute will be held in Nelson, B. C., on September the 10th, next, for the purpose of organizing a working section or branch of the Institute in British Columbia.

We are requested to announce that the annual meeting of the Southwest Miners' Association will take place at Los Angeles, California, on July the 8th.

COAL EXPORTATIONS AND TRADE.

COAL shipments from the Vancouver Island collieries during April were divided as follows:

	Tons.
New Vancouver Coal Co.	35,826
Comox	16,694
Ladysmith	16,978
Total	69,498

In May the shipments were:

New Vancouver Coal Co.	28,557
Comox	11,308
Ladysmith	30,705
Total	70,570

Mr. J. W. Harrison, coal and metal broker, of San Francisco, in his latest circular thus comments on conditions in this market:

"The coal market is pronouncedly showing the inroads that are being made into its consumption by oil. Of course it is a very marked advantage to all consumers of steam fuel, to be enabled to purchase their power at a great reduction on the prices of former years. The prices now ruling for coal are also very materially reduced. The best Australian coals were selling two years ago at fully \$2 per ton more than is being offered to day. This is a large shrinkage, and is caused principally by the influx of oil. Low priced oil enables the gas companies to produce cheap gas for stoves and grates; this precludes the Wellington company from changing its present price, unless it would be a further reduction. It is questionable if the prices this year for Australian coals will be repeated next year, as the inclement weather there this season has given the farmers almost nothing to export. The coal strike East will not materially affect this market, except for importations of Cumberland and Anthracite, which doubtless will be somewhat increased in price locally."

PATENT OFFICE REPORT.

MR. ROWLAND BRITAIN, Patent Attorney, of Vancouver, sends the following list of patents granted to British Columbian inventors during the month of May: George Cassidy, Vancouver, a Canadian patent on a rotary engine; T. H. Hazard, Vancouver, a U. S. patent on a diving vessel designed for salvaging submerged wrecks; M. Barret, Grand Forks, a U. S. patent for a tapping jacket; D. J. Matheson, Naaimo, a U. S. patent on a supplementary door fastener; A. B. W. Hodges, of Grand Forks, a U. S. patent on a furnace charging system.

The following patents were published in the Canadian Patent Office Record for March: C. Schallberger, Vancouver, wood preserving compound; A. W. A. Phair, Lilloet, photographic exposure meter; W. F. Bedel, D. McPhail and T. F. Adams, Kaslo, amalgamator; W. G. Trethewey, Vancouver, rain pipe coupler; W. T. Jones, Westminster, device for ringing net floats.

TRADE NOTICES, CATALOGUES AND CIRCULARS.

A COMBINED TRANSIT AND LEVEL.

MESSRS. JOHN DAVIS & SON (Derby), Ltd., represented in Canada by Mr. Francis T. Peacock, M.E., of Montreal, call attention to a specially designed combined Transit and Level, embodying all the latest improvements and specially constructed to stand hard usage and suitable for climates where temperatures vary from 70 degrees below to 110 above zero. The instrument rests upon rubber cushions, so that the disarrangement of the adjustments by transportation may be prevented. The specifications are as follows:—Length over all of telescope, 11 ins.; diameter of object glass, 1½ ins.; transit both ends; object slide and eye-piece provided with dust and rain guards; fixed Stadia wires to subtend one foot on levelling rod, placed 90 feet from the instrument; two feet at 200 feet; collimation true for all distances; reversion level 6 in. to telescope, with German silver graduated scale to read bubble; clamp and tangent screw; inverting eye-piece; diagonal eye-piece for vertical sighting; screw movement to eye-piece for focussing cross wires; sensitivity of 6 in' level in seconds of arc per graduations—20 ins. per division; vertical circle 5 ins. in diameter, divided on solid silver to ½ degrees, with vernier reading to 1 minute; horizontal limb 6½ ins. diameter; graduated on solid silver to ½ degrees, with two verniers reading to 30 seconds; graduation, two rows, 0 to 360 degrees, inclining the way it is to be read; ground glass vernier reflecting shades; compass ring, with double row of figures, the inner row figures in quadrants, 0 to 90 degrees, and the outer row 0 to 360 degrees; 5 in. needle; circle completely covered, and compass and vernier openings water-tight; two graduated right angle levels; socket, long compound centre; levelling screws protected by dust caps and provided with ball and socket cups. There are in addition a number of accessories. The price of this instrument is £43. The manufacturers issue a very neat catalogue in which all engineering requirements are listed and priced.

THE ALLIS CHALMERS CO.

The Salt Lake office of the Allis-Chalmers Co., report the following sales for the month of May:

2 Converters for the United States Mining Co.; Power Plant for the Troy Laundry, Salt Lake City, consisting of 12 in. x 39 in. Reynolds engine, Reynolds heater, shafting, pulleys, etc.

500-ton Sampling Works for the Park City Sampling Co., of Park City, Utah.

4 Matte Ladles for the Bingham Con. Mining & Smelting Co.

1 150-h.p. Return Tubular Boiler, for the Honorine Mining Co. at Stockton, Utah.

Elevator material for the Utah Fuel Co.

2 Converters for the Bingham Con. M. & S. Co.

1 No. 6 Gates Style "D" Crusher for the Lime King Mining Company.

HERCULES WIRE ROPE.

Messrs. A. Leschen & Sons Rope Co., of St. Louis, Mo., publish a catalogue describing their specialties, the most notable being the Hercules Wire Rope, which the manufacturers claim is the strongest, toughest and most durable rope on the market. The Messrs. Leschen also recommend their patent flattened strand wire rope, which is more flexible than the ordinary round strand rope, and has a more wearing surface. The company are now installing at Wyoming, Mo., a remarkable aerial tramway, sixteen miles in length, which is said to be the longest distance ever attempted in the direction of aerial transportation.

SURFACE AND UNDERGROUND HAULAGE.

Those who desire information on the subject of the application of wire rope to surface and underground haulage cannot do better than apply to the Treaton Iron Company, of Trenton, New Jersey, for a copy of a booklet bearing this title, of which they are the publishers, and a well-known authority, Mr. William Hewitt, M. E., the author. The work is a most comprehensive one and contains much valuable information and many instructive useful tables. The illustrations, too, are most instructive. The comparative advantages of the two methods of haulage, the "tail rope" and the "endless rope" system are considered at length, the main difference appearing in the items of power and labour. While, the author remarks, the endless rope system is more economical of power, it is most costly for the labour in handling the cars, and this fact should be taken into consideration in the selection of either system. There are chapters on "Hoists," "Inclined Planes," "Track Rollers and Mine Cars, Tipples, etc."—a most excellent little text book.

JEFFREY SCREENS.

This is a very handsomely illustrated catalogue published by the Jeffrey Manufacturing Co., of Columbus, Ohio, in which all classes of screening machinery manufactured at the company's works are fully described and priced.

HYDRAULIC PIPING.

The plant of the National Hydraulic Mining Co. operating at Beaver River, Cariboo District, was successfully and finally installed this month. This equipment includes 2,000 feet of pipe line, the pipe being 22 inches in diameter reducing to 9 inches. The piping was manufactured by the Vancouver Engineering Works, of Vancouver, and is pronounced by the mining company's engineer as being the best he has ever laid, every joint fitting perfectly, and there were absolutely no leakages.

MINING RETURNS AND STATISTICS.

BOUNDARY DISTRICT.

PRODUCTION from this district for the year to June 21st has been divided as follows:

	Tons.
Granby Mines, Phoenix.....	168,482
Snowshoe, ".....	1,080
Mother Lode, Deadwood.....	64,684
Sunset, ".....	1,370
B. C. Mine, Summit.....	1,680
Winnipeg, Wellington.....	785
Golden Crown ".....	625
No. 7 Mine, Central.....	310
Jewel, Long Lake.....	1,580
	240,596

ROSSLAND.

The average production of the Rossland mines is being maintained at a rate of rather over 6,000 tons weekly. Shipments for the year to date approximate 163,000 tons. To June 21st the returns were:

Le Roi.....	113,304
Le Roi No. 2.....	31,305
Centre Star.....	4,070
Rossland G. W.....	2,400
Giant.....	360
Cascade.....	300
Bonanza.....	90
Velvet.....	250
Spitzee.....	20
Total tons.....	156,704

SLOCAN.

Shipments through the port of Kaslo during 1902 have been as follows:

Month.	Tons.
January.....	1,725
February.....	1,868
March.....	1,660½
April.....	926
May.....	768
To June 21st.....	874½
Total to date.....	7,822

According to a table published by the New Denver Ledge the total returns from this district to date aggregate 14,500 tons. The following mines have contributed to this result:

	Tons.
Payne.....	390
Ivanhoe.....	275
Sunset (Jackson Basin).....	641
Reco.....	302
American Boy.....	490
Arlington.....	1,361
Hewett.....	642
Bosun.....	590
Last Chance.....	150
Wonderful.....	100
Enterprise.....	520
Monitor.....	565
Queen Bess.....	160
Silver Glance.....	37
Whitewater.....	2170
Ottawa.....	8

	Tons
Neepawa.....	60
Hartney.....	25
Marion.....	80
May.....	5
Paystreak.....	7
Surprise.....	22
Slocan Star.....	404
Duplex.....	7
Emily Edith.....	20
Prescott.....	4
Rambler.....	1867
Molly Gibson (since last report).....	1500
Washington.....	30
Folliott.....	2
C. O. D.....	2
London Hill.....	15

From the Slocan City division the shipments to June 20th were:

	Tons.
Mine.....	
Arlington.....	2060
Enterprise.....	640
Ottawa.....	7
Neepawa.....	60
May.....	5
Paystreak.....	7
Duplex.....	5
	2784

ATLIN.

The first clean-up of the season on McKee Creek, representing 100 hours' piping, were made on June 19th, \$1,000 being recovered.

THE METAL MARKET.

QUOTATIONS during the month have remained stationary, silver alone having slightly advanced. The *Engineering and Mining Journal*, of New York, reports the copper market quiet with little new business and no material change in prices. Most producers are well sold up, and consumption is very large, as all manufacturers are exceedingly busy. In London the market has been rather flat, and standard copper is lower. Refined copper is steady, however, and standard is merely approaching more nearly the normal difference between that grade and electrolytic. Lake copper is quoted at 12¼ and 12½; electrolytic, 12 and 12¼ and casting copper, 12.

Copper production, as reported by Mr. John Stanton, who acts as statistician for the companies, showed an increase in May which was larger even than we had anticipated. The total output from the United States mines for the month was 25,763 tons, of which 21,763 tons came from the reporting mines, and 4,000 tons from the outside sources—that is, from the smaller mines and from the smelters who treat ores carrying copper with other metals. The total shows an increase of 3,371 tons, or 15.1 per cent. over May 1901. This gain, which indicates that the mines are now, as a rule, working very actively, was large enough to do much more than offset the decreases shown in the earlier months of the year. The total output for the five months to the end of May was 113,708 long tons, being greater than that for the corresponding period of last year by 2,715 tons, or 2.4 per cent. The indications are that June will show another large gain. The foreign reporting mines—including all the principal European mines—also show a large increase in output, their total for the five months having been 44,344 long tons, a figure which exceeds that of last year by 6,019 tons, or 15.7 per cent. Notwithstanding this greater production abroad the exports from the United States continue large. Although they were 3,814 tons less than the high level reached in March, they were only 141 tons less than in April; while the total for the five months was 83,439 tons, which is considerably more than twice the quantity—38,185 tons—reported last year. Up to the end of May this year we exported 73.8 per cent. of our total production, against 33.5 per cent. in the corresponding period last year.

Lead is in about the average demand, at unchanged prices. Consumption has been good this year. New York, 4.05 @ 4.10; St. Louis, 3.97½ @ 4.05.

Spelter is still somewhat excited, and the quotations show little change. There is a very good demand at 4¼ @ 5.

Silver continues to hold its own in demand and quotations, and even to show some improvement. Indian orders in London have been fair.