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The Canadian Mining Journal

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Editor

REGINALD E. HORE

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CIRCULATION.

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ANNUAL MEETING CANADIAN MINING INSTITUTE

The sixteenth annual meeting of the Canadian Mining Institute will be held in Montreal on Wednesday, Thursday and Friday, March 4th, 5th and 6th. It is announced that Dr. Edward D. Peters, metallurgist, and Mr. Gardner F. Williams, mining engineer, have been invited to attend as guests of the Institute. Dr. Peters has consented to address the Institute on the subject of "The Production of Heat in Metallurgical Furnaces." Mr. Williams, if he is able to attend, will give some account of the Kimberley diamond mines.

A preliminary list of papers promised for the meeting was published in our last issue.

The attention of members is directed to the announcement that the Institute's rooms at the Windsor Hotel have been vacated. The office is now at the Ritz-Carlton.

The meetings of the Canadian Mining Institute are always interesting and well worth attending.

KIRKLAND LAKE

Numerous comments are being made on the flotation in London of a company organized to conduct mining operations in the gold field at Kirkland lake, Ontario.

The comments are not very complimentary and there appears to be reason for some of the criticism.

The readers of the Canadian Mining Journal are aware that a very promising new gold field is being opened up in Ontario. In our issue of July 15 some account was given of the gold deposits and the results obtained at the Tough-Oakes mine. Since that date our special correspondent, Mr. Ben Hughes, has several times reported the progress at the mine. Our readers have been advised that the Tough-Oakes is a rich little mine, with good prospects. The shaft has been deepened to 200 ft. and short drifts run east and west at the 100 ft. and 200 ft. levels. The vein is very thin, only a few inches, but rich. The reports given out indicate that much of the wall rock for the width of the drifts contains gold in paying quantities. A recent report by Manager Charles O'Connell shows that the development has continued to be satisfactory, and indicates that the ore blocked out by the work thus far done can be mined at a handsome profit. Mr. O'Connell states that the ore taken out in making the openings has more than paid for the cost of development. Such a statement makes it clear that the ore is unusually rich and that the mine will probably be a very profitable one.

In England, however, the prosperous condition of the Tough-Oakes mine is, according to the critics, being ex-

aggerated. The public has been invited to buy shares in a company which has control of valuable property; but which has a large capitalization. It is as yet an exploratory and development company rather than a mining company.

The critics should bear in mind that the properties have been as yet only slightly explored. The one vein which has been developed to any extent has proven remarkably rich. There are other veins which are regarded by the former owners as very promising.

A real basis for criticism is to be found in the optimistic advertisements published by the company. There is confusion of probabilities and actualities. The advertisements are likely to give the public a false impression.

There is every indication that the Tough-Oakes property will be an important producer of gold when developed and equipped. There is a good chance of neighboring properties proving up well. It is fortunate for the district that a strong company has been formed to explore and develop the properties. Investors should, however, be advised of the fact that the actual value of the ore blocked out is small in comparison with the price of shares.

Those who are willing to assume the risks of the venture, knowing the facts, need no guardian. Mining men will distinguish between ore reserves and "probable" and "possible" ore. They will examine the properties themselves, or have them examined, before investing large amounts. There are many who are willing to take the risks. It will be unfortunate if stock is purchased by anyone who is under the impression that the company's properties have been very extensively explored or that there are as yet any large producing mines in the Kirkland Lake district. There is one rich little ore body which may prove on further development to be a large one. Concerning the value of other deposits very little is yet known.

Ontario has in the Kirkland Lake district an important addition to the known mineral resources of the Province. The development of the district is greatly to be desired. The prospects are good. It is to be hoped that those who do not understand the risks, the very great chance of many of the deposits proving unprofitable after money has been expended on them, will leave the development to those who do understand the conditions and who, understanding, are willing to take a chance.

INCREASED PRODUCTION AT THE DOME

During the past few months the production of the Dome mill has been very considerably increased. The plant was designed to treat about 350 tons; but, without increasing the number of stamps, the mill superintendent has raised the output to over 450 tons. The results obtained are very creditable to Mr. W. F. Battersby, who has been in the employ of the company since the beginning of the operations, and who was appointed mill superintendent last fall.

HOLLINGER GOLD MINES REPORT

The third annual report of Hollinger Gold Mines, Limited, has been issued, and extracts from it will be found in this issue of the Journal. The main facts as to production, costs and profits have been given throughout the year in four-weekly statements. In the annual report the facts given in these periodical reports are summarized and commented upon. Much other interesting information, including maps of the mine workings and estimates of ore reserves is given.

It will be recalled that in November, 1912, there occurred a strike among the miners at the Hollinger, and that the mine was operated under adverse conditions for some months. While the strike was ill-advised and unsuccessful, the company suffered considerably from the conditions brought about by the agitators. The general manager reports, however, that the final result has proven satisfactory, as the new men who displaced the strikers are doing better work than did the dissatisfied miners. The tonnage now being mined per man is greater than before the strike.

Throughout the year there has been a gradual improvement in the total costs per ton.

Mr. Robbins shows that successful results have been obtained in treating the ore. He intimates that the company is still considering the advisability of using a continuous decantation process, and states that the mill is now being extended to permit of a larger tonnage being treated.

The report is accompanied by plans of each of the four levels and by stope sections of several of the veins, and is of such a character as to give the shareholders a good idea of the condition of the property, of what has been done and of what may be expected. It is a credit to the directors and to the general manager.

CANADIAN MINING INSTITUTE.

The following nominations have been received for offices falling vacant at the close of the annual meeting 1914:

For President:

Mr. G. G. S. Lindsey, Toronto, Ont.

For Vice-President:

Mr. Chas. Fergie, Montreal, Que.
Mr. W. F. Sutton, Victoria, B.C.

For Councillors:

Mr. D. B. Dowling, Ottawa, Ont.
Mr. Norman R. Fisher, Cobalt, Ont.
Mr. John E. Hardman, Montreal, Que.
Mr. W. S. Johnson, Montreal, Que.
Mr. J. J. Penhale, Sherbrooke, Que.
Mr. M. E. Purcell, Rossland, B.C.
Mr. J. W. Pyke, Montreal, Que.
Mr. C. E. Smith, Toronto, Ont.
Mr. P. A. Robbins, Porcupine, Ont.
Mr. O. E. S. Whiteside, Coleman, Alta.

Council 1914.

The Council during the year 1914 will be constituted, therefore, as follows:

Past Presidents:

Dr. W. G. Miller, Toronto, Ont.
Dr. F. D. Adams, Montreal, Que.
Dr. A. E. Barlow, Montreal, Que.

President:
Mr. G. G. S. Lindsey, Toronto, Ont.

Vice-Presidents:
Mr. Thos. Cantley, New Glasgow, N.S.
Mr. Chas. Fergie, Montreal, Que.
Mr. W. J. Sutton, Victoria, B.C.
(One vacancy to be filled at Annual Meeting.)

Councillors:
Mr. M. B. Baker, Kingston, Ont.
Dr. J. A. Bancroft, Montreal, Que.
Mr. R. W. Brock, Ottawa, Ont.
Mr. D. H. Browne, New York, N.Y.
Mr. E. T. Corkill, Copper Cliff, Ont.
Mr. T. Denis, Quebec, Que.
Mr. D. B. Dowling, Ottawa, Ont.
Mr. E. Dulieux, Montreal, Que.
Mr. Norman R. Fisher, Cobalt, Ont.
Mr. J. E. Hardman, Montreal, Que.
Mr. W. S. Johnson, Montreal, Que.
Mr. J. McEvoy, Toronto, Ont.
Mr. J. J. Penhale, Sherbrooke, Que.
Mr. M. E. Purcell, Rossland, B.C.
Mr. J. W. Pyke, Montreal, Que.
Mr. P. A. Robbins, Porcupine, Ont.
Mr. C. E. Smith, Toronto, Ont.
Mr. L. Stockett, Calgary, Alta.
Mr. O. E. S. Whiteside, Coleman, Alta.
Mr. W. A. Williams, Grand Forks, B.C.

NIPISSING.

N. Y., Feb. 11.—President Earle of Nipissing Mines Co. will send this statement to shareholders:

The annual report for 1913 will be sent to shareholders in April, and will contain full particulars concerning operations for the year and condition as of Jan. 1, 1914, but as there has been of late a falling off in net earnings, due to the lower average grade of ore produced, and as it is impossible for the management to state whether this condition will prove temporary or permanent, it is deemed best to submit a brief statement.

The nature of the ore bodies in the Cobalt district is such that it is not possible to predict earnings in advance. It is, however, well known that mining costs increase with the development and gradual extraction of ore bodies.

The earnings will in future, as they have in the past, depend on the continuation of the veins now known and being operated, and the discovery of new ore bodies.

There have been periods in the past when earnings have fallen off because of conditions similar to those that now exist.

The company holds a large area of undeveloped territory, which presumably contains ore bodies of value.

Your management has confidence in the value of your property and will continue to make to shareholders the largest possible returns compatible with economical operations and proper development.

In carrying out this policy, distributions to shareholders in the past eight years have amounted to $11,340,000.

N. Y.—Supplementing statement by Pres. Earle of Nipissing it has been learned that during the past three months Superintendent Watson has, in the course of development work, encountered five new veins, eight inches in width and assaying about 2,000 oz. of silver per ton of ore.

These veins were first struck near the third level, or at a depth of between 200 and 300 feet. Stoping has not begun as yet, so that the extent of these ore bodies has not been ascertained. The discoveries were all in practically new ground.

Ore reserves on Jan. 1, 1914, were practically unchanged from the 9,600,000 oz. reported on Jan. 1, 1913. This indicates that for every ounce of ore extracted during the year, another ounce was put in its place.—Boston News Bureau.

INTERNATIONAL NICKEL.

N. Y.—Practically all 3,000 shares of International Nickel Co. common stock, voting trust certificates, offered for subscription to employees and officers at 110, have been subscribed for. Of the 4,000 persons on the payroll about 40% subscribed for their allotment of shares.

The right to subscribe expired on Jan. 31. The minimum subscription was one share to any employee of under five years' service and receiving up to $825 yearly, while the maximum subscription was ten shares to any one receiving over $4,033 who had been in the employ of the company over ten years.

Officers and employees will pay for their subscriptions in monthly instalments, receiving dividends on the stock as soon as first instalment is paid, and receiving an extra compensation equal to 5% on the stock paid for, payable annually to such employees as retain their stock and remain in employ of the company. The first deduction as payment for the stock allotted will be made on the February salary or wages.

The management of International Nickel Co. is highly gratified with the result of the offering.

PETERSON LAKE.

Mr. R. B. Lamb, who has just returned to Toronto from the property at Cobalt reports to the president of the Peterson Lake Mining Company as follows:

During the past ten days we have been drifting on No. 7 vein, shaft No. 2 on Peterson Lake, and we had assays up to 140 oz. per ton.

On the 7th of February we encountered a cross vein striking north east and south west which intersected No.7 (striking east and west). Beyond this point we encountered high grade ore in two veins on the right side of the drift. For a width of about three and one-half inches the ore will assay 3,500 oz. to the ton. The cross vein is four inches wide of good ore. Altogether the drift shows about six inches of ore which will average over 2,300 oz. to the ton. The drift is all in mill ore, which should average over fifty oz. to the ton.

We are only thirty feet into conglomerate and the ore is improving every round. I think it is an ore shoot and not a pocket. The rock is hard, compact conglomerate. I estimate that we have a thickness of 140 ft. of conglomerate. The discovery was made on the contact of Keewatin and conglomerate.

I believe that this discovery will prove to be of distinct importance to the Peterson Lake Company. We are now sorting ore.

A QUICK-ACTING COUPLING FOR MINE SERVICE

The Cleveland Rock Drill Co. has placed on the market an improved coupling designed to overcome the waste of air in mines. The old style malleable iron union which has been in service for many years is not satisfactory. The claims made for the new coupling are that it never leaks, makes easy connection, is air-tight, cannot be accidentally disconnected, requires no wrench, has no threads, and has less parts than a union. All the couplings are interchangeable.

BOOK REVIEWS

METAL STATISTICS, 1914—Seventh Annual Edition—Issued by American Metal Market and Daily Iron and Steel Report.

This is an interesting summary of production and prices of metals during 1913. The statistics should prove useful to buyers and sellers of metals as well as plant managers and engineers.

MANUAL OF HYDRAULIC MINING—By T. F. Van Wagenen. Fourth edition, revised and enlarged—D. Van Nostrand Co., New York—Price $1.00 net.

This is a little book of 123 pages written for the miner rather than for the mining engineer. Its pages are devoted partly to methods of mining and partly to the elements of mathematics and physics. In this new edition there appears a chapter on dredging. The aim of the author is to provide a guide to the miner in preliminaries only, to be supplemented by advice from an engineer.

THE BASINS OF NELSON AND CHURCHILL RIVERS.

The Geological Survey has just published a report by Mr. Wm. McInnes on the country between Saskatchewan river and Hudson bay. It contains new information, geological and geographical, and presents also a summary of earlier publications. A map covering a rectangular area of about 220,000 square miles, having Fort Churchill at the northeast corner and Prince Albert at the southwest accompanies the report.

Mr. McInnes made several explorations in the area in 1906, 1907, 1908, 1909, and 1910. Other members of the Geological Survey whose work has been made use of in the descriptions and map making are Robert Bell, A. S. Cochrane, R. G. McConnell, J. B. Tyrrell, A. P. Low, and D. B. Dowling.

Concerning the resources of the region, Mr. McInnes says:

"The commercial possibilities of the region are great and varied. It contains, in the southern part, large areas of land suitable for settlement; its fisheries promise to be important, and, under proper restrictions, could be carried on commercially without the depletion of the waters. The timber, though confined principally to a belt on both sides of the Saskatchewan and its tributaries, is an important asset. Over the northern portion the trade in furs is of very considerable value.

"There is reason to hope that the region will be found to contain valuable minerals; it is traversed by several belts of Keewatin rocks (which probably include also areas of Huronian), and these, from our experience of like rocks elsewhere, may be looked upon as affording promising fields for the search for valuable minerals. Similar areas in central Canada have been found to contain many valuable deposits of ore, including ores of iron, nickel, silver and gold."

"The total amount of power capable of being developed from the many falls and rapids which occur on the rivers within the area, is almost incalculable. Some of the rivers are of great volume and all, along parts of their courses, have rapid descents.

"Of the rivers, the Nelson, by reason of its great volume and numerous falls, is the most important from the point of view of power development. Between Lake Winnipeg and Split lake, a distance of about 230 miles, the river has a descent of 240 feet, and between Split lake and the sea, 200 miles, a descent of 470 feet."

BRITANNIA MINES, B.C.

According to Mr. Wm. Fleet Robertson, Provincial Mineralogist of British Columbia, the extent to which the Britannia Mining and Smelting Company has enlarged its mining and concentrating operations, and the present and steadily increasing importance of the copper-mining industry this company has established on its property on and near Howe Sound, are not generally known. Between 600 and 700 men have been continuously employed for some time past, and the extensive development and construction works in hand, and to be undertaken as soon as can be done with advantage, assure the retention of fully that number at work for some time to come. Outlining briefly what is being done, it may be mentioned that, while the mines are being developed and ore extracted on a larger scale than in past years, the work of driving a 5,000-foot adit is also in progress, with 3,000 feet already driven and a daily advance of about 15 feet being made. As this tunnel is being driven on a level 1200 feet below the bottom of the lowest present mine-workings it will, if ore be found to continue down to that depth (which will give a total of fully 2,200 feet), make accessible for stoping an enormous quantity of ore. Mine equipment on a commensurate scale, hydro-electric development of 5,000 horse power, construction of railway from the mouth of the adit tunnel to Britannia Beach and other additional facilities for transportation, and the installation of a modern and effective system of ore-concentration, are included in the progressive programme adopted and being energetically carried out. It is understood that the "flotation process" of the Minerals Separation, Limited, for the recovery of copper minerals has been adopted here, and that a large treatment capacity is being arranged for, with the old concentrating-mill being altered to suit the new conditions and for use pending the erection and equipment of a new mill. The company mined about 193,000 tons of ore in 1912, as against rather more than 100,000 tons in 1911, and recovered between 14,000,000 and 15,000,000 lbs. of copper and between 70,000 and 80,000 ozs. of silver.

MICA.

Canada is one of the three principal mica-producing countries of the world, the others being India and the United States. The average value of the mica produced annually in Canada during the last ten years has been about $185,000.

With the exception perhaps of Ceylon, Canada is the only country, as far as is yet known, in which the variety phlogopite—or "amber mica," as it is termed in the trade—is known to occur in economic quantities. The mica of commerce is of two kinds—muscovite, or "white mica," and phlogopite, or "amber mica." The former is obtained from both India and the United States, while the latter is secured almost wholly from Canada. Of the two varieties, phlogopite commands rather the higher price, being softer and more flexible and altogether more suitable for use as an insulator—this being the principal use to which mica is put at the present day.

Mr. Hugh L. Cooper announces that he has completed the water power development of the Mississippi River Power Co at Keokuk, Iowa, and that he has opened offices at 101 Park avenue, New York City, where he will engage in the practice of general hydraulic engineering, including the design, construction and management of hydro-electric power plants.

GRANBY CO.'S METHODS OF MINING AND SMELTING AT PHOENIX AND GRAND FORKS

The main orebody at Phoenix has been opened up and mined at several levels. The upper three are tunnel levels, known as No. 1, No. 2, and No. 3, respectively, and have in turn been shipping levels. The lower levels, known as the 200-ft., 300-ft., etc., are served by a shaft known as the Victoria shaft.

The tunnels and the Victoria shaft have separate rock houses. During the past year 545,121 tons were taken from above No. 3 tunnel, and 505,623 tons from Victoria shaft.

A large portion of the deposit has been worked open cast. The underground openings are large and untimbered, the roof being supported by rock pillars. The main levels are at 100 ft. intervals. The method of developing and mining the ore body has been described* by Mr. C. M. Campbell as follows:

"In opening up a level parallel drifts, usually 75 ft. apart, are started in the direction of the strike of the deposit. At intervals of 45 ft. along the drift raises are begun. An 18 hole round is drilled and blasted. Before the muck is cleared away the bar is again set up and another round drilled and blasted. The third round is then drilled, but only the cut holes are blasted. All the rock is then shovelled up and the chute is built. The remaining holes of the last round are then blasted. As these throw the rock to the sides of the raise the timbers of the chute are uninjured. The raise is then carried ahead at an angle of about 45 degrees. This allows the ore to run and also enables the men to get about without the aid of timbering. For ventilation purposes the first raise of a series is usually carried through to the level above or some other convenient opening. In the case of the highest level the most convenient opening is the surface.

When the face of No. 2 raise is about 30 ft. above the sill-floor, stoping is commenced and it is widened out until it connects with No. 1 raise. The same thing is done at an elevation of about 60 ft. and breaking through to the next level at 100 ft. The only small work is the first 30 ft. In this way a network of pillars is left throughout the stope. So far a column only has been used. As soon as the sill floor above has been reached, tripods and long steel can be used to advantage. In this way a glory-hole is started and the opening can be widened out until the sides of the glory-hole get too flat for the ore to run. Machines are also put to work where the connections between the raises have been made and at other advantageous places. The stope may thus be turned back to meet the hanging wall and the pillars reduced in size. Where the nature of the ground permits, a pillar may be eliminated altogether.

"One series of raises is seldom sufficient to tap all the ore. If the foot-wall is flat a parallel drift in waste with accompanying raises will have to be driven. There will also be several drifts between the foot and the hanging walls. At one place on No. 3 tunnel level there are five parallel drifts now operating and at least another will be required. In this case the pillars in the stopes are left nearly vertical instead of at an angle as when the deposit is steeper. It is often advisable when breaking a raise through from a lower level to make the connection at the back of the chute timbers. The timbers can be taken out and a glory hole started. At the same time the raise can be carried ahead as a stope ten to fifteen ft. beneath the foot of the old stope. While stoping ahead, upper holes are drilled into the undercut rock. In this way the back is always within reach. In fact, it is rarely necessary to work in a stope at any great distance from the roof.

"When raising in waste no connections are made until the ore is reached. If the ore is at any considerable distance the raises are put in less frequently and are branched so as to tap the ore at two or three places. After the ore is blasted the large blocks that can be reached are bulldozed. No blockholding is attempted. It has been found cheaper to buy more powder than bother with hand or air-hammer drilling. When the raises are in ore there are always convenient temporar-

Granby glory-hole, Phoenix, B.C.

*Rossland Meeting, Canadian Mining Institute, May, 1908.

ily abandoned chutes which have been cleaned out, through which access is had to the broken ore in the raises. In the case of raises through waste where no connections have previously been made it is necessary to drive manways. To do this a staging is constructed midway between two chutes and about eight feet above the track, high enough to allow the trolley wire to pass under. The planks at the centre of the staging, over the cars, are movable. A miner with an air-hammer drill or a small ordinary drill starts a raise at about 60 degrees and continues for about 25 feet when he branches and drifts till he connects with the raises on each side. The waste with a little help is run into the cars without interfering with traffic."

Drifting.—"On the sill floors the haulage tunnels are always being driven ahead. On the levels where the big cars run these are about 9 ft. by 11 ft. in size. A twenty-hole round is used. This is made up of 4 lifters, 4 cuts, 8 breast holes in two rows, and 4 back holes. All the rock broken on the sill floor is hand-shovelled.

Handling the Ore.—"On the No. 3 tunnel level 10-ton, steel, hopper-bottom and 7-ton wooden, gable-bottom cars are operated. These run on a 3-ft. gauge track and are hauled by an electric locomotive. . . . A special steel car has been designed at the works. This car is 5 ft. high and can be used for sill-floor shovelling as well as for loading from the chute. The box has a 5-ton capacity and has an automatic side dumping arrangement. When a train comes to the unloading pocket, the motor goes ahead with slackened speed and a side wheel attached to the box runs up an inclined plane. The box tips, dumps its load and closes again. This arrangement has given excellent satisfaction."

"The Victoria shaft cuts the ore body where that deposit crosses the 400-ft. level. The shaft is on a 60-degree incline and connects with large storage pockets below the 400-ft.level. These pockets, ore and waste are connected by raises with the 300-ft level."

On the 400-ft. level the ore is hauled to the shaft in 5-ton steel cars by an electric locomotive.

Present Methods of Mining.—There has been no important change made in the terminals or haulage systems since Mr. Campbell's paper was published in 1908.

Mr. Campbell states that most of the changes since made in mining methods are minor ones, resulting from the fact that the ore bodies now being worked are in places flatter and not as regular as those formerly worked.

The method as formerly is to leave rock pillars to support the roof. These pillars are afterwards shot out and the ground allowed to cave. Where buildings are being undermined more ore is left in place and the stopes are filled with waste rock.

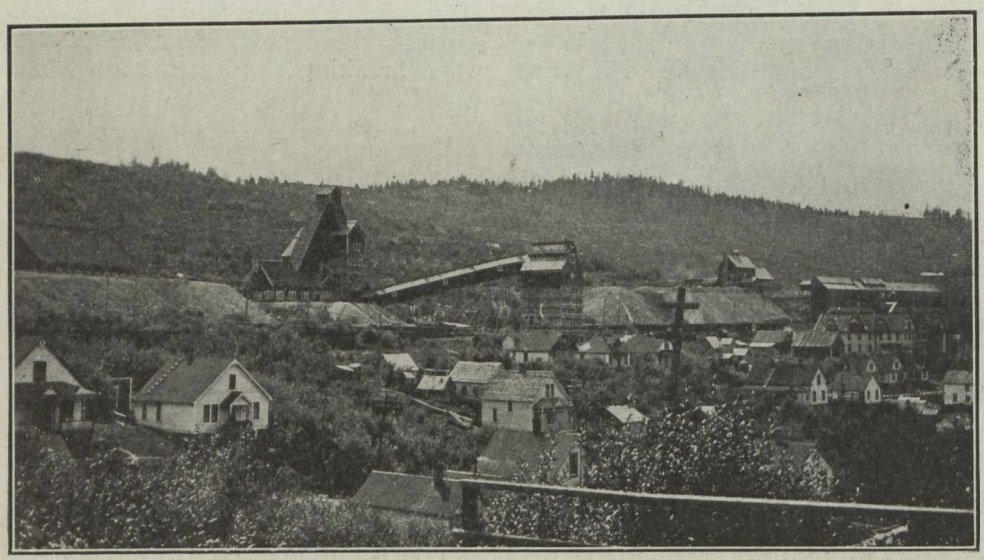
All the waste rock mined on the 200-ft. level has been used for stope filling, none of it having ever been hoisted. Most of the waste rock from the lower levels is hoisted and then dumped back into the mine and redistributed to fill the openings.

In 1910, the No. 3 tunnel terminals and some other mine buildings were destroyed. These were soon rebuilt, and, except for an increase in tonnage, the conditions are much the same as in 1908.

Victoria Shaft.—Mr. A. B. W. Hodges has described the Victoria shaft and equipment as follows:

"The shaft is 3-compartment, having a man-way 4 by 6 ft. in the clear, and two skipways each 5 x 6 ft. in the clear. The skips are balanced, hold about 5 tons of ore and run at a speed of about 900 ft. per minute. This will hoist 2,000 tons in two 8-hour shifts. The skips are hoisted by a double conical drum hoist driven by a 250 h.p. variable speed induction motor at 2,000 volts pressure. They generally run in balance; but can be operated separately in either direction.

"The sheave wheels of the gallows frame are about 90 ft. above the ground and are so elevated that the skip can dump about 60 ft. up and the ore run into either of two coarse ore bins, each holding 500 tons of ore."



Victoria Shaft, Granby Mines, Phoenix, B.C.

Crushing the Ore.—The crushers at the Victoria shaft and at the tunnels are very large Blake-type crushers having a jaw opening of 42 x 36 in. The breakers handle about 150 tons of ore per hour, crushing to about 7 or 8 inch. They are driven by 150 h.p. induction motors.

Transportation.—The crushed ore is loaded into 30 to 50-ton steel bottom dump railway ore cars. It requires about eighty 50-ton and eighty 40-ton ore cars, and five or six 150-ton steam locomotives to convey 3,000 tons per day to the smelter, which is located at a distance of

24 miles. The grade is about 3 per cent., making a stiff return pull with the empties.

"These ore trains are weighed at the smelter on track scales and are run out over the ore bunkers and the ore dropped into the different bins. Here there are three sets of ore bunkers parallel with one another and 750 ft. long, and each holds about 5,000 tons of ore.

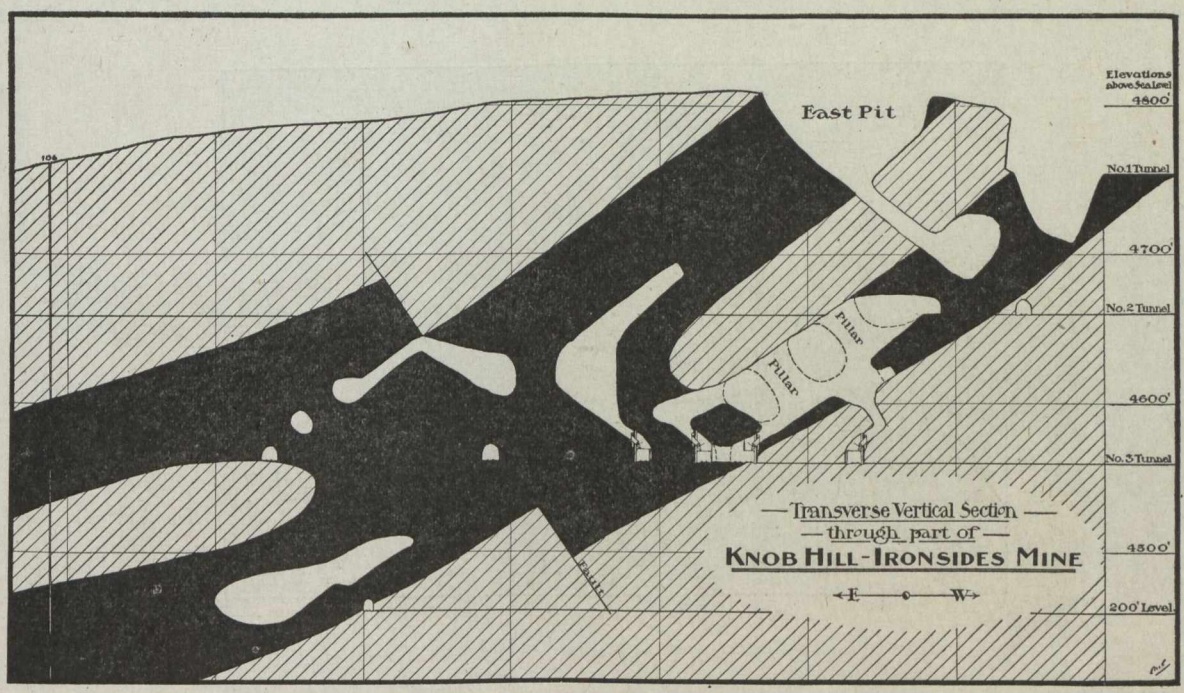
"About one car in ten is set over the sampling bin and the ore from this is re-crushed and a sample automatically taken which fairly represents the day's shipments. The metal contents of the ore being so uniform very careful sampling is not required to determine its contents, in fact, one lot of 30,000 tons will not vary more than 20 cents per ton over or under another of similar quantity.

Charging the Furnaces.—"The ore chutes at the bottom of the bins are about 6 ft. above the furnace charging floor, so that the furnace charge cars are run under these spouts and receive the crushed ore by gravity, and these cars, which have already received the requisite quantity of coke in the bottom, are weighed again to get the proper amount of ore, and then the train of three cars is pushed on a 20-in. gauge track into the end of the blast furnace, when the charge is dumped into the proper place, these cars being just the length of the inside of the furnace. Each train of cars feeds two 44 x 210-in. blast furnaces and handles from 750 to 900 tons of ore per 24 hours.

"The track rails do not enter the furnace, but the cars are carried in on auxiliary wheels on the upper corners of the cars and run on tracks built in the sides of the furnace. These cars are divided longitudinally in the centre, and the doors open on each side, the hinge being at the top. This spreads the charge along each side of the furnace in the proper place. These charging cars are used only at the Granby smelter, and are an invention of the writer's. They are pushed around by a 30 h.p. electric locomotive, 250 volts direct current. Each train holds a little more than four tons of ore, together with the proper amount of fuel at the bottom of each car."

Smelting the Ores.—Mr. Frank E. Lathe, in a paper presented at the 1910 meeting of the Canadian Mining Institute, describes the smelting plant as follows:

The Furnaces.—There are eight blast furnaces, housed in a steel building of 290 ft. by 71 ft., along the lower side of which is a shed 13 ft. wide. The old blower room is at one end and the converter department at the other, the second and newer blower room being near the converters. To facilitate the handling of ore, the bins parallel the furnace building. Recent enlargements have increased the length of furnaces from 213 in. to 266½ in., and the depth from 11 ft. 9½ in. to 15 ft. 8 in. The width at tuyeres remains the same, 44 in. The furnaces have two rows of jackets on each side and end, these reaching practically to the feed-floor. Above them is brickwork, ordinary red brick being used for the outside and firebrick for those parts exposed to the greater heat. The whole brickwork is strongly bound with 56 lb. rails, while I-beams, in addition to the buckstays mentioned above, keep the jackets in position. Two outlets are provided for the gases, one leading to the dust chamber and the other, for use in emergencies, opening into the air. Both are provided with dampers. The jackets are of riveted steel, 7-16 in. and ⅜ in. thick on fire and air sheets, respectively. The water space on upper jackets is 3 5-16 in., on lower ones 4⅞ in. All have deflectors to throw cold water to the bottom, and hot water is taken from the extreme top. The lower jackets are 7 ft. 6 in. high, and the upper 7 ft. 9 in. There is a good circulation of water, cold water entering the upper jackets and flowing thence to the lower set. This tends to keep a cool top, and prevents undue chilling at the tuyeres, which might attend an opposite circulation. For this purpose 2,000 gallons of water per minute are required by the eight furnaces or the equivalent of three gallons of water per minute per square foot of hearth area. Water enters at a temperature of from 35 to 50 degrees F., and issues at an average of 140 degrees F. The blast varies from 24 to 28 ounces, and each furnace takes about 25,000 cu. ft. of air per minute. There is a con-



Courtesy C.M.I.

A vertical section showing the ore body at Knob Hill, Ironsides Mine, Phoenix
This sketch was made in 1908

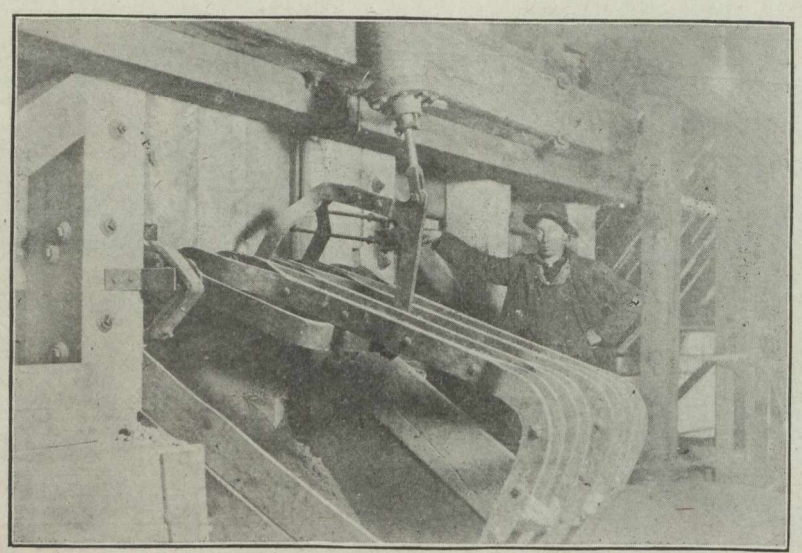
stant flow of matte and slag from each furnace into its settler through a water-cooled spout. The trap is 5 in. to 5¼ in.

As the ore is low in both copper and sulphur a high ratio of concentration is possible, this being usually about 32:1. Moreover, a recovery of 85 per cent. of all values is regularly attained. This high percentage is all the more noteworthy when the grade of the ore is considered. The coke consumed is about 12½ per cent., with few extras under ordinary conditions.

An average analysis of all Granby ores is about as follows:

SiO_2, 35 per cent.; Fe, 13 per cent.; CaO, 17 per cent.; Al_2O_3, 8 per cent.; MgO, 3 per cent. Copper varies from 1.2 per cent. to 1.6 per cent. The "insoluble" in the ore is considerably higher than the silica given above, the latter being determined by fusion. The iron is present as silicates, uncombined oxides and sulphides, while nearly all the lime and magnesia exist as carbonates. Chalcopyrite is the only copper-bearing mineral, and it also carries gold and silver. Of the sulphur about 65 per cent. is burnt off, producing a matte of 35 per cent. to 40 per cent. copper.

Briquetting.—"The greater part of the dust from the furnaces is collected in the new steel flue chamber paralleling the furnace building. This chamber is at a height of about 21 ft. above the feed-floor level, and consists of a rectangular flue 15 by 13 ft., of 3/16 and 5/16 steel plate. A partition across the chamber, as shown, prevents an undue quantity of gas from going to either stack. The bottom is made up of hoppers, which discharge through 9-in. openings into a trough kept clean by a wire rope drag conveyor. The attendance of one man is required for a short time each day



Courtesy C.M.I.

Granby air operated ore bin gate

Slag.—With the above ore charge the slag will have the following composition:

SiO_2, 44.8 per cent.; FeO, 19.3 per cent.; CaO, 21.8 per cent.; Al_2O_3, 10.2 per cent.; MgO, 3.9 per cent. In the actual operation, owing to the return of converter slag, the silica is slightly lower and the iron oxide a trifle higher than these figures. In this slag the ratio of oxygen in the silica to the sum of that in the iron oxide, lime and magnesia is 1.87:1. From the above analyses it will be observed that the ore is easily self-fluxing, and while not quite ideal in composition, the addition of barren fluxes would be attended with loss rather than profit. Owing to the small percentage of iron in the slag the specific gravity is low—about 3.0. Hence a good separation of matte and slag is obtained. The percentage of copper passing into the slag varies from 0.20 per cent. to 0.25 per cent., though some furnaces, operating under ideal conditions, have attained, during a month's operation, even better than this lower figure.

Furnace Output.—"As mentioned above, ore is charged every 20 to 30 minutes, giving a daily capacity of 500 to 600 tons per furnace. A maximum of about 750 tons has been reached, equal to nine and a quarter tons of ore per sq. ft. of tuyere area. This is in addition to converter slag and briquettes, though the amount of these is comparatively small. As the work of alteration was but recently completed no figures are yet available for tonnage on 8 enlarged furnaces, but 7 have smelted 4,200 tons in 24 hours. An average of 4,000 tons per day has been maintained for some time with 7 furnaces, and with 8 in operation it may reasonably be expected that this figure will be raised to 4,500 tons, with a maximum of not less than 5,000.

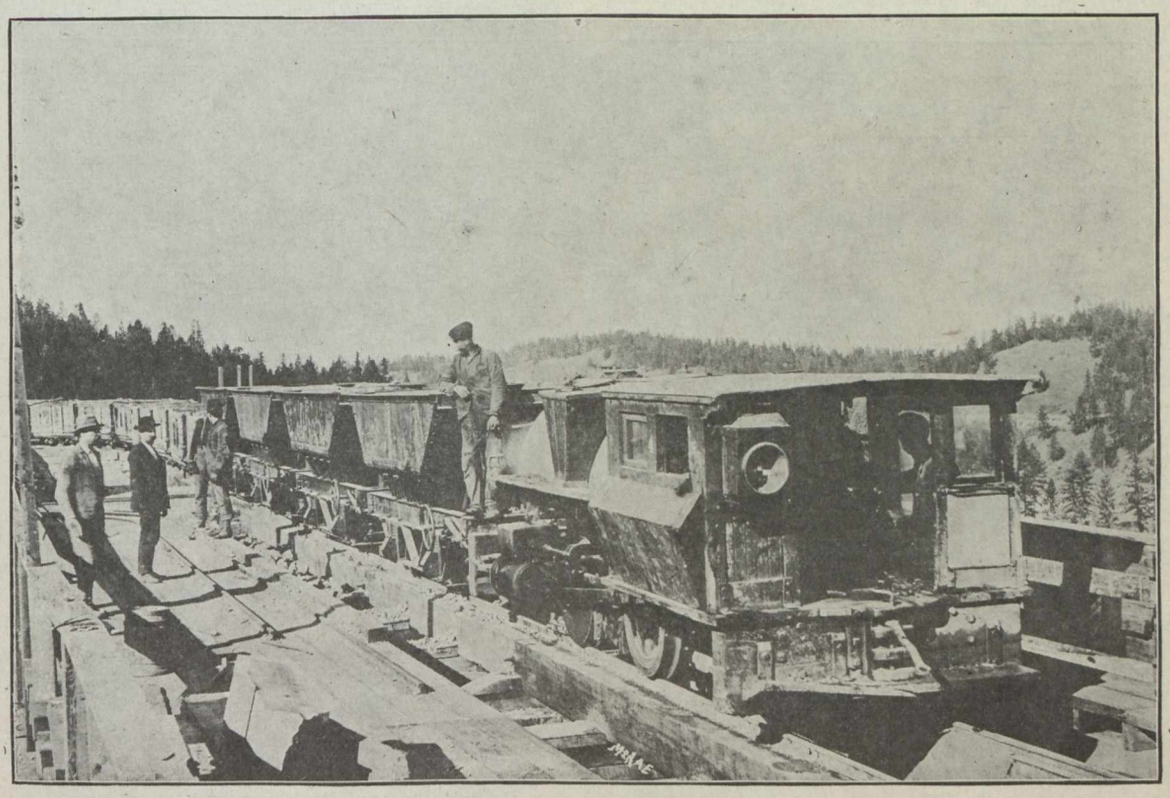
to control the flow of dust from the hoppers, all other movements being automatic. The brick chambers at either end of the steel chamber collect a comparatively small quantity of dust, this being drawn by hand out of openings in the side and conveyed in barrows to the briquetting mill. Here all flue dust is dumped into a receiving bin from which it is drawn by an automatic feeder to a mixer. After being moistened it is mixed thoroughly, no binder being necessary, and then goes to a No. 2 White briquetting machine with a capacity of 4,000 briquettes per hour. This ejects the newly made briquettes on a belt conveyor, which transfers them to furnace charge-cars. They are returned to the furnace without drying. The output of the briquetting mill is about 24 tons per day.

Settlers.—"Two settlers are used for each furnace. The one next the furnace, and which receives the matte and slag as they flow out continuously, is rectangular in shape, 7 ft. by 5 ft. with corners rounded, and 3 ft. high. It is surrounded by a 2-in. continuous water-jacket, the inner plate being ⅜ and the outer ¼ in. steel. The bed-plate is of cast iron, 2 in. thick, and

removable. Before being used the settler receives a course of fire-brick on the bottom, and is then lined on both bottom and sides with quartz cemented with clay, as for the converters. The life of a settler is usually determined by the rate at which it fills with metallics. When the bottom becomes so high as to materially decrease the capacity of the settler, the latter is replaced by a newly lined settler, while the metallics are removed from the former and broken up with a heavy ball weight. The separation of matte and slag is nearly complete in the settler just described; but a small amount of matte is obtained in the second settler to which the overflow from the first passes. This is smaller, about 4½ by 5 ft., but of the same general construction. Once a day it is tapped into a small pit, and the product thus obtained is broken up and returned to the furnaces. The large settler is tapped as often as may be necessary, the height of matte being found by introducing vertically a small iron rod, to which only the slag adheres. From the second settler the slag passes into slag cars standing on tracks of 36-in. gauge which run on either side and are used alternately. The capacity of these cars or pots is 5 tons each, and they are so balanced that when full they are in unstable equilibrium. Small steam locomotives convey them in trains of 4 to 6 cars to the edge of the dump. Here a chain is first thrown around the car frame and under the track on which the car is standing, to prevent the car from tipping over when the slag is dumped. The pot is then released from its upright position and turns on its side, the molten slag pouring out. Being empty the pot is now easily brought back to its original position, so that when the chain is removed it is ready to return to the furnace for another load. Before being refilled each pot receives a wash of clay water, to prevent the solidified shells of slag from adhering to it when dumped. Four locomotives handle all the slag from the 8 furnaces, while 30 to 40 pots are usually in commission at one time.

"Two 10-ton electric cranes run the whole length of the furnace building, handle matte, change settlers, remove furnace spouts, etc. One is usually kept in reserve. The matte is taken in 5-ton pots into the converter building, where it is received by the 40-ton crane operating there and poured into the converters.

"**The converter department** is housed in a new steel building 100 by 240 ft. The equipment consists of 10 converter shells, 84 in. by 126 in., recently purchased from the Power and Mining Machinery Co., 3 shells 72 by 100, 3 stands for the large and one for the small converters, moulds for metallic copper, with their trucks, a slag-casting machine with conveyor, and, in the relining department, clay stalls, quartz bins, and 3 mud mills. The old converters were operated by hydraulic power, while the new ones are equipped with 25 h.p., 220 volt, D.C. motors. All are lined next the shell with chrome brick, some magnesite brick being used around the tuyeres, to protect the metal with a layer of material that will not be readily attacked by matte or slag. Inside this is placed a 2-ft. layer of silicious ore, cemented with clay, and well tamped. Silica brick is used on the caps. The ores are of several classes, all high in silica and low in sulphur and bases, but containing their values as gold, silver, copper or any combination of them. The Granby Company has no highly silicious ores on its own properties; but has no difficulty in obtaining enough such custom ores, so that no barren quartz is used. There is no definite quantity of matte per charge, as the converters are seldom run to the limit of their capacity. Besides obviating the necessity of a receiving furnace for matte this also enables a transfer of charge to be made from one converter to another, when the occasion arises.

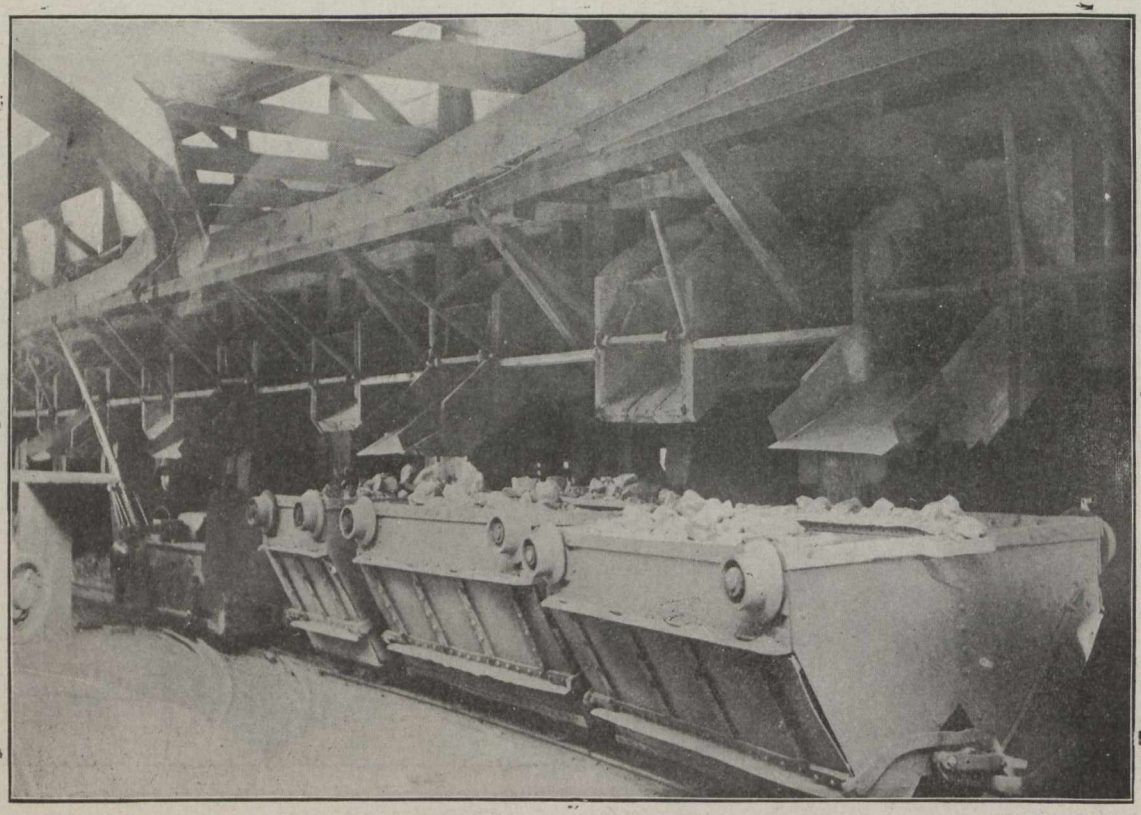


Courtesy C.M.I.

A Granby Ore Train

Converter Output.—"The yearly capacity is fully 40,000,000 pounds of copper. A blast of about 12 pounds per sq. in. is used, and the copper produced is 98.50 to 99.00 per cent. pure. The trucks which carry moulds for the metallic copper are 16 ft. long, and run on 44-inch. gauge tracks. Each carries 8 moulds 33 in. by 24 in., outside dimensions, forming a continuous row from car to car. A train of these cars is drawn by a wire rope underneath the converter to be poured. When the last mould is directly under the mouth of the converter it is turned over and the copper is then poured out in a continuous stream, the train being pulled forward as the moulds are filled. Each bar of copper as thus cast weighs about 220 lb., and after being removed from the mould and trimmed it is weighed and placed in a car for shipment.

Converter Slag.—"The pot into which slag has been poured is picked up by the crane and placed in a frame which is gradually tilted by hydraulic power. The slag pours out into the moulds of a conveyor that carries it up an inclined plane, under sprays of water, into a bin from which it is drawn to steel railroad cars. A 5 h.p. motor is sufficient to drive the conveyor, which moves at a speed of about 12 ft. per minute. About 100 tons of converter slag are produced in 24 hours. This contains up to 40 per cent. of silica, and varying amounts of copper, the remainder being principally iron oxide. It is returned to the bins and thus to the blast furnaces.



Courtesy C.M.I.

A Granby Furnace-charging Train at Ore Bunkers, Grand Forks

Power.—"The blower building recently rebuilt of brick and steel, houses three No. 7 and four No. 8 Connellsville blowers, the capacities of which are 12,000 to 14,000 cubic feet per minute each; and one No. 10 capable of delivering 30,000 cubic feet per minute. The small blowers are each driven by a 100 h.p. Westinghouse induction motor, 400 volts, 3 phase, 60 cycle, which, however, carries some overload. The large blower is driven by two 150 h.p. motors of the same type. In the newer building, which is also of brick and steel, and has lately been enlarged, are four blowers similar to the large one in the other building, and the three blowing engines supplying air to the converters. These are Nordberg 36 by 36 and Allis-Chalmers duplex 34 and 34 by 36, of 3,700 and 6,000 cubic feet per minute capacity, respectively, both belt driven, and a Nordberg 40 and 40 by 42, with rope drive, furnishing 10,000 cubic feet per minute. Power is supplied to these engines by motors of 200, 300 and 500 h.p., in the order named. In this building are also a small compressor, supplying air at 80 lb. pressure for tamping the converters, riveting, etc., a 200 h.p. motor generator set, and a pump furnishing water for hydraulic purposes at 200 lb. per square inch pressure. This pump supplements a gravity hydraulic system which supplies water at 160 lb. pressure. The Granby power house, situated immediately below the smelter on the river bank, receives water under 40 to 50 feet head from a flume coming down the bank of the river from a dam about three-quarters of a mile above the smelter. Power is furnished for the pumps, of which there are five, each capable of delivering 500 gallons per minute, against 200 feet head. Of these, two are connected to waterwheels, the other three being driven by motors. Direct current is also supplied at 110 volts for the office and laboratory, and for lighting, and alternating current at 440 volts for use on the works, in all about 900 h.p. In addition to this about 1,200 h.p. is received from the West Kootenay Power and Light Co., and now transmitted at 60,000 volts from Bonnington Falls. This is transformed to 440 volts and then distributed to the smelter. The motor generator set in the blowing en-

Settlers, Granby Smelter. Grand Forks, B.C.

gine room supplies the cranes and electric locomotives with direct current at 250 volts.

Results of Furnace enlargements.—"The enlargement of the furnaces has brought about many changes. It has been conclusively proved in practice that, other things being equal, the tonnage smelted per square foot of tuyere area will be greater for long than for short furnaces. This is true for several reasons. As the end surfaces are the same, any enlargements having affected the sides only, the cooling surface has not increased proportionately to the area. The same applies to incrustation. Moreover, as the percentage of end surface has decreased, so also has the formation of accretions, these having much less opportunity to adhere firmly to the long sides than to the ends and corners. There being a greater flow of matte and slag from the furnace these will be hotter, and more fluid. The ratio of cooling surface to tuyere area having been reduced so will the amount of jacket water per ton decrease, and with it the loss of heat, thus making a saving of coke. It will usually be found also that the labor required does not increase proportionately to the output. All these points are true for the lengthening of furnaces without deepening, and the Washoe Smelter at Anaconda, Mont., may be given as the most conspicuous example of success attending such enlargements. There are, however, still further and no less important advantages to be derived from the deepening of furnaces, in some instances at least, and these will now be considered in the case of the Granby Smelter.

"Other things being equal, the deeper the column of ore in a furnace the less sulphur will be burnt off, the result being a lower grade of matte, and as this requires more iron to unite with the sulphur the slag will be somewhat more silicious. With the deepening of the Granby furnaces the copper in the matte was decreased by from 5 to 10 per cent. and the iron in the slag about 1 per cent. This meant more matte to handle, additional work for the converters, and more converter slag to be returned to the furnaces, as well as a more difficult fusible blast furnace slag. Here, however, the disadvantages end.

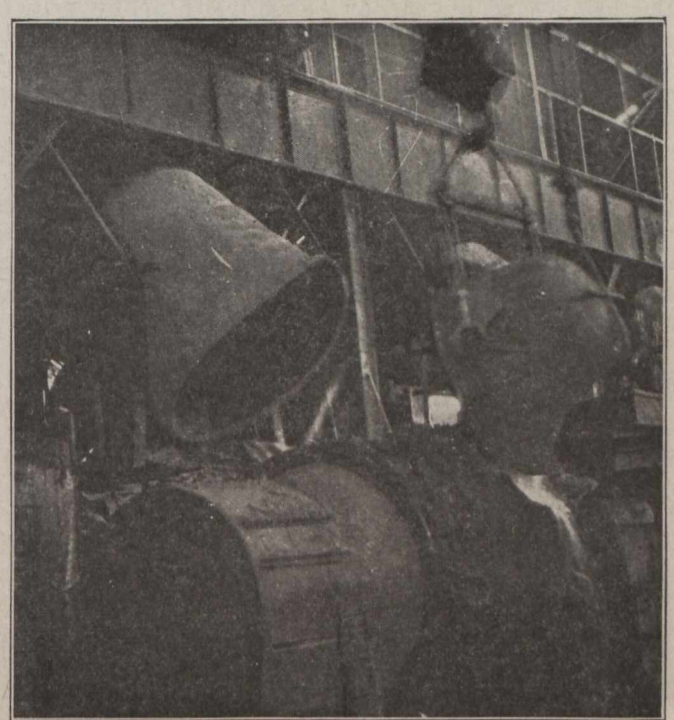
"When the matte is low grade more silicious custom ore will be used for converter lining, and, although this only partly offsets the additional expense, yet the cost of converting, compared with that of the initial smelting, is small per ton of ore treated. Moreover, the converter slag is useful in the furnaces, and often assists materially in righting a furnace that is working badly. It is worthy of notice that however much iron is taken from the blast furnace slag to form a low grade matte all is finally returned to the furnace, the only disadvantage being that some additional silica is returned with it.

"The smaller the amount of sulphur burnt off in furnace the less chance there is of the formation of metallics. This has been a marked improvement on the deepening of the Granby furnaces, especially in the case of the two with the smaller tuyeres.

"The present blast furnace slags are more silicious than formerly, as already noticed; but the operation of the furnaces is so much more even that there is less difficulty under present conditions. A good tonnage has been maintained with 47 per cent. silica slags over a period of several weeks, while before deepening there would have been difficulty in preventing the furnace with this slag from freezing. The tonnage attained per square foot of tuyere area is about 10 per cent. greater than formerly.

"In the old furnaces, with a lower column of ore, much of the heat necessarily extended to the top of the charge, so that the gases on leaving were highly heated. This not only caused a needless loss of sensible heat in the gases, but the high temperature to which the downtakes and the steel flue chamber were subjected necessitated more frequent repairs. By a deepening of the furnace this hot gas has to pass up through a body of cooler ore, to which it imparts a considerable portion of its heat, thus saving from two to three per cent. of coke and the damage done to the metal with which it comes in contact is much less.

"The labor required at the smelter to handle the larger output is practically the same as before, so that a considerable gain is made here.



Charging a Converter, Granby Smelter, Grand Forks, B.C.

"The greatest saving of all, however, is found in the amount of copper that passes into the slag. The lower grade of matte, greater matte flow, hotter matte and slag, and even running of the furnaces all tend to a more perfect separation of matte and slag, and the danger of the formation of copper oxide is decreased. The percentage of copper in the slag has thus been lowered 0.05 per cent. While this quantity may not seem great at first sight, it amounts in the course of a year to $150,0000 or $200,000."

THE INTERNATIONAL GEOLOGICAL CONGRESS*

By H. Mortimer-Lamb.

The meeting of the International Geological Congress in Canada in 1913 was of exceptional interest and magnitude; and its success was a performance in the highest degree creditable to all those concerned in making it so. Probably no international organization has had lavished on it in the past more attention, respect and hospitality than the International Geological Congress. The meetings in Russia, Mexico, and Sweden, to mention but three, were remarkable instances of successful organization. But, although in these respects the difficulties and disabilities in Canada were incomparably greater, it is conceded generally that the meeting in this country was the most memorable of all. In Russia only were the problems associated with arrangements for long distance traveling as knotty as those solved by Canadians; but the railways in Russia are owned and operated by the State, and the official service was at the disposal of the geologists. Here it was obligatory to carry on negotiations with a dozen different transportation companies, and but for their hearty goodwill and co-operation, the undertaking would have been impossible. In Mexico, the necessary funds, amounting to an enormous sum, were provided by the government. In Canada, the Federal and Provincial administrations were asked to contribute but moderately, the balance of the money being made up by private contributions. The attendance, moreover, in Canada was the greatest on record—a thousand, it is said, registered in Toronto and five hundred or more participated in the different excursions. Of these excursions there were twenty-eight, representing probably in the aggregate from forty to fifty thousand miles of travel. The figures are stupendous. But the most distinguishing and outstanding feature of the Congress was the disinterested, unselfish and wholesouled devotion and zeal of those who were directly responsible for its success. Many will not even get recognition; few will either expect or desire it. Theirs was that service which is the expression and manifestation of true communal feeling and high sentiment. The best work is not done for reward. Some have mentioned the practical advantages of meetings such as these. If they served no other purpose than to bring out these better sides of human nature, their occasion would be amply justified. We are so concerned with materialities that we are apt to overlook the fact that the development of the higher qualities of the race is more important than the exploitaion of natural resources. Yet the Geological Congress has its practical, its utilitarian side, too. There never was a time when the strictly scientific study of geology was so subordinated to economic enquiry and ends. The art of mining to-day owes an immense debt to the science of geology, and that debt continues to accumulate in increasing ratio. The intercourse, the interchange of views at such meetings as these, between men of the highest eminence, must necessarily advance knowledge and facilitate the solution of problems having in many cases a direct and important connection with economic considerations.

Visual impressions are more indelible than impressions obtained from descriptions, and it may be safely assumed that having seen conditions as they exist in Canada, our geological and mining literature will be read hereafter by those who visited the country last summer not only with greater avidity, but with greater grasp and interest. In consequence, geologists in every country will become better familiarized with Canadian mineral resources, potentialities and phenomena, and from these sources accurate information will presently filter into commercial circles. A further accomplishment by the last Congress, in the highest degree of practical utility, was the publication of a monograph on the subject of the coal resources of the world. The contributors are all recognized authorities. The work itself was edited, printed and published by Canadians.

I have referred to the disinterested zeal of those Canadian geologists and mining men on whose co-operation the success of the meeting was mainly dependent. But just as after the battle, it is the victorious general on whom the glory reflects, although the prowess of his army is fully recognized, so now, without invidiousness, no name may be mentioned excepting that of the Worker-in-Chief. The choice of Dr. Frank D. Ddams for the Presidency of the Congress was a singularly appropriate one. It was a recognition in the first place of his scientific standing and attainments; but it was still more a recognition of his abilities as an organizer and leader. That in the person of one individual there should be developed to an equal degree of perfection both the scientific and business faculties, is not believed by most laymen to be possible. Dr. Adams has (and there may be others) clearly demonstrated that a really good geologist, so good as to have a big international reputation, can be also an exceedingly capable man of affairs. He directed the organization arrangements with tireless energy, patience and tact. No detail was too small for his personal attention. As presiding officer, host, and chief representative of Canadian geology, he worthily upheld the dignity of his profession, his office and his country. When the general is honored, the army is honored, and the Government of Canada could take no action that would be better appreciated by the mining men of the Dominion than by recommending to His Majesty, the King, that some special distinction be offered to Dr. Adams in acknowledgment of this and the many other great public services, both to education and science, by which his career has been marked and distinguished.

*From McGill University Bulletin, December, 1911.

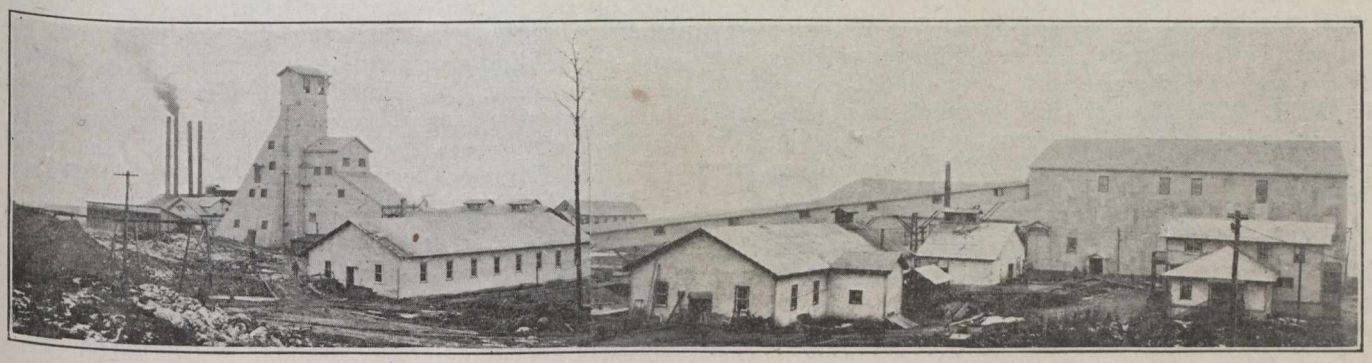
VANCOUVER CHAMBER OF MINES.

In our last issue we published a paper on the treatment of zinc ores, with special reference to those of British Columbia. This paper was prepared by Mr. A. J. C. Nettell for presentation at the January 19 meeting of the Vancouver Chamber of Mines. This organization, composed of business and professional men interested in mining, is endeavoring to promote the industry in British Columbia. A number of interesting papers have been read at meetings during the winter.

HOLLINGER GOLD MINES, ANNUAL REPORT, 1913

The report of the Hollinger Gold Mines, Limited, for the year ending December 31, 1913, has been issued. President N. A. Timmins says, in part:

In spite of the great handicap imposed by the very serious labor disturbance which existed during its early months, the year has been a prosperous one, and the developments in the mine have in all cases come up to expectations. From the treatment of 138,291 tons of ore, a profit of $1,628,113.64 has been made. The total profit is not all represented by cash, for there has been re-invested in plant $105,751.56 and in development $10,100.97, besides an expenditure of $3,600.00 for the purchase of lots in the town of Timmins. The amount brought forward as "Surplus" at the beginning of 1913 was $351,801.69, and during the year, after paying out $1,170,000.00 in the form of dividends, there was added to Surplus Account the sum of $458,113.64, which brought the account up to $809,915.33. Following a policy of reducing to a minimum those assets which are not convertible, there has been written off from "Plant" the sum of $105,751.56, from "Development" the sum of $15,100.97, and from "Real Estate" the sum of $600.00, thereby reducing the surplus which has been carried forward to the new year to $688,462.80.



Hollinger Mine Buildings and Mill, Timmins, Ont.

It will be readily seen that this latter amount approximates a cash surplus owing to the ease with which the "gold" items may be converted into cash. From a mining standpoint, our position is much stronger than the Balance Sheet would show, owing to the large sums which have been expended upon development work, but which sums have been absorbed in costs of operation. It is usual to carry these development costs as a deferred charge, to be apportioned at a fixed rate per ton to all ore made available by the development work, and in order to place our costs upon a basis for fair comparison with the costs of mining companies in other parts of the world, we shall in future adopt the policy of carrying the costs of development in a "Deferred Charges" account. It will be noted that during the past year there has been added to Capital Expenditures the sum of $10,100.97 on account of development. This item represents the expenditures made in connection with the sinking of shafts Nos. 4 and 5, located respectively upon veins Nos. 7 and 44. These two shafts are entirely new work, carried on at considerable distances from the main workings, and represent in reality two new operations, distinct from the producing mine, and therefore rightly chargeable to capital expense.

Ore Reserves.—The matter of ore reserves is all important, and it is felt that shareholders will not be disappointed over the results of development as set forth in the Manager's Report. After removing $2,566,666.24 from the mine during the year, an increase in the ore reserves is recorded, which means that approximately $3,000,000.00 of new ore has been opened up. Considering the small progress made upon development work during the first half of the year, while during this same period heavy inroads were being made into the ore previously blocked out, it must be admitted that the mine has shown remarkable recuperative power, in not only recovering from this heavy drain upon its resources, but actually at the year's end having more ore in sight than at the commencement of the year. In connection with the estimated ore reserves, the fact that we now have a surplus account which shows $510,462.80 in cash and quickly convertible assets, must not be lost sight of, nor must we forget that besides an increase in the estimate of ore reserves, there was, before writing down, an addition of $458,113.64 made to the surplus; that is to say, besides taking from the mine the amount of our dividend requirements, we also converted over $450,000.00 of our last year's estimated ore reserves into a definite "surplus."

Probable Ore.—While it is not permissible for an engineer to include "speculative" ore in his estimates of ore reserves, yet it is permissible and desirable that the speculative features shall not be passed by without comment. You will find in the Manager's Report that he draws attention to the probable results if the main ore bodies extend throughout to the depth of our deepest workings. This is a very reasonable assumption, and the matter is brought to the attention of shareholders in order that they may have some conception of future possibilities. There are no local data upon which to base a definite estimate of possible depth for the persistence of ore bodies—we are all quite in the dark in regard to this important matter—but so far as we have gone there has been nothing to indicate to our engineers that the veins are not likely to persist to considerable depths below present workings. All information possible is placed before shareholders in order that they may form their own conclusions and estimate for themselves the possibilities.

Milling.—The results of milling are very satisfactory, and while there is, of course, a steady improvement in metallurgical practice throughout the world, it will be found that the Hollinger practice is modern in every respect, and our engineers are constantly striving to

keep their practice thoroughly up to date, being careful meanwhile to avoid costly mistakes. After eighteen months of operation it can be said that the mill is entirely satisfactory and the correctness of the process adopted has been amply proven.

Labor, Etc.—Your directors are pleased to be able to report that the very serious labor trouble which was in progress during the early part of the past year has entirely subsided. It was an ill-advised movement, and the responsible parties were only successful in imposing a great deal of hardship and suffering upon the workmen and their families. During the year $46,832 was expended upon bunk houses and dwellings. This is in keeping with our policy to house our men comfortably. We now have ten 5-room cottages, three 7-room cottages and seven 2-family cottages with four rooms to a family, in all, accommodation for twenty-seven of our married men and their families. This is in addition to quarters which have been provided for heads of departments and their families. Our new bunk houses consist of plastered rooms, two single beds in a room, steam heat, electric light and modern sanitary arrangements. Various other departures which will be of benefit to the men are under consideration, and it is our intention to continue a policy of fair treatment to employees. This year we are inaugurating a system of rewards for loyal services, whereby employees will participate more fully than before in the earnings of the company.

The faithful and very efficient service of the general manager calls for words of especial appreciation, nor can we omit a reference to his very capable assistant, Mr. A. R. Globe, and the other members of the staff, without whose hearty interest and co-operation the favorable report submitted could not have been possible.

975.10, a rate of depreciation far exceeding the requirements of ordinary wear and tear. Development charges amounting to $175,000.00 are carried forward in capital account, a sum which distributed over the indicated tonnage in ore reserves, amounts to but slightly over twenty cents per ton, and while further development of the ore bodies is necessary before the entire 845,300 tons may be removed, the cost per ton will nevertheless be small.

Directly and indirectly, the labor troubles experienced during the first months of the year cost us approximately $120,000.00, as indicated by the high operating costs shown for the period of unrest. During the last three or four months we have been gradually getting back to normal working conditions and our costs of operating have benefited thereby.

Expenditures for plant and equipment have amounted to $105,751.56.

Approximately twenty-seven per cent. of the ore hoisted from the mine came from development. Considering the small amount of development work accomplished during the first six periods of the year, owing to the unsettled labor conditions, this showing is most satisfactory.

There has been a gradual improvement in the efficiency of the workers, beginning with an output of approximately one-half a ton per man per day in January, and ending with something over one ton per man per day during the last three months of the year. Concurrently with the increase in tonnage produced, a steady and decided improvement has been made in the amount of development work done. The efficiency of the men is higher at the present time than it was previous to the strike, and it is evident that the strike had a beneficial effect in bringing a better class of men into the district, and thereby raising the standard of workmanship.

Estimated Ore Reserves, Hollinger Mine, January 1, 1914.

	Tons.	Value per ton.	Estimated Gross Value.	Estimated at beginning of 1913.
No. 1 Vein	284,200	$19.56	$5,559,900.00	$6,026,100.00
No. 2 Vein	208,400	10.22	2,129,500.00	2,648,250.00
No. 3 Vein	22,600	7.47	169,000.00	169,000.00
No. 4 Vein	121,100	11.55	1,398,800.00	1,012,000.00
No. 5 Vein	35,200	11.55	406,500.00	.....
No. 7 Vein	25,200	10.51	265,000.00	.....
No. 8 Vein	35,900	9.11	326,000.00	77,150.00
No. 37 Vein	32,800	12.22	400,900.00	400,900.00
No. 38 Vein	8,100	15.31	124,000.00	124,000.00
No. 41 Vein	2,200	15.09	33,200.00	33,200.00
No. 44 Vein	9,600	20.00	192,000.00	.....
Veins 9, 11, 12, 13, 14, 23, 33, 35, 36, 39, 42, and 43.	60,000	10.00	600,000.00	730,000.00
	845,300	$13.71	$11,604,800.00	$11,271,400.00

The Manager's Report.

General Manager P. A. Robbins says, in part:

Earnings in 1913 amounted to $2,471,273.19. Of this $843,159.55 has been charged to operations, $1,170,000 paid in dividends, and $458,113.64 added to surplus. The surplus carried forward shows a healthy condition, being made up of approximately $510,000.00 of cash and quickly convertible assets, and only $178,000.00 of capital assets. The position of the company is stronger than the Balance Sheet indicates, owing to the large sums which have been spent upon development work, and which sums have been absorbed in costs of operations. From plant costing $711,975.10, there has been written off in two years, the sum of $211,

The average value of the reserves in No. 1 Vein are this year estimated at $19.56 per ton, while last year they were estimated at $28.86 per ton. This falling off in value is largely due to the fact that during the early part of the year we were engaged in a serious labor dispute, and in order to keep up the output of gold, it was necessary to draw ore from the richer parts of the mine, to compensate for the small tonnage being treated. In consequence of this the ore in No. 1 Vein above the 100 and 200-ft. levels was robbed of some of the richer portions, and the balance of ore now left above those two levels naturally shows a smaller value than was the average value before the richer portions were removed. There has also been some falling off

in the average value of the ore upon the 300 and 425-ft. levels, as compared with the values encountered upon the surface and 100 ft. levels, but by way of compensation for this, the average width of the ore upon the lower levels is greater than upon the upper levels.

No. 2 Vein shows a decrease in the estimated value of the reserves. This is primarily due to more conservative estimating. Last year the estimates for this vein were largely based upon the results of bore holes and crosscuts, while in the present case the estimates are based upon the more extensive development work which has been accomplished during the past year.

No. 3 Vein is included at the same figures that were given last year, as practically no new development work has been done upon this vein during the past year. An important point which has not affected the estimate, but which may be noted, is the result of diamond drilling for No. 3 Vein upon the 200 ft. level immediately below the drift upon the 100 ft. level. A drill hole passed through 10 ft. of ore showing high values, but owing to the known characteristic of this vein to carry high values in spots, the results of the drilling test have been disregarded and no allowance made for the ore indicated.

No. 4 Vein shows an increased reserve, although considerable ore from this vein has been milled during the year.

Nos. 5 and 7 were last year included under miscellaneous veins, and the estimated values of the reserve are based upon development work.

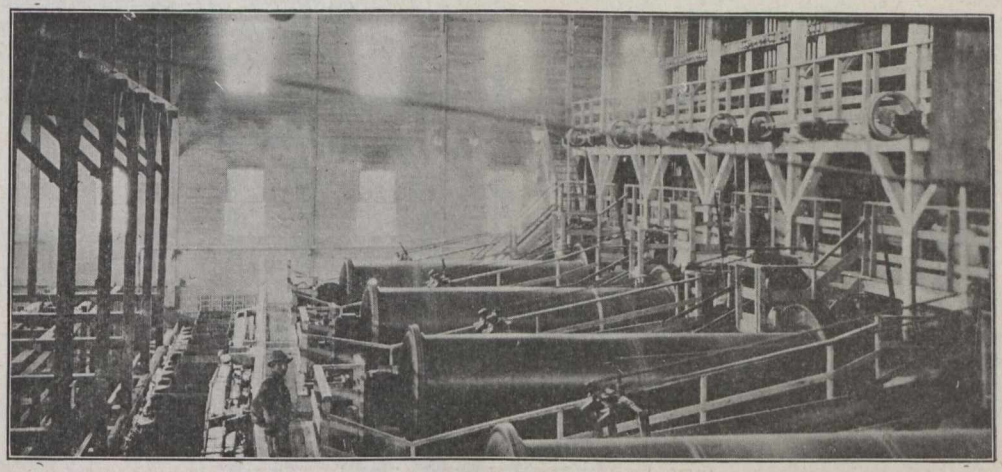
Veins 37, 38 and 41 are included at the figures estimated at the beginning of 1913.

In the last annual report Veins 5, 7, 9, 11, 12, 13, 14, 23, 33, 35, 36, 39, 42 and 43 were grouped as "miscellaneous," and were included in the estimate of ore reserves for an aggregate of 70,000 tons containing $730,000. During the year 1913, No. 5 Vein has been partly developed upon the 100 and 200 ft. levels, and shows a reserve of 35,200 tons estimated to carry $406,500.

A shaft has been sunk upon No. 7 Vein to a depth of 123 ft. and the vein at that level is found to be unchanged, so that No. 7 Vein is estimated to contain 25,200 tons carrying $265,000.

No. 44 Vein, not previously included in estimates, is another of the miscellaneous veins and sufficient work has been done upon this ore body to justify an estimate of 9,600 tons carrying $192,000 as proven ore. The work done upon these three veins shows the conservatism of the previous estimates, and the inclusion of Veins 9, 11, 12, 13, 14, 23, 33, 35, 36, 39, 42 and 43 in the present estimate of ore reserves, for a tonnage of 60,000 and a gross value of $600,000, is merely a nominal rating. No work has been done upon these twelve veins other than the sampling of their outcrops. Recently, by means of a diamond drill hole driven horizontally from the workings upon the 425 ft. level, we have found two ore bodies, located to the east of No. 1 Vein in unprospected territory. No allowance has been made for the possibilities of these discoveries.

The estimates at the commencement of 1913 showed 644,540 tons, valued at $11,271,400.00. During the year there have been removed from the mine 138,291 tons, containing $2,566,414.59 gross value. The present estimate shows 845,300 tons, containing $11,604,800.00, which incidates the development during the year of 339,051 tons of ore, containing $2,899,814.59. The average grade of all ore in reserve shown at the beginning of the year was $17.48 per ton, while that shown by the present estimate is $13.71 per ton. This falling off in average value is due principally to the fact that by far the greater part of the year's development work has been done upon veins of comparatively low values, thus bringing about a lowering of the over-all average in the mine. The policy followed in development has been to open up all ore of a profitable grade, rather than to confine development to the higher grade ore bodies. By systematic development and working of the ore bodies, operating costs may be reduced to a minimum, and the installation of plant may be gauged to meet the requirements.



A View of the Tube Mills, Hollinger Mill

The above cut of "Transverse Section of Principal Workings" illustrates the occurrence of some of the more important veins. It is not possible to include all of the ore bodies in one cross section, and the above is merely to show how the veins continue roughly parallel at depth, and to give shareholders an idea of the amount of work which has to be done upon each level in the development of the numerous ore bodies.

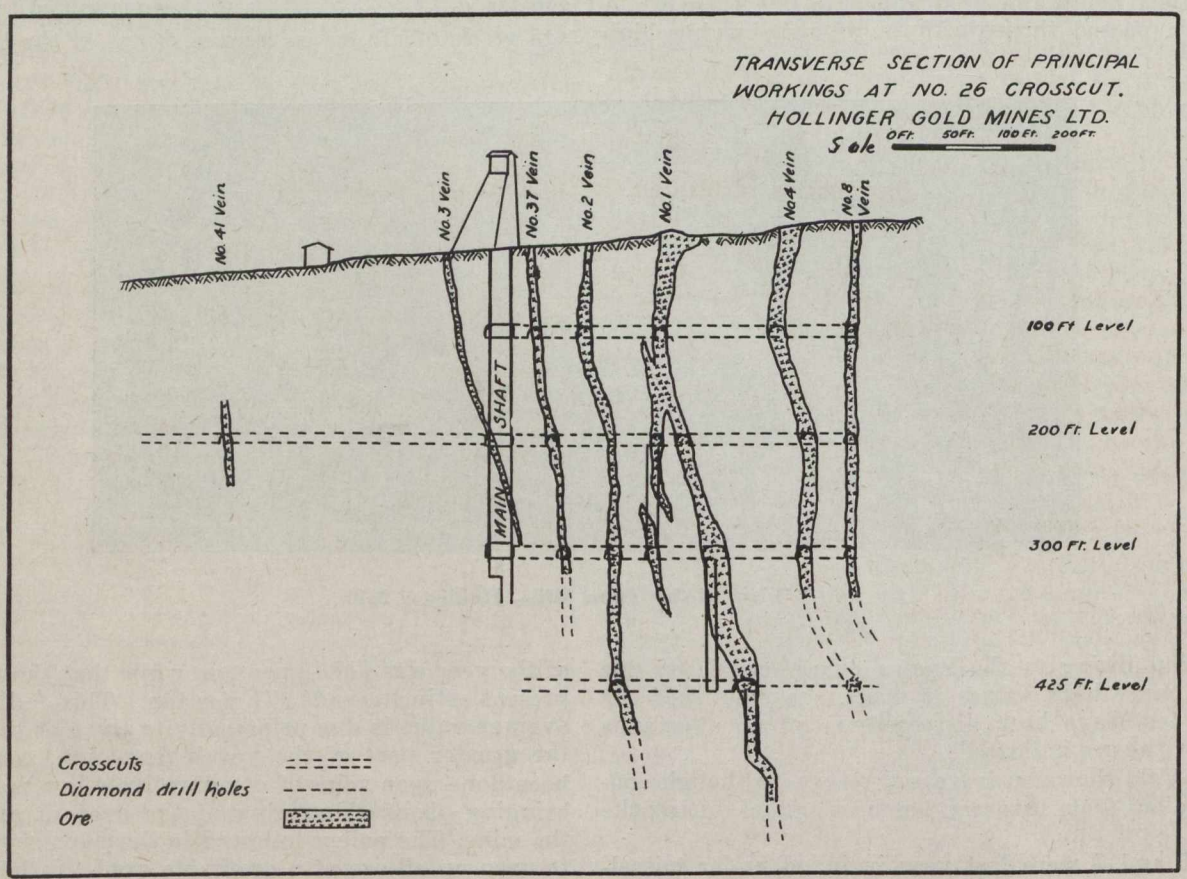
Speculative.—Beyond the limits of the estimates of proven ore, there are possibilities which cannot be disregarded.

For purposes of convenience in mining, and to facilitate the opening up of the lower levels, a winze has

been sunk to a total depth of 550 feet below the surface. This winze happens to be located at a certain point upon No. 1 Vein. There is no reason to believe that this is the only point to which this vein penetrates to the depth attained.

Level after level has been opened up, and unfailingly the veins have been found where sought for. It is not unreasonable, then, to forecast the possible results which will accrue if future exploration proves that the principal ore bodies persist without change to at least the level of our deepest workings, namely, 550 ft. below the surface.

Based upon this hypothesis the extra depth of ore bodies would account for the following additions to the estimates already given:



	Tons.	Value.
No. 1 Vein	53,400	$948,000
No. 2 Vein	158,400	1,862,000
No. 4 Vein	95,700	1,162,000
No. 5 Vein	56,300	626,800
No. 7 Vein	41,000	451,000
No 8 Vein	37,500	308,400
No. 38 Vein	33,500	539,600
	475,800	$5,897,800

We are located in one of the great pre-Cambrian areas of the earth's crust, and the results of mining in similar rock formations cannot be ignored. Western Australia, Southern India, South Africa and Brazil have all contributed to a building up of knowledge concerning the occurrence of gold in deposits in these older rocks, and, as pointed out by Dr. Malcolm Maclaren, before the recent Canadian meeting of the International Geological Congress, gold deposits of this type are deep seated in origin and persist in depth until some unfavorable change in rock formation occurs to adversely affect the gold-bearing lode.

While it is true that such an unfavorable change in rock may at any time be encountered, either because of folding in the earth's crust or through the intrusion of rock masses, yet we are certain that such a change has not been encountered in the depth to which our workings have penetrated, nor has such a change been shown by the somewhat deeper diamond drilling which has from time to time been done in our vicinity.

The expectancy, therefore, that our principal ore bodies will all persist to at least the depth of our deepest working, is not unreasonable.

I anticipate that my critics of two years ago will again take me to task for daring to anticipate the future, but I must remind shareholders that provisions for increased milling capacity, additions to hoisting and air compressing plants, the housing of employees and their families, the planning of underground development, and the many other items which go to swell the Capital Expense Account, result from the anticipation of events which may reasonably be expected to transpire.

Milling Record.

	Hollinger.	Acme.	Total.
Tons of ore milled	138,291	1,840	140,131
Average value per ton	$18.56	$12.49	
Total values sent to mill	$2,566,414.59	$22,978.17	$2,589,392.76
Average tons per day			383.92
Per cent. of possible time run			86.3%
Average tons per 24 hours of running time			444.87
Stamp duty tons per 24 hours of running time			11.51
Values lost in tailings			$101,370.18
Values recovered			$2,488,022.58
Total values per ton in tailings			$0.723
Per cent. of total gold extracted			96.085%
Cyanide consumed per ton of ore			0.461 lb.
Lime consumed per ton of ore			2.422 lb.
Zinc consumed per ton of ore			0.663 lb.
Lead Acetate per ton of ore			0.0065 lb.
Tons of solution precipitated per ton of ore			3.164
Zinc added per ton of solution			0.209
Average value of pregnant solution			$5.612

Distribution of Milling Costs, Hollinger Mines, 1913.

Account.	Labor.	Stores.	Total.	Per Ton Ore Milled.
General Milling Charges	$6,068.26	$4,940.90	$11,009.16	$0.081
Superintendence	9,110.86	.....	9,110.86	.066
Tailing Disposal	1,103.60	1,011.15	2,114.75	.015
Heating	2,345.60	3,128.78	5,474.38	.039
Lighting	457.62	1,790.42	2,248.04	.016
Mill Power Plant	267.05	167.30	434.35	.003
Sampling	554.26	23.42	577.68	.004
Coarse Crushing	5,337.74	5,484.21	10,821.95	.078
Conveying	4,318.18	2,898.16	7,216.34	.051
Stamping	9,144.61	13,175.78	22,320.39	.159
Class and Tube Milling	6,427.24	23,835.23	30,262.47	.219
Concentration	5,550.71	3,769.88	9,320.59	.068
Handling Concentrates	1,131.70	1,397.10	2,528.80	.018
Retreating Concentrates	2,843.19	2,929.62	5,772.81	.041
Handling Pulp	1,716.76	2,765.14	4.481.90	.032
Thickening	2,297.83	1,799.13	4,096.96	0.29
Agitation	3,858.32	1,661.58	5,519.90	.039
Filtration	11,965.01	9,158.77	21,123.78	.151
Neutralization	913.13	1,710.12	2,623.25	.019
Clarifying and Precipitation	2,218.43	10,434.25	12,652.68	.091
Smelting and Refining	7,413.38	10.474.88	17,888.26	.120
Pumping Solutions	1,542.68	1,795.06	3,337.74	.024
Cyanide	44.43	10.750.63	10,795.06	.078
Cleaning up Mill	5,724.28	62.40	5,786.68	.041
Alterations to Plant	6,292.83	8,475.08	14,767.91	.105
Assaying	1,739.72	994.41	2,734.13	.020
Watchman	619.10	1.50	620.60	.004
Acid Washing	130.26	728.84	859.10	.006
Shovelling in Bins	837.30	.....	837.30	.006
Stables	60.71	192.44	253,15	.002
Shops	144.50	286.14	430.64	.003
	$102,179.29	$125,842.32	$228,021.61	$1,628
Less treatment charges on Acme Gold Mine Ore— 1840 tons at $3.00			5,520.00	....
			$222,501.61	$1.609

The detailed costs are based upon the total tonnage treated.

Based upon the tonnage of Hollinger ore milled, 138,256 tons, the total cost per ton was $1.609.

Besides treating 138,148 tons of Hollinger ore, the mill treated 1,840 tons for our neighbors, the Acme Gold Mines, Limited, a charge of $3.00 per ton having been made for this service.

The capacity of the mill has been gradually raised from 300 to 500 tons per day. Extensions are now under construction which will further increase the capacity to 650 tons per twenty-four hours. As pointed out in my report of one year ago, we have been experimenting along the lines of continuous decantation, and while the results of our own work, and that of one of our neighbors, seem to indicate certain economies to be derived, we shall proceed slowly before coming to any definite conclusions. Approximately $14,000.00 has been spent in making alterations to the mill during the past year, this whole amount having been absorbed in working costs. The treatment of concentrates is receiving special attention and certain changes now being planned will, no doubt, lead to a higher extraction being made of the values contained in the concentrates. With an extraction of over 96 per cent. as at present obtained, it will be understood that any benefits to be derived from changes can only be small in amount. A comparison of our milling costs during the latter part of the year with those obtained in other camps will show that the possible economies are gradually growing less. We hope, however, to show slightly improved results before the end of 1914.

General.

The work of the year has been handicapped by the poor showing made during the first five or six months.

The members of the staff have all felt the strain of the seven months' struggle with the labor unions, and the work of reorganizing, after the strike was called off, made still further demands upon their strength.

How well these demands were met, is shown by the record of steady improvement which has marked the work of the last six months.

The average working costs for the year were high, owing to the inefficiency of operations during the first part of the year, but the last few periods show more nearly what may be anticipated in the way of working costs in the future, the average being approximately:

General	$0.90 per ton
Mining	2.87 per ton
Milling	1.44 per ton
Total	$5.21

Underground operations will be cheapened by better arrangements for tramming and by hoisting with skips instead of cages.

Milling costs will be reduced as the tonnage treated increases, and general charges will show a decrease per ton when spread over a larger tonnage than at present.

All things considered, it is probable that the total costs of production and treatment will be reduced to about $4.50 per ton. The reduction, however, will be gradual and can only follow upon increased output.

Our mining and milling plants are being gradually worked up to larger capacities, to keep pace with developments in the mine, but it is intended that all steps shall be taken slowly, for the property is now in such excellent condition that we can afford to expand operations at a conservative rate.

INTERNATIONAL ENGINEERING CONGRESS, 1915.

In connection with the Panama-Pacific International Exposition in San Francisco, in 1915, there will be an International Engineering Congress, in which engineers throughout the world, represeting all branches of the profession, are invited to participate.

The Congress is to be conducted under the auspices of the following five U.S. National Engineering Societies, namely: The American Society of Civil Engineers, the American Institute Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers.

The organization and conduct of the Congress have been placed in the hands of a Committee of Management consisting of the Presidents and Secretaries of these five Societies, and of eighteen other members representative of them and resident in or near San Francisco.

The Honorary Officers of the Congress will consist of a President and a number of Vice-Presidents, selected from among the most distinguished engineers of the world.

Colonel George W. Goethals, Chairman and Chief Engineer of the Isthmian Canal Commission, has consented to act as Honorary President of the Congress, and is expected to preside in person over its general sessions. The names of the Vice-Presidents will be announced in the near future.

The Congress will hold its sessions during the week, September 20-25, 1915, in San Francisco, in the auditorium and section rooms which will be placed at its disposal by the management of the Panama-Pacific International Exposition Company.

Two distinct, though perhaps equally important, purposes of the Congress should be here emphasized. These are:

The gathering together of a large and representative body of engineers from all civilized countries, with the opportunities which this will present of forming or renewing personal acquaintances, and of interchanging views on the various phases of professional work.

The reading and discussion of papers before the various sections, and their later publication in such form as to constitute a valuable addition to any engineering library.

In scope and character, it is intended that the Congress shall be truly international, and that it shall embrace, in a thorough and comprehensive manner, the various branches of the engineering profession. Eminent engineers throughout the world will be invited to contribute papers on assigned topics, and in the selection and distribution of these topics the Committee will use its best endeavors to render the series of resulting papers widely representative of the world's best engineering practice in the various branches of the profession.

COBALT-FRONTENAC.

The Cobalt-Frontenac Mining Co., Ltd., announces that it has let a contract for 1,000 ft. of diamond drilling to Messrs. Smith & Durkee, of Sudbury. The drilling is to begin at once, both at surface and underground. Mining operations have been suspended, pending an increase in water supply.

THE SUCCESSFUL TREATMENT OF ZINC SULPHIDE ORES

By Frank L. Wilson.*

Treating the heavy sulphide ores for the extraction of their zinc content has been experimented upon insistently. Numerous more or less successful processes have been invented and some tried out. Some have been tried on a large commercial scale, failing with a loss of considerable invested capital. These processes have been advertised throughout the metallurgical world, and, in their fall have carried away many enthusiastic supporters and created a rather harsh feeling toward new ideas. Some have again risen to noteworthy prominence.

An Ammonia Process.—Most hydro-schemes for treatment of zinc ores are acid. And now an alkaline scheme presents itself. This scheme using ammonia and carbon dioxide in solution was one of the discards, as it were. Dr. Carl Schnabel first describes it ("Hand Book of Metallurgy," Vol. 1, p. 677-680), as installed at Lautenthal and later at Hoboken-les-Anvers for the treatment of the zinc-lead-silver crust produced in the Parkes process. The scheme was abandoned at these two plants because distillation of this crust was installed and proved to be cheaper.

During the stage of experimentation at Broken Hill, when the sulphides were encountered, Dr. Schnabel was called to Australia for consultation. He unsuccessfully tried this scheme on the ores and returned to Germany without accomplishing that end.

S. E. Bretherton, in looking for a process to treat the Afterthought ores of Shasta County, California (see "Smelting of Zinc-copper Ores," Mining and Scientific Press, April 12th, 1913), made a series of leaching tests with ammonia and carbon dioxide in solution. D. Mosher, who was at that time interested in his ammonia-cyanide process (see "Ammonia-cyanidation and the complex zinc problem," Mexican Mining Journal, August, 1910), suggested the use of it.

The writer in the spring of 1912, obtained some Afterthought ore and made several interesting and satisfactory tests with this process. Several schemes presented themselves whereby the troubles that Schnabel encountered could be overcome. As a result of these satisfactory tests, active experimenting was started at the Afterthought mines. Here, a preliminary 25 lb. plant and later a 50 lb. testing plant were erected. The results (see "Preparation of ore containing zinc for the recovery of other metals such as silver, gold, copper and lead by the elimination and subsequent recovery of the zinc as a chemically pure zinc product." Trans. A.I.M.E., Vol. XLVI.), checked those obtained from the smaller bottle tests in a most satisfactory manner.

The Ore, and Method of Treatment.

Ore from the Afterthought mine is a complex 'black jack,' composed of intermixed zinc blende, chalcopyrite, a trace of galena and silver sulphide, iron pyrite, barytes, calcite, etc. The ore averages from 20 to 30 per cent. zinc, running as high as 40 to 45 per cent. zinc.

The ore is crushed and ground to pass 30 mesh. It is then given a sulphatizing roast in a multiple hearth furnace and then slimed to pass 150 mesh. This slimed ore is then mixed with a 4:1 solution containing approximately 9 per cent. ammonia (NH_3) and 9 per cent. carbon dioxide (CO_2) and agitated under pressure until the solution is saturated, or nearly so, with zinc salts. It is then filtered and the residue given a wash, first with strong solution and finally with hot water to remove traces of ammonia. The solution from the agitator after filtering passes to a tank where it comes in contact with scrap zinc or zinc dust. Any copper or silver that has been dissolved is precipitated as cement copper. Again filtering this solution and removing the cement, the solution is sent to a battery of specially constructed stills where the ammonia and excess carbon dioxide is boiled off with steam and caught in absorbers. The zinc precipitates as a white basic carbonate and is caught in an enclosed type filter press. It is either sold as the basic carbonate or calcined to an oxide. This oxide has been pronounced by experts as of the best for paint body. The cement copper can be sold for pigment or added to the residue to be smelted in a matting furnace.

Recovery, Etc.

Extractions of the zinc vary with the percentage of the zinc in the original ore. That is, the higher the zinc in the ore the greater the extraction. On a 20 per cent. zinc ore the extraction varies from 82 to 89 per cent. and on a 30 per cent. zinc ore 87 to 95 per cent. The recovery of the zinc as basic carbonate on several complete tests was 100 per cent. and as all solutions and wash waters are used over again, any trace of zinc remaining in them will ultimately be recovered.

With copper, to get a maximum extraction requires a slightly different roast and a longer contact with the leaching liquor. As high an extraction as 90 per cent. has been obtained, from an ore assaying 2.96 per cent. copper, without careful roasting. Even higher than this has been obtained when care is taken. At the Afterthought mine, where the copper is to be added to the residue and smelted, the extraction averages about 55 per cent.

Lead and silver are only slightly soluble. Where care is taken in roasting the extraction of these metals is practically nil.

Ammonia losses are only what is mechanically held in the gangue matter of the residue. This varies from 1 to 5 pounds per ton of ore in the tests run. By preheating this residue and drying, most of the ammonia held back could be recovered.

The residue is only from 46 to 56 per cent. of the original ore and the cost of smelting reduced that amount.

The cost of operation compares favorably with any known process for zinc recovery. The initial cost of the plant is extremely low, as compared with an electric furnace or retort plant. The recovery of metals is greater. The plant itself has been worked out on the simplest design and contains no complicated or large dimensional machinery.

The apparatus and the more important features of the process described above are covered by patents, controlled by Consulting Engineer, S. E. Bretherton, of San Francisco.

There are many mines lying idle to-day, which contain ore similar in character to the 'black jack' ore of the Afterthought, waiting for some method of concentration and extraction to work them profitably. The method of procedure with this process is simple. No expensive lead lined tanks and apparatus is necessary. They need be only gas tight to retain the volatile ammonia. Wooden tanks can be used for the weaker solutions.

*Metallurgical Chemist for the Afterthought Copper Company, Ingot, Shasta, County, California.

CANADIAN NORTHERN RAILWAY MOUNT ROYAL TUNNEL*

By D. J. O'Rourke.

Tunnel Methods.

When the Canadian Northern Railway, headed by Sir William Mackenzie, President; Sir Donald Mann, Vice-President, and Mr. H. K. Wicksteed, chief engineer of survey, decided that the most advantageous way of entering Montreal was by a double track tunnel under Mount Royal, all modern methods of tunnel driving were carefully investigated. As time was a great factor, more rapid methods were sought than those afforded by earlier American examples.

They were fortunate in securing the services of Mr. S. P. Brown, a tunnel engineer of many years' experience, who had, on trips to the Swiss and Italian tunnels, studied their methods closely. Mr. Brown was given entire charge as managing engineer, to construct the tunnel on the plans he outlined; and as a matter of record he has made no changes in those plans in getting the satisfactory results he has obtained up to date.

He selected as his most important assistants on this work, Mr. W. C. Lancaster, electrical and mechanical engineer; Messrs. J. C. K. Stuart, first assistant engineer, and H. T. Fisher, tunnel engineer; Mr. Richard Byers, superintendent at the west portal; Mr. P. J. Morante, superintendent at east portal. Mr. Morante resigned the 1st of April to enter the contracting business for himself. Mr. Edward Duffy succeeded Mr. Morante as superintendent at the east portal and made the record for tunnel driving referred to later in this article. Mr. Rufus Gent was appointed master mechanic in full charge of the electrical and mechanical equipment under Mr. Lancaster.

The plan on which Mr. Brown decided to drive this tunnel, while partly on the European system, is not entirely so. He adopted a bottom heading, according to foreign practice, and in one heading is using a drill truck or carriage, another European feature. The drills are mounted on arms, supported by a heading bar.

The mountings and drilling round are described later. His method of excavating the rock above the heading is being used for the first time in this class of work on the Mount Royal tunnel. The rock above the heading is supported on Jumbo timbers set up as shown. The rock is removed by "break-ups," or raises, carried up to roof grade at intervals and used as starting points for widening the tunnel out to its full section.

This timber is taken down and moved ahead as the break-up advances. This system permits practically all the rock in the tunnel section above the heading to be loaded by gravity, greatly reducing the amount of time and labor needed for its removal.

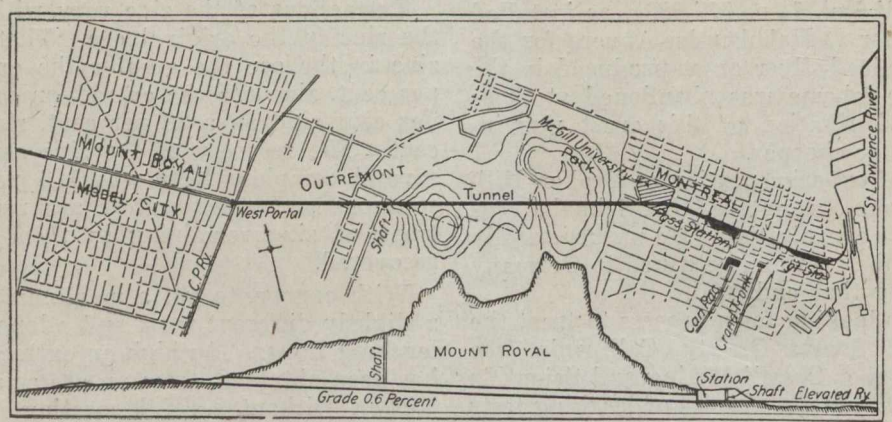


Fig. 1—Plan and Profile, Mount Royal Tunnel

General Plan of Work.

The map shows the general layout of this work. It was originally intended to sink three shafts. Shaft No. 1 in the station site on Dorchester St.; Shaft No. 2 on the side of the mountain above McGill College, and Shaft No. 3 at Maplewood Ave. in Outremont. As a site for Shaft No. 2 could not be secured, it reduced the possible working faces to four, which, since April 5th, when the heading between the West Portal and Shaft No. 3 met, are reduced to two working faces.

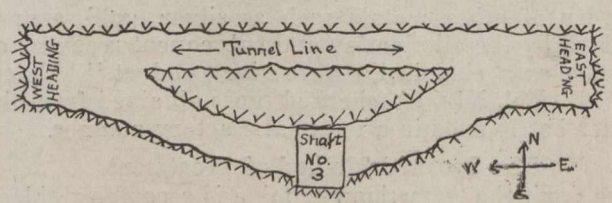


Fig. 2—Method of reaching the tunnel line at Shaft No. 3

West Portal Heading.

Ground was broken at the west portal in the heading, known as No. 4 East, having cross-section 8 x 12 ft. on July 8, 1912, and the first set of timber placed in the portal on that date. The character of the ground encountered was wet hardpan with many boulders, and springs of water were frequently struck that gave considerable trouble, particularly where they burst up around the timber, requiring the placing of a new set.

*From "Mine and Qnarry," Published by the Sullivan Machinery Co.

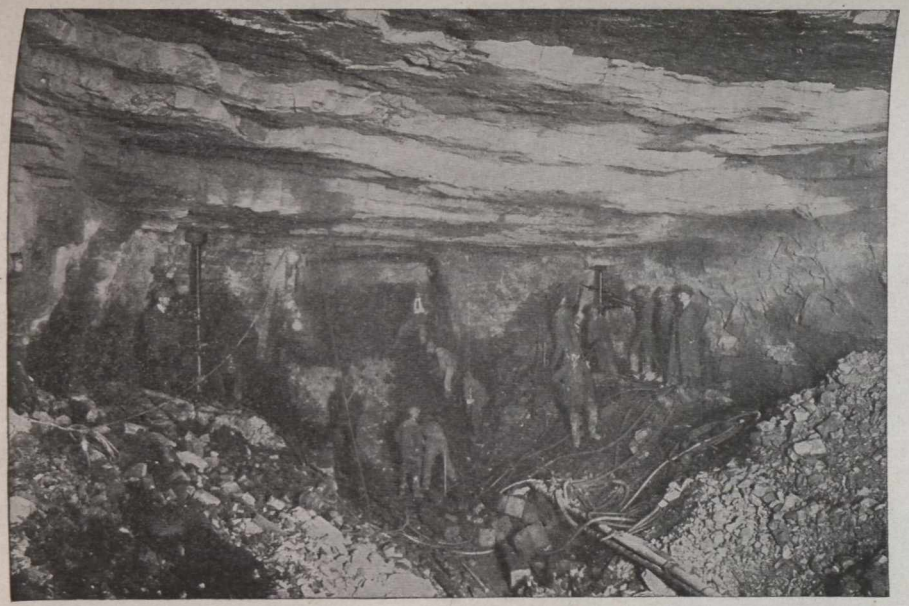


Fig. 4—Widening the tunnel in a "break-up," entry in centre, column drills at sides

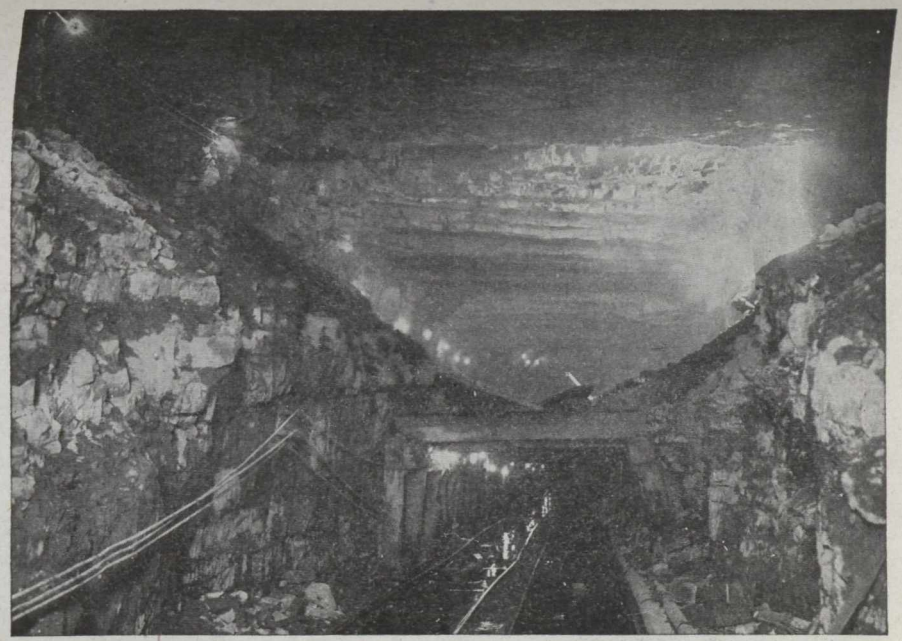


Fig. 3—A "break-up," showing bottom heading, timbering and top excavation above

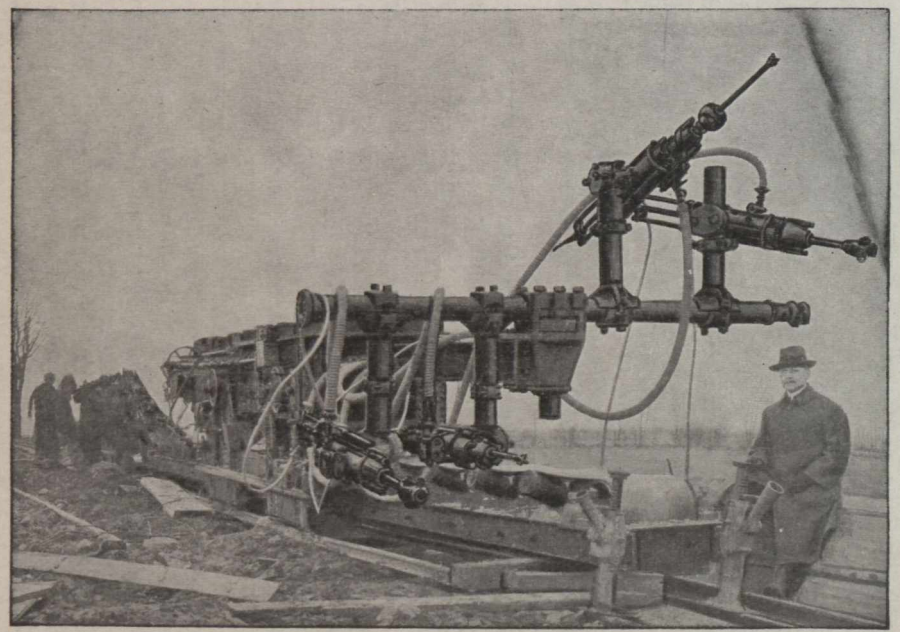


Fig. 8—Drill carriage and conveyor, with Sullivan "UH-2" (3⅝in.) Water Drills

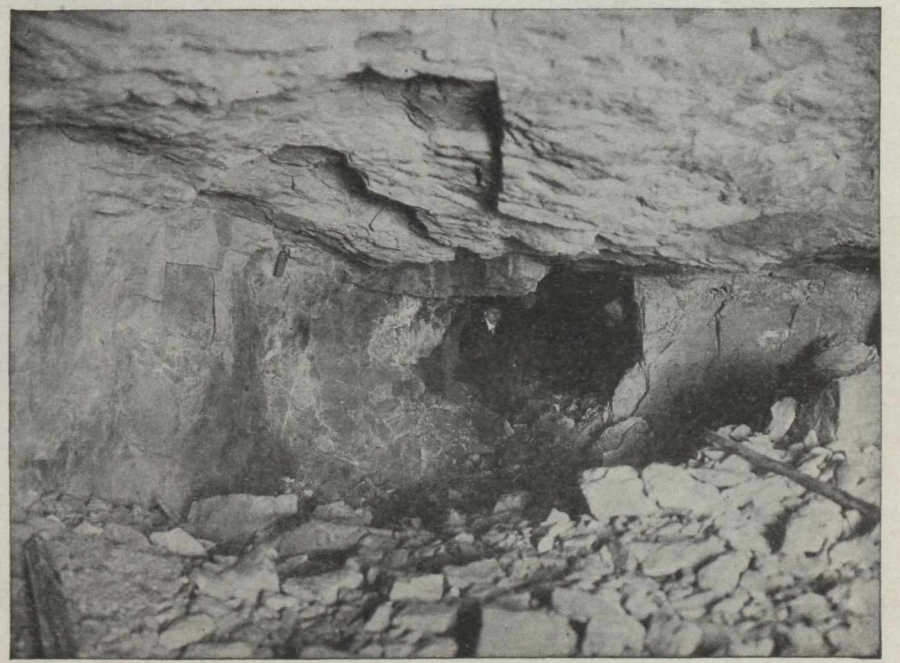
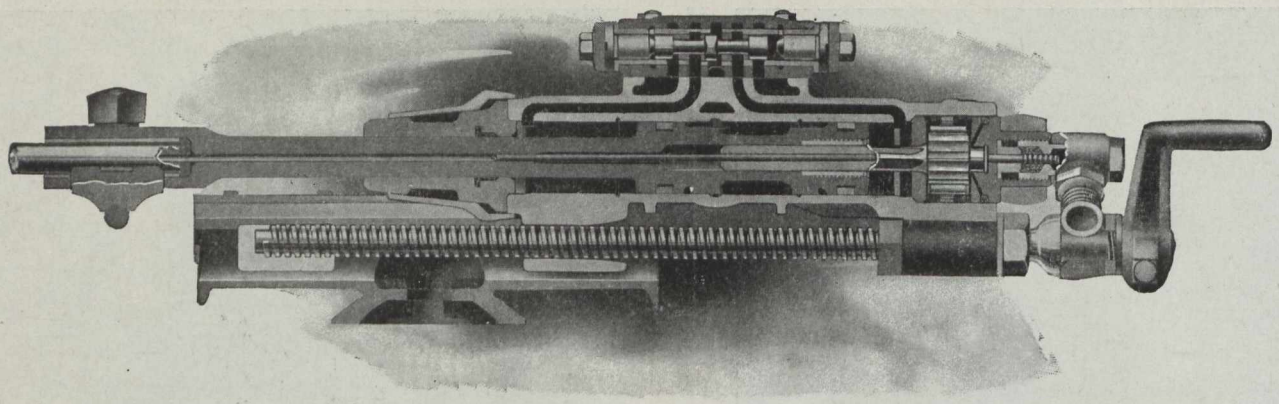


Fig. 10—Where the headings met, after an advance of 1,100 feet per month



Sectional View Sullivan Water Type Rock Drill

At about 100 ft. from the portal the heading crossed under the Canadian Pacific Railway tracks, and great care had to be exercised to prevent caving at this point. The total advance on August 31 was 301.2.

About August 8 rock was struck at sub-grade, and the heading continued to be rock and hardpan until September 6. Up to this date the timber was carried up to the heading face.

Arrangement of Drills and Holes.

After the rock was reached the timbering did not interfere so much with the work, but the rock, which lay in horizontal strata, was very blocky and difficult to drill and blast. When rock was reached, bars 11 feet long, four inches in diameter, carrying special arms for mounting the drills, were used. A special arm or brace, having a jack screw at its outer end, was clamped to the centre of the column, of sufficient length to allow it to be jacked against the face of the heading, giving the necessary stability to the bar.

In setting up, the muck was raked down so that the bar was placed about three feet from the roof, or one foot above the centre of the heading, and four Sullivan "FF-12" "Liteweight" Water Drills, (2⅝-in. diam.), were mounted on the bar. The heading was drilled as follows: Four roof, two cut, two relief and two rib holes were drilled with the arms above the bar, and four cut, two relief and two rib holes were drilled with the arms below the bar, making a total of 18 holes in each round. This was changed somewhat from time to time, depending on the character of the rock; for considerable periods 22 holes were necessary to break the heading satisfactorily.

From the first of October until April 5, at which time this heading met the heading coming west from the shaft, a total period of six months and five days, the heading advanced 2,469 ft., making an average advance per month of 411 ft., with a maximum advance for November of 486.7 ft. During this time the crews worked only every other Sunday and several days' work was lost around Christmas and New Years.

In driving this distance the rocks cut were ordinary Trenton limestone, a siliceous and hard crystalline limestone, and camponite. Considerable trouble was experienced in maintaining a uniform drilling and blasting system, due to dikes of extremely hard rock. This made it necessary to change the rounds drilled from five to three, and in some few cases only two rounds were gotten in 24 hours. Sullivan "UH-2" Water Drills (3⅝-in. diam.) were put in and retained till the heading was holed through.

Maplewood Avenue Shaft. No. 3.

Being unable to secure property rights on the tunnel line, this shaft was sunk about 40 ft. from the line, and the tunnel line was reached by the plan shown above.

The dimensions of this shaft are 12 x 24 ft. outside the timber, and it reached grade at a depth of 242 ft. At a depth of 69 ft. the section was reduced to 12 x 16 ft. in the clear and required no further timbering.

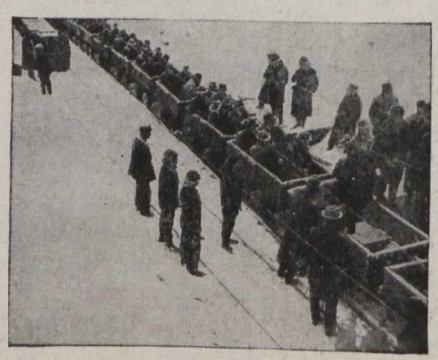
On July 21, 1912, excavation was started on this shaft, which, together with the west portal, was under the superintendence of Richard Byers, with Edward Farrell as walking boss.

From December 1, 1912, until April 1, 1913, the No. 2 heading, west-bound, having a cross-section of 10 x 12½ ft., and using five "FF-12" (2⅝-in.) Sullivan drills with water attachment, made an average advance per month of 445.5 ft. and met the west portal heading on April 5.

Heading No. 3 East, driving from the shaft under Mount Royal to meet No. 1 West from Dorchester Street, struck very hard rocks (known as essexite and camponite). Sullivan "UH-2" (3⅝-in.) drills, using a cross bar with arms for mounting the drills, were used.

Drill Carriage and Conveyor.

Knowing that this hard rock would be encountered, Mr. Brown decided early in the work to use a drill carriage for mounting heavy drills. He also knew from experience that a carriage merely for carrying the drills, which necessitated removing it after the bar was jacked in position, or allowing it to remain in the heading, in which case it could not but interfere with the mucking, would not answer his purpose.



A Trip Through the Heading

He therefore had his mechanical department build one to suit his requirements. This has an arm carrying the cross-bar and drills, which may be advanced about 20 ft. ahead of the frame; also a belt conveyor supported on a movable frame, which may be advanced eight or ten feet ahead of the frame proper, so that the end of the conveyor belt may be kept close to the muck pile. After each shot is fired the muckers go ahead of the machine and throw the muck off the track, which is riveted on to a steel plate until the machine gets close enough to the heading to position the bar carrying the drills, the heading being drilled from one position of the bar.

The accompanying illustration gives a fairly good idea of the construction of this carriage, as it was being tested out before it was put in the tunnel, except that there is a hopper arrangement around the front end of the belt, not shown in the picture. Muck can be shovelled on to the belt at any point back to where it rises to convey the muck to the horizontal belt, which in turn delivers it into the car, openings being left in the frame for that purpose.

four are in operation between Shaft No. 3 and the west portal.

Fig. No. 4 shows the face of this break-up and the method of advancing it. An entry is broken down on top of the timbers, the first holes next to the timber being shot light, with the charge increased after the second shot. In this way this entry is carried to the roof grade. A cross-car mounting four of the 2⅝-in. drills before mentioned is used in the entry, and 10-ft. holes are drilled. This requires two setups of the bar, the drillers standing on the loose muck when drilling the top round.

This entry is carried ahead of the wings only a sufficient distance to allow setting up the bar to drill the succeeding round. A double screw column with arm, mounting one drill on each column, is kept at work on each wing, and corresponding rounds on each wing are shot together, a system which keeps the bulk of the muck at all times on the top of the timber, from which point, by removing the lagging, it rolls practically by gravity into the cars.

Fig. 6.—Sullivan Liteweight (2⅝-in.) Rock Drills on an 11-ft. heading bar in the Mount Royal Tunnel

The combined carriage and conveyor was started in Heading No. 3 East on May 5 last, and some idea of its advantage may be gained from the following figures:

From December 1, 1912, until May 1, 1913, a period of 5 months, the average monthly advance was 344.2 ft., the advance for the month of April being 351.4 ft. (without carriage). During May the 10 x 12.5-ft. heading was advanced 510 ft. in 27 working days, in itself no mean record. This was done in extremely hard rock and the muck was all removed as soon as, if not before, the drilling was finished.

There has been no delay due to this machine since its installation, which is a remarkable performance for a new machine for tunnel work.

Break-up Excavation.

Fig. No. 3 shows clearly the method of setting the Jumbo timber in the break-ups (see page 731), of which

Shaft No. 1, Dorchester Street.

Shaft No. 1, at Dorchester Street, is located in Montreal's busiest section, and the tunnel line passes under both the business and residential sections, which caused the blasting in the heading to be greatly restricted. No shooting was allowed between 11 p.m. and 7 a.m.

This shaft started August 3, 1912, and was broken 14 x 22 ft. outside the timber; grade was reached in about 5 ft. of rock on August 29 at a depth of 46.2 ft.

No. 1 Heading West.

After the usual delay of installing head house, cages, and pumps, actual work was begun about September 5, in the heading, which continued to have earth and bad rock in the roof for a distance of 1,200 ft.

Including all delays, no Sunday work, and no blasting allowed between 11 p.m. and 7 a.m., and counting a full working month for September, 1912, on April

30, 1913, a period of eight months, this heading had advanced 2,912.3 ft.; the advance for February being 374 ft.; March, 517 ft.; April, 507 ft.

810 ft. in 31 Days.

At this time they were under a heavy cover of rock, and Mr. Brown decided to take off all shooting restrictions on May 1 and let the men, who were chafing at the restraint on the shooting, go ahead and see what they could do. So at midnight, April 30, the 12 o'clock shift started with a test run of 27 days in view. As the work progressed it was found that record runs were being made, and it was decided to make the limit of this test 31 days.

As no work was allowed on Sunday, except the last Sunday in May, when the men took a chance, the run was finished at midnight, June 4, making a total advance of 810 ft., an average of 26 ft. for each 24 hours.

Eight hundred and ten ft. of 8 x 12-ft. tunnel in 31 consecutive working days (three shifts), constitutes a record for tunnel driving with percussive rock drills that has never before been equalled on this continent. It also constitutes a world's record for excavating a tunnel in hard rock.

Four "FF-12" Sullivan Reciprocating, Percussive drills with water attachment, using hollow steel 1⅛-in. in diameter, through which alternate pulsations of air and water are forced to the bottom of the hole, were used in this heading, and the drills were mounted as shown.

Steel Used.

It will be of interest to learn that there was practically no breakage of the steel, due undoubtedly to the reciprocating action of the drill. Hollow steel, when subjected to hammer drill action (which, until the Sullivan reciprocating water drill was put on the market, was the only type of rock drill that used hollow steel), must have more or less breakage.

"FJAB" steel was used, made up in 22-in. changes; about 500 sharp steels were used each 24 hours. When the hard dikes were numerous, this number was greatly exceeded. The gauges were as follows:

No.	Cuts to in.	Gauge in.
Starter	22	2¼
No. 2	44	1⅞
No. 3	66	1⅝
No. 4	88	1½
No. 5	100	1⅜

The No. 5 was rarely used, and the gauge of 2¼ in. on the starter was used to give more freedom at the collar of the hole, also making it easier to remove the steel. The size of hole required at the bottom was only large enough to receive 1¼-in. dynamite.

The Holes.

The sketch shows the usual layout of the holes drilled when 22 holes were used, which was most frequently the case, although the heading has been shot with 20 holes, and in a few cases with 18 holes. The placing of the holes and the set-up of the bar is as described.

Contrary to the practice usually described on work of this kind, no regularity in depth of holes was possible, due to the character of the rock. A long round of 6 or 7 ft., at times alternated with a short round of 4 or 5 ft., and great credit is due to the men for the judgment used in the number and depth of holes required for each round. Usually 6 rounds were drilled and shot each 24 hours.

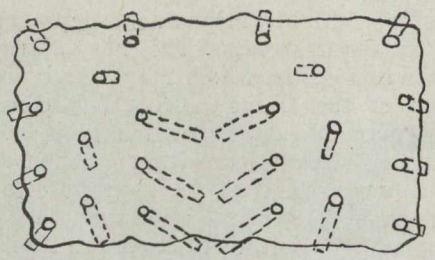


Fig. 7—Mount Royal Heading, 22-hole round

Powder.

Forcite dynamite of 60 per cent. strength was used, and exploded by No. 8 electric exploders, comparing in strength to Canal Specials, and the round was fired from the wires used for lighting the heading, at a switch generally kept at about 700 ft. from the face, and on the opposite side of the heading from the lighting system. The amount of dynamite used in each round varied, and it was found necessary to shoot the cut twice before it broke to the bottom. Occasionally the relief holes were shot with the second shot in the cut, but quite often the old guns left in the cut were loaded the third time and shot with the relief holes.

Mucking.

Two temporary rails were laid on their sides, the ball of each locked under the ball of the permanent rail, and on top of these temporary rails slick sheets were laid. The slick sheets were raised and the temporary rails, which were 30 ft. long, were advanced each round, and the slick sheets pushed forward and relaid and covered with sufficient muck to prevent the shot from lifting them. Seven muckers were used on each shift of eight hours. It was the duty of three of these men to work back the muck from under the bar onto the slick sheets, and the other four men, shoveling entirely from the slick sheets, loaded the entire excavation into the cars, making over eight yards of muck in the solid (or 15 yards in the loose) per man per eight-hour shift, for the four men mucking off the slick sheets.

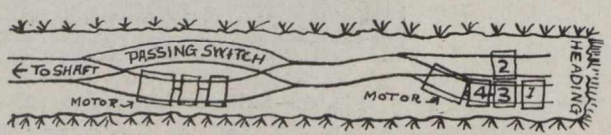


Fig. 9—Arrangement of Tracks and Cars

The accompanying sketch will in a manner explain the handling of the cars, which were of 40 cu. ft. capacity and built by the mechanical department on the work. A passing switch has always been maintained as nearly as possible halfway between the shaft and the heading, and two storage battery locomotives were used. Two cars were kept at the heading, and before each round was fired they were pushed back as far as the shooting switch, so there were no obstructions in the way of the men when coming from and returning to the heading after each shot. When the last shot was fired, the cars were pushed back by the men as they went in, and were placed in position, (No. 1 and No. 2 sketch). Car No. 1 on spur track was loaded first, Car No. 2 on main track being left back a slight distance, to allow the muckers room to work in. By this time the locomotive with two empty cars, Nos. 3 and 4,

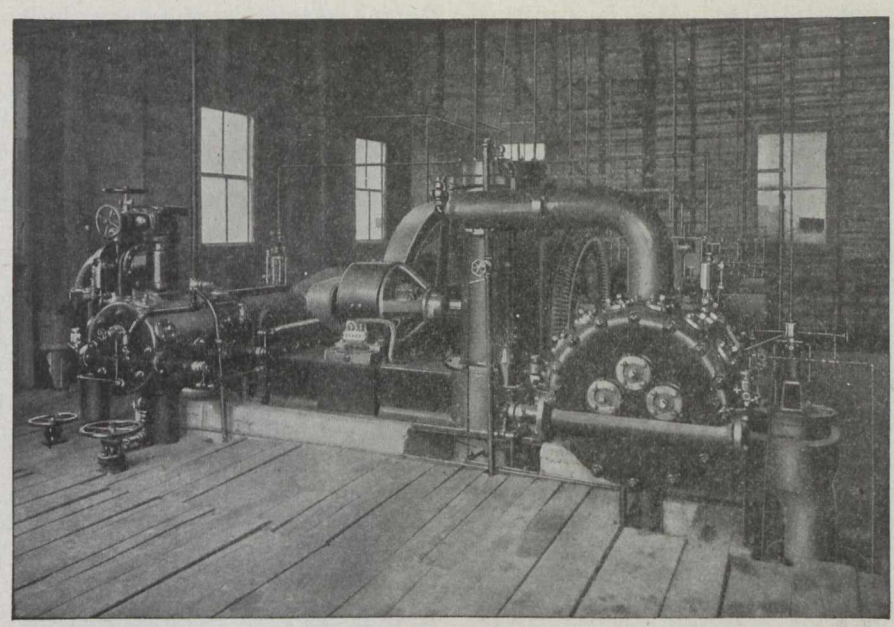


Fig. 14—One of the two Sullivan Class "WN-2" direct-connected motor driven air compressors at the Mount Royal Tunnel

comes in and couples on to No. 1, which, as soon as loaded, is run back and pushed in behind No. 2, which has been pulled up to the muck as soon as No. 1 is loaded, the muckers hooking their shovels over the end of the car to pull it ahead. The locomotive then returns empties Nos. 3 and 4 to the spur track, shifting back and picking up 1 and 2, now loaded, and proceeding to the shaft. The men start loading No. 3, and a man called the car wrangler pushes No. 4 back and switches it in on the main track to the position of No. 2, as shown in the sketch.

The locomotive, with two empties that have passed the loaded cars at the passing switch, then comes in and repeats the operation. It can be noted from this system of handling that no time is lost by the muckers in waiting for cars, and the spur track is changed frequently to reduce the switching distance.

Air Compressors.

The air for operating the entire outfit of Sullivan drills, now in use on this work, and the hammer drills used for putting in holes for centre plugs, and for sup-

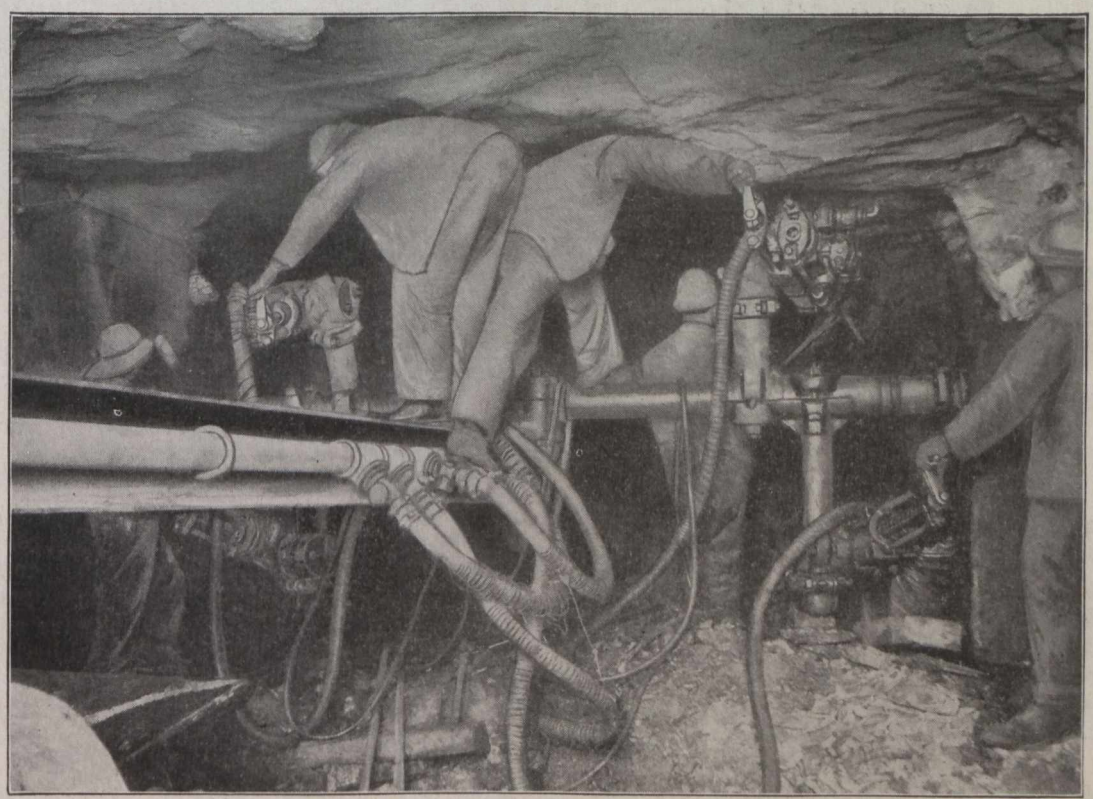


Fig. 11—Mount Royal Tunnel, Carriage in Heading No. 1 West

ports for ventilating pipe and light wires, is furnished by two direct connected compressors of Sullivan "WN-2" type, 2,000 ft. capacity at 100 lb. pressure. One is located at each end of the work, and in each plant, in addition to the direct connected compressor, are three Blaisdell belt driven units of about 1,100-ft. capacity, making a total of 5,300 ft. of air at each end of the tunnel.

When it is considered that in driving this 810 ft. of 8 x 12-ft. heading, the crew at Mount Royal drilled a total of 20 per cent. more holes and excavated a total of 18 per cent. more hard rock than was excavated in the Loetschberg tunnel in driving 1,013 ft. in soft rock, a world's record can hardly be disputed for tunnel driving where air driven percussive drills were used.

Meeting of Tunnel Headings.

The tunnel crews shattered the last barrier between the two headings at seven o'clock on the morning of December 10th.

ite and syenite were among the kinds of rock encountered, sometimes singly, sometimes in combination.

Drill Carriages.

Drill Carriages.—Heading No. 1 West ran into harder and harder rock after June 1st, and the 2⅝-in. drills were replaced, about three months later, with 3⅝-in. "UH-2" machines, for which a tunnel carriage with cross-bar was built, similar in principle to that previously designed for Heading No. 3 East, but modified in form and without the muck conveyor.

A large saving in time was gained by the use of these carriages, as compared with mounting these heavy drills on a bar or columns. This is indicated by the average monthly progress in No. 3 East heading, which rose from 350 ft., prior to the installation of the carriage, to 485 ft. afterwards.

The carriage with the drills on it in No. 1 West heading (without conveyor) was run back to a siding after each round, to permit the passage of cars to the face.

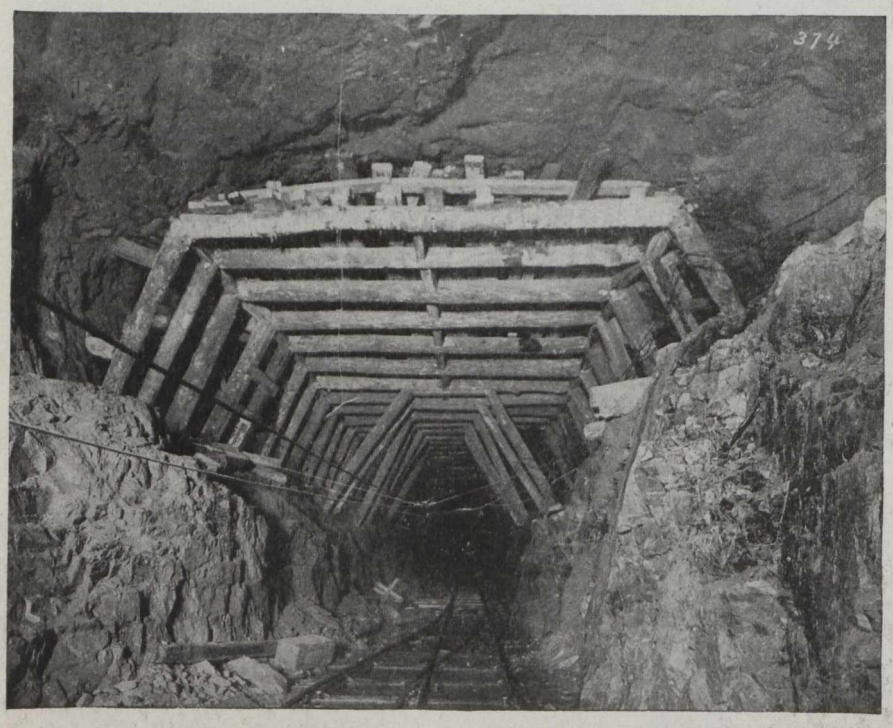


Fig. 13—The Mount Royal Tunnel; timbering for the heading and completed "break-up." Bench not Removed.

From the starting of the real tunnel excavation on September 6, 1912, to the time of holing through was fifteen months and four days, a splendid record of progress. The tunnel is 3¼ miles long, and the headings were driven 8 by 12 ft. (No. 1 West), and 10 by 12 ft. (No. 3 East) in size.

The average monthly progress per heading for the entire work was 420 ft.

When the wide range in the character of the rock is considered, the engineering skill and resourcefulness and the thoroughness and efficiency of the working organization exhibited by this consistently uniform and rapid progress, are remarkable. Certain it is that a more varied assortment of hard rocks has seldom been encountered in any one instance in the history of American tunnel work. Trenton limestone, hard siliceous crystalline limestone, hard igneous intrusions, or dikes of bostonite, camptonite, volcanic breccia, essex-

The girder or arm was there supported by a pipe hanger, carried by "A" frames at each rib.

Four "UH-2" 3⅝-in. drills were regularly mounted on the cross-bar of the carriage, and the whole round of 20 to 24 holes was drilled from a single setting of the carriage.

Owing to the great hardness of the rock, the holes were carried to as great a depth as the proper breakage of the ground would allow. Cut holes were drilled 8 ft. and rib holes 6½ ft. deep. This gave an advance of 5½ to 6 ft. per shift. After the round had been drilled, shot and muck cleared away, if the shift was not over the crew, working on the bonus system, would run the carriage to the face again and start the new round before the next shift began. In this way a round was gained on an average every 48 hours, or seven rounds were put in in six shifts, giving an average advance per working day of 19.2 ft. of single heading.

The engineers of the tunnel contractors, Mackenzie, Mann & Company, Ltd., estimate that the tunnel construction will be completed by the latter part of 1914. About 1½ miles of break-up excavation above heading grade are now done. The entire break-up will be finished by about May 1, 1914, after which the bench at each side of the heading will be removed, thus completing the section of the tunnel to its full area of 31½ x 21 ft.

The tunnel will probably not be lined throughout with concrete, but only in sections where the rock requires it. A large part of the tunnel length is driven through rock so hard and firm as to require no finish of this sort.

The Mount Royal tunnel is notable for the variety and hardness of the rock encountered; for the fact that it is the first of American tunnels to use a bottom pilot heading, with the break-up system of enlargement carried on jumbo timbers, thus permitting muck cars in the heading below to be loaded by gravity; for the first use of reciprocating type rock drills with hollow drill steel and water jet attachment; for the most rapid heading advance ever recorded for hard rock; for the first American use of a drill carriage and muck conveyor, and for the first American example of the practice of drilling shallow holes instead of deep ones, in a tunnel of so large heading area and over so long a period. It is also notable for the small loss of life attendant upon its construction thus far.

Government figures show that 4.7 men are killed per thousand engaged in tunnel work. In metal mining in the United States 4.3 per thousand lose their lives, and in coal mining 3.7. In building the St. Gothard Alpine tunnel 800 men were killed in eight years; at the Simplon, the latest of the great tunnels between Switzerland and Italy, 67 men out of 900 were killed in seven years' time.

At Mount Royal about 1,000 men are employed. Thus far only a single man has been killed in the tunnel proper, during the fifteen months' work, and this man did not lose his life in the headings.

These accomplishments speak highly for the quality of engineering ability and of the organization and methods employed in prosecuting this interesting undertaking.

The writer is indebted to Mr. S. P. Brown, managing engineer for Mackenzie, Mann & Company, and to his assistants for the information and pictures used in this report.

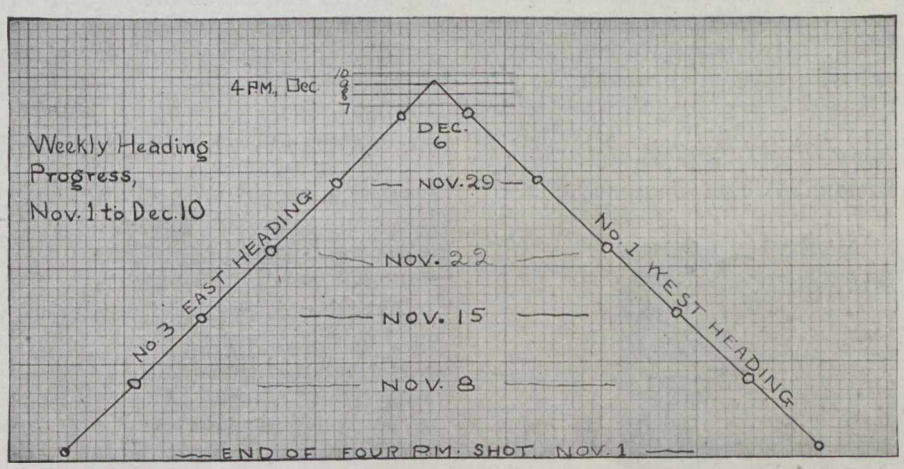


Fig. 12—Progress Chart for November and December (a rough copy of the original)

NIPISSING.

The decline in Nipissing to 6 3/16—at which price current dividends return an income of 23 per cent.—is due to the growing conviction that a reduction in the $1.50 dividend rate is near at hand.

There has been a recent drop in earnings, due to a rather significant decline in output. Figures of monthly operations during the last half of 1913—figures not heretofore published—show this declining tendency.

	Ounces.	Gross value.
July	380,372	$224,216
August	376,374	222,360
September	315,159	191,753
October	363,168	218,772
November	283,531	159,220

The company is fairly well fortified as to cash, but during the six months from June 30, 1913, to Dec. 31, 1913, there was a drop of $240,000 in the cash surplus, or from $1,484,000 to $1,244,000, as seen below:

Quarter ending	Cash surplus.
Dec. 31, 1913	$1,244,000
Sept. 30, 1913	1,384,000
June 30, 1913	1,484,000

It is apparent from the above that in its annual report for last year Nipissing will show that its dividend disbursements were not met from the earnings of last year.—Boston News Bureau.

BRITISH COLUMBIA COPPER CO.

British Columbia Copper Co. new financing will, according to present plans, be accomplished through a new company to be formed with $5,000,000 stock and $1,000,000 6 per cent. 10-year convertible debentures. The bonds will be offered to British Columbia stockholders for subscription at par on the basis of $1 in bonds for every share held. As the British Columbia Co. now has 600,000 shares there will be raised through this method $600,000.

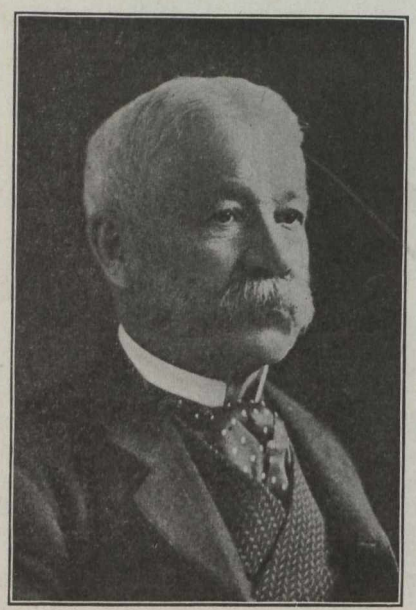
The issue will be underwritten and for their services the underwriters will get an option on the treasury bonds which will carry a stock bonus.

The management plans the erection of a 1,000-ton concentrator to handle the ores from recently acquired and developed properties. Concentrates will be shipped to the present smelter.

Should new financing be needed beyond that to be arranged for at this time it will doubtless be through the medium of a stock issue.—Boston News Bureau.

OBITUARY

Major Robert Gilmour Leckie, who may almost be described as the father of mining engineering in Canada, died at Sudbury, Ont., on November 5th last, in the eighty-first year of his age. Major Leckie was born in Renfrewshire, Scotland, on August 23rd, 1833. He came of fine old stock, being the representative of the ancient Stirlingshire family of Leckie of that ilk. He was educated at the Glasgow High School and Glasgow Technical College. He came to Montreal at the age of twenty-three, and for a time was associated here with a shipbuilding enterprise. Very shortly thereafter, however, he became interested in mining, first in the Eastern Townships of Quebec, and later in Nova Scotia. In the Eastern Townships he was associated with early copper mining effort, and also held an interest in nickel properties in the Township of Orford, which were acquired subsequently by Boston capitalists, headed by Mr. W. E. C. Eustis, who organized a company first known as the Orford Nickel Company, then as the Orford Nickel and Copper Co., and finally the Orford Copper Company, which again, after a lapse of time, was merged in the International Nickel Company. Major



The Late R. G. Leckie

Leckie was for some time managing director of the Orford Nickel Company. In Nova Scotia he was associated with numerous coal and gold mining enterprises, and about the year 1880, was responsible, in association with the late William Hedley, of Halifax, and Senator Senecal, of Montreal, for the consolidation of the coal companies operating in the neighborhood of Springhill, in Cumberland county, with the Springhill & Parrsborough Railway Company, thus forming the Cumberland Railway & Coal Company, of which he became managing director. Under his direction, this undertaking from modest beginnings presently grew to great importance, attaining an output of 500,000 tons of coal per annum. Again during Major Leckie's regime at Springhill, the Provincial Workmen's Association—or coal miners' union—was organized in Nova Scotia; but, it is interesting to note, that although after his retirement there were at Springhill something like twenty-three strikes within a period of twenty-one years, no strike took place during his term of management, which was characterized by moderation combined with firmness. In 1890, Major Leckie became general manager of the Londonderry Iron Company, a post he held for three years. At this time he was also successful in consolidating the numerous smaller coal undertakings in Cumberland County, including the Joggins Mining Company and the Milner (while the Joggins Railway was also taken in) under the title of the Canada Coal & Railway Company, now operating as the Maritime Coal Power and Railway Company. Before his departure from Nova Scotia in 1898, Major Leckie acquired the Torbrook iron mines, which he worked until they were purchased by the Messrs. Drummond, of Montreal. After leaving Torbrook, he acted in the capacity of examining engineer for Mr. Robt. M. Thompson, of New York, and in this connection reported on nickel and other mines in New Caledonia, Norway, Sweden, and Australia. He was also for many years resident consulting engineer at Sudbury to the President of the Canadian Copper Company. Since his retirement from consulting practice his activities have been employed in acquiring and partially developing promising prospects in Northern Ontario. Of these, at least one, a gold property at Long Lake, near Sudbury, has been placed on a productive basis, and having been acquired is now being sucessfully worked by the Canadian Exploration Company.

This then is the brief outline of a long and honorable professional career. It merely suggests the energy and enterprise of him who is the subject of this sketch. But Major Leckie's activities and interests were not bounded by the limitations of his profession. He was public spirited to an eminent degree. He, in co-operation with Mr. Charles Fergie and Mr. John E. Hardman, was chiefly responsible for the organization of the Mining Society of Nova Scotia. He was the first President of the Federated Canadian Mining Institute, and a charter member of the Canadian Mining Institute, which was, as is well known to members, a re-organization of the former society. He joined the American Institute of Mining Engineers in 1879, and was a Vice-President of that Society in 1893-94. He took a great interest in military affairs, and during the Fenian Raid held a commission as Lieutenant in a rifle company raised in the Eastern Townships at that time. In 1882 he was gazetted Major in the 53rd Battalion, with which regiment he remained for several years. He was an ardent Imperialist, a stalwart Conservative in politics, and a member of the Church of England. Last, but far from least, he was a sportsman to the core. Sport of every description, racing, hunting, fishing, cricket, curling, all held for him the greatest attraction, and he believed always "in playing the game." Only once in twenty years has he failed to be present at the annual meetings of the Canadian Mining Institute. Of these meetings, and more especially of "after-meetings" he was the life and soul, and despite his years ever the youngest man there. He will be sorely missed, for as one of his oldest friends has just written to the writer: "Leckie's passing over to the majority leaves the world a less happy place for all his friends; but we are sure he will be waiting for us on the other side with a smile and a hearty handclasp."

Major Leckie married in 1866, Sarah, daughter of the late John Edwards, then of Montreal. His first wife died in 1893, and he married again in 1910, Margaret Harriet, daughter of the late James Potter, of Sudbury. His surviving children by his first wife are Lieut.-Col. R. G. E. Leckie

and Captain J. E. Leckie, D.S.O., of Vancouver, B.C.; Margaret A. G., wife of B. W. D. Gillies, M.D., of Vancouver, B.C.; Marion A. N., wife of the Rev. F. Graham Orchard, of Port Hope, Ont.; Edith L. Leckie, of Vancouver, B.C.; Florence S. W., wife of A. G. M. Mainwaring, Esq., of Brockville, Ont.; and Dorothy F. W., wife of Fleet Paymaster, J. H. Annesley, R.N. By his second wife, Major Leckie leaves a little daughter, Phillys Gilmour.—H. Mortimer-Lamb.

THE LATE JAMES D. SWORD.

On January 15, news reached Victoria, B.C., of the death by drowning the previous day of Mr. James D. Sword, a well-known mining engineer. Brief information was received from the deputy mining recorder at Quathiaski cove, in the vicinity of Cape Mudge, a point within a short distance of the east coast of Vancouver Island, about halfway up its length from south to north. It is stated that Mr. Sword was proceeding in a small launch from a neighboring island to record assessment work on mining claims at the deputy recorder's office at Quathiaski cove. There was a heavy sea running and it is feared Mr. Sword when standing up in the launch lost his balance and fell overboard. Immediately on the news reaching the official at the Cove he sent out several launches and boats, but the body of the missing man was not found.

The late Mr. Sword, who was about 45 years of age, came from an old family in Staffordshire, England. After his arrival in Canada he was for some time engaged in mining enterprises in the Province of Quebec. Later, he went thence to British Columbia, and in the height of Rossland's activity in the nineties, he made that camp his headquarters, while, as the representative of the James Cooper Manufacturing Co., he sold much placer mining machinery for installation at mines in various parts of Kootenay and Boundary districts. Afterward, he was for some time in Nevada, chiefly at Tonopah and Goldfield. Returning to British Columbia he actively interested himself in new mining properties in the Coast district, for some time giving particular attention to mineral claims on the Queen Charlotte Islands, and quite recently on Valdez Island, lying between Vancouver Island and the mainland. He was of an optimistic temperament, and energetic in directing attention to the mineral resources of the newer districts of the British Columbia coast, so that his untimely death is a decided loss to the mining interest of the province. He was an early member of the Canadian Mining Institute, but some years ago, during his roving career, permitted his membership to lapse. He has left a son, about thirteen years of age, at present attending school in Vancouver, B.C.

"The Week," of Victoria, edited by Mr. Wm. Blakemore, one of the charter members of the Canadian Mining Institute, on January 17 printed the following obituary notice:

It came as a great shock to the writer of this paragraph to learn on Thursday morning that Jim Sword had been drowned in Quathiaski cove. He had no older friend in Canada, for the acquaintance dates back to the period antedating his arrival in this country. Sword was an extraordinary man in many respects. Twenty years ago he was one of the finest athletes to be met with anywhere, and probably the best boxer in Canada. This trait in his character stood for more than mere physical prowess. He was a straightforward, outspoken, care-for-nothing, hard hitter; the warmest friend a man could have, and an enemy from whom one might well wish to be delivered. He had in him a streak of the Bohemian; he could not settle long in one place. Perhaps the Kootenays claimed him longer than any other district, for he lived at Rossland and in the Boundary for upwards of ten years. Sword was essentially a free lance. The trammels of any business organization were irksome to him; he preferred a loose rein and a free foot. This spirit carried him to Colorado, Nevada and Mexico, in each of which he engaged in mining. His hobby was prospecting; he was always looking for properties, and was an excellent judge of ore. Latterly he had made his headquarters in Victoria and Seattle, and had done considerable mining business for important firms in both cities. His last enterprise was the formation of a copper company to operate on Valdez Island. He thought he had a good thing there: in his own words, "a sure winner," and had just been up to record the assessment work in order to hold the title for another year. Then fate wrote "Finis" to a strenuous and perhaps stormy career. No man was more widely known. No man was more respected for sterling qualities. Wherever one traveled in the mining districts of the West, the question was sure to crop up, "Have you see anything of Jim Sword lately?" and this wide-spread interest in his career was the best evidence that he had secured a permanent place in the thoughts of men. It is not an easy thing to appraise the value of a man's life work, but this much may well be said of Sword, that he has blazed many a mining trail, that he has been a pathfinder to ore deposits in a hundred places and that his name will forever be associated with the strong, honorable, rugged pioneers of mining in British Columbia.

CANADIAN BUILDING AT PANAMA-PACIFIC EXPOSITION.

Whatever the result of the efforts which are still being made to secure adequate representation for the Government of Great Britain, at the Panama-Pacific International Exposition, to be held in San Francisco in 1915, it is certain that the Dominion of Canada will play a most creditable part in the celebration.

The final plans for the Canadian pavilion, which is to be one of the handsomest among the buildings representative of foreign nations and states, were accepted January 21, and the process of actual construction will have begun before the publication of this article, under the supervision of Colonel William Hutchison, of Ottawa, the Canadian Exhibition Commissioner.

Colonel Hutchison arrived in San Francisco, January 14, to inaugurate the work upon the building, preparatory to the arrival of the Canadian exhibit, which is now on the way here. He was joined here by George Freeman, the London architect, who is designer of the building, and his staff.

The pavilion, which will cost approximately $300,000, will be the largest exposition building ever erected by the Canadian Government. It will be 340 ft. long, 240 ft. wide and 50 ft. high. The whole sum expended upon the building and its contents will amount to $600,000 or more.

METAL MINES AND SMELTERS IN CANADA.

The Mines Branch, Ottawa, has issued a list of the producing metal mines and the smelters of Canada. While incomplete, and issued primarily for obtaining corrections and additions to the list on file, it will be found a useful reference list.

ANNUAL MEETING AMERICAN INSTITUTE OF MINING ENGINEERS.

The Executive Committee of the New York Section has accepted an invitation from President of the Institute to arrange for the annual meeting, and it announces the following brief programme: Monday, 7 p.m.—Registration and distribution of badges. 8.15 p.m.—Address of welcome followed by smoker and collation. Ladies invited.

Tuesday, Wednesday, Thursday.—Annual meeting and technical sessions. Arrangements will be made for luncheon each day in the Engineering Societies Building.

Admission tickets required for the following evenings:

Tuesday, 8.15 p.m.—Illustrated lecture by H. W. DuBois on Placer Mining in British Columbia, at the American Museum of Natural History, 77th Street and Central Park West.

Inspection of large-scale models of the Copper Queen mine and stope, the gift of Dr. James Douglas to the Museum. These have been constructed along entirely new lines for such exhibits.

This will be followed by a collation.

All members, guests, and ladies invited.

Wednesday, 6.15 p.m.—Reception and subscription banquet at the Waldorf-Astoria.

Technical Programme.

Tuesday, Feb. 17.—10.00 a.m.—Annual Business Meeting. 10.30 a.m.—Mining and Mining Methods in the Southeast Missouri Disseminated-Lead District, by H. A. Guess; The Mill and Metallurgical Practice of the Nipissing Mining Co., Ltd, Cobalt, Ont., Canada, by James Johnston; The Disposition of Natural Resources, by George Otis Smith. 2.00 p.m.—Use of Electricity at the Penn and Republic Iron Mines, Mich., by William Kelly and F. H. Armstrong; The Application of Electric Motors to Shovels, by H. W. Rogers; Electric Traction in Mines, by Charles LeGrand; Safeguarding the Use of Electricity in Mines, by H. H. Clark; The Safety of Underground Electrical Installations, by C. M. Means; The Injection of Cement Grout into Water-Bearing Fissures, by Francis Donaldson; Drilling Performances at the Kensico Dam, Catskill Aqueduct System, New York, by W. L. Saunders; The Work of Crushing, by Arthur F. Taggart.

Wednesday, Feb. 18, 10.00 a.m.

Papers on Iron and Steel.—Notes on the Plastic Deformation of Steel During Overstrain, by H. M. Howe and A. G. Levy; Notes on Some Heating and Cooling Curves of Prof. Carpenter's Electrolytic Iron, by Albert Sauveur; The Influence on Quality of Cast Iron Exerted by Oxygen, Nitrogen, and Some Other Elements, by J. E. Johnson, jr.; Research with Regard to the Non-Magnetic and Magnetic Conditions of Manganese Steel, by Prof. B. Hopkinson and Sir Robert Hadfield; Manganese Steel, with Especial Reference to the Relation of Physical Properties to Micro-Structure and Critical Ranges, by W. S. Potter; The Heat Treatment of Steel Castings, by C. D. Young, O. D. A. Pease, and C. H. Strand; Notes on an Iron-Ore Deposit near Hong Kong, China, by C M. Weld.

Papers on Mining Law.—Why the Mining Laws Should be Revised, by Horace V. Winchell; Comparison of Mining Conditions To-day with those of 1872, in Their Relation to Federal Mineral-Land Laws, by R. W. Raymond; Objections to the Apex Law in Mining Practice, by C. F. Kelley; Should the Apex Law be Now Repealed? by Charles H. Shamel; The Apex Law in the Drumlummon Controversy, by Charles W. Goodale; The Classification of Public Lands, by George Otis Smith.

2.00 p.m.

Papers on Iron and Steel—American Steel Rail Situation, by R. W. Hunt; Manganese-Steel Rails, by Sir Robert Hadfield; Notes on Blast-Furnace Operation with a Turbo Blower, by S. G. Valentine; Data Pertaining to Gas Cleaning at the Duquesne Blast Furnaces, by A. N. Diehl; Pig Steel from Ore in the Electric Furnace, by Robert M. Keeney; Notes on the Utilization of Blast Furnace and Coke Oven Gas for Power Purpose, by Heinrich J. Freyn; Notes on Conservation of Lake Superior Iron Ores, by Charles K. Leith; The Need of Uniform Methods of Sampling Lake Superior Iron Ore, by C. B. Murray; Sound Ingots, by Sir Robert Hadfield.

Papers on Mining Law.—The Segregation and Classification of the Natural Resources of the Public Domain, by Frederick F. Sharpless; The Initiation of Title to Mineral Lands, by Albert Burch; Good Ideas in the Mining Laws of British Columbia and Mexico, by F. L. Sizer; Provisions for Judicial Review of Land Office Decisions, by M. D. Leehey; The Apex Law Illustrated by Decisions in the Cœur d'Alêne, by F. T. Greene; Uniform Mining Legislation in all States Based on Federal Acts, by C. L. Colburn; Location of Mining Claims upon Indian Reservations, by Will L. Clark; What is Mineral Land, by Grafton Mason; Mining Law Revision—How to Obtain it, by E. B. Kirby.

4.30 p.m.

Illustrated Paper on Mining of Bituminous Coal, by Samuel A. Taylor.

Thursday, Feb. 19, 10.00 a.m.

Paper on Mining Geology.—Discussion on the question (1) To what depth below the surface do the standing ground-waters extend? Opened with a paper by Alfred C. Lane. (2) To what extent is chalcocite a primary, and to what extent a secondary, mineral in ore deposits? (3) To what extent are the contact zones, often called garnet zones, produced by intrusive rocks from limestone walls, due to re-crystallization of matter original with the limestones; and to what extent are they and their associated ores due to contributions from intrusive rocks? Opened with papers by Waldemar Lindgren and C. K. Leith.

Papers on Petroleum and Gas.—The Anticlinal Theory of Oil Accumulation, by H. A. Wheeler; Scientific Installations for the Economical Burning of Liquid Fuel of any Specific Gravity, by W. N. Best; The Use of Petroleum in Dust Prevention and Road Preservation, by W. W. Page; The Killing of the Burning Gas Well in the Caddo Oil Field, La., by C. D. Keen; An Oil Land Law, by George Otis Smith.

2.00 p.m.

The Equilibrium Diagram of the System Cu_2S — Ni_3S_2, by Carle R. Hayward; Cyanidation of Silver Sulphide, by Robert Linton, Ocampo, Mex.; The Genesis of the Mercury Deposits of the Pacific Coast, by J. Allen Veatch; Ore Dressing at the Morning Mill, Mullan, Idaho, by Rush J. White; A Proposed New Converter, and the Application of the Bessemerizing Process to the Smelting of Ores, by Herbert Haas; Milling versus Hand Sorting of Lead Ore, by R. S. Handy; Nickel Deposits in the Urals, by H. W. Turner; The

Burning of Coal Beds in Place, by Alexander Bowie; The Use of Oxygen Helmets in Mine Fire, by E. P. Dudley; Geology and Ore Deposits of the Bully Hill Mining District, California, by A. C. Boyle, Jr.

Papers on Petroleum and Gas.—Cementing Oil and Gas Wells, by I. N. Knapp; The Age and Manner of Formation of Petroleum Deposits, by E. T. Dumble; Geology and Technology of the California Oil Fields, by Ralph Arnold and V. R. Garfias; Water Intrusion and Methods of Prevention in California Oil Fields, by Franklyn W. Oatman; Chlorides in Oil Field Waters, by Chester W. Washburn.

4.00 p.m.

Illustrated Address on Oil and Gas Sands, by I. N. Knapp.

PERSONAL AND GENERAL

Dr. Alfred Stansfield has completed the revision of his book on the Electric Furnace.

Mr. C. C. Hascall and Miss Margaret Sherman were married in Calumet on Jan. 31.

Mr. P. B. McDonald is at North Adams, Mass.

Mr. Robert Bryce was in Toronto last week, having completed examination of claims in MacArthur township.

Dr. F. H. Hatch, of London, president-elect of the Institution of Mining and Metallurgy, is expected in Canada shortly to make a report on mining properties at Kirkland lake, Ontario.

Col. Carson, president of the Crown Reserve Mining Co., recently visited the property at Cobalt.

Mr. W. R. P. Parker and Mr. H. P. Watson attended the meeting of the Cobalt Townsite Co. in London last month. Mr. Parker is president and Mr. Watson vice-president of the Canadian company.

Mr. G. W. Nickerson, president of the Kerr Lake Mining Company, visited the mine at Cobalt last week.

Mr. Roy H. Clarke, formerly associated with mining in Rossland camp, recently resumed practice as a mining engineer with office in Spokane, Washington, after having been for three years engaged in investigating mining properties in the southern States for the United States Smelting Co.

Mr. E. V. Buckley, manager for the Queen Mines, Incorporated, operating the Queen gold mine and 20-stamp mill in Sheep Creek camp, Nelson mining division, has returned from a trip to his home in Wisconsin.

Mr. J. M. Ruffner, manager for the North Columbia Gold Mining Co., which during recent years has operated on a larger scale than any other company working in Atlin camp, recently arrived at Vancouver from Atlin on his way to his home in Cincinnati. He was a passenger on the C. P. R. steamer "Princess Sophia," which ran on the rocks while making for shelter in Blenkinsopp bay in extremely rough weather and in a blinding snowstorm.

Mr. John A. Finch, of Spokane, who is the largest shareholder in the Standard Silver-Lead Mining Co., and who with Mr. G. H. Aylard developed the Standard mine from a prospect to its present productive condition, is spending the winter in southern California.

Mr. W. J. Elmendorf, manager of the Portland Canal Tunnels, Ltd., recently came south after having been in the Portland Canal district all the winter. He has since been visiting Tacoma and Seattle, Washington, on business matters.

Mr. Douglas Clermont Livingston, of Moscow, Idaho, has been appointed head of the mining engineering department of the University of Idaho, in succession to Mr. S. R. McCaffery, who has joined the faculty of the University of Wisconsin. Mr. Livingston was for a time with the Tyee Copper Co., of which his father, the late Mr. Clermont Livingston, of Duncans, Vancouver Island B.C., was organizer and for years general manager. After graduating from McGill in 1906, Mr. Livingston went to Mexico, where, in the capacity of superintendent for the Fortuna Mining Co. and the North Tigre Mining Co., he was engaged in opening mining properties near Yzabel, Sonora. About three years ago he was appointed associate professor of mining engineering at the University of Idaho, which position he has held until now he becomes head of the department.

Mr. Thos. L. Goldie is in Toronto.

Mr. Geo. Rogers, superintendent of the Mann mine, who has been in Toronto recently, has returned to the property at Gowganda.

The Canadian Westinghouse Co. has issued a well illustrated bulletin on mine locomotives.

Canadian Allis-Chalmers, Ltd, has issued a bulletin on iron ore washing plants.

Rock & Power Machinery, Ltd., Toronto has been awarded the contract for centrifugal pumps for pumping out Cobalt lake. The pumps to be supplied are De Laval split castings centrifugals.

The Herbert Morris company has secured from English firms two contracts, each calling for several large travelling cranes.

KIRKLAND LAKE.

Mr. H. H. Johnson, in a report on the Tough-Oakes mine, makes the following recommendations to the directors of the Kirkland Lake Proprietary, Ltd:

1. The early development of all the known veins as soon as power is available, as the exploitation of No. 2 vein at present only affects a fraction of the property.
2. The provision of an ample electric power supply to enable the necessary work to be done in the quickest and most efficient manner.
3. The erection of a reduction plant of sufficient size to act as a central plant for all of your Kirkland lake mines, and as a customs mill for neighboring mines, which would be sure to avail themselves of the manifest advantage of such a scheme.
4. The continuance of shipping high-grade ore to the smelter pending the erection of a customs smelter at Kirkland Lake.

Concerning the present equipment at the mine, Mr. Johnson says:

During the past summer a considerable number of substantial buildings have been erected on the property, including offices, assay office, drawing office, boarding house, bunk house to accommodate sixty men, store, recreation room, etc. A good water supply has been obtained from Gull lake, from whence a steam pump provides a service through a 2-in. main to the mill power plant and other buildings. The power plant consists of a 40 h.p. locomotive type boiler, supplying steam to a 25 h.p. horizontal single cylinder mill engine, a 9 k.w. direct current steam generator set for providing power for lighting and assay offce motors, and a small straight-line Ingersoll air compressor. At No. 1 shaft house is a vertical boiler and single drum steam friction hoist.

The mill consists of five 1,050 lb. stamps by Allis-Chalmers, complete with good-sized ore bin with rock-breaker above. Challenge type feeder and stepped amalgam table.

SPECIAL CORRESPONDENCE

BRITISH COLUMBIA

Recent advices from some of the older mining districts have been distinctly satisfactory, notably from Rossland and Slocan.

Consolidated Mining and Smelting Co.

While no particulars have been made public, it is generally known at Rossland that late developments at depth in the Consolidated Mining and Smelting Co.'s Centre Star-War Eagle group of mines have been decidedly favorable, important extensions of previously known shoots of ore having been proved, and the producing capacity of the mines increased accordingly.

Standard Silver-Lead Co.

In Slocan district, the finding above No. 5 level of much more ore in the Standard Silver-Lead Mining Co.'s mine, situated in the vicinty of Silverton, Slocan lake, has proved an agreeable surprise for those who have been closely connected with that productive property during its development. The discovery referred to has led to development of a shoot of ore, not previously known to occur, that at last reports had been found to widen to about 12 ft. While less important at the present time, developments in the deeper levels of the Slocan Star mine, too, are satisfactory, for ore of high grade is being mined, so that smeltery returns leave a good margin of net profit; further, there is reason to expect early successful results from development work being done on the tenth level, which is the deepest working of this mine.

In Nelson Mining Division.

While gold is the product of mines in what is known as Sheep Creek camp, in Nelson mining division, there are lead mines within a few miles, and of these latter three have lately been shipping ore to the smeltery at Trail, namely, the Emerald, H. B. and Zincton properties, the last-mentioned being a new addition to the list of shippers.

For years the Arlington mine, in Erie camp, a few miles south of Salmo, was the most productive mine in that part of the division, although the Second Relief was an intermittent producer. Latterly the position has been changed, for the Arlington has not shipped much ore, while the Second Relief was worked during the greater part of last year. Now it is announced that a sale of the latter mine and 10-stamp mill has been made to Minneapolis men: also that it is intended to drive an adit 700 ft. to open the mine at 200 ft. greater depth, and to remodel the stamp mill so as to make it more efficient as a gold-saver.

The Yankee Girl mine, near Ymir, also in Nelson mining division, has resumed shipment of ore. For a time there was little ore in sight, but development work has improved the position, so that it is again practicable to send ore to the smeltery. In the neighboring Dundee mine, too, conditions are better, according to published statements, so that production from this property is also expected.

Progress at Britannia Mine.

Substantial progress has been made in connection with important development work undertaken at the Britannia mine in 1912 and continued throughout 1913, and with the additions to machinery, plant, transportation facilities, buildings, etc., at the mine and at and about the concentrating mill at Britannia Beach. Particulars were given some time ago of these improvements; recently some information was obtained as to progress made to date.

The intention being to provide for the main outlet from the mine being lower down the mountain side than near the upper end of the existing aerial tramway, the work of driving a crosscut adit into the mountain, to come under the older workings of the mine now being operated, at a depth 1,200 ft, below what is known as the 1,000-ft. level was undertaken in 1912. At about 4,350 ft. in from the portal of the adit driving was stopped and raising commenced in two places. One raise is an exploratory working in the mineralized zone; the other is a larger and more important undertaking, intended for use as the main working shaft of the mine. The latter is to be a three-compartment shaft, with two hoisting compartments, each 6 ft. by 7 ft. 6 in. in the clear, and a manway 3 ft. by 7 ft. 6 in. This shaft is being timbered with 12 by 12-in. Douglas fir, which is the best timber obtainable on the Coast. By the middle of February some 275 ft. had been raised. At 200 ft. up a station was cut. Later, after the shaft shall have been completed, a crushing plant, to consist of one 36 by 24-in. Blake crusher and one No. 7½ gyratory crusher, will be installed on this level, which will be 1,000 ft. below the present 1,000-ft. level of the mine and 200 ft, above the new main outlet level. Miners employed in this shaft are taken up to their working places in a cage operated by a compressed air hoist set at the foot of the raise.

It is noteworthy that this shaft or raise will be one of the longest on the American continent. The hoisting engine to be used in it after completion of the shaft is a double-drum hoist, having a capacity of 18,000 lb. vertical lift. Two cages will be run in counter-balance, and there will be 2,000 ft. of 1¼-in. rope on each drum of the hoist.

The railway for transportation of ore has been graded for about five miles, from the face of the main adit to the top of the incline above the concentrating mill. The rolling stock for use on this railway will consist of two electric 15-ton locomotives, to be driven in tandem, and a number of 20-ton cars. The incline down to the ore storage bin is 5,500 ft. long, with a difference of 1,400 ft. in elevations of terminals. It will be double-tracked all the way, and 60-lb. steel rails will be used. Two 15-ton skips will convey ore from the upper to the lower bin. The bins, at head and foot of incline, respectively, will each have a holding capacity of 1,000 tons. The engine for use in connection with the incline will be double-drum run with clutch; it will be operated by a 75-h.p. motor geared to 300, and 700-ft. speeds. Each drum of the hoisting engine will carry 6,000 ft. of 1½-in. rope.

Power supply has been increased to 3,000 h.p.—2,000 h.p. generated by water-power and 1,000 by steam. Preparations are being made for a further increase to 5,000 h.p.

New buildings include more houses for employees and, at Britannia Beach, a laundry. In addition, a superior dancing floor has been laid down, the vanner and concentrating table floor of the old concentrating building having been triple-boarded, so as to provide an unusually good floor for the company's employees for dancing purposes.

Acquirement of Forfeited Mineral Claims.

At the annual convention of the Conservative Association of British Columbia, held in Victoria on Jan.

23-24, among the many resolutions submitted by numerous local associations in various parts of the Province was one from Rossland relating to sale to the highest bidder of Crown-granted mineral claims forfeited to the Government for non-payment of taxes, and on which, after forfeiture, discovery of mineral shall have been made. Under existing regulations, the procedure is for an applicant to guarantee certain costs and then tenders are invited for purchase of such claims. This means that a man may prospect a forfeited claim and discover valuable mineral, and then have to compete with others in tendering for purchase of same. The object in view in urging a change is to provide for a prospector deriving the benefit, upon reasonable conditions, of any discovery of mineral he shall make on a claim forfeited to the Crown. As it is, there is nothing to encourage prospecting on forfeited claims, since there is no provision assuring to a prospector benefit from his work, it being open to any one to tender for purchase of a claim after it shall have been shown by the work of prospecting that mineral occurs on it. The change recommended by the Rossland resolution has for its chief object the protection of the prospector from competition and probable loss after his work shall have proved the claim to either be valuable or that there are indications of promise of favorable developments on further work being done. The last clause of the resolution, as endorsed by the convention, reads thus: "Be it resolved that the Provincial Government be urged to make such provision as would allow of such forfeited mineral claims becoming available for being acquired by prospectors and others at a cost equivalent to that of fulfilling all ordinary requirements of the Mineral Act up to and including Crown-granting, and to make provision for arranging for deferred payments, so as to make it practicable for prospectors to acquire such mining property. Such a regulation would protect prospectors from undue competition, would provide for the payment to the Government of as much as is required to be paid in either cash or work in order to obtain a Crown grant to a mineral claim in the ordinary course of procedure under the regulations relating to the Crown-granting of mineral claims, and would give the applicant for purchase the benefit of deferred payments similar to those under which other Crown lands are purchaseable ordinarily.

Portland Canal Tunnels, Ltd.

A report made by the manager of the Portland Canal Tunnels, Ltd. (Mr. W. J. Elmendorf), under date Jan. 1, has been published. It reviews the work done in connection with driving a long deep-level crosscut adit during a period of fifteen months—October, 1912, to the end of 1913. The report first mentions the object in view in driving this tunnel, with connections, "for the principal purpose of mining and handling the ores from the 'Portland Canal fissure zone.' Another important reason for driving the tunnel is the ultimate improvement and utilization of the water-power from Glacier creek."

Continuing, the report says: "Preliminary work for the tunnel was begun in September, 1912, and it consisted of clearing, road-making, and the erection of necessary buildings. The portal set of timbers was in place on Oct. 23, 1912, 42 ft. beyond the point where the ground was first broken. The progress from the portal to bedrock through the hillside gravel was necessarily slow and costly, but by Jan. 1, 1913, the face of the tunnel was 141 ft. in and the gravel left behind. From that point to the present face the bore has been in solid rock, and no timbering has been needed. On Jan. 1, 1914, the face of the tunnel was in 2,813 ft. from the portal, or 2,855 ft. from the starting point. During July and August, 1913, an adit 80 ft. in length was driven from a point 730 ft. in the tunnel, out to the Glacier Creek canyon. This supplies an excellent dumping ground and shortens the tramming and ventilating distance by 650 ft. In addition to the work in the tunnel proper and the adit, 50 ft. of drifting was done during December, 1913. The total of underground work done in 1913 was 2,844 ft. This work has been done at a cost of less than $22 per foot, including all equipment and the salary of the manager. In the case of rails, pipe, air drills and blowers, not more than 50 per cent. of the first cost should be charged off at this time. A similar proportion, at least, applies to the salary of the manager, as his services have been largely along the lines of acquiring property for the company and assisting in the general conduct of its policy and administration. With a proper allowance for these items the cost will approximate $20 a foot. When consideration is taken of the facts that $4 a day was paid to miners and muckers, and that the men were very well fed, the cost of driving the tunnel is low.

"On Dec. 22 drifting to the south on the No. 2 vein, cut by the crosscut, was commenced at a point about 2,638 ft. from the portal of the adit. By January 1 the face of this drift was in 27 ft., and the showing is described as having been 'most promising.' On Dec. 27 drifting to the north on No. 1 vein, crossed by the adit, was commenced at about 2,343 ft. from the portal, and this drift was in 21 ft. at the end of the year. The manager's comment was, 'this work will be pushed, as any round may open ore.'"

Driving the crosscut adit is now being made secondary to drifting on the two veins, just mentioned. However, its further extension will be given attention whenever practicable, for, as stated in the report, "the face of the tunnel, 175 ft. beyond No. 2 vein, looks promising for cutting another vein and, judging from the distance between the veins on the surface, another is nearly due. Three more veins, at least, are included in the 'fissure zone' and the tunnel must ultimately be driven across them."

The manager concludes as follows: "With known ore to the north and south of the tunnel and the veins encountered entirely normal, as to physical condition and position, it would seem that there should not be any question as to the nature of future operations. Drifting, preferably on both veins, should be energetically pushed until ore bodies are reached. At the same time, the tunnel should be continued across the 'fissure zone' when such work can be done without interfering with the drifts. We may still be fortunate enough to cut the veins ahead in ore and, in any event, they will be ready for later development."

COBALT, GOWGANDA AND ELK LAKE

Gowganda.—There has been a decided revival in the interest in Gowganda within the past two months and that portion of the silver field of Northern Ontario is now assured of considerable fresh capital.

It is also significant that for the first time the T. & N. O. Commission will visit Gowganda this month. Too much may be inferred from this visit; but it is certain that Mr. Englehart is more seriously considering the much urged extension of the railway from Elk Lake or he would not undertake the somewhat tedious journey. The agitation for the extension has been most persistent ever since the Elk Lake branch was put under construction.

The prospects for the mining industry are brightening. It is now definitely confirmed that the only proved mine on the West Ridge has been sold to a strong British syndicate, composed of Sir John Graham, of Glasgow, and Messrs. Hudson Bros., of Newcastle, they being represented in Canada by Mr. Claude Maitland. For the past three or four years the camp has been urgently in need of stable companies with enough money to spend in development to give the various prospects a chance. It is not likely that the purchases of the new syndicate will stop with the Mann if that property lives up to its present promise.

The Miller Lake-O'Brien, too, is doing very well. Not only is the ore on the lower or 350 ft. level as good as on upper workings, but much new ground is being broken, with excellent results. Good progress is being made with the hydro-electric plant. So excellent appear the prospects of the new find on the Millerett that a permanent head frame is being erected above the shaft near the old office. Sinking will commence at once. The vein is one of the system uncovered last summer. To date the shaft has been sunk 20 ft., the vein is 2 in. wide of 2,000 oz. ore. The shaft will be taken down to the 100 ft. level. To date a good quantity of high grade ore has been taken out of the shaft and treated in the sorting plant on the Miller Lake O'Brien.

On the Miller Lake O'Brien itself a surface discovery made about a month ago is developing well. It is on the surface about two in. wide of high grade and has now been uncovered for 200 ft.

A little high grade ore has also been found at the 40 ft. level of the Walsh mines on Miller lake.

Coniagas.—The strike at the Coniagas mine was very short lived. Claiming that the Coniagas mine had made no difference in their working hours and was therefore evading the eight-hour-day law, the local branch of the Western Federation of Miners called a strike. About seventy-five men walked out. Their places were filled in a few days and as many of the men as could get back, went back. Very little attempt was made on the part of the local union to support the strike.

Hudson Bay.—The production of the Hudson Bay mine for the last month of 1913 was 49,721 oz. During the month 1,945 tons were crushed in the mill. The average assays of heads was 23.6 oz., while the tailings ran 2.8 oz. The average extraction was 88.7 per cent. 74.8 tons daily were treated at the mill. A production of slightly less than 50,000 oz. was made, the greater part coming from mill ore.

Crown Reserve.—High grade has been opened up for 30 ft. in a branch stringer from the Fleming vein on the 150 ft. level of the Crown Reserve mine. The ore runs between 3,000 and 4,000 oz. to the ton. The Fleming vein itself has been cut in a crosscut from the Crown Reserve; but results have not been promising for the future. For the 150 ft. driven, most of the ore is low grade, with an occasional patch of high grade.

In the annual report just published, Mr. S. W. Cohen, general manager of the Crown Reserve places the probable ore reserves at 3,000,000 oz. He explains the sudden drop in ore reserves as follows: "In the last annual report it was stated that 25 per cent. of the 100 ft. stope on the Carson vein was left, which, figuring that 25 per cent. of the values would also be contained, meant 1,500,000 oz. Only 200,000 oz. was mined from the vein during the year, with no material amount to be further expected, and this falling off caused a decrease in the company's earnings. Mr. Cohen adds that the mine is still a good mine, with known ore reserves, even if its earning capacity could no longer be considered as phenomenal. The production for the past year showed a decrease of approximately 1,000,000 oz., being 1,776,678 oz., against 2,714,766 oz. in 1912. Of this amount 523,382 oz. was produced from mill ore and remainder from high grade. The cost per oz. rose to 23 cents, as compared with 14.027 cents an oz. last year.

Compressors for Gowganda.—A three-drill compressor and accessories have been purchased by the Hewitt Lake mining syndicate of Gowganda, and have been shipped. The Miller Lake O'Brien, in the same camp, has also ordered a twelve drill compressor.

Bailey.—What is supposed to be the old discovery on No. 1 vein of the Bailey has been found on the fifth level of the mine, and drifting operations have revealed a strong vein with some values. The fifth level, at a depth of 280 ft., was opened since the first of the year, and from this depth it is contemplated much exploration work will be done. The annual meeting was held in Chicago at the end of January, but so far nothing has been made public. At this meeting it was to be decided whether the interests in control would realize on what they had in sight, or embark on a further development of the mine. Development this year has been unsatisfactory. On the Penn Canadian, the adjoining property, the Big Pete vein has been picked up again, giving promise of a considerable extension of this important ore body.

Wettlaufer.—The annual report of the Wettlaufer mine shows that the only present producer of the South Lorrain camp is without ore reserves or future profits, and has been shut down accordingly. The profit shown is only $38,042, against $320,248 the previous year. The production was 252,864 oz., while reserves amount to only 3,000 oz. left in one pillar underground. There has been paid in dividends since 1913 $141,659, and there is cash on hand and quick assets $141,920. The shipments for the past year amounted to 147,425 oz. of first-class, 11,417 oz. of second class, and 72,965 of concentrates and 17,182 oz. of bullion.

Mr. Robert Livermore, the manager, summarizes this most mournful report with "development at depth was most disappointing."

The only hope of South Lorrain is now the old Keeley, which under Hamilton-Ehrlich management proved quite promising the latter part of 1913, but was closed down until the winter was over.

PORCUPINE AND KIRKLAND LAKE

Hollinger.—The annual report of the Hollinger mine was, from an engineering point of view, generally regarded as excellent, though speculators were inclined to hope for more declared ore in the reserves and an implied increase of dividend. Mr. Robbins continues to adopt the practice of estimating ore blocked out and superadding ore which he regards as probable. Ore actually blocked out amounted, after a production of $3,500,000 had been made to over $11,000,000 and ore blocked out and "possible" ore to $17,000,000. Just as the report was compiled two new veins were cut with the diamond drill from the 425 ft. level.

Merger of Pearl Lake Properties.—While the proposed merger on Pearl Lake is not likely to be as comprehensive as first planned, it is quite probable that some consolidation will preface resumption of activity among some of the prospects. The properties mentioned at first in the proposed merger were the Plenaurum, Jupiter, Pearl Lake, McIntyre, Schumacher, and two properties of the McMartin-Dunlap syndicate. It is now certain that the Schumacher will not be included, since Mr. Schumacher has applied for a charter, and will

capitalize at $2,000,000. Of the others it is possible that the McIntyre and the Pearl Lake may be worked jointly, and the Plenaurum and the Jupiter. The Vipond is likely to be developed without co-operation from other mines.

Dome.—The Dome mill is now treating from 450 to 500 tons of ore per day. One day the total of 550 tons was reached. The installation of the extra 40 stamps has made such good progress that it is most probable that all the eighty stamps will be dropping in March or early in April. The Dome has ordered a 25 drill compressor to augment its present power plant.

McArthur Township.—The Cobalt syndicate, for whom Mr. Robert Bryce was acting, has thrown up its option on the St. Paul claims in McArthur township. The claims were very thoroughly sampled, and it was at one time hoped that another large low grade ore body had been discovered. But a mill run of three tons proved disappointing.

Tough-Oakes.—Much interest was experienced in the first annual report of the Tough-Oakes gold mines since it is the mine which this company owns that is the main possession of the Kirkland Lake Proprietary. Mr. Chas. O'Connell in a summary of his report of physical conditions, states that in the first year of development the ore extracted has a value in excess of the actual cost of all development work. The net results from the ore and bullion shipments, ore on the dumps and contents of the mill tailings was nearly equal to the total amount expended on the property. The gross value of the ore blocked out on three sides is over $750,000.

As to ore reserves, it is stated that on both sides of the main vein the conglomerate as well as the porphyry contains numerous stringers and veinlets of quartz, all of which contain gold. Several hundred samples have been taken in the foot-wall section throughout the workings. From the results of these samples, as well as the milling record of 1915 tons, the average value of the milling ore exposed to date is taken at $23.30 per ton. There has been only a small amount of exploration in the hanging wall section to date; but from the information it is expected that about three feet can be stoped on each side of the main vein with excellent results.

Work has been commenced on No. 3 vein. It is 400 ft. north of and parallel with the main vein, and has been stripped for 510 ft. It will average 17 in. in width. The results of close sampling indicate that it will average high grade for at least 350 ft. A shaft has been started at a point 160 ft. from the west end and levels will be driven at 100 and 200 ft. At the 200 or second level a crosscut will be driven south to connect with the main vein.

Before Mr. C. A. Foster returned to England he had acquired the Burnside claim, presumably for the Kirkland Lake Proprietary, and had options on the control of the Teck Hughes, the Sylvanite and other Kirkland lake properties.

McIntyre.—The McIntyre is working at the 400 and 600 ft. levels from the Pearl lake shaft owing to an arrangement with the latter company. On the 600 ft. level a new vein has been cut. The first cut samples averaged $8.40. This is the second ore body encountered during the month of January on the McIntyre.

Porcupine Crown.—The annual report of the Porcupine Crown shows that there has been blocked out 86,000 tons of ore valued at $1,923,806. The average value of the ore is $22.37 per ton. The total cost per ton, based on the period when the mine was running at full efficiency, was $7.79, leaving a profit of $14.58 a ton. In his summary of operations Mr. S. W. Cohen, general manager, states that at the present rate of production 35,000 tons will be handled during the coming year or almost twice as much as during the past year. There should be no difficulty in earning a net profit of $300,000, Mr. Cohen thinks. The report states that in the winze below the 400 ft. level the ore ran $70 over 5 ft., but that the vein had not been picked up yet in the level. The mill treating 100 tons per day is making an extraction of 96 per cent. at an average cost of $1.50 per ton.

Porphyry Hill.—A thirty-six ton car of gold ore has been shipped from the old Preston East Dome claims, now worked by the original owners. The car contained about $175 a ton ore. The Preston East Dome is now known as the Porphyry Hill.

Schumacher.—Mr. F. W. Schumacher has decided to capitalize his holdings in Porcupine and make a public offering of stock. One ore shoot on one vein has been opened up for 125 ft. on the 100 ft. level. It is of good grade ore and of good width. Another shoot of ore on the same vein is from 30 to 40 ft. long. Only two drills are at work at present on the property.

Hollinger Reserve.—It is understood that the General Development Co. has made its big payment on the Hollinger Reserve and that it has now been practically decided to take up that Ogden property. The property is being developed at the 200 and 300 ft. levels and results are understood to be satisfactory. There are between 50 and 60 men at work.

A sharp drop in the market value of Nipissing is accompanied by rumors of decrease in earnings and consequent probability of reduction in distributions to shareholders.

London papers comment unfavorably on the recent flotation of Kirkland Lake Proprietary, Ltd.

It is reported that the Mann mine at Gowganda has been sold to English interests represented by Mr. Claude Maitland.

The third annual meeting of Hollinger Gold Mines, Ltd., was held in Montreal on Monday, Feb. 2, 1914.

The improved condition of the Rossland properties of the Consolidated Mining and Smelting Company of Canada is arousing interest in that company's operations.

COBALT ORE AND BULLION SHIPMENTS.

The ore shipments for the week ending Feb. 6 were:

	Pounds.
Cobalt-Aladdin	103,000
Crown Reserve	45,990
Coniagas	140,130
Dominion Reduction	85,150
McKinley Darragh	64,390
Seneca-Superior	64,680
Trethewey	87,570
Beaver	58,790
Timiskaming	73,690
Total	733,390

The bullion shipments for the week ending Feb. 6, are:

Mines.	Bars.	Ounces.	Value.
Nipissing	55	43,192.55	$24,835
Kerr	11	7,848.00	4,565
Casey Cobalt	4	4,893.00	1,484
O'Brien	17	16,044.30	9,225
Buffalo	68	70,511.00	41,000
Totals	155	140,488.85	$81,110

MARKETS

STOCK QUOTATIONS.

(Courtesy of J. P. Bickell & Co., Standard Bank Bldg., Toronto, Ont.)

February 9, 1914.

New York Curb.

	Bid.	Ask.
Alaska Gold	22.62	23.00
British Copper	3.50	3.75
Braden Copper	7.50	7.75
California Oil	306.00	310.00
Chino Copper	43.25	43.50
Giroux Copper	1.00	1.50
Green Can.	40.00	42.00
Granby	85.00	94.00
Miami Copper	23.00	23.37
Nevada Copper	16.25	16.50
Ohio Oil	159.00	161.00
Ray Cons. Copper	20.00	20.25
Standard Oil of N. Y.	187.00	189.00
Standard Oil of N. J.	422.00	424.00
Tonopah Belmont	7.87	8.12
Tonopah Merger	.65	.67
Inspiration Copper	17.25	17.75
Goldfield Cons.	11.50	11.62
Yukon Gold	2.37	2.62

Porcupine Stocks.

	Bid.	Ask.
Apex	.01	.02
Dome Extension	.07¾	.08
Dome Lake	.27	.27½
Dome Mines	16.50	18.00
Foley O'Brien	.17	.18
Hollinger	16.50	16.75
Jupiter	.08½	.08¾
McIntyre	1.33	1.36
Moneta	.01	.04
North Dome	...	.40
Northern Exploration	2.85	3.00
Pearl Lake	.07¼	.07½
Plenaurum	...	.60
Porcupine Gold	.11¼	.11½
Imperial	.01¾	.02
Preston East Dome	.01	.01¼
Rea	.15	.25
Standard	...	.01
Swastika	.03	.04
West Dome	.05	.07
Porcupine Crown	1.23	1.25
Teck Hughes	.20	.30

Cobalt Stocks.

	Bid.	Ask.
Bailey	.04¼	.04½
Beaver	.25½	.26
Buffalo	1.75	2.00
Canadian	...	.10
Chambers Ferland	.17½	.18
City of Cobalt	.30	.35
Cobalt Lake	.60	.70
Coniagas	7.50	7.75
Crown Reserve	1.79	1.82
Foster	.05	.08
Gifford	.03	.04
Gould	.02½	.02⅝
Great Northern	.09½	.09¾
Hargraves	.02	.02½
Hudson Bay	71.00	76.00
Kerr Lake	4.65	4.85
La Rose	1.63	1.66
McKinley	1.18	1.24
Nipissing	6.30	6.40
Peterson Lake	.27	.27½
Right of Way	.04	.05
Rochester	.02½	.02¾
Leaf	.01	.02
Cochrane	...	.40
Silver Queen	.05	.08
Timiskaming	.13½	.14
Trethewey	.22	.25
Wettlaufer	.05	.08
Seneca Superior	2.70	3.00

TORONTO MARKETS.

Feb. 11.—(Quotations from Canada Metal Co., Toronto):
Spelter, 5¼ cents per lb.
Lead, 5½ cents per lb.
Tin, 42 cents per lb.
Antimony, 8½ cents per lb.
Copper, casting, 15½ cents per lb.
Electrolytic, 15 cents per lb.
Ingot brass, 10 to 15 cents per lb.

Feb. 10.—Pig Iron—(Quotations from Drummond, McCall & Co., Toronto):
Summerlee No. 1, $26.00 (f.o.b. Toronto).
Summerlee No. 2, $25.00 (f.o.b. Toronto).

Feb. 10.—Coal—(Quotations from Elias Rogers Co., Toronto):
Anthracite, $8.25 per ton.
Bituminous, lump, $5.25 per ton.

GENERAL MARKETS.

Feb. 9.—Connellsville coke (f.o.b. ovens):
Furnace coke, prompt, $1.90 per ton.
Foundry coke, prompt, $2.40 to $2.65 per ton.

Feb. 9.—Tin, straits, 40.45 cents.
Copper, Prime Lake, 14.87½ to 15.12½ cents.
Electrolytic copper, 14.65 to 14.75 cents.
Copper wire, 15.87½ to 16.00 cents.
Lead, 4.15 to 4.20 cents.
Spelter, 5.45 to 5.50 cents.
Sheet zinc (f.o.b. smelter), 7.25 cents.
Sheet zinc (f.o.b. smelter, 7.25 cents.
Antimony, Cookson's, 7.25 cents.
Aluminum, 18.75 to 19.00 cents.
Nickel, 40.00 to 45.00 cents.
Platinum, hard, 10%, $46.00 to $47.50 per ounce.
Platinum, hard, 20%, $49.00 to $51.50 per ounce.
Platinum, soft, $43.00 to $44.00 per ounce.
Bismuth, $1.95 to $2.15 per pound.
Quicksilver, $38.00 per 75-pound flask.

SILVER PRICES.

	New York cents.	London pence.
Jan. 29	57½	26 9/16
" 30	57¼	26 7/16
" 31	57¼	26 7/16
Feb. 2	57¾	26 11/16
" 3	57⅝	26⅝
" 4	57⅜	26½
" 5	57⅜	26½
" 6	57½	26 9/16
" 7	57⅝	26⅝
" 9	57¾	26 11/16