

# THE CANADIAN MINING JOURNAL

VOL. XXXV.

TORONTO, May 15, 1914.

No. 10

## The Canadian Mining Journal

With which is incorporated the  
"CANADIAN MINING REVIEW"

Devoted to Mining, Metallurgy and Allied Industries in Canada.

Published fortnightly by the

### MINES PUBLISHING CO., LIMITED

Head Office . . . . . 2nd Floor, 44 and 46 Lombard St., Toronto  
Branch Office . . . . . 600 Read Bldg., Montreal.  
London Office . . . . . Walter R. Skinner, 11-12 Clement's Lane  
London, E.C.

Editor  
REGINALD E. HORE

SUBSCRIPTIONS—Payable in advance, \$2.00 a year of 24 numbers, including postage in Canada. In all other countries, including postage, \$3.00 a year.

Advertising copy should reach the Toronto Office by the 8th, for issues of the 15th of each month, and by the 23rd for the issues of the first of the following month. If proof is required, the copy should be sent so that the accepted proof will reach the Toronto Office by the above dates.

#### CIRCULATION.

"Entered as second-class matter April 23rd, 1908, at the post office at Buffalo, N.Y., under the Act of Congress of March 3rd, 1879."

#### CONTENTS.

Editorials—	Page.
The Observation of Mining Regulations . . . . .	325
Mining Accidents . . . . .	326
Dome Mines Annual Report . . . . .	327
Microscopic Characters of the Ore Deposits and Rocks of the Kirkland Lake District, Ontario. By Charles Spearman . . . . .	329
Treatment of British Columbia Zinc Ores . . . . .	333
The Mining Society of Nova Scotia. By F. H. Sexton . . . . .	337
La Rose Consolidated Mines. By R. B. Watson . . . . .	338
Iron Ore Deposits, Bathurst Mines, N.B. By G. A. Young . . . . .	339
The Minerals Separation Decision . . . . .	340
Copper Leaching and Electrolytic Precipitation at Chuquicamata, Chile. By E. A. Cappalen Smith . . . . .	341
The Weight of Rand Stamps . . . . .	342
Modern Rock Drills. By P. B. McDonald . . . . .	343
Book Reviews . . . . .	348
Proposed T. & N. O. Railway Extension to James Bay. By J. G. G. Kerry . . . . .	349
The Vertical Range of Metals Deposited by Secondary Processes. By W. H. Emmons . . . . .	353
Personal and General . . . . .	355
Special Correspondence . . . . .	356
Markets . . . . .	360

## THE OBSERVATION OF MINING REGULATIONS

The tendency to ignore regulations which interfere with the easy carrying on of operations is common to all industries. Regulations affecting mining have been drawn up after careful consideration by specialists and yet everyone knows that many of the regulations designed to protect the workmen are not properly observed. The fault is sometimes with the employer and sometimes with the employee.

In a recent report Mr. T. F. Sutherland, Chief Inspector of Mines of Ontario, calls attention to the present condition of affairs. He says:

"The investigations by this Department into many of the accidents during the past year show a non-observance of the Mining Act by some operators and many employees, and emphasize forcibly the need of further Government supervision. The Mining Act is wide in its requirements, and penalties are provided for non-observance. Infringements have to be proven in court on information laid by the Inspector. The policy so far followed has been to take action only in flagrant cases where life has been endangered. Thus, it is only after an accident has happened that a prosecution follows. The result has been that, in several instances, mine operators have taken chances with dangerous conditions, trusting that they could get through without an accident and have the work completed before an Inspector visited them. The men under ground handle powder carelessly, drill into old bottoms, and follow other dangerous practices, knowing that, if caught by the foreman, the worst that will happen is to be discharged, and they know that they can go to the next mine and obtain employment. Foremen rarely report an infringement of the Mining Act to the Inspector. The result is that careless and reckless workmen drift from mine to mine, endangering their own safety and that of their fellow workmen.

"If only licensed men were allowed to be in charge of actual mining operations, and if the holding of such a license depended upon the safety of the mining methods followed, it would tend to decrease the high accident rate of the mines of Ontario."

Proper appreciation of the danger involved is the first necessity. Workmen grow careless and take undue risks. It is the duty of those in charge to prevent such carelessness if they can. The reports of the mining inspectors of various parts of the country show that most accidents are avoidable.

## MINING ACCIDENTS

The quarterly report of the Chief Inspector of Mines of Ontario, part of which is reproduced in this issue of the Journal, shows that there are very numerous accidents in quarries, gravel pits, clay banks, and other works that are not as well superintended as are underground workings. There are so many small quarries and pits that it is difficult to gather data concerning them all; but the department has made good progress so far. The information gathered shows that stricter regulations concerning operations of this kind are necessary if accidents are to be avoided.

The fatal accidents at mines during the three month period numbered eight. This is a fairly small number compared with 45 fatal accidents during the preceding 12 months. A very noteworthy feature is the splendid record obtained by two of the companies which have adopted special inspection systems of their own.

The Beaver Consolidated Co. employs an inspector who makes a daily round of all the working places and makes very complete reports as to the conditions obtaining. Prompt attention is given to his recommendations, and as a result the company has few accidents. The system so successful at the Beaver has been put in force recently at the Temiskaming mine.

The Canadian Copper Co. has found that the establishment of a Safety Department with a safety specialist in charge has been a complete success. The showing made by this company since the appointment of Mr. E. T. Corkill is a remarkably good one.

Those who have charge of mining operations will do well to insist on the exercise of every precaution to prevent accidents. The men at work should be confident that the management is doing everything possible to make the work safe. It is in the interest of both employer and employee that safety be considered first.

The strict enforcement of the laws regulating mining operations and the adoption of systems of inspection such as those at the mines of the Beaver Consolidated Company and the Canadian Copper Company would make mining a safer occupation. Recognition of the danger too often comes too late.

## A DAILY FINANCIAL PAPER

Canada now has a daily financial paper, the first issue of the daily Journal of Commerce having appeared on May 5. It is a very creditable paper, and with Hon. W. S. Fielding as editor-in-chief, and Mr. J. C. Ross as managing editor, will soon find its place among the leading financial dailies of the world. For some years Canada has had weekly financial papers. There is now room for a daily. Those who are interested in Canadian investments of any kind will appreciate the improved service offered by the Journal of Commerce.

## CROWN RESERVE.

Montreal, May 6.

The action, Black vs. the Crown Reserve Mining Co., dismissed this morning by the Privy Council with costs against Black, confirms the judgment of all the Canadian courts that have heard the case.

The case, which has just been decided in London, and in which mining circles in Canada have been greatly interested, was an appeal from a judgment rendered by the Court of King's Bench on October 31st, 1912, confirming a judgment of the Superior Court of the 28th June, 1912, by which all of the Canadian Judges dismissed the action taken by John Black and others to obtain from the Crown Reserve Mining Co., John Carson and others, an accounting for 569,950 shares of the capital stock of the Crown Reserve Mining Co. alleged to be held by them in trust, and praying for judgment in favor of each of the appellants for his share of the balance of his stock.

This litigation has been pending before the courts in one form or another between five and six years, three suits having been previously taken by other parties interested, in the form of injunctions and other proceedings, in order to attack this stock, referred to in the present action.

The result of the judgment now confirmed is that the position taken by Colonel Carson and the Crown Reserve Mining Co. is fully justified by the courts, and John Black and the others interested with him are condemned to pay the costs in all the courts.

Previous to the institution of any of the litigation herein, the Crown Reserve Mining Company had for the purposes of the company disposed of about 338,807 shares of the company's stock. This transfer also was attacked by the appellants.

It is now finally decided and the shareholders of the Crown Reserve Mining Co. will be gratified to know that the 231,143 shares now held by the trustees are now declared by the highest court to be the property of the company beyond danger of attack, and the sale already made by the company is ratified.—Journal of Commerce.

## CANADIAN PEAT CO.

The Canadian Peat Company, Limited, capitalized at \$250,000 is offering 650 shares of preferred stock, bearing interest at the rate of seven per cent., at par. The company has property located at Alfred, Ont., on which machinery for the production of peat fuel has been in operation for some time. It is now proposed to instal additional machinery and enlarge the scope of the company. The secretary-treasurer of the company, H. Poynter Bell and the manager, E. V. Moore, are the vendors of the company. Both of these gentlemen are experts in matters pertaining to peat.

The directors of the Canadian Peat Company Limited, are: J. W. Sutherland, Hamilton; M. Chapman, Toronto; G. A. Howell, Toronto; H. Poynter Bell, Toronto; G. C. Campbell, Toronto.—Financial Times.

## DEPARTMENT OF MINES PUBLICATIONS.

The Geological Survey has recently issued the following:

Map 29A, topographical map of part of Simcoe and Ontario counties, Ontario.

Map 101A, geological map of St. Hilaire and Rougemont mountains, Quebec.

Map 99A, geological map of southern portion of Cranbrook map-area, British Columbia.

Memoir 44, Clay and shale deposits of New Brunswick, by J. Keele.

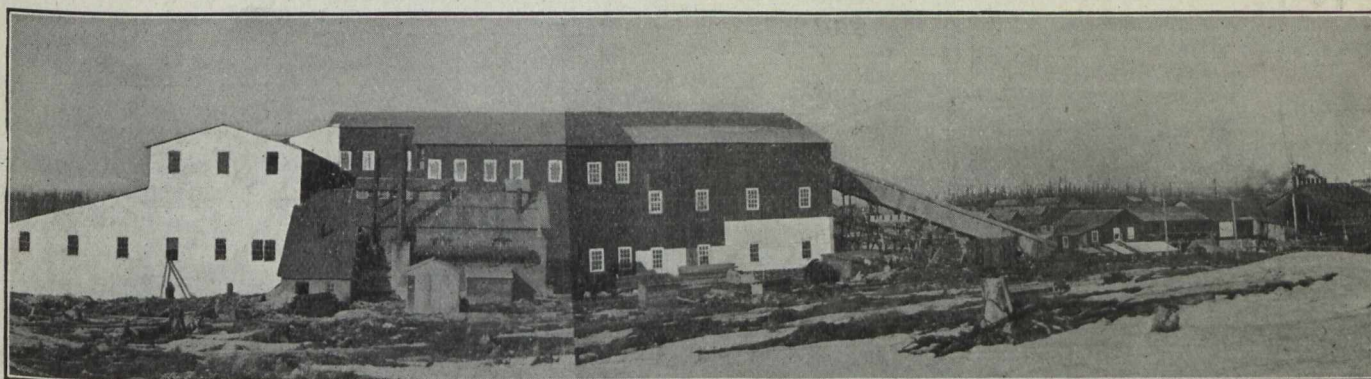
## DOME MINES ANNUAL REPORT

The report of the Dome Mines, for the year ending March 31, which has just been issued, is the most complete statement yet published by the company, and gives full information regarding operations, ore reserves and costs.

During the year ending March 31st, 1914, there was mined a total of 163,177 tons. Of this amount, 144,281 tons was ore sent to the mill, of which 121,800 tons came from the open pits, 4,782 tons from third level stopes at No. 2 shaft and 17,699 tons from development. There was milled a total of 145,305 tons, from which was made a net recovery per ton of \$8.29, or a total of \$1,204,597.64. In addition to this, \$2,694.83 was realized from interest, discount and exchange. During the year, the following amounts were spent:

where a large body of ore equivalent to a horizontal area of 100,000 square ft. has been disclosed. This was defined by 859 ft. of drifts and 969 ft. of crosscuts, the sampling value being \$3.49 per ton.

On the fourth and fifth levels only a small amount of development work has as yet been done, but this work shows further areas of ore. The fourth level shows 29,480 square ft., determined by 539 ft. of development, with an average sampling value of \$4.03, and the fifth level shows an area of 37,000 square ft., determined by 644 ft. of development, with a sampling value of \$4.94 per ton. A much greater amount of development, however, will have to be done on the fourth and fifth levels before any safe estimate of the probable size or value of the ore body can be attempted.



**DOME MILL AND CYANIDE PLANT**

<b>Expenditures During the Year.</b>	
Operating . . . . .	\$453,965.70
Development. . . . .	161,547.76
Plant and equipment . . . . .	303,999.02
<hr/>	
Total . . . . .	\$919,512.48
Balance. . . . .	287,779.99
<hr/>	
	\$1,207,292.47

On March 31st, 1913, the excess of current liabilities was \$55,138.24, while the net current assets over current liabilities now stands at \$237,117.82, in addition to an accident fund of \$4,476.07, and the enlarged plant.

The balance of general development as at March 31st, 1913, amounting to \$342,403.48, has been written off against surplus, while current development during the year amounting to \$161,547.76 has been written off against current revenue as an operating cost. While this step is somewhat drastic, it permits the company to start with a clean sheet.

**The operating cost for the year**, excluding all development charges, was \$3.084 per ton, which represents a decrease of \$1.49 per ton as compared with the cost during the previous year. This improvement is due to the use of hydro electric power, larger tonnage milled, and increased efficiency of methods. The consulting engineer states that the working costs will be further reduced and should be less than \$2.50 per ton when the enlarged plant is in operation.

**Development work**—Practically all development work has been done at No. 2 shaft in opening the third, fourth and fifth levels, and in further shaft sinking. The most extensive development was on the third level,

A certain amount of diamond drilling was done at No. 2 shaft, and in addition, six holes were put down west of the "Dome" outcrop, with results that warranted the extension of a drift from the 100 ft. level to develop this new area.

The expenditures for development during the year were largely in excess of normal requirements, and this excess development has been a direct charge on current operations. The total amount expended equals \$1.11 per ton milled during the year, but when figured against ore developed, the charge will be very small.

The annual report of last year, showed 315,000 tons, averaging \$7.53 above the 45 ft. level and 250,000 tons of undetermined grade between the 45 and 100 ft. levels. During the past year, there has been taken from this 121,800 tons averaging \$9.24.

**Ore Reserves.**—Upon applying a definite value to ore of undetermined grade, which was previously considered incompletely developed ore, and upon including certain additional small tonnages, the balance now remaining above the 100 ft. level stands at a total of 512,600 tons, averaging \$4.81 per ton. In addition to this tonnage of fully developed ore, there has been indicated an additional tonnage which is partially developed, amounting to 2,000,000 tons, averaging \$3.50 per ton. Development work now extends along the strike of the formation for a distance of 1,250 ft.

**Exploration.**—The results of diamond drilling from holes bored to the east and below the present development on the fourth and fifth levels, indicate additional large bodies of low grade ore for which no credit has been taken in the tonnage estimated. In addition,

two surface trenches to the west of the open pits, showed a width of 234 ft., averaging \$3.82.

In the No. 4 shaft section, six diamond drill holes put down within an area of 15,000 square ft. indicated a new ore body, which will be developed from the 100 ft. level.

**Plant.**—During the year it was decided to increase the treatment capacity of the plant to 28,000 tons per month, this work necessitating the following expenditures:

Mill. . . . .	\$207,778.83
Mine. . . . .	19,543.21
Pumping plant . . . . .	27,185.41
Crusher station . . . . .	23,236.21
Shops, dwellings and miscellaneous. . . . .	17,080.46
Power, steam, electric and air lines. . . . .	15,174.90
	\$303,999.02



No. 2 Shaft, Dome Mine

This increase necessitated the installation of an additional 40 stamps and of sand leaching tanks. This modification of the present all sliming practice will give greater economy for the treatment of low grade ore.

The company possesses a deposit of low grade ore, which should be worked by a policy of non-selective mining, and which gives assurance of profitable life on a basis of the new treatment capacity. The advisability of still further increasing the capacity of the mill cannot be satisfactorily determined until further development work has been done from the lower levels of the No. 2 shaft, and until the limit of low operating costs has been firmly established with underground mining conditions.

During the year, a total of 6,579 ft. of drifts, crosscuts and raises were driven and No. 2 shaft was sunk an additional 223 ft.

**Efficiency records** for the year show that an average of 4.023 tons was produced per man per shift for all underground employees and 1.73 tons per man per shift for the total number of employees on the property. The stoping record shows 43.7 tons broken per machine shift, with the large piston drills and 61.01 tons per machine shift for the small machines. In the mill 60.7 per cent. of the total value was recovered by amalgamation and 39.3 per cent. was recovered by cyanidation, while the average stamp duty was 10.6 tons per 24 hours. The average recovery was 94.5 per cent.

Operating costs of \$3.08 were distributed as follows:

Mining . . . . .	.68
Hoisting. . . . .	.07
Crushing and conveying to mill . . . . .	.25
Stamping, tube milling and amalgamation. . . . .	.86
Thickening, cyaniding and precipitating . . . . .	.50
Refining. . . . .	.08
General. . . . .	.64

Total. . . . . \$3.08

It is expected that the item of 25c for crushing and conveying to mill will be reduced to 10c. Compared with the previous year, costs of operation are \$1.49 less.

The balance sheet shows cash on hand of \$168,749.12, while the surplus as of April 1st, 1914, is \$486,520.20.

The report of this company leaves little to be desired in the way of information. Of particular interest is the statement that operating costs will be reduced to \$2.50 per ton. Previous to the operations on the Dome property, such a cost for any Ontario gold mine was considered absolutely out of the question, and if the company is successful in carrying out its policies, it should have a marked effect on the development of low grade gold properties throughout the Province. Some properties which heretofore have been considered too low grade to be of any interest may now with this encouragement be susceptible of economic development. The establishment of such low costs in Porcupine, where conditions are to some extent unfavorable, reflects great credit upon the management of the property.

The purchasing power of a company of this sort is also an important factor and although it is not likely to be of much interest to the individual shareholders, it is extremely important to the Province as a whole. During the past two years, the company has spent approximately \$1,000,000 a year, and with the enlarged plant, the yearly expenditures in the future should be about the same. The benefit of this distribution can hardly be estimated, as the effects are far reaching, but the annual disbursement of such a sum as this by a single company which has, according to its estimates, several years of profitable life before it, and with the possibilities for future development by no means exhausted, will be an important factor in a permanent development of Northern Ontario.

The Granby Consolidated Co. last month sent a number of artisans and much building material to its Midas mine, near Valdez, Alaska, to make provision for accommodation for miners and cover for machinery, preparatory to commencing to ship ore to the company's smeltery at Anyox, Observatory Inlet, B.C.

# MICROSCOPIC CHARACTERS OF THE ORE DEPOSITS AND ROCKS OF THE KIRKLAND LAKE DISTRICT, ONTARIO

By Chas. Spearman.

The Kirkland Lake district presents an area of great interest to the petrographer as well as to the geologist. The different types of ore bodies, the occurrence of somewhat rare minerals in those ore bodies, the mode of introduction, and the succession of introduction of the various minerals, all afford a field, unique, somewhat complex, and interesting from many standpoints.

A few photomicrographs will probably serve to illustrate some of the more important features of the ore deposits and rocks of the district.

very fine grained aggregates, forming dark wavy and irregular lines in the quartz (photo No. 2), and also in disseminated particles. In some of the coarser particles the cleavage and the prismatic structure are plainly visible. Some of the thin sections show this mineral to occur quite abundantly, especially in the "porphyry" type of ore deposit, and in the ore at the contact between the porphyry and the sediments. Molybdenite ( $\text{MoS}_2$ ) occurs frequently, and is associated with the pyrrargyrite in the dark bands along fractures in the quartz, and also in isolated particles in the



No. 1 x42



No. 2 x42

## GOLD ORE, TOUGH-OAKES MINE, KIRKLAND LAKE

Gr. quartz; C. calcite; Al. Altaite; Mo. molybdenite;  
P. pyrrargyrite. White dots represent tellurides.

Photomicrograph No. 1, ore from the 100 ft. level of the Tough-Oakes mine, shows gold and altaite encased in pyrite crystals. In the many fractures in the quartz is shown native gold, and tellurides of lead, zinc, silver and gold. In addition to minerals named in previous papers\* may be mentioned, the occurrence of the mineral pyrrargyrite,\*\* ( $3 \text{Ag}_2 \text{S.Sb}_2 \text{S}_3$ ), which occurs quite frequently. This mineral appears in the thin sections as having a greyish black color and rather an adamantine lustre. In thin splinters it shows a deep red color by transmitted light. It occurs in

quartz. No argentite was recognized in any of the thin sections examined, and it is probable that pyrrargyrite contributes largely to the comparatively high silver values in the Kirkland Lake ores. Occasionally throughout the ore calcite occurs as a secondary mineral.

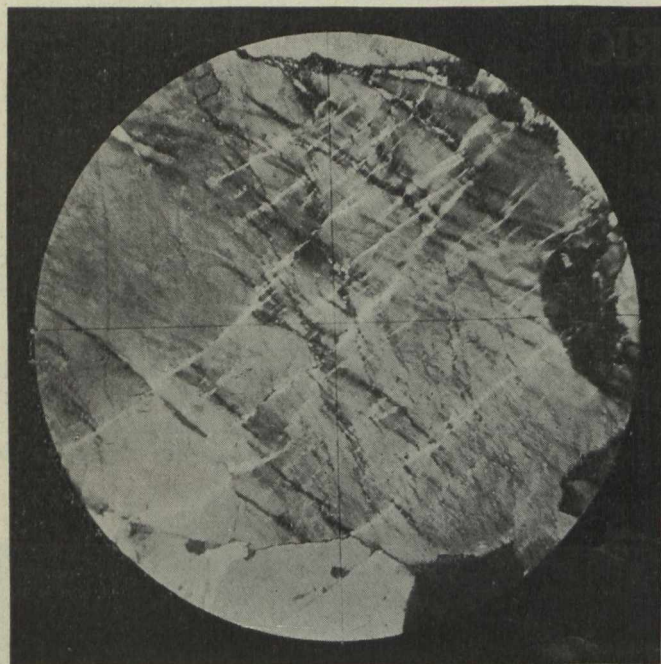
Photomicrograph No. 2, shows the nature of the dark wavy bands of mineralization, often occurring in the quartz of the deposits. In these bands are found crystallized pyrite, pyrrargyrite, molybdenite, and at times the various tellurides and native gold.

\*—"Kirkland Lake Gold Deposits," by R. E. Hore, Can. Mining Journal, July 15, 1913, pp. 424-31; "Ore Deposits of Kirkland Lake District," by C. Spearman, *Ibid.*, Oct. 1, 1913, pp. 599-601; "Discussion of Ore Deposits and Geology," by J. B. Tyrrell, J. M. Bell, and A. G. Burrows, *Ibid.*, April 1, 1914, p. 235; "The Tough-Oakes Gold Mine, Kirkland Lake," by R. E. Hore, *Ibid.*, April 15, 1914, p. 259.

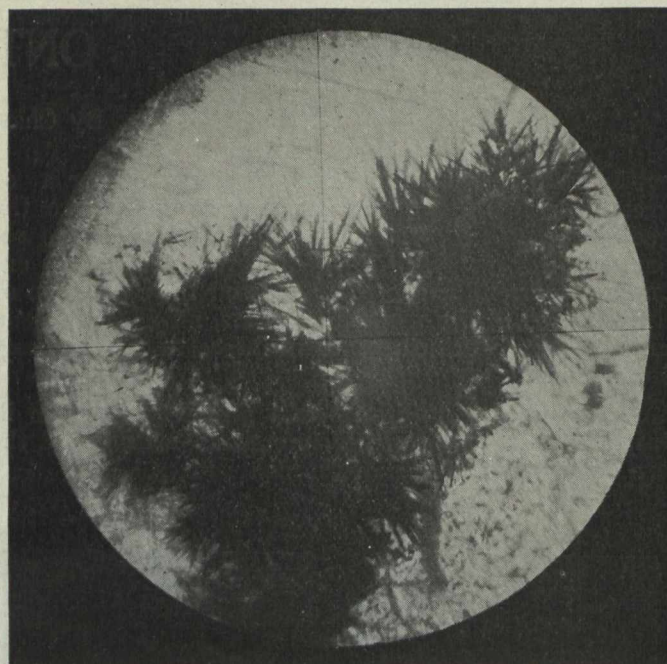
\*\*—Several slides made from pannings from typical Kirkland Lake ore showed a few particles of mineral resembling proustite, but being very minute they were difficult to determine.

Photomicrograph No. 3, will convey some impression of the severe pressure to which the quartz of the ore bodies was subjected after deposition. The sections show two series of fractures at about right angles

pyrite within the quartz, and gold within this pyrite. Photomicrograph No. 4, shows pyrite within the calcite, and No. 7, shows what appears primary pyrite in the "mineralized" porphyry from the 100 ft. level, west



No. 3 x42



No. 5 x200

and again others in intermediate directions. In this particular section the fractures are filled with later quartz.

Photomicrograph No. 4, displays an unusual occurrence of pyrite. The pyrite is massive, with a border of very delicate radiating aggregates, or groups resembling millerite. This occurrence is within the calcite only, and not in the quartz.

Photomicrograph No. 5, shows the structure highly magnified.

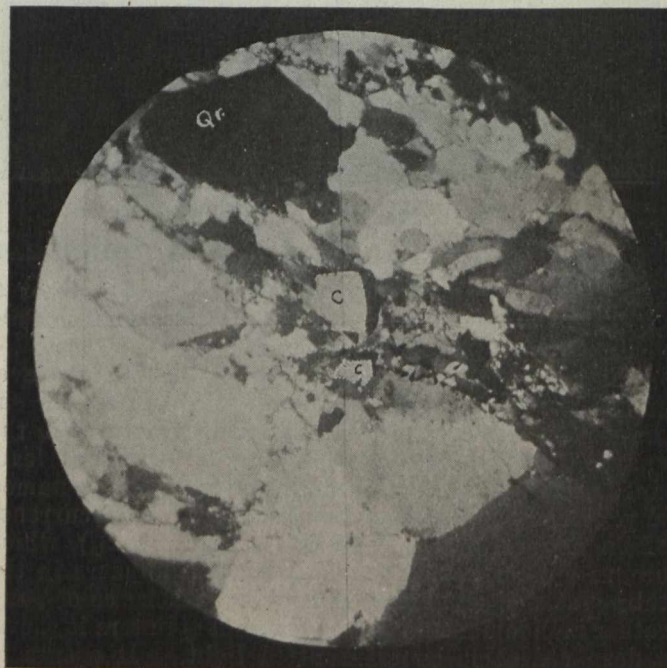
drift, Tough-Oakes Mine. In this photomicrograph is seen a large plagioclase phenocryst of the soda-lime variety, probably albite, whose outline is interrupted by the growth of the pyrite crystals.

Photomicrograph No. 7, shows both orthoclase and plagioclase phenocrysts.

Photomicrograph No. 8, from a thin section from a rock specimen from the 100 ft. level, west drift, Tough-Oakes, exhibits several orthoclase phenocrysts together with acid plagioclases. The whole is very much de-



No. 4 x42



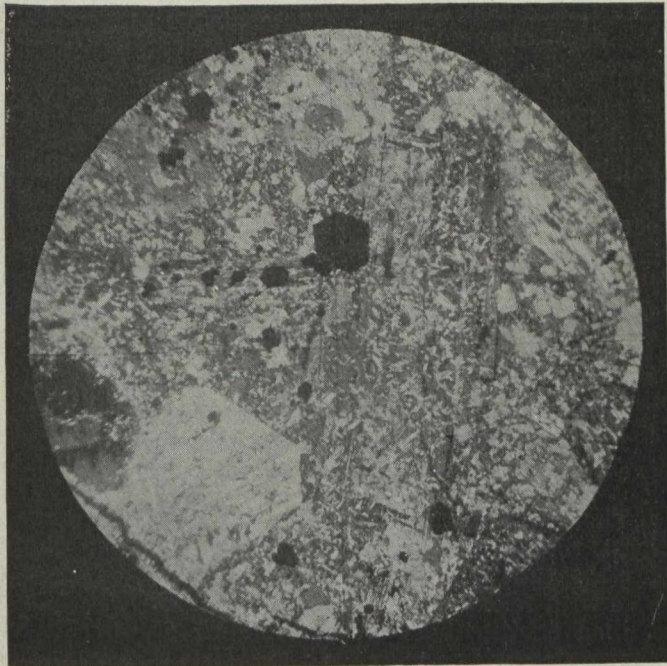
Gold Ore, Kirkland Lake

No. 6 x42

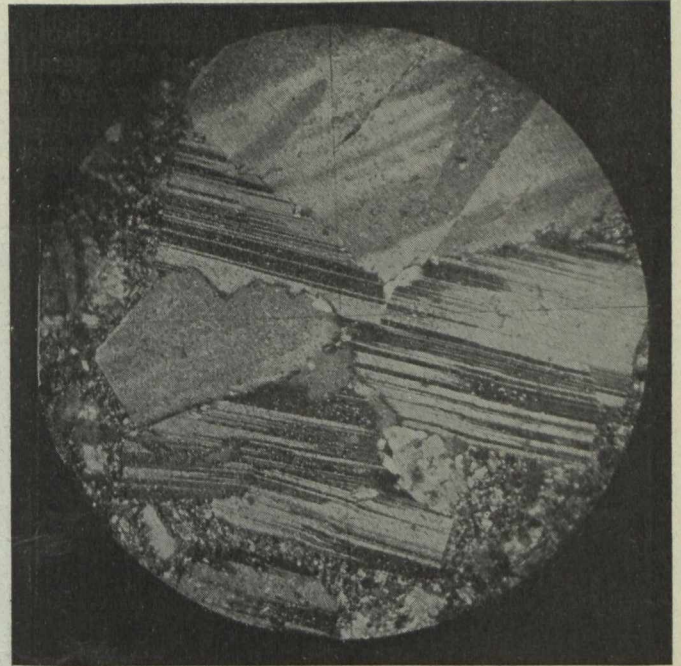
Photomicrograph No. 6, shows pyrite coating over calcite. Then again photomicrograph No. 1 shows composed, showing calcite, chlorite, saussurite and sericite as secondary minerals.

Photomicrograph No. 9, from porphyry exposed at the No. 9 vein of the Burnside, 25 ft. level, gives evidence of movements within the porphyry after the

ritic rocks of the district. This specimen was taken from a dike about one inch wide, encountered in a cross-cut through the sedimentaries on the Burnside



No. 7 x42

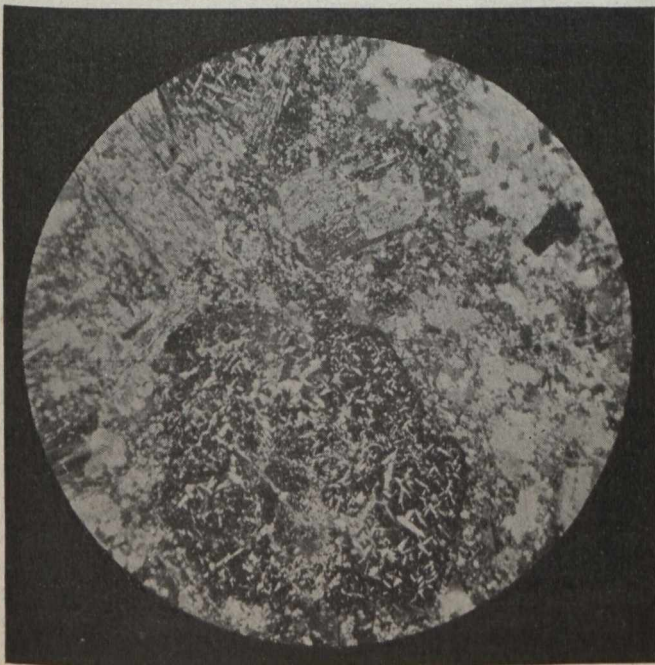


No. 9 x42

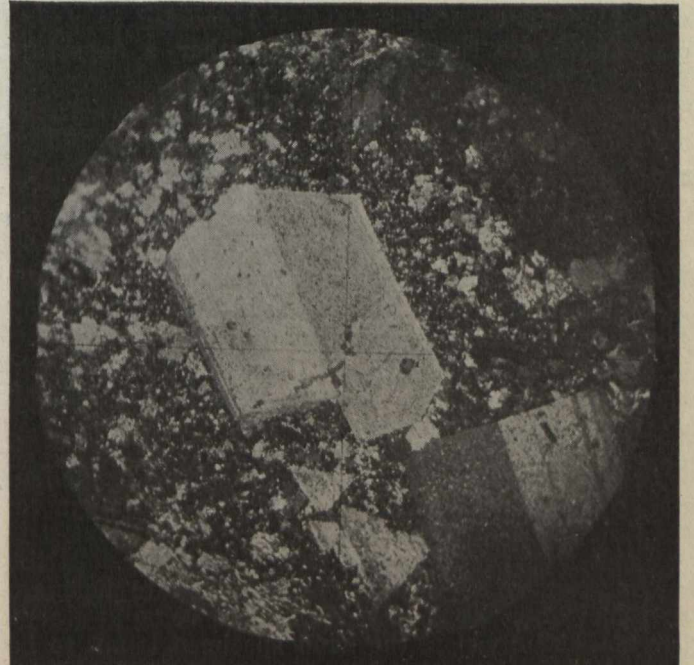
feldspar phenocrysts had formed, and before the magma as a whole had crystallized, as the crushing and fracturing is confined to the feldspar phenocrysts.\*

Both orthoclase and plagioclase appear in this section as well as in photomicrograph No. 10, taken from the same occurrence as photomicrograph No. 9, which shows evidences of crushing also. Both sections show abundant decomposition products in the ground mass, but the feldspars are comparatively fresh as compared with photomicrographs Nos. 7 and 8.

property, at the 90 ft. level. The hand specimen presents an aphanitic texture, and greenish color, the color being due to the abundance of secondary minerals, principally chlorite and calcite. The dike is younger than the four-inch high grade ore deposit, found in the sedimentaries in the cross-cut, and it is younger than the porphyry, for it cuts both the ore deposit and the equally narrow bands of the reddish dense felsitic facies of the porphyry, lying on both the hanging and the footwall of the deposit. The photomicro-



No. 8 x42



Wall Rocks, Kirkland Lake No. 10 x42

Photomicrograph No. 11, displays a texture somewhat different from the usual texture of the porphy-

graph shows the typical parallel arrangement of the flow structure. The lath shaped feldspar crystallites

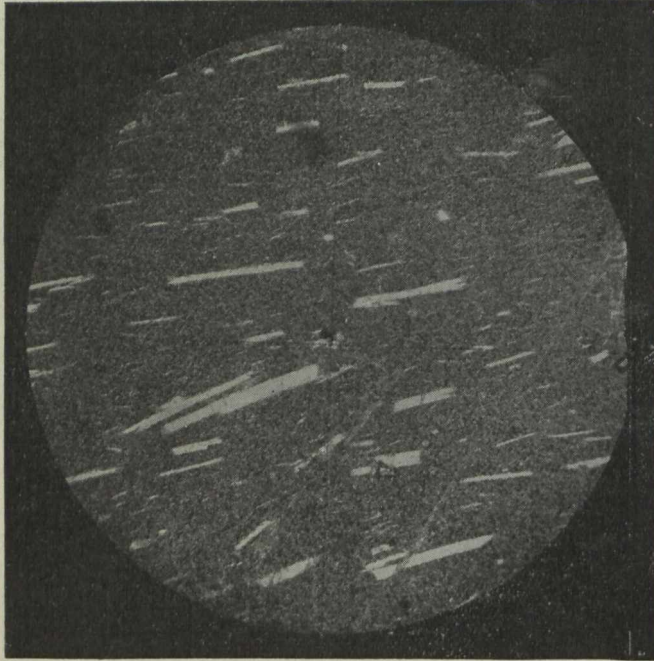
\*—"Ore Deposits of Kirkland Lake District," by Chas. Spearman,

Ibid, Oct. 1, 1913, p. 601, under "Deposits Within the Porphyry."

are highly altered, so that the species cannot be definitely determined. The ground mass shows a more or less isotropic residue.

#### Conclusions From Observations.

Every indication points to the conclusion that the gold and the tellurides were the first of the metallies to find a place in the ore deposits. They are very closely associated and bear evidence of contemporaneous origin. Pyrite, appearing at several stages in



No. 11 x42

the history of the deposits, had its initial introduction immediately after the gold and tellurides. Frequently the gold and tellurides are found encased in pyrite crystals (Photo No. 1). This is rather a departure from the usual order of occurrence—as usually the gold deposition is induced by the pyrite.† This is the case in the Porcupine District where gold is often found as a coating, on the faces of pyrite crystals.

Although very little native gold is found in actual contact with the pyrite in the Kirkland Lake District, it being nearly always found with the tellurides, or in isolated particles, yet it is a very interesting fact that wherever pyrite is found in the "impregnated zone," gold is found also, and "the smaller the pyrite crystals, the higher the assay." This rule holds good also for the type of deposit within the porphyry.

Next in succession comes pyrargyrite and molybdenite, so closely associated and bearing so similar relationship to the minerals already deposited that it is difficult to determine their respective order. In the sections examined pyrargyrite appeared to be more abundant than the molybdenite. Both being in a very fine state of division, the hand specimen is apt to be misleading, giving the whole the aspect of being impregnated with molybdenite. It was commonly supposed that molybdenite acted as a precipitant of the gold, and its presence therefore was invariably regard-

ed with favor, but the order of succession above outlined does not bear out this supposition.

With subsequent shearing and fracturing of the deposit, due to strains caused by certain movements, quartz and sometimes calcite was later introduced into the many almost microscopic as well as the larger fractures.

Photomicrograph No. 6, shows what resembles pyrite replacing calcite. This occurs in a crushed zone, and calcite filled in the voids in the breccia. Evidently, later solutions carrying pyrite replaced the calcite, showing a still later introduction of pyrite. No trace of gold or silver bearing minerals or molybdenite were found associated with this introduction. Again calcite and pyrite appear together (Photo No. 4) and pyrite appears as a primary mineral in the porphyry (Photo No. 7).

There are many indications that certain post-Temiskaming porphyry intrusives are genetically related to the ore deposits as outlined previously.\*

There appears substantial proof that there are at least, three different ages of porphyry in the district. On the Burnside property a dense porphyritic intrusive with feldspar crystallites (Photo No. 11) cuts the chilled felsitic facies of the reddish porphyry. This shows clearly two ages, both post-Temiskaming. Then again many of the pebbles in the uptilted Temiskaming conglomerate are typical feldspar porphyry pebbles, identical with pre-Temiskaming feldspar porphyries exposed in the Kirkland Lake District.

Mr. Tyrrell apparently assumes that the porphyries are all of the same age, and correlates them as pre-Temiskaming. He concludes that they, being separated from the Temiskaming series by an erosion unconformity, can have no genetic connection with the ore deposits within the sediments. In part he is correct. The pre-Temiskaming porphyry is not genetically related to the ore deposits, but he overlooks the fact that the post-Temiskaming porphyries are intruded into the Temiskaming series, and not faulted contacts.\*\*

What relationship does he establish between the porphyry and the ore deposits within the porphyry? The older of the two post-Temiskaming porphyritic intrusives, from evidence gathered from the field, is genetically related to the ore deposits in the Temiskaming series as well as to those within the post-Temiskaming porphyry itself.‡

Several thin sections from the principal ore deposits of the Porcupine District, kindly loaned the writer by Mr. Tyrrell, show a feldspar porphyry which is identical with the Kirkland Lake acid porphyries. Some thin sections showed a few quartz phenocrysts, and on the whole the porphyry may be said to be slightly more acidic than the Kirkland Lake porphyry. Many of the feldspar phenocrysts show the resorption phenomenon in a marked degree, and some showed the flow structure and still others showed fracturing of the feldspar phenocrysts. All the sections examined displayed an abundance of the usual secondary decomposition products. It would be interesting to know whether or not this porphyry bears any genetic relation to the Porcupine ore deposits. The presence of acid porphyries in connection with gold deposits is widespread and worthy of note and opens a broad field for investigation.

†—T. A. Rickard, *The Indicator Vein, Ballarat, Australia*, T. A. I. M. E., Aug., 1900.  
\*—"Discussion of Ore Deposits and Geology of Kirkland Lake," by A. G. Burrows, *Ibid*, April 1, 1914, p. 235; also "Ore Deposits of Kirkland Lake District," by C. Spearman, *Ibid*, Oct. 1, 1913, p. 600.  
\*\*—"Occurrence of Gold in Northern Ontario," by J. B. Tyrrell, Nov. 20, 1913; *Inst. Mining and Metallurgy*, *Ibid*, Oct. 1, 1913, pp. 599-601.  
‡—"Ore Deposits of Kirkland Lake District," by Chas. Spearman,

I. M. E., Aug., 1900.  
\*—"Discussion of Ore Deposits and Geology of Kirkland Lake," by A. G. Burrows, *Ibid*, April 1, 1914, p. 235; also "Ore Deposits of Kirkland Lake District," by C. Spearman, *Ibid*, Oct. 1, 1913, p. 600.  
\*\*—"Occurrence of Gold in Northern Ontario," by J. B. Tyrrell, Nov. 20, 1913; *Inst. Mining and Metallurgy*, *Ibid*, Oct. 1, 1913, pp. 599-601.



## TREATMENT OF BRITISH COLUMBIA ZINC ORES

In August, 1905, a Commission was appointed "to make an investigation of the zinc resources of British Columbia and their commercial possibilities. That Commission consisted of Mr. Walter Renton Ingalls, of New York City with Mr. Philip Argall, of Denver, Colorado, and Mr. A. C. Garde, of Nelson, British Columbia, as his assistants. This investigation was undertaken by the Government of Canada, in response to petitions from the Associated Silver-Lead Mines of British Columbia, and the Associated Boards of Trade of Eastern British Columbia. The letter of instructions from Dr. Eugene Haanel, then Superintendent (now Director) of Mines for the Dominion, included the following:

"This examination is to cover:

"1st. Examination of the present development of the mines to determine approximately the tonnage of zinc ore immediately available, its occurrence and character and the future prospects, together with the cost of mining.

"2nd. Examination of the present methods of milling.

"3rd. Investigation of the adaptability of the ores to the new methods of concentration (magnetic, electrostatic, etc.).

"4th. Study of the conditions affecting marketing of the concentrate, including the question of smelting in the Province or elsewhere in Canada.

"5th. Investigation of the possibility of special utilization of the zinc ore of high silver content."

Dr. A. E. Barlow and Mr. Joseph Keele, of the Geological Survey of Canada, were detailed to investigate the undeveloped zinc ore deposits, and Provincial Gold Commissioners supplied information relative to zinc ore occurrences in their respective districts. The metallurgical investigation of the samples of ore collected were conducted by Mr. Henry E. Wood, of Denver, Colorado, under the supervision of Mr. Argall and in consultation with Mr. Ingalls.

The report of the Commission, contained in a volume of nearly 400 pages, was submitted to the Minister of the Interior for Canada toward the end of September, 1906. The following "brief summary of some of the more important points brought out in the report," was printed in the "Report of the Minister of Mines for British Columbia, 1906:"

### Present Possible Zinc Output.

"**East Kootenay.**—The two mines working are essentially lead mines, although containing considerable zinc—one of them has more developed zinc ore than any other mine in British Columbia—but the character of the ore is such that zinc extraction is almost hopeless (p. 47 of Report).

"**Ainsworth Mining Division.**—Assuming Blue Bell ore to contain 15 per cent. zinc mined en masse, then, if mined and concentrated at rate of 200 tons of ore a day, it might produce 39 tons a day of 50 per cent. concentrates. All other mines in the division might produce 15 tons a day of 50 per cent. concentrates.

"**Slocan.**—Mr. Ingalls says 15,000 tons per annum of concentrates (45 to 50 tons a day) would be a liberal estimate for Slocan, and this could only be produced as a by-product from the lead mining (p. 41-47).

"**Coast.**—The zinc deposits of the Coast are still of unknown magnitude; they are, in fact, nothing but prospects (p. 56).

### Possibilities and Cost of Zinc Smelting in B. C.

"The ore must be taken to the coal, as the consumption of coal is 2 tons to 1 of ore; hence the only places adapted for zinc smelting in British Columbia are Crowsnest or Coast (pp. 51 and 52). Ore or concentrate must contain more than 40 per cent. metallic zinc. 'It is difficult to see how zinc smelting could be profitably carried on in British Columbia with coal at Crow's Nest Pass Coal Co.'s price'—\$2 a ton (p. 52).

"The prospect for zinc smelting on the Coast, at least by the standard method, is too remote to merit detailed consideration at the present time' (p. 56).

"The estimated cost of smelting in British Columbia, given by Ingalls, for the running expenses of a perfectly equipped and economically run modern zinc smelter—with no allowance for interest on investment or legitimate profit—with coal at \$1.50 a ton, and skilled labor at \$3 a day of 10 hours, is \$15 a ton (p. 54).

"(If we substitute in this estimate the lowest prices at present available, namely: Coal at \$2 to \$2.25 a ton, and skilled labor at \$3.25 to \$3.50 for 8 hours, it will make the estimated costs of operation about \$18.75 a ton of 50 per cent. concentrates). Mr. Ingalls further estimates the cost of marketing the spelter produced from 1 ton of zinc concentrates at \$8.50, which makes his total estimate \$23.50 a ton of concentrates (or, if corrected as above noted, \$26.75 a ton).

"The Report further estimates the cost of shipping the same concentrates to Europe for treatment would be \$25.03 a ton, from which it would appear that zinc smelting is not at present feasible in British Columbia.

### Electric Smelting of Zinc Ores.

"The following are the conclusions arrived at by the Commission as to electric smelting of zinc ores in British Columbia (pp. 132-133):

"(1) 'Electric smelting will never displace ordinary (fire) smelting, if it is necessary to generate the power from coal.

"(2) 'Electric smelting, may be, in the future economically conducted at places where very cheap hydro-electric power is available.' (By 'cheap' he means less than \$15 per horse-power per annum. Nelson and Trail are now paying \$45 per h.p. (See p. 67).

"(3) 'Aside from the question of power, up to the present time, certain peculiar and serious metallurgical difficulties in electric smelting have not been satisfactorily overcome.'

"It is unlikely that electric smelting of zinc ores can ever be profitably carried on in the zinc-producing district of East and West Kootenay' (p. 133)."

### INVESTIGATION OF PROCESSES FOR THE REDUCTION OF REFRACTORY ZINC ORES.

In the "Summary Report of the Mines Branch of the Canada Department of Mines" for 1910 (pp. 11-13), may be found a copy of a petition from the zinc producers of East and West Kootenay, B.C., addressed to the Dominion Minister of Mines, asking for an investigation of modern processes for the extraction of zinc from refractory ores. This petition reviewed the situ-

ation as exhibited by the "Report of the Zinc Commission" above quoted from; narrated briefly what had been done by the Canada Zinc Co., at Nelson B. C., in experimenting in the electric smelting of zinc ores; stated that monetary assistance was required to the extent of \$20,000 to \$25,000 to make certain changes in the company's plant, and to operate it. . . . "to complete the experiments and demonstrate the commercial practicability of smelting the zinc ores with electricity." A proposal was made "to divert \$50,000 of the unearned portion of the lead bounty fund to be used to complete the experiments in smelting zinc ores by the electrothermic process," and eventually there was adopted the recommendation of Dr. Haanel, Director of Mines, that such an amount be placed at the disposal of the Mines Branch of the Department of Mines, to be employed:

"1st. For the investigation on a commercial scale of the processes above enumerated, namely, (1) the De Laval process, in operation at Trollhatten, Sweden; (2) the improved process of De Laval, plant for the demonstration of which was then being erected in England; (3) the Cote-Pierron process, recently invented in France; (4) the bisulphite process, plant for the demonstration of which on a commercial scale was then nearly completed in Wales—or of any other process.

"2nd. For the setting up and operating of an experimental plant at Nelson, B.C., to test that one of the processes reported upon, which promises commercial success in treating the zinc ores of British Columbia."

In June, 1910, Mr. W. R. Ingalls was authorized "to inaugurate and carry through an investigation for the discovery or development of a method for the economic treatment of the mixed zinc sulphide ores of Canada in the production of metallic zinc of a marketable zinc product." Dr. Haanel wrote to Mr. Ingalls:

"The following recommendations made by you regarding the conduct of the investigation are approved, and are to be adhered to:

"1st. That you devote personal attention to all schemes that may be presented to the office in the interest of the problem to be solved.

"2nd. That it is specially agreed, that no invention that may result from this investigation be patented in the Dominion of Canada, but that rights may be reserved as to other countries.

"3rd. That all possible work in connection with this investigation be done in Canada.

"4th. That such small-scale experiments as would be most conveniently done by you outside of Canada be permitted to be done in such place as you may direct."

Progress reports of Mr. Ingalls were printed in the "Summary Report" of the Mines Branch for 1911 (pp. 14-15) and 1912 (pp. 8-10), and references were made to the work done at McGill University laboratory in connection with this investigation in a paper presented by Mr. Ingalls at the 1912 annual meeting of the Canadian Mining Institute (see Transactions of C.M.I., Vol. XV., 1912, pp. 101-114). The Mines Branch "Summary Report" for 1913 has not yet been published, but the position to-day in connection with the investigations that have been going on since 1910 is indicated in the following account of an address given on April 18, last, at Nelson, British Columbia, by Mr. Ingalls, before the members of the local Board of Trade and others interested. As reported in the Nelson "Daily News," Mr. Ingalls said:

The problem of treating mixed ores containing more or less zinc has been one of the most baffling of metallurgical problems of the last 60 years or more, and it is one that has remained without general solution. Much progress has been made in mechanical separation and in simple zinc smelting, which have rendered profitable ores that only 10 years ago were not so. There remain many kinds of zinc ores which are still unprofitable, because of their remoteness from market, adverse conditions of production, or complex character and low grade, and, unfortunately, they are the kinds possessed by many mine owners, including some of those in Kootenay district. With regard to these, the problem is not simply how can they be treated, but how can they be rated profitably, which means the discovery of some process cheaper than any known to metallurgists to-day.

When the Canada Department of Mines commenced an investigation with the object of finding such a process, it was not with the idea that in electric smelting alone would a solution be found. First there was reviewed all recent work in the general metallurgical field that we learned of. Besides making our own studies we considered the processes that were offered by many inventors, but were unable to find anything that gave even reasonable promise. Without abandoning consideration of other matters, we turned our attention to electric smelting, which is a subject of unknown possibilities, attractive because unknown, and the surface indications of which looked good. We were of course aware that electric smelting had for a number of years actually been done in Sweden and Norway; but we were also aware that it had not been successful, neither metallurgically nor commercially. If reference be made to the "Report of the Commission on the Investigation of the Zinc Resources of British Columbia," published by the Department of Mines, in 1906, with which report I had much to do, it will be found that information relative to electrothermic smelting of zinc ore was included. We were aware also that many persons other than those mentioned in the report, in America as well as in Europe had experimented in electric smelting, but up to that time none had been successful. It was therefore a fair field for study.

About two years ago a summary of a report upon electric smelting in Sweden and Norway was published in some of the technical journals, and I was asked through the Department of Mines why the Scandinavian process could not be transplanted to British Columbia. Having in possession the full text of the report, including all the figures given, I stated that costs in British Columbia for electric power, labor and other things were from two and one-half to three times higher than corresponding costs in Sweden and Norway. Under these conditions electric smelting in British Columbia would be out of the question.

Since that time the production of electric spelter in Scandinavia has attained considerable proportions, amounting to some thousands of tons per annum. While this spelter is obtained partly from smelting zinc dross and zinc junk generally, some of it is the product of ore smelting. However, I may mention as a recent substantiation of my opinion relative to the suggested introduction of this process into British Columbia that the directors of the principal Scandinavian company engaged in electric zinc smelting reported officially last November that up to August, 1913, they had not been able to smelt at a profit; they were hopeful,

though, that improvements then being made would enable them to do so eventually.

What then is the chief difficulty with the Scandinavian process? Primarily it requires too much power, and among the reasons for the extravagant use of power is the inability to condense a sufficiently large proportion of the zinc directly as spelter. The blue powder obtained is chiefly zinc, but in a non-commercial form. In order to get spelter from it a resmelting is necessary, and this adds greatly to the cost of treating the ore. The blue powder difficulty has perplexed everyone of the score or two score of investigators on electric zinc-smelting, save perhaps one who failed for other reasons.

We set out to learn how the condensation of zinc as blue powder could be reduced, and how the need for electric power could be otherwise cut down. We had no idea that blue powder could be wholly avoided, inasmuch as it is produced to a considerable extent in the ordinary process of fire smelting, and we could not hope to do better than that. Theory indicated that we might in this respect attain similar results to those from fire smelting; also that the requirement of electric energy might be otherwise reduced and possibly sufficiently to render power consumption no great obstacle to profitable operation. With that difficulty overcome, there were the chances of smelting in a unit of relatively larger size with possible economy of labor, and some other advantages as compared with ordinary fire smelting. Then, too, there was a possibility that silver-lead, copper matte and spelter could be produced by one furnace in a single operation, and that a higher percentage of extraction of the zinc, and especially of the silver and lead, could be made than in ordinary smelting. Moreover, it might be that some kinds of ore that at present it is not possible to treat—and there are such ores—would be found amenable to electric smelting. I say that these were possibilities; there was sufficient justification for spending time and money in testing them. However, they were never in my mind anything but possibilities, and I have never held out hope that they would be realized. On the contrary, I have been distinctly sceptical and guarded in what I have stated publicly concerning our results. I have been confident that metallurgic success would be attained, but herein I distinguish between metallurgical and commercial, although, of course, broadly speaking, a metallurgical success is not a real success unless it also be a commercial success.

In our work in the laboratory at McGill University, Montreal, where we tested our theory, experimented with different types of furnaces, and learned the A, B, C of the art, we succeeded in assuring ourselves that the production of blue powder could be reduced to something like the proportions of those of ordinary smelting, and we had some hopeful indications of reduced power consumption. Then we came to Nelson to try things on a larger scale. When in the laboratory we graduated from a 20-lb. to a 200-lb. furnace we encountered a new line of practical troubles. When we came here and graduated to a 2,000-lb. furnace, again we encountered new troubles, but magnified.

As I observe operations from day to day I experience the whole gamut of emotions. Some days, when things are going well, I am inwardly carried away with visions of what may be accomplished; on other days I am chastened in spirit. The fact is, electric smelting is a process of extraordinary delicacy. I know of nothing else in metallurgy that is compar-

able in its requirements to this one. In most processes, if things be set right, they stay right, with ordinary attention, but in this process there are at least eight different controls, all closely correlated, but more or less independent, which may change from hour to hour, and even more quickly, and make things go badly. The ordinary process of zinc smelting is one of delicacy, but electric smelting is far more so—at least, as we know it yet. A friend of mine, himself an experienced zinc smelter, can see no future for electric smelting, for this reason alone. I am far from being as pessimistic as that, but I will say to you positively that I cannot see any commercial possibility in a one-ton electric zinc furnace, nor a battery of such furnaces, and when I think of a 10-ton furnace I am appalled. Just as we have experienced new and magnified troubles in going from a 20-lb. to a 200-lb. furnace, and from a 200-lb. to a 2,000-lb., so we shall do in going from a 2,000-lb. to 20,000-lb. furnace. Indeed, the lines and working of a 20,000-lb. furnace are quite beyond my conception and, I am sure, that of the staff engaged here.

We have not yet got our furnace here running to our satisfaction. We seem now to be able to keep it going, and we make some spelter and matte and lead. If the work be continued, I think it probable that before long the control of the variables would be learned and metallurgical success be pronounced. At the annual meeting of the Canadian Mining Institute, held in Montreal, Quebec, early in March, Mr. W. McA. Johnson, who has been working for ten years on electric smelting of zinc ores, presented a paper entitled "The Commercial Aspect of Electric Zinc-Lead Smelting," in which he described a run with a 1-ton furnace at Hartford, Connecticut, which was a metallurgical success to a considerable degree. I saw that furnace in operation during that run and at the time of my visit it was working smoothly and encouragingly. Mr. Johnson deserves very great credit for what he has accomplished. We have been working on similar lines, but he is a lap or two ahead of us. He has organized a company which will erect a 10-ton furnace at some place in the United States and make a commercial test. He expresses himself confidently as to the result. Our own experience has led me to be much less sanguine, as you will have gathered from what I have already stated.

As you know, the money appropriated for our work has nearly all been spent. If the work is to be continued here, more money must be provided for it. I am speaking to you now merely as a consulting engineer, telling you squarely what the situation is from the technical standpoint and expressing to you very frankly what my opinions are, and I have been duly authorized by the Deputy Minister of Mines and the Director of Mines to do this. Of course I cannot speak for the Dominion Government. It is my understanding that more money was promised if necessary, and that that is recognized at headquarters in Ottawa. But it is my duty only to advise, and I cannot advise a Government any less honestly than I could a private client. I think that in due course of time the work being done here would, if continued, be brought to reasonable metallurgical success. I am positive, though, that even so there could be no commercial success expected from a 1-ton unit nor an extension of 1-ton units. What it would cost to go on and develop an 8-ton or a 10-ton unit is beyond human capacity to estimate. Those who promote such pioneering devel-

opments usually do so with the idea that when the money first provided is gone they will get more. In this case, although I will not venture to make an estimate or even a guess, I foresee that a great deal of money would ultimately be required. Now, an additional and large expenditure may be worth while, but when we see others, who are farther ahead than we are, about to do the same thing—and I can say from my own knowledge that their intentions are serious, and that their financing, if not adequate, is at least considerable; also, in view of the great uncertainty of the outcome any way, I am of opinion that it will be wisest to await that outcome, which will not be long delayed, and let it then be decided whether or not any more money ought to be spent here in doing similar work. You will not be any worse off, save in a little loss of time and perhaps not even in that, and you may save a lot of money. This is my advice to the Department of Mines and to you.

**Production of zinc in British Columbia for five years—1909-1913:**

	Lb.
In 1909 (approx.) .....	8,600,000
In 1910 .....	2,634,544
In 1911 .....	4,184,192
In 1912 .....	5,358,280
In 1913 .....	6,608,088
Total for five years .....	27,385,104

**Note.**—Forest fires in the summer of 1910 caused destruction of Whitewater concentrating plant and several miles of Kaslo & Slocan Railway, and resulted in cessation of production from Whitewater and Lucky Jim mines. The latter, two years later, resumed production in a small way. The chief producers of zinc last year were the Standard (with more than one-half of the total output), Rambler-Cariboo, Van-Roi, Lucky Jim, and, in much smaller degree, the Surprise and Noble Five. All the mines mentioned are situated in Slocan district. Two others—the Slocan Star and Hewitt-Lorna Doone—are expected to be added to the list this year.

**Nelson Board of Trade Supports Proposal of Grant for Establishment of Demonstration Plant at Trail.**

Nelson, B. C., May 6.—

“That this board favor and support the proposal that a grant be made by the Dominion Government to the Johnson Electric Smelting, Incorporated, of \$25,000 on completion by them of a demonstration plant of 10-ton capacity in West Kootenay ready for operation, and a second government grant of \$25,000 upon a successful commercial demonstration of the operation of same by a continuous 30-day run under the oversight and to the satisfaction of the representative of the government,” was the substance of a resolution unanimously passed at a special meeting of the board of trade last night after a lengthy discussion of two proposals made by the Johnson Electric Smelting, Incorporated, for the establishment of a commercial demonstration plant in this district with the possibility of there being ultimately established in the district

a commercial smelter of sufficient capacity to handle the zinc ore output of this district.

Immediately on their return from Trail last night the Johnson party, composed of Byron E. Eldred, W. McA. Johnson, Dr. James Struthers and Dr. Barlow, attended the meeting and Mr. Eldred informed the gathering that after a long discussion of the process and their proposals with the Trail Smelter people that the promise had been made to them that they would be allowed to use a portion of the Trail smelter site for the erection of their demonstration plant, that they would be furnished with suitable ore up to 2,000 tons in quantity at the exact cost of mining, roasting and delivering at their furnace. They had been treated very fairly indeed, said Mr. Eldred, and at the present time he said that he could see no place that would be better for their demonstration than Trail. They would save considerable by going there both in the matter of obtaining roasted ore and power. Part of the equipment of the local government experimental plant could be used by them at their proposed plant at Trail. He also stated that they had a great many offers from other sections of the continent to encourage them to locate their plant, but he felt that they were bound to stick with one proposition and not jump before the completion of negotiations for better or for worse.

The members of the party will leave to-night for Victoria, where they will meet Sir Richard McBride on the recommendation of R. F. Green, M. P., for Kootenay, with whom they were in touch during their stay at Ottawa.

During the evening votes of thanks were tendered to the members of the Johnson party for their prompt response to the invitation from the board of trade and their businesslike manner of dealing with the board since their arrival here, and to George C. Mackenzie and E. Dedolph for the work which they had carried on at the government experimental smelter while it was in operation recently. Suitable replies were made by Mr. Eldred for the Johnson party and by Mr. Mackenzie.

The proposition of the Johnson people recommended by the committee provided that they should construct the demonstration plant at an approximate cost of \$75,000, being guaranteed the sum of \$25,000 when ready to blow in the plant and an additional prize of 25,000 being guaranteed on completion of a 30-day run completed to the satisfaction of government experts who would be appointed to watch the test. They would require that the duties on certain machinery that they required be rebated, and they would underwrite the whole smelter.

George C. Mackenzie, who had in charge, on behalf of the Dominion Government, the experiments just concluded in the local smelter, informed the meeting that a shipment of 40 tons of zinc ore from this district was to be sent to the smelter now operated by the Johnson people at Hartford at the expense of the Dominion Government, and a resolution passed at the meeting asked the Dominion Government if possible to send Dr. Stansfield, professor of metallurgy at McGill University, Montreal, to watch the trial there and that E. Dedolph, who has been conducting the experiment here for the government, be sent to assist Dr. Stansfield in his work.—Nelson Daily News.

# THE MINING SOCIETY OF NOVA SCOTIA

By F. H. Sexton.

It is a pleasure to greet the members of The Mining Society of Nova Scotia at its twenty-second annual meeting, and the distinguished visitors from outside the province. We have the honor of being the oldest mining society in the Dominion, started as the Gold Miners' Association in 1884, and re-organized into The Mining Society of Nova Scotia in 1892. For four years we were united with the Federal Canadian Mining Institute, but it was not a happy or profitable alliance for Nova Scotia on the terms under which the federation was operated, so that we have pursued a separate existence since 1898.

The development of our little association on independent lines is in keeping with our position and tradition. Nova Scotia is more or less isolated geographically, and in other ways from the rest of Canada. No other province has as large a proportion of its population engaged in the fisheries. With the exception of a little coal and iron mining in New Brunswick, there is no mining industry of any great importance in the great stretch of area between Nova Scotia and Western Quebec. Our province has made great sacrifices in revenue and in hardy intelligent men to develop the great Northwest without yet receiving an adequate return in subsidies or land. The dominant labor organization of coal miners is a provincial organization. After a protracted and spirited struggle with the General Mining Association of London, the Government of Nova Scotia secured the titles to their mineral deposits and have reserved them for the benefit of all its people ever since. Aside from tariffs and bounties, the mining population of this province is not deeply interested in federal mining legislation. Without enumerating other instances, I believe I am within the facts in saying that most of our interests, our quality of life, manners, customs and institutions, are strongly provincial. Insular and narrow we may be, but we possess strength and vitality from our very limitations. It is idle to suppose that the present condition of our sentiments, actions, or ideals will materially alter within any short period of time.

The Mining Society of Nova Scotia has enjoyed a long and honorable career, and has rendered valuable service time and again to the mining fraternity which it represented, and to the province.

In its early days when gold mining was booming, its activities were most closely associated with that branch of the industry. Concurrent with the rapid development of the coal mining industry, a large number of eminent engineers in this field became identified with the society, and all worked together with a will for the good of the mining industry of this province. Many of the good features of our mining legislation, stand to the credit of this society. Under the energetic leadership of our former President, Mr. A. A. Hayward, and the efforts of Mr. Alexander McNeil, we were chiefly instrumental in bringing home the importance of technical education to the members of our Government prior to the establishment of a comprehensive system of industrial training in 1907. We have been active in securing funds for the perpetuation of the memory of the late Hugh Fletcher, among those who will not have known him well enough to cherish

the remembrance of his rare personality, high ideals, and professional ability. These things and more can be adduced, but I hesitate lest we stifle our customary modesty in self-adulation.

With the recent temporary decline in the gold-mining industry, and the rapid expansion in coal production, it became evident to those who had the well-being of our society closest to heart, that we should have our headquarters in Sydney, while our quarters in Halifax should still be maintained. In order that this end should be accomplished, the council appealed to the large steel and coal companies to assist the project financially. A favorable response came immediately from the interested corporations, and to-day we are proud to state that we possess comfortable and attractive rooms in a central location in the Iron City, where we have placed a technical library replete with modern books on geology, metallurgy, and mining, the transactions of all the important mining associations all over the world, and the leading mining and metallurgical magazines. We have secured the services of Mr. E. C. Hanrahan as Secretary. His competency to fill this position has been demonstrated by his activities in a similar capacity in many other associations. Besides these provisions, we still retain our quarters in Halifax, and the indefatigable services of our Associate-Secretary, Mr. E. A. Saunders. In recognition of our expansion in effort, the Provincial Government has assured us of an increase in its annual subsidy.

By these changes in organization and policy, we have added a large number of members to our society, most of whom could not have participated personally in the activities and good-fellowship of our association. We extend to these members of the metallurgical and coal mining fraternity our hearty welcome.

Recently there has been proposed some merger, affiliation, federation, or some other form of union between our society and the Canadian Mining Institute. There may be some members of the latter association who think that we should give up our organization and become a branch of their institution. I believe, however, it is the sentiment of a majority of our members who believe that we should not cast away our identity, and who think we can serve the best interests of the mining industry in this province, by retaining our name and individuality. There are many ways, however, in which our society could be benefited by becoming affiliated with the Canadian Mining Institute. There must be some plan by which the two societies could unite their efforts with greater effectiveness, and make the Institute a truly national organization. It would be a benefit in many ways if the members of the Nova Scotia Mining Society could be admitted to the privileges of membership in the Canadian Mining Institute, to receive their transactions, and to enlarge their scope of interest and action in co-operative goodwill with the mining fraternity of the other provinces. We declare ourselves narrow and prejudiced if we do not earnestly strive to consummate such a desirable end, and we show a small degree of intelligence if we cannot evolve some working plan of united effort which we may adopt without loss of individuality and provincial prestige.

### LA ROSE CONSOLIDATED MINES.

In his report for the year 1913, Mr. R. B. Watson, general manager, gives the following information concerning operations at the La Rose, Lawson, Princess, Fisher-Eplett and other properties:

The production in silver ounces at the La Rose Mine in 1913 fell below the production at the Princess and also below the Lawson. Nothing of much importance was discovered on the parent claim during the year; several small stringers in the vicinity of No. 3 vein and a vein coming in from the Right-of-Way furnished most of the new ore. Considerable exploration was done in the bottom of the mine. A crosscut at a depth of 500 ft. below the collar of the main shaft, was run to the fault and 130 ft. of drifting was done. This work developed a large calcite vein along the fault which, however, carried only a small amount of silver. An incline shaft was then sunk on the fault for a distance of 233 feet below the 500 ft. level. Near the bottom, at a depth of 215 ft. drifts were run both ways for a combined distance of 80 ft. The exploration on this large calcite vein in the fault, while very promising at times, did not produce any pay ore, so work on and below the 500 ft. level was discontinued. Exploration is now centred on the 380 ft. level which is in the conglomerate, just above the Keewatin contact; cross-cuts are being driven in three directions on this level. The high grade ore left in the La Rose claim is estimated at 417,000 oz. Most of this is in No. 1 vein, near the surface. The claim has been well prospected underground and unless the exploration work on the 380 ft. level shows favorable results, the outlook at this property is not promising.

Although the Lawson showed a reserve of only 148,000 oz. a year ago, the production during the year amounted to 708,000 oz., and there remains a reserve of 125,000 oz. This result was due to the finding of several small ore bodies in the main vein to the west of No. 8 shaft. These ore shoots have all been stoped and there is very little in sight at present, except the broken ore in the stopes. Recently, a new vein was found in a cross-cut on the 188 ft. level, near the southern boundary of the claim. The vein is several inches wide, and while not high grade, carries some silver and gives promise of producing ore of value above this level. No. 8 shaft has been sunk to the 400 ft. level, and the main vein will be explored at this depth.

The Princess made a splendid record in 1913, having produced 909,000 oz. of silver, not taking into account the concentrating ore. More development work was done on this claim than on any others, and resulted in finding veins No. 10, No. 11 and No. 12. A winze was sunk on No. 7 vein from the third or 185 ft. level, down to the Keewatin contact, and the fourth level was driven at a depth of 225 ft. Some drifting was done on the Cobalt Lake fault on the third level, but no more favorable results were obtained here than at the La Rose. The balance of the main vein was stoped and hoisted, during the year; the only ore now in reserve in No. 12 vein. This vein was cut on the 132 ft. level; the ore shoot is 120 ft. long, and will probably go to the surface; there is an inch to an inch and a half of high grade ore, and a good width of mill rock. The Princess claim contains but 17 acres, and has been well prospected above the contact.

At the Fisher-Eplett work was carried on actively throughout the year. The shaft was sunk to the 300 ft. level, where 696 ft. of drifts and 561 ft. of cross-

cuts were driven, without finding any ore of commercial value. A large flow of water has delayed operations somewhat, but the situation is improving. There still remains some promising territory to be developed from this shaft, and work will be continued.

Some cross-cutting was done on the Violet, without success. No further work was started on the La Rose Extension or on the University. The latter claim will be explored this year from the Lawson workings.

Mr. Watson gives the following summary of results obtained in 1913: The results in 1913 were much better than we had reason to expect a year ago. Over 2,636,000 oz. of silver were produced at a total cost of 22.8 cents per oz., leaving a profit of 36.52 cents per oz. on the shipments. The cost of production was 3.13 cents per oz. less than in 1912, but the price received for silver was 2.34 cents less. The market for these ores was poor during part of the year, and is still restricted on the lower grade products. The marketing charges have risen for this reason from 9.43 per cent to 10.42 per cent of the gross value. The net profit was \$955,418.27; this is 61.38 per cent of the gross value of the ore. The concentrating ore on the dumps is about the same in amount as last year, but the high grade ore in reserve has been decreased by half. The chances of finding new high grade veins become less each year as the properties are more fully developed. Dividends declared for the period amount to \$931,000. The net current surplus was increased to \$1,528,776.94, made up of—cash and call loans \$1,677,330.68; Supplies, ore on hand and at smelters \$253,407.78, less dividend and accounts payable \$401,961.52.

### THE CONSTRUCTION OF CAGES.

The following amendment to the Mining Act of Ontario was introduced into the Legislature during the session of 1914 by Hon. Mr. Heart, Minister of Lands, Forests and Mines:

(1) Section 164 of the said Act is amended by adding as Rule 32a the following:

32a. All cages or skips used for lowering or raising men shall be constructed as follows:

(a) The hood shall be made of steel plate not less than three-sixteenths of an inch in thickness;

(b) The cage shall be provided with sheet iron or steel side casing not less than one-eighth of an inch in thickness, or with a netting composed of wire not less than one-eighth of an inch in diameter, and with doors made of suitable material;

(c) The doors shall extend at least five feet above the bottom of the cage, and shall be closed when lowering or hoisting men;

(d) The cage shall have overhead bars so arranged as to give every man an easy and secure handhold;

(e) The safety appliances shall be of sufficient strength to hold the cage or skip with its maximum load at any point in the shaft;

(f) The cage shall not have chairs attached thereto which are operated by a lever through or from the floor.

(2) This section shall not come into force until the 1st day of January, 1915.

During March the Le Roi No. 2, Ltd., shipped from its Josie group of mines at Rossland, B.C., 1,480 tons of ore and 143 tons of concentrate. The month's receipts from the smeltery were \$23,846; total expenditure was \$18,300. Corresponding figures for January were: Total receipts, \$31,662; expenditure, \$20,400. February: Receipts, \$9,977 (hoisting plant not running during one week, having been under repair); expenditure, \$17,170.

# IRON ORE DEPOSITS, BATHURST MINES, NEW BRUNSWICK\*

By G. A. Young.

The iron ore deposits of Bathurst Mines occur in three main bodies or groups of bodies, the longer axes of which, at the surface run about north and south. These deposits occur within a limited area on the northern bank of Nipisiguit river and in the vicinity of Austin brook a south-easterly flowing tributary of the main river. One of the groups of iron ore bodies known as No. 2 deposit, outcrops on the northeast side of Austin brook valley and extends northward for at least 1,200 feet (360 m.). Another ore body, known as No. 1 deposit, outcrops on the southwest side of Austin brook valley about 900 feet (275 m.) west of No. 2 deposit and extends southerly for several thousand feet. The third group of ore bodies known as No. 3 deposit, lies nearly due north of No. 1 body at a distance of about 800 yards (730 m.).

In the immediate neighborhood of the ore bodies all the rocks are of igneous origin and belong to three main types, namely, quartz-free porphyry, quartz porphyry and diabase. The rocks in the district are largely covered by drift and therefore the relationship existing between the different rock varieties has not been established, but it is assumed that the quartz-free porphyry and the quartz porphyry are closely related in origin and age, and that the diabase occurs in dike or sill-like bodies cutting the porphyries.

The quartz-free porphyry outcrops in the eastern and southwestern portion of the area; the quartz porphyry forms the central portion of the area; and the diabase occurs in the western portion. No. 2 deposit lies within and just along the boundary between the area of quartz-free porphyry on the east and the central zone of quartz porphyry; No. 1 and No. 3 deposits occur along the western margin of the zone of quartz porphyry near the area occupied jointly by diabase and quartz-free porphyry.

The ore has generally a prominent slaty cleavage, is fine grained, and is composed largely of finely granular magnetite with a variable amount of hematite. Slight variations in grain are visible along regularly alternating bands. The banding varies in degree from microscopic to very broadly developed, being indicated where coarse by the occurrence of various impurities distributed along bands. The ore has a general black colour, tinged greyish from the presence of minute grains of quartz and feldspar which in some bands are finely and uniformly disseminated, while in other cases they occur in lines, narrow streaks and lenticular areas. Considerable pyrite is present and tends to occur in large and small, elongated, lenticular aggregates. Quartz is relatively abundant occurring in veins and stringers. A large number of analyses indicate that the iron content of the ore ranges from 39.5 per cent. to 58.7 per cent.; sulphur from 0.009 per cent. to 0.27 per cent.; and, phosphorus from 0.385 per cent. to 1.222 per cent.

Examined in thin sections under the microscope, the ore is seen to be composed of minute, rapidly alternating bands of nearly pure iron ore, or of iron ore with considerable finely granular quartz and feldspar; and other bands of nearly pure quartz, with varying proportions of feldspar, iron ore, etc.

In the case of No. 2 body, a portion of its southern end, and of the east and west walls is visible. The

greatest width of the body where stripped, is a little over 40 feet (12 m.). The containing walls are sharply defined, and the body appears to dip to the west at angles varying between 60° and 80°. The ore is banded and some quartz is present in comparatively large, irregular veins. Little or no pyrite is to be seen except immediately along the walls.

On the hanging wall side, at a distance of about 150 feet (45 m.) from the ore, ordinary schistose quartz porphyry crowded with phenocrysts of quartz and feldspar is visible. At exposures intermediate between this and the ore body, the rock gradually assumes a more schistose habit. On the foot-wall side an analogous set of phenomena is visible, but the rock there appears to be a quartz-free porphyry.

The southern termination of the ore body has been laid bare. The mass of ore ends in a number of angular, finger-like projections extending a few feet into the country rock and associated with considerable quartz.

In the case of No. 1 deposit, the foot-wall is exposed for a short distance. The rock, probably a much altered, schistose quartz porphyry, is very heavily charged with pyrite. It has a pronounced schistose parting along which occur seams and veins of quartz. The boundary of the ore body is remarkably sharp. The ore seems to end abruptly along the plane corresponding to that of the slaty parting and banding in the ore and of the schistose parting in the wall rocks.

The ore bodies have the form of abruptly terminating beds or bands, with, in each case, a fairly constant thickness. The walls where seen, are always sharply defined and dip westward at angles varying from 45° to nearly 90°. In the case of No. 1 deposit the ore body at its outcrop at the northern end has a thickness of 105 ft. (32 m.). In a drill hole which intersected the body at a vertical depth of 410 feet (125 m.), the ore body had a thickness of 65 feet (19.8 m.). As indicated by the results obtained from a magnetometric survey, the ore body has a length of about 2,000 feet (610 m.).

It is believed, for the following reasons, that the ore bodies have formed through the partial replacement of schistose quartz porphyry by iron ore, along sharply defined zones.

The prominent banding of the ore, sometimes on a coarse scale, sometimes microscopic in its fineness, is, when seen in thin sections under the microscope, very regular, and gives the impression of being an original structure, not a secondary one imparted in some way to the ore after its formation.

The parallelism of the banding of the ore (seemingly an original structure) and its attendant slaty cleavage, with the walls of the ore bodies and with the planes of schistosity in the neighboring rocks, forcibly suggests that the ore has replaced a schistose rock, and has partly preserved the original schistose structure.

The finely granular quartz present throughout the ore, as well as the less abundant granular feldspar, may readily be regarded as representing original constituents of the replaced, schistose rock, possibly sheared quartz porphyry. That the original rock was schistose is supported by the fact that in all cases where observa-

\*Extracts from an article in Guide Book No. 1, published by the Geological Survey for the Twelfth International Geological Congress, August, 1913.

tions were possible the country rock, as it neared the ore bodies, was found to be progressively more schistose.

Under the above hypothesis, the occasional narrow bands of dark green schist seen in No. 1 body may represent a rock variety that more strongly resisted the replacing action of the ore bearing solutions. The apparently basic composition of these bands, and the occurrence of schistose diabase along the western walls of the ore body, suggest that they may represent dikes of diabase.

As regards the quartz veins, in the case of a thin section of ore charged with small reticulated and crenulated quartz veins, it was seen that the alternating microscopically fine lines and extremely narrow bands of quartz, quartz impregnated with iron ore, and nearly pure iron ore, conformed as nearly as possible to the intricate folding exhibited by the quartz veins. On the assumption that the ore and its structure are due to the replacement of schistose rock, the minutely corrugated forms exhibited by the ore represent a corrugated structure previously existing in the now replaced schist.

The appearance of the ore in thin section did not seem to indicate that the ore would fracture along the old corrugation planes, and so permit the formation of later quartz veins following similar crenulated courses, and, therefore, it is concluded that the veins did not originate after the formation of the ore.

The appearance in the thin sections of the bands or zones of quartz veins, and of the ore body as a whole, does not warrant any supposition that the quartz veins were bent after the formation of the ore.

It is true that the veins might have been formed contemporaneously with the ore, but, on the other hand, the puckering and bending of the veins in the ore are duplicated over a part of the exposures of country rock on the foot-wall of No. 1 body. This would indicate that the original rock had been twisted and bent, that quartz veins were introduced either before, during, or after the folding, and that after this the rock had been replaced by ore that still retains many indications of the original crenulations, as well as many or all of the quartz veins.

#### THE MINERALS SEPARATION DECISION.

The complete opinion of the United States Circuit Court of Appeals at San Francisco in the matter of James M. Hyde vs. Minerals Separation Ltd. and Minerals Separation American Syndicate Ltd., which decision was favorable to Hyde, covers 16 pages of type-written matter. The bulk of this constitutes a review of the case tried in the lower court and references to other processes apparently similar or somewhat the same.

The finding itself, as rendered by Circuit Judge Gilbert, follows in full:

"We hold that to sustain the appellees' (Minerals Separation) patent would be to give to the owners thereof a monopoly of that which others had discovered. What they claim to be the new and useful feature of their invention, as stated by their counsel, is 'agitating the mixture to cause the oily coated mineral to form a froth.' As we have seen, that feature was clearly anticipated by the prior art, and when the elements of the appellees' claims are read one by one, it will be found that each step in their process is fully described in more than one of the patents of the prior art, with the single exception of the reduced quantity

of oil which they use. The patentees of the appellees' patent made a valuable contribution to the art in discovering the smallest quantity of oil which would produce the desired result. In doing so they pursued the course which all skilful metallurgists would be expected to pursue. They made a series of experiments to determine how small a quantity of oil could be used successfully. They found, as all must find who use the oil flotation process, that certain oils are adapted to use with certain ores, and that a larger quantity of oil is necessary for one kind of an ore than for another. The appellees admit that for some ores they use four times as much oil as for others. Their discovery that a small fraction of 1 per cent of oil is sufficient to produce flotation of the metalliferous matter cannot, as we have seen, be made by itself or in combination, the subject of a patent.

"The appellees cannot take from others the right to use oil economically. This was evidently the ruling of the patent office on their application for the patent. One of their claims in the original application was 'the process of concentrating powdered ore, which consists in separating minerals from gangue by coating the minerals with oil in water containing a fraction of 1 per cent of oil on the ore, and recovering the oil coated minerals.' This was rejected in view of the Cattermole patent 'as expressing merely a difference of degree as to the proportion of oily matter employed.' Counsel for appellees admit that the claim was properly rejected for the reason that it leaves out the agitation and froth and says 'our invention is something else than the mere reduction of oil.' The decree (of lower court favoring Minerals Separation) is reversed and the case is remanded with instructions to dismiss the bill."

The lower court had sustained letters patent No. 835,120 issued to Sulman, Picard and Ballot on Nov. 6, 1906, and assigned to the Minerals Separation Ltd. The appellant denied that these men were the first inventors of the process, or that there was any invention described in the patent.

The decision referred to the British patent to Haynes issued in 1860 and the United States patent issued to Everson in 1886. Miss Everson, the opinion reads, was the first to make the important discovery that the affinity of the oil for the metal was increased by the addition of an acid.—Boston News Bureau.

Notwithstanding that the Tye Copper Co.'s smeltery and that of the Britannia Mining and Smelting Co., both situated on Vancouver island, only four or five hours' steaming distance from Vancouver, have been idle for years, an agitation is being worked up to try and secure the establishment of smelting works at that city.

The suitability of parts of Quesnel river, Cariboo district of British Columbia, for gold dredging is being claimed and an effort is being made to attract the attention of dredge operators to the possibilities of successful gold dredging in that part of the province.

Ore receipts at the Consolidated Mining and Smelting Company of Canada's smelting works at Trail, B.C., during the current year to April 23, totalled 111,250 tons, of which 87,040 tons came from the company's own mines in East and West Kootenay districts, and 24,210 tons was custom ore from various parts of the Province and the neighboring State of Washington.



# COPPER LEACHING AND ELECTROLYTIC PRECIPITATION AT CHUQUICAMATA, CHILE\*

By E. A. Cappelen Smith.

The Chuquicamata copper mine is located at Chuquicamata, a station on a branch of the Antofagasta and Bolivia Railroad, in the Province of Antofagasta, Chile, between 22 and 23 degrees south latitude. Chuquicamata is 165 miles by railroad from Antofagasta, and 82 miles in a straight line from the coast and lies at an altitude of 9,500 ft. above sea level.

The deposit has long been known as the atacamite deposit of Chile, and for many years past has been mined by the natives. As evidence of their operations we find in the old workings many stone utensils, hammers, etc.—and mummies.

The deposit is a brochantite mineral contained in the cleavages of the granodiorite, mixed in part with chalcantite and to some extent with atacamite, and with a deposit of salt. A small amount of caliche containing nitrates is also present in the upper layers of the ore-body.

The so-called Llampera ore-body extends for a distance of approximately 8,000 ft. with an average width of about 500 ft. Throughout the whole length of the deposit numerous tunnels have been run and a very large quantity of ore has been left on the dumps from these tunnels. From the tunnels raises have been made almost to the surface, leaving in places a shelf over the workings 8 to 12 in. thick. A few shafts have also been sunk in the ore deposits, the deepest one to a depth of 110 meters.

## Acquisition and Development of the Property.

The property was acquired by Mr. Albert C. Burage of Boston, who, in connection with the firm of Messrs. M. Guggenheim's Sons, formed the Chile Exploration Company, which company now owns the property.

The property has been explored by churn-hole drilling. The drilling has developed an ore-body in excess of 200,000,000 tons. Most of the drill holes, however, were stopped while the bottom of the hole was still in ore.

The general direction of the ore body is north and south. Lately a number of drill holes have been sunk at a considerable distance west of the Llampera, and after going through from 300 to 400 ft. of capping, chalcocite and chalcopyrite have been encountered, giving indications of a very materially increased tonnage over that reported up to date.

In the Llampera zone, of the 200,000,000 tons of ore so far developed, approximately two-thirds is brochantite and one-third sulphides. No change in the formation has been shown, even in the deepest drill holes, the ore still appearing to be in the cleavages of the granite. The lower drill holes show primary ore. From the amount of ore developed and indicated, it appears that the Chuquicamata mine is probably the largest copper deposit known to-day.

It was generally assumed that this large and well-known deposit of ore was atacamite, and as such could not be treated at a profit by any of the established methods; first, on account of the highly siliceous nature of the ore and the absence of sulphides and water, and, secondly, on account of the volatilization in smelting of the copper chloride.

It was demonstrated that the mineral was not atacamite (oxy-chloride) but brochantite (oxy-sulphate) and that mixed with the brochantite in the upper parts of the ore-body was a deposit of salt. The brochantite, being an oxy-sulphate of copper, is insoluble in water but very readily soluble in dilute sulphuric acid. It was, therefore, evident that the way to treat the brochantite ore-body would be by wet methods.

## Design of Plant Now Building at Chuquicamata.

On account of the very large ore body already developed at Chuquicamata the first unit of the plant now building has been designed to treat about 10,000 tons of ore per day. The electrolytic refinery will have a capacity of about 335,000 pounds of copper per day.

The ore will be mined by steam shovels, practically no stripping being necessary. The ore will be transported to the mill, distant about 2½ miles from the mine, in standard American gauge railroad cars of 60 tons capacity each.

Arriving at the plant, the ore will first pass through gyratory crushers, thence through 48-in. Symons disc crushers, and finally through Garfield rolls until a product is obtained of about ¼ in. mesh. The ore will be carried on conveying belts from the crushing plant, after sampling, to the leaching vats. Each of the leaching vats has the following dimensions, 110 ft. wide, 160 ft. long and 16 ft. high. The leaching vats, six in number, will be placed end to end.

The belt delivering the ore from the crushing plant will be discharged into the leaching vats with the aid of an electric traveling bridge, spanning and traveling the entire length of the leaching tanks. The leached and washed residue will be removed from the leaching tanks by a 15-ton grab bucket traveling on an unloading bridge and, after sampling, will be delivered onto a conveying belt for disposal to the tailings dump.

The tanks are being built of heavily reinforced concrete, and will be lined with mastic asphalt 1½ in. thick. This tank lining has been developed by the Vulcanite Paving Company of Philadelphia, and consists of a specially refined Trinidad asphalt mixture, to which is added crushed quartz or granite.

In our experimental plant, where this lining has been in use for considerably more than a year, both in the leaching and electrolytic tanks, absolutely no difficulty has developed—not even a single leak. We have tested the material at a temperature of 50 deg. C. without finding any signs of softening, and as this is far beyond the range at which we intend to operate tests at higher temperatures have not been made, although the temperature limit, so far as softening is concerned, will probably lie somewhere between 50 deg. and 70 deg. C.

Tests have also been made to try the strength of this material from a physical standpoint, and in one case a 250-pound cathode was elevated about 5 ft. above the bottom of the tank and then dropped in such a way that one of the sharp corners of the cathode hit the bottom of the asphalt-lined tank. In this case a piece of the lining about ¼ in. thick and

\*A lecture delivered at the 25th General Meeting of the American Electrochemical Society, Columbia University, New York City, April 18 1914.

2 ft. in diameter was broken away, and as far as we could see the tank lining was just as good as ever.

The material has been tested in strong and weak acid solutions and found to be absolutely unattacked.

From the bottom of the leaching tanks the solution will be removed through eight 6-in. openings equally distributed over the tanks. A filter-bottom, consisting of two layers of 2-in. planks with a layer of cocoa-matting between, will be employed. This filter-bottom will be raised 4 in. above the bottom of the tank.

For the main solution circuits, 9-in. and 16-in. lead-lined iron pipe will be used. Open-boot horizontal centrifugal pumps, made of type-metal, will be used for pumping the solutions. The pumps will have a capacity of 550 cu. ft. per minute, elevating to a height of 60 ft.

In the leaching plant the cycle of operation will require approximately six days, of which one day will be occupied in filling the tank, two days in leaching, two days in washing and draining and one day in discharging.

The solutions will be conducted to the leaching tanks by gravity from nine solution-storage tanks placed above the leaching tanks. The dimensions of these solution-storage tanks are as follows:

Two tanks	12 ft. x 130 ft. x 150 ft.
Seven tanks	12 ft. x 70 ft. x 150 ft.

From the strong-solution tank the solution will flow by gravity through the dechlorinating plant, consisting of twenty-one 30-ft. long by 4-ft. inside diameter revolving steel drums lined with earthenware. These drums will be half full of shot copper. From these drums the solution, containing the cuprous chloride in suspension, will flow to seven Dorr thickeners made of concrete and lined with mastic asphalt. The clear solution overflowing will travel by gravity to the electrolytic refinery, while the thickened cuprous chloride, together with approximately 1 per cent. of the original solution, will go to filter presses.

The electrolytic refinery will consist of 510 electrolytic tanks of the following dimensions: 19 ft. long, 3 ft. 6 in. wide, 4 ft. 10 in. deep. They will be made of concrete, lined with mastic asphalt, and will be set through the floor, having inspection aisles underneath and a concrete working platform between the rows of tanks. The tank-house will be of concrete and steel construction.

Of the 510 tanks, 30 will be used for making cathode starting sheets, and the balance, 480 tanks, will be used for electrolytic deposition of the copper from solutions. The tanks will be arranged in five electrical circuits, with 96 tanks to a circuit, and will be divided into 30 solution circuits, the solution in each circuit flowing through 16 tanks placed in cascade.

The anodes, made of magnetite, will be 5 in. wide, 2 in. thick and 4 ft. long, with five to a bar. The cathodes will be 3 ft. wide by 4 ft. deep.

The spent electrolyte, containing about 1.5 per cent copper, will be pumped back to the storage tanks to be used for leaching subsequent charges of ore.

The cuprous chloride from the dechlorinating plant will be smelted and cast into shot copper for use in the dechlorinating drums.

The power plant will consist of a primary power station at the coast, using oil-fired Babcock & Wilcox boilers driving four steam turbines, connected to four 10,000 kw. alternating current generators. The current will be transmitted 85 miles at 100,000 volts to a sub-station located at the mill-site. The sub-station

for the electrolytic refinery will consist of seven motor-generator sets, each of 2,500 kw. capacity.

### THE WEIGHT OF RAND STAMPS.

According to the South African Mining Journal South Africa leads the world to-day in stamp milling practice. Here there are employed the heaviest gravity heads erected, and, excepting pneumatic and steam stamps, such as are, for instance, employed at the Dolcoath Tin Mine in Cornwall, and the copper mines of the Lake Superior region, the duty per head is the largest of any mining field in the world. Last year the duty per stamp per day along the Main Reef Series was 8.82 tons, as against 8.39 tons in 1912, 7.88 tons in 1911, 7.19 tons in 1910, 6.79 tons in 1909, and 6.27 tons in 1908.

"This rate of increase in tonnage milled per stamp in 24 hours is likely to be maintained this year, and it is anticipated that the duty for 1914 will work out at nine tons or over. Towards the end of this year the "State Mines" 50,000 tons per month equipment on the Modderfontein Government Areas will be completed, and at a somewhat later date the Modder Deep Levels reduction plant, which will consist of 60 stamps and 6 tube mills, and which will crush 30,000 tons per month, will come into operation. It is probable, too, that the Sub-Nigel will extend its crushing equipment in the near future. This mine is outside the Witwatersrand area, but as it comes under the control of one of the most progressive metallurgical administrations in the world, the subject of a possible extension to the Sub-Nigel mill certainly falls within the scope of this article. In the case of each of the mines mentioned in the foregoing, the stamps will be of "heavy pattern." The Rand's stamp duty has been increased, not alone by the use of coarse screening and the employment of tube mills, as auxiliary fine grinding machines, but by greatly increasing the falling weights of the stamps, that is by adding to the weights of stems, heads, tappets and shoes. Just to what degree extra falling weight has been responsible for the increase in duty, and to what extent coarse crushing in the mortar boxes and subsequent fine grinding in tubes have played their respective parts it is difficult to say; the subject is worthy of inquiry.

"In the middle nineties the duty of five tons per day was considered exceedingly good, and if we recollect rightly, the heaviest heads on the Witwatersrand at that time were the 40 stamps of the New Modderfontein, each of which had a falling weight of 1,250 lbs.

"There are in all erected on the Rand to-day 1,380 stamps of over 1,750 lb. weight, and of these between eleven and twelve hundred are at work. It seems clear that these weights are considerably greater than those of other gold mining fields, whilst the duties, too, are substantially higher. The world's record duty for gravitation stamps will be obtained by the Shamva Co., in the Abercorn district of Mashonaland, but it should be pointed out that these heads are of Nissen pattern, and are not of ordinary Californian type, such as this article is concerned with.

"The stamp weights referred to in the foregoing are substantially heavier than those recorded in respect of United States gold mines. Most of the installations in the United States are from 1,000 to 1,200 lb. per stamp. On the Mother Lode of California they vary from 850 to 1,250 lb., with an average, for 24 mills containing 1,090 stamps, of 1,000 lb. Heavier stamps, 1,400 lb., have been installed in the United States, and last year

1,500 lb. stamps were specified for the Commonwealth mill, Pearce, Ariz. We note an opinion recently expressed by a United States mining authority that on the Rand the weight of stamps appears to have reached a maximum. The accuracy of this view is open to question. Year after year the duty and the average weight of stamps operating along the Main Reef series increases. A tendency to ask for larger and larger tonnages from a given number of stamps is evident, in other words a disposition to intensify milling efficiency is to be observed. It is not unlikely that the deliberations of the Sunday Observance Commissioners will tend towards further intensification of efficiency. That is to say the falling weights of Rand stamps may be further increased and the duties correspondingly raised."

## MODERN ROCK DRILLS

By P. B. McDonald.

It seems that a new rock drill is invented every week. The mine manager nowadays has as much trouble keeping track of the latest in rock drills as the average citizen has in automobiles. It used to be possible to classify drills by their mechanical principles, but there are too many principles, too intricately mixed, to allow one to remember them all. The most convenient classification is the use for which they are desired, sinking, drifting or stopping.

### Sinking.

Shaft sinking is, at first thought, an insignificant part of mining, yet in many mines there is always sinking going on, in one form or another—deepening old shafts, starting new ones, winzes, etc. Usually the best miners are reserved for shaft sinking (probably because it costs several times as much as drifting), and short shifts are allowed, particularly in wet ground.

For sinking a drill must be adapted for "down-holes," practically vertical. The heavy, reciprocating drill mounted on tripod or bar, has always been popular. One man was accustomed to bail water with a can into the muddy hole where the drill-steel was pumping up and down, while the other manipulated the crank for feeding the drill ahead. Full length holes were favored, six ft. or more, on account of the bother in removing all the heavy paraphernalia when blasting. The tendency lately has been toward little one-man sinkers, on the order of a "plugger" drill, that is, unmounted and held in the hands. These sinkers are not reciprocating; but are of the "hammer" type. The drill steel is stationary and is hammered with a great number of comparatively light, quick blows. The same principle made "stopper" drills very popular.

At first, such drills had to be rotated by hand, but automatic rotation was introduced and is largely responsible for the type's popularity. As compared with a reciprocating drill, the feeding is accomplished merely by "pushing" by the miner, and not by a screw-feed regulated by a crank. Obviously, these light sinkers are easily removed at blasting time. There is therefore a tendency toward the European practice of shorter holes and more frequent blasting. Their chief advantage, however, is in the fact that about twice the number of drills can be used in a given space as with the tripod drill. Whenever used, these little sinkers are making records.

### Drifting.

Drifting is still accomplished from a column or bar. There has been occasional talk of drifting with an un-

mounted drill, but only in exceptional cases has it succeeded. This statement, of course, does not apply to soft rock, such as the hematite on the Mesabi range in Minnesota, for which unmounted drills and power augers are already replacing the hand auger methods. One decided innovation in hard rock drifting is the application of the "hammer" principle in place of the reciprocating drill. There is at least one widely successful drill, which combines the hammer principle with a heavy, mounted, screw-fed type, and is particularly adapted to hard rock.

In drifting, more than in stopping or sinking, attention has to be directed to removing the rock cuttings which are liable to remain in the drill hole and cause trouble. In sinking it is easy to put water into a down-hole, while in stopping—meaning overhand stopping—the rock chippings fall down by gravity. But in drifting there are some holes of a slight upward inclination, not steep enough to cause the chippings to fall back and a little too steep to throw water up. Hence the success of the "water" drill, which forces a stream of water through the hollow drill-steel.

Of course, the most decided tendency in recent reciprocating drills has been the advent of light, one-man machines, with special light weight bar and column. This has been brought about by the demand for greater efficiency, inasmuch as one man, with a fast drilling, light machine can frequently do as much work as two men with a heavy drill.

### Stopping.

The success of the "stopper" drill is an old story. Wherever "up-holes" are desired, as in over-hand stopping and in raising, the one-man, hammer type, air-feed drill is an acknowledged winner. It has revolutionized stopping the world over. There are a few districts where, for some reason, stopper drills never got a start; but it is usually for some exceptional reason or prejudice. The stopper has one big advantage—it is a one-man drill which is easy to run. Of course, the runner has to rotate it, by short arm swings, through a quarter circle, but it feeds itself—or rather the pressure of the air feeds it ahead; it requires no "rigging up." There are no nuts to loosen and changing steel is the simplest of operations. It is easy to drag around. Since it is used only for up-holes, the rock chippings fall back by gravity. Very often, the mine foreman will pick out from the force of miners some man who has a capacity for doing things unaided, and will keep him regularly at raise work with a stopper drill.

The total value of the metalliferous minerals produced in the Coast district of British Columbia is shown by official records to be increasing to an important extent. By five-year periods it has been as follows: For 1899-1903, \$3,148,256; for 1904-1908, \$4,264,525; for 1909-1913, \$7,270,495.

A news item lately published in British Columbia is as follows: The Kennicott Mines Co., operating the Bonanza copper mines in Alaska, controlled by the Morgan-Guggenheim syndicate, has declared and paid a \$1,000,000 dividend. This brings the total distribution since 1910 up to \$5,000,000.

The Canadian Pacific Railway Co. is stated to be applying for running rights over the Canadian Northern Railway from just east of Rocky Mountain House, where the lines of the two companies junction, west to the Brazeau coal mines, so that Red Deer, Alberta, expects to be by late next summer connected by both railways with large coal deposits.

## LILLOOET DISTRICT, BRITISH COLUMBIA

The following are excerpts from an official report made to the Provincial Government by Mr. G. M. Downton, British Columbia land surveyor, on Lillooet district, the only town of importance in which is Lillooet, distant from the city of Vancouver, taking the route of the Pacific Great Eastern Railway, now being constructed, 163 miles.

The Pemberton section is looked upon by mining men who have a knowledge of the district as offering great possibilities in iron, copper and silver. The provision of transportation facilities will make accessible several properties hitherto unworkable. The number of "wildcats" which in years gone by have shaken the confidence of investors throughout the Province in Lillooet mining propositions, have done much toward hampering the development of the mining industry in this region. But, in the opinion of mining experts, the country opened up by the Pacific Great Eastern Railway in passing through from Green river to Seton lake and Lillooet is one of the most promising mining regions in British Columbia.

The railway follows the west side of Anderson lake close to the water throughout the entire length of the lake, a distance of about ten miles. Both McGillivray and Roaring Creeks flow into Anderson lake on the west side. There is a water power of considerable magnitude near the mouth of McGillivray creek, where this creek falls over a cliff about 100 ft. high, in a magnificent waterfall. A small amount of this power is utilized at a saw mill on the lake shore near the mouth of the creek. The country lying on both sides of McGillivray creek, from its headquarters to its mouth, is highly mineralized, and a large number of mineral claims have been staked and prospected, but owing to lack of transportation very little development work has been attempted.

At present the town of Lillooet is reached by way of Lytton or Ashcroft, both on the main line of the Canadian Pacific Railway, the former being 47 and the latter 63 miles distant. It has a daily mail service and a telegraph office, and has telephone communication with Lytton, Shot Portage and Bridge River. It has three churches, two good hotels, several well supplied stores and a population of about 300, which has been largely augmented recently by the floating population connected with railway construction. It is beautifully situated on an extensive bench above the Fraser river, with a south-easterly aspect, and is well protected from the northerly winds by a high mountain at the rear of the town. The climate is dry and invigorating, the heat in summer seldom excessive, and the winter comparatively mild. Snow seldom lies for any length of time in the winter, and the water supply is good. With the completion of the railway, Lillooet will be within seven hours' run of Vancouver. It is immediately surrounded by a country the possibilities of which have up to the present hardly been recognized, owing chiefly to the lack of markets and adequate means of communication.

The north fork of Bridge river, about 18 miles north of Lillooet, is reached by pack trail up the valley of the main Bridge river, which enters the Fraser river five miles north of Lillooet. As with many other parts of the district, lack of transportation facilities has seriously hampered development, for up to the present time the only means of access has been by pack trail; but late last autumn the Provincial Government commenced the construction of a wagon road into this valley, and will probably complete it before the end of 1914. There is

a post office situated on Messrs. Birch and Duncan's ranch, about three miles above the junction of the north fork with the main Bridge river, with a monthly mail service. The name of this district is "Moha," an Indian name signifying "Junction of Waters." Placer mining has been carried on in a desultory manner for several years in this neighborhood, but as yet results have not justified extensive operations.

To Mr. Downton's notes may be added the information that lode mining has been done both on McGillivray creek and on Cadwallader creek, the latter being a tributary of the north fork of Bridge river, and that the 1910 Annual Report of the Minister of Mines for British Columbia contains an illustrated report on Lillooet district by Mr. Wm. Fleet Robertson, Provincial Mineralogist, which report is obtainable gratis on application to the Department of Mines, Victoria, B.C.

### LE ROI NO. 2, LTD.

The thirteenth annual meeting of the shareholders in the Le Roi No. 2, Ltd., operating the Josie group of mines and a concentrating mill in Rossland camp, British Columbia, was held in London, England, on February 23 last. Lord Ernest Hamilton, chairman of the Board of Directors, presided.

The following is the greater part of the directors' report for the fiscal year:

**Accounts.**—The accounts show a balance of £1,598 4s. 2d. in favor of Profit and Loss, after writing off £21,650 3s. 5d. as depreciation in respect of development, machinery, buildings, etc., which, added to the balance brought forward from 1912, namely £26,924 10s. 9d., makes £28,522 14s. 11d. to be carried forward.

**Production.**—On reference to the mine manager's report, it will be seen that 40,575 tons of ore was mined, of which 19,032 tons was shipped to the smeltery, the average value per ton being \$19.60, as against 18,257 tons of an average value of \$20.10 per ton shipped during the previous year. From 16,530 tons of low grade ore there was produced 1,595 tons of concentrate, averaging \$19.62 per ton. Mining costs worked out at \$3.57 per ton and smelting charges at \$6.07 per ton, making a total, after allowing for development and depreciation, of \$12.48 per ton, as against \$12.18 per ton for 1912.

**Exploration.**—A large amount of exploration work has been done during the period under review; the most important has been the development of the Rodney ore body on the 1,500 ft. level. Thanks to the courtesy of our neighbors, the Consolidated Mining and Smelting Company of Canada, we have been able to explore this ground from their workings. Moreover, satisfactory arrangements have recently been come to with them for the investigation and stoping in the future.

The importance of this ore body, which was foreshadowed by the chairman in his speech a year ago, has been amply confirmed. The work done has been more than paid for by the ore extracted in the course of development, and the winze now being sunk is revealing a width of 22 ft. of mineral of an average assay value of \$16 a ton.

Exploration on the 600 ft. level on the Annie vein, west of what is known as the white dike, disclosed No. 37 ore body, which proved to be of great value, containing good gold and copper values. Some of the richest ore from the mine has been obtained here. The

vein has been traced to the 900 ft. level, but it was at that point unprofitable. The rich ore, however, has been proved to extend below the 700 ft. level, and it is not unreasonable to expect further discoveries in the neighborhood.

As regards the northern development, although nothing of a sensational character has yet been encountered, the diamond drill has revealed 2.5 ft. of well mineralized ore on the Monita claim. A drift is being run to explore this find, which may prove to be important, in view of the exceptionally fine ore body which, it is understood, the Consolidated Co. has in the adjoining ground. Altogether 4,633 ft. of drifting, raising and crosscutting has been done at a cost of \$15.87 per ft., and 15,075 ft. of drilling at a cost in labor and material of \$24,142, or \$1.60 per ft.

**Van-Roi Mining Co., Ltd.**—The confident hopes expressed at the meeting last year in respect of this company (in which the Le Roi No. 2 holds a large interest), have unfortunately not been justified by results. At that date the ore exposed at all working points had greatly improved in grade, and it seemed reasonable to expect satisfactory and profitable returns as soon as adequate ventilation permitted stoping to be resumed. Subsequent work was, however, disappointing, the ore becoming poor in grade. Owing to the few points of attack available, this necessitated a fresh scheme of development and exploration, the benefit of which is only now beginning to be obtained.

#### At the Meeting.

At the meeting, the chairman stated that among the important improvements at the company's mines at Rossland during the fiscal year, was the proving of the existence of profitable ore on the 900 ft. level of the company's Josie mine, which is a zone heretofore looked upon as more or less unprofitable. The most important development had been on the 1,500 ft. level, which corresponds to the 1,650 ft. level of the adjoining Le Roi mine. There had been proved to occur at that depth an ore body about 22 ft. in width. By the courtesy of the Consolidated Mining and Smelting Co., which owns the Le Roi, the Le Roi No. 2 company had been permitted to explore on its 1,500 ft. level from the 1,650 ft. level of the Le Roi, but so far no ore had been stoped from these new workings. Arrangements have, however, just been completed with the Consolidated Co. that will allow of ore being extracted from this new region and sent out through the Le Roi workings. This new development opens up great possibilities for the future, not only as regards the value of this particular ore body, but because it offers facilities for further development at depth which may, and should, result in the discovery of other ore bodies on that level, and at greater depth.

Mr. Chas. H. Stewart, of Alex. Hill & Stewart, managers and consulting engineers for the Le Roi No. 2, Ltd., also gave the annual meeting information of much interest to shareholders in the company. He said that the production for the four months from the end of the last financial year had a value of \$124,000, while working expenses had been \$41,000, and development expenditure \$42,500, leaving a net profit for that period of approximately \$40,000. It was impossible to forecast the tonnage of ore reserves which would be opened on the deep ore body, for as yet they had only two dimensions of it—they knew its length and width, but had not yet explored its depth, except that a winze had been sunk in it 17 ft. It had the appearance of being a large, important and valuable ore body, and,

occurring as it did at the deepest level yet reached in the company's property, it added to the chances of discovering other ore bodies in depth. A few years ago it was supposed that ore bodies in Rossland mines were of no value below the 500 or 700 ft. level, but recent experience in Rossland camp pointed to the recurrence of good value at greater depths. A year ago the Le Roi No. 2 company might have deepened its own shaft and crosscut to the ore body at the 1,500 ft. level at a cost of £5,000 or £6,000, but by not doing so, while they had lost in time, they had gained in cash, for arrangements had since been made under which they will be able to work that ore body through the shaft and other workings of the neighboring Le Roi mine.

With regard to the development of the northern part of the Le Roi No. 2 company's property, Mr. Stewart said that by boreholes and other explorations they had discovered the westward continuation of an important ore body, which had been successfully exploited in the adjacent War Eagle mine. It was not proved absolutely that it was the same ore body, but both they and their neighbors believed it to be the same. It was situated on the Monita claim, which the Le Roi No. 2 company acquired in the course of exchanges with the Consolidated Co. last year in connection with the elimination of extra-lateral rights. Another borehole had discovered what they believed to be the downward continuation of No. 1 vein; the value was good, but the width was very small; it must be left to further exploration to follow it and determine its worth. As to the No. 37 ore body—it contains ore of high copper value and a fair value in gold. It was the North Annie vein; it had been found on the 600 and 700 ft. levels, and was now being worked above the 900 ft. level, but they had not found it to exist as deep as the 900 ft. level, therefore there was no reason to look for its downward continuation. However, there was sufficient ore in that body to keep them busy for some months.

#### ANNUAL REPORT OF VAN-ROI MINING CO., LTD.

The annual report of the directors of the Van-Roi Mining Co., Ltd., for the year ended September 30, 1913, submitted to the general meeting of shareholders held in London, England, on February 23, contained the following:

**Accounts.**—The accounts, after writing off £10,715 1s. 4d. as depreciation on development, machinery, buildings, etc., show a balance to the debit of profit and loss of £20,559 7s. 3d., which, deducted from the amount brought forward from last year, namely, £23,711 13s. 5d., leaves £3,152 6s. 2d. to be carried forward. The Board wishes to emphasize the point that practically the whole of the development of the mine has been paid for out of revenue.

**Production.**—On reference to Messrs. Alex. Hill & Stewart's detailed report, it will be seen that during the period under review 26,617 tons of ore was mined.

The mill ran for 4,271 hours, and 25,702 tons of ore was treated of an average assay of 8.31 oz. silver per ton, 2.28 per cent. lead and 4.99 per cent. zinc. There was produced 688.5 tons of lead concentrate assaying 145.23 oz. silver per ton, 56.8 per cent. lead and 11.38 per cent. zinc, and 841 tons of zinc concentrate assaying 47.46 oz. silver per ton, 4.1 per cent. lead and 43.93 per cent. zinc. The cost of mining was \$2.98 per ton, and of concentrating \$1.03 per ton.

**Development.**—There was done 1,891 ft. of drifting, crosscutting and raising at an average cost of \$13.68 per ft.

In view of the poor results obtained and on a resurvey of the mine being made, it was resolved to have recourse to diamond drilling with a view to ascertaining whether or not the main vein had forked, and if a more important, or possibly chief branch, existed to the north of Level 9. There was accordingly drilled 998.5 ft., at an average cost of \$1.71 per ft. The results, though not finally conclusive, have indicated the existence of a northerly vein, which will be the subject of further exploration.

The Board much regrets that the hopes expressed at the meeting last year have not been justified by results. At that time all the working faces had much improved in grade, and it only required adequate ventilation to proceed with satisfactory and profitable extraction of the ore bodies. Unfortunately subsequent work proved disappointing with a marked falling off in grade at every point. As a consequence of this it became necessary to shut down the mill for some months until development and exploration had opened up fresh ore. The result of this work and systematic diamond drilling has been the discovery of new ore and the partial resumption of milling, and present indications are once more favorable.

The meeting was presided over by Lord Ernest Hamilton, chairman of the company, who after reviewing the year's operations and results moved the adoption of the report and balance sheet, which was done, following an address by Mr. Chas. H. Stewart, of Alex. Hill & Stewart, managers and consulting engineers for the company, who visited the company's mine and concentrating mill near Silverton, B.C., last November. Mr. Stewart informed the shareholders that though the fiscal period ended September 30, 1913, had been an unsuccessful year, the five months subsequent to the closing of that year's accounts had been successful. His belief was that they would continue to make profits. Since November they had made a profit of \$15,500, and they were now milling ore at the rate of 2,200 tons a month. This was about half the rate of the successful year they had reviewed at their last meeting. Recent development work done in the Van-Roi mine had been with the object of finding new ore supplies, but they had not yet stoped ore they had found. Their policy was to limit, as far as possible, fluctuation in production, so as to keep up a regular supply of ore for the concentrating mill. Their greatest commercial recoveries were made when they got silver value with the lead concentrate rather than with the zinc, consequently it was economical to hold back high grade ore in lead in order to help the ores that were deficient in that metal. They had been developing high grade lead ore on the 900 ft. level, where for 132 ft. the ore averaged 36 oz. of silver to the ton, with 7.5 per cent. lead. That ore shoot had not been stoped, and it certainly ensured further considerable supplies of ore; but it did more—it showed that in the deepest level of the mine they were getting ore just as good as they had found in the upper levels.

Part of the chairman's comment was: "Those of you who follow closely the fortunes of the Van-Roi mine will have noticed that the last monthly returns show a steady and progressive improvement, and there is every reason to believe that the improvement will continue to be maintained. It is a hopeful feature that our property is of considerable extent. The chief trouble is that there does not appear to be any regular

fixed rule to assist mining engineers in forming an exact estimate as to where the ore bodies may be looked for.

### GEOLOGICAL SURVEY PUBLICATIONS.

In this issue we reprint extracts from reports on Geology and Mineral Resources of the Tulameen District, B.C., by Charles Camsell, and Bathurst District, Nova Scotia, by G. A. Young. The complete reports, known as memoirs No. 26 and 18, respectively, can be obtained on application to the Geological Survey.

### COAL-DUST INVESTIGATIONS.

Mr. J. Taffanel, mining engineer, former French Inspector of Mines and now the distinguished Director of the French Mine Experiment Station at Lievin, is paying a visit to the United States. He is known internationally for his original investigations of coal-dust explosions and means of prevention. He is a guest of the United States Bureau of Mines, while collaborating with Chief Mining Engineer, George S. Rice, and other of the bureau's staff in especial experiments at the bureau's experimental mine near Bruce-ton, Pennsylvania. Mr. Taffanel arrived in New York from France on April 12, and proceeded immediately to Pittsburgh, where he has been busily engaged in the tests and in studying the records of past tests at the experimental mine, the final object of which is to diminish the danger of coal-dust explosions. While fire-damp is a serious menace, its effects if ignited, would be local if dry coal-dust was not present to extend the explosion throughout the mine.

Mr. Taffanel's studies at Pittsburgh and Bruce-ton were interrupted by the news of the disaster at the Eccles Mine, West Virginia, to which he went with Mr. Rice for an investigation. This is not Mr. Taffanel's first investigation of an American mine disaster. In 1907, on behalf of the French Association of Coal Operators, which has established the Lievin Station as a result of the great Courrieres disaster of 1906, he came over to investigate the terrible Monongah disaster with 356 victims, and while here investigated the Darr Mine and Naomi Mine explosions. He has also investigated the large British mine disasters of recent years, including Hulton and West Hanley Collieries and the recent great disaster at the Universal Colliery at Senghenidd, South Wales.

Besides the explosion investigations, Mr. Taffanel carries on at the Lievin Station, tests of safety lamps, explosives and mine-rescue apparatus and he has an organized crew of rescue men ready to visit any mine disaster in Northern France.

In response to inquiry, Mr. Taffanel said, "I came to this country with the purpose of studying in collaboration with the Bureau of Mines and the Chief Mining Engineer, Mr. Rice, some questions concerning the danger of coal dust and the means of prevention of this danger.

"I began the experiment on this subject in 1907, when the Coal Mine Owners' Association of France decided, some months after the Courrieres disaster, to organize the experimental station at Lievin. I have made up to now more than 1,400 explosions in the experimental gallery and collected a considerable amount of data concerning the relative danger of many coal dusts or coal and stone-dust mixtures. Although they are pursued on a big scale, in a gallery 1,200 ft. long, the experiments at Lievin do not realize exactly the condition of the mine, and the results must be checked

by means of comparative tests in an actual mine. I made such tests last year, in an abandoned passage way of the Community Mine, in France, but was obliged to stop after an explosion which destroyed a part of the passage way. In two months, I will make tests of the same kind in another abandoned French mine at Montvieq. In the meantime, I was very glad to be invited by the Bureau of Mines to follow the experiments in the Bruceston Mine, which is perfectly equipped for such experiments. I find a great profit in studying the very important results obtained in this mine by Mr. Rice. Moreover, the experimental comparison of the Lievin and Bruceston results is doubly important as it gives a confirmation of the Lievin results under the real conditions of the mine. It allows to be taken into account the large amount of data obtained at Lievin for the application to the Bruceston Mine or, generally speaking, to the American mines.

"Some years ago, I designed the first form of arresting barriers which have proved, in many tests, to be effective for stopping coal-dust explosions. About one year and a half ago, I began studying new forms of arresting barriers, i.e., tanks or boxes, containing a great quantity of extinguishing materials, water or stone-dust, and automatically opened by the air wave preceding the flame. Mr. Rice has followed paralleled studies and we find a great profit in collaborating for improving these devices in order to get the most practical and effective solution.

"The coal-dust problem is a very difficult problem of international interest. All countries which have undertaken to minimize this great danger must unite their efforts."

#### MINING ACCIDENTS IN ONTARIO.

Mr. T. F. Sutherland, Chief Inspector of Mines, Ontario, reports that during the first quarter of 1914 there were 17 fatal accidents, causing the death of 20 men, at the mines, metallurgical works and quarries regulated by the Mining Act of Ontario. The quarries include quarries proper, clay banks, and sand and gravel pits.

In and about the mines 8 men were killed; 6 of these fatalities occurred underground, and 2 on the surface. At metallurgical works 5 men were killed, 2 of the fatalities resulting from railroad operations. In the quarries there were 6 fatal accidents, resulting in 7 men killed; 4 men were killed in clay pits, 2 in sand and gravel pits, 1 in a quarry proper.

The increase in the number of fatalities reported from quarries is due to the efforts being made by this Department to obtain complete returns of such accidents. It is not believed that complete returns are yet being obtained from such works. The inspectors have found that such work is conducted in a much more hazardous manner than underground mining operations. This is due to several causes—the majority of such works employ only from 4 to 10 men and work intermittently; the men employed are unskilled and unacquainted with the danger of their work; there is not usually intelligent supervision of the work, the main thought being to get out the material as cheaply as possible. Clay banks and gravel pits are undermined and allowed to fall from their own weight. If a workman is caught, the blame for the accident is immediately thrown on him by the management; if he refuses to work under such conditions, he is discharged.

Climatic conditions were responsible for 6 fatalities. On January 13th, the coldest day in lower Ontario for 20 years, 4 men were killed in 2 accidents, both accidents being due to the unusually low temperature. The first warm weather in the second week of March resulted in conditions responsible for 2 fatal accidents.

It is only fair to draw attention to the fact that the classification adopted by this department is very wide, and includes some fatalities which might reasonably be omitted as not being due to actual mining operations.

R. L. Brooks, the night superintendent of the Canadian Furnace Co. at Port Colborne, jumped into the bell of the blast furnace (refusing to wait for a rope) in a heroic but foolhardy attempt to rescue one of his employees.

An employee of the Porcupine Miracle Mining Co., while off duty, was killed in a shaft accident. A teamster employed by a city contractor was killed at Ellins' gravel pit, Toronto, through refusing to obey the pit foreman and persisting in loading at a dangerous place. An employee of the Dominion Bridge Co. was killed on the steel construction work at the Dome mill, South Porcupine. In these three cases the deceased at the time of the accident was not under the control of officials of the mining company.

Louis Pizzolletti, who had his back broken in an accident at the smelter of the Mond Nickel Co., Victoria Mines, on September 16th, 1912, died at St. Michael's Hospital, Toronto, on January 25th, 1914.

K. O. Olsen, who had his back broken in the cave-in at the Creighton mine on December 9th, 1913, died in the Toronto General Hospital on March 21st, 1914.

William Janes, Canadian, aged about 40, married, and employed at the Cobalt Lake silver mine as a foreman in charge of the cutting to lower the water in Cobalt lake, was instantly killed about 8.30 a.m., January 20th, 1914, by the fall of a derrick.

G. Holovaci, Roumanian, aged about 26, unmarried, employed at the Cobalt Townsite silver mine as a hammer-drill runner in the Townsite mine, Cobalt, fell down a raise about 8.30 p.m., March 17th, and died as a result of his injuries March 24th, 1914, in the Cobalt Mines Hospital.

John Johnson, Finn, aged between 40 and 45, married, with a wife and three children in Cobalt, was instantly killed about 11.30 a.m., March 7th, by a fall of rock in stope 29 east, in the Crown Reserve mine.

Napoleon Roy, of Point Levis, Quebec, aged 36, single, employed as a riveter by the Dominion Bridge Co., contractors for the steel work of the extension to the stamp mill at the Dome Gold mine, fell 40 feet from a scaffold, about 10 a.m., January 26th, and died at 1.15 that afternoon from injuries received in the fall.

James Dunn, English, aged about 38, single, employed as a driller, was killed about 4.45 a.m., February 24th, by falling out of the bucket, or by a round of shots in the shaft of the Hewitt Lake Mining Co.'s prospect at Gowganda.

Maxim Mushta, Russian, aged 32, married, employed as a shoveller, was killed shortly before 5 p.m. January 18th, by falling down the shaft at the Miracle mine in Langmuir township. Mushta had been in the employ of the company about two months, and was a good workman, but one of the worst offenders in the practice of riding the bucket.

Edwin Mattson, Finn, aged 26, married, employed as drill runner, and Hunka Kalari or Hugo Kalliomaki, Finn, aged 27, married, employed as drill helper, were found dead in 43 raise of the Garson mine of the Mond

Nickel Co., Limited, at 6.30 a.m. March 28th. Death was due to carbon monoxide poisoning, the bodies showing to a very marked degree the post-mortem cherry red discoloration.

Peter Rofel, an Austrian, aged 45, married, employed as a keeper at No. 3 blast furnace of the Algoma Steel Corporation, received burns about the face and body on February 1st at 5.50 p.m., which resulted in his death at the Sault General Hospital on February 4th, at 2 p.m. The deceased had been in the employ of the company around the blast furnaces for three years.

James Doyle, a Canadian, aged 20 years, unmarried, employed as a brakeman for the Algoma Steel Corporation, received injuries while riding on the footboard of an engine in the blast furnace yard on Thursday, February 5th, at 11.15 a.m., which resulted in his death at the Sault General Hospital at 1.15 p.m. of the same day.

Robert Lester Brooks, aged 47, Canadian, married, and Ernesto Tisiott, aged 16, Italian, single, were asphyxiated, and found in the second or large bell of the blast furnace at the works of the Canadian Furnace Co., Ltd., Port Colborne, about 8 p.m. on Tuesday, January 13th.

H. Benoit, a Canadian, aged 20, single, employed as a brakeman in the smelter yards of the Mond Nickel Co., Coniston, was injured in a wreck at 5.50 p.m., January 15th, receiving injuries which resulted in his death at the Sudbury Hospital on the morning of January 18th.

Francesco Sicilia, an Italian, aged 35, married, employed as a laborer in the clay pit of the Dominion Sewer Pipe Co., at Aldershot, was instantly killed at 7 p.m., March 13th, by being crushed under the electric shovel when it overturned.

Dennis McCluskey, English-speaking, aged 22, single, employed as a teamster by contractor John Mullin, of Toronto, was instantly killed by a fall of ground in the gravel pit of Wesley Ellins, Scarlett road, York township, at 1.30 p.m., March 14th.

Victor Pevi, Finn, unmarried, aged 33, received injuries on March 4, 1914, about 11 a.m., in the quarry of the Intercities Quarry Co., near Port Arthur, from which he died the following day.

Joseph Bowers, a native of England, aged 36, married, living with his wife and family of five children at Glenburnie, and employed as steam truck engineer by the Kingston Sand & Gravel Co., was struck by a large lump of frozen sand at the pit of the company, 11 a.m. March 3rd, receiving injuries which caused his death three hours later.

On January 13th, in the clay pit of James Pears & Son, 118 Eglinton avenue, Toronto, George Woodhouse, a Canadian, aged 50, married, employed as a laborer, and Henry Martin, a Canadian, aged 35, married, laborer, were killed by being struck by a fall of clay which was being undermined.

Edward Smith, a Canadian, aged 35, married, employed as foreman at the Russell Brick works, 40 Blake street, Toronto, was instantly killed by a fall of clay at 2.30 p.m., February 25th.

The Canadian Pacific Railway Co. is preparing to complete the work of standardizing the Kaslo & Slovan Railway, well advanced, before the winter's snow became too deep to allow of work being continued. Shipment of ore from the Utica mine will be resumed as soon as transportation shall be provided.

## BOOK REVIEWS

**A TEXT-BOOK OF GEOLOGY**—By James Park, Professor of Mining in the University of Otago, N.Z.—Charles Griffin & Co., Ltd., London—Price, Fifteen Shillings.

This book of 554 pages has been written for use in mining schools, colleges and secondary schools. It comprises a systematic course of lectures, carefully revised and expanded. It is well illustrated with half-tones and drawings.

There are three parts.

Part I. (pp. 1-299) deals with first principles, scope of geology, denudation of the land, work of stream and rivers, snow and glaciers, geological work of the sea, rock-building, rock structures, earth movements, joints, faults, cleavage, composition of the earth's crust, rock-forming minerals, sedimentary rocks, volcanoes and volcanic action, igneous rocks, plutonic, hypalysal and metamorphic rocks, fossils, conformity and unconformity.

Part II. (pp. 300-503) is historical. The several eras and systems are taken up in order, the chapters being headed: History of the Earth, Eozoic Era, Paleozoic Era, Ordovician System, Silurian System, Devonian System, Carboniferous System, Perinian System, Mesozoic Era, Triassic System, Jurassic System, Cretaceous System, Canozoic or Tertiary Era, Miocene and Pliocene, Pleistocene and Recent, Development of Surface Features.

Part III. (pp. 504-550) is devoted to economic geology and the elements of field geology and geological surveying.

Appendix A gives method of converting magnetic bearings to true bearings. Appendix B describes the determination of strike and dip from contoured maps.

There is a short bibliography and a voluminous index.

**COMPRESSED AIR—A Treatise on the Production, Transmission and use of Compressed air**—By Theodore Simons, E. M., C. E., Professor of Mining Engineering, Montana State School of Mines—McGraw-Hill Book Co., 1914—Price \$1.50—Fore Sale by Book Department, Canadian Mining Journal.

In this book of 167 pages Professor Simons presents the principles underlying the production, transmission and use of compressed air, without attempting extensive descriptions of all existing types of compressors and the countless appliances using compressed air.

It is designed essentially as a text-book, to give the student a thorough grounding in principles, with emphasis on practical applications, and problems to make clear and fix the subject in the student's mind.

There are four parts. The first three are devoted respectively to production, transmission, and use of compressed air. The fourth deals with air compressors and accessories. The contents are indicated by the following chapter headings:

The Physical Properties of Air. Definition of Terms Used in Discussing Compressed-Air Problems. Behavior of Air Undergoing Compression and Under the Application of Heat. The Compression of Air in Air Compressors. Theory of Air Compression. Clearance, Volumetric Efficiency, Capacity, Speed, Mechanical Efficiency of Compressors. Two-Stage and Multi-Stage Compression, also Known as Compound Compression. Effect of Altitude on Air Compression. The Compressed Air Indicator Card. Cooling Water Required in Compression; Efficiency of Compressor Plant; Air-Compressor Explosions.



Transmission of Compressed Air. Dimensions of Pipe Lines for Conveying Compressed Air.

Theory of Air Engines. Effect of Loss of Heat, Generated During Compression, on the Ultimate Useful Energy Residing in a Given Quantity of Compressed

Air. Internal or Intrinsic Energy of Air. The efficiency of a Compressed Air System. Reheating of Compressed Air.

Examples of Modern Air-Compressors of the Reciprocating Type. Important Mechanical Features of Air Compressors. Compressor Accessories.

## PROPOSED T. & N. O. RAILWAY EXTENSION TO JAMES BAY

By J. G. G. Kerry,  
Consulting Engineer, T. & N. O. Ry. Commission.

The construction of the Temiskaming and Northern Ontario Railway was commenced about the year 1900, the enterprise being undertaken by the Provincial Government of that date in a somewhat blind compliance to the popular demand that a very definite effort should be made to open up the large and unknown area of land that lay to the north of the main line of the Canadian Pacific Railway and between the north shore of the Great Lakes and the south shore of Hudson's Bay. Almost simultaneously, the Provincial

larger unit is located entirely to the south and east of a line joining Orillia and Pembroke. The district lying between these two lines, with the exception of such towns as North Bay, Sudbury and Port Arthur, may be said to be entirely unsettled; this was absolutely true little more than 10 years ago, and in large measure remains true to-day. A possible result of the existence of so definite a cleavage in the settlement of the Dominion is the growth of a distinct west and a distinct east. From a national point of view this, more



Fig. 1

Government sent out a number of exploring parties throughout this area. These parties were in charge of various members of the Ontario Association of Land Surveyors, and from their reports the province first learned of the existence of that large area of arable land that is now known as the Clay Belt, and shown in Fig 1.

The importance of this so-called Clay Belt, not only to the Province of Ontario but to the Dominion of Canada at large, cannot be over-estimated. A study of the geographical distribution of our population at the present time will show that it consists of one large and rapidly growing unit which is located entirely to the west of the line of Lake Winnipeg. A second and

than any other one thing, is what we all desire to prevent and no effort should be spared that will tend to keep this possibility from becoming a reality.

Examining a map, such as Fig 1, upon which the outline of the Clay Belt is marked, it will be seen that this Belt, which consists of most fertile land, stretches almost half way across the unsettled area which at present divides the Dominion. The writer, therefore, regards the work of the commission in opening up the Clay Belt for settlement as possibly the most important national work now in progress in Canada.

Other organizations are also active in this work of development; the Algoma Central Ry. is building in from the south and west; the National Ry. is tra-

From an address to the Toronto Branch, Canadian Society of Civil Engineers, March 26th, 1914, published in The Canadian Engineer, May 7.

versing the Belt from west to east. The next work of importance would, therefore, appear to be the establishment of an outlet to the north and the establishment of a rail connection with the only ocean line within the confines of the Province of Ontario. With such an end in view the commission has directed the carrying-out of the investigations that are discussed in this paper.

The most attractive location for the proposed terminal so far as present information goes, is at the mouth of the Moose River, as shown in Fig. 2, and this point may be referred to as Moose Harbor. It may be remarked that by far the larger portion of the Clay Belt is drained by the tributaries of the Moose River

arduous undertaking. The distance can readily be run within 24 hours, and, as a matter of illustration, the run may readily be compared to the present journey from Montreal to Chicago, or from Toronto to Port Arthur; in each case the distance between the points mentioned is rather greater than the distance from Toronto to Moose Harbor will be, this distance being roughly estimated at 670 miles.

The enterprise of extending the Temiskaming and Northern Ontario Railway to the Bay must be regarded as one of colonization and development; it is not possible to prove from statistics of present traffic that the undertaking will be a commercial success, the simple fact being that no traffic at present exists, al-

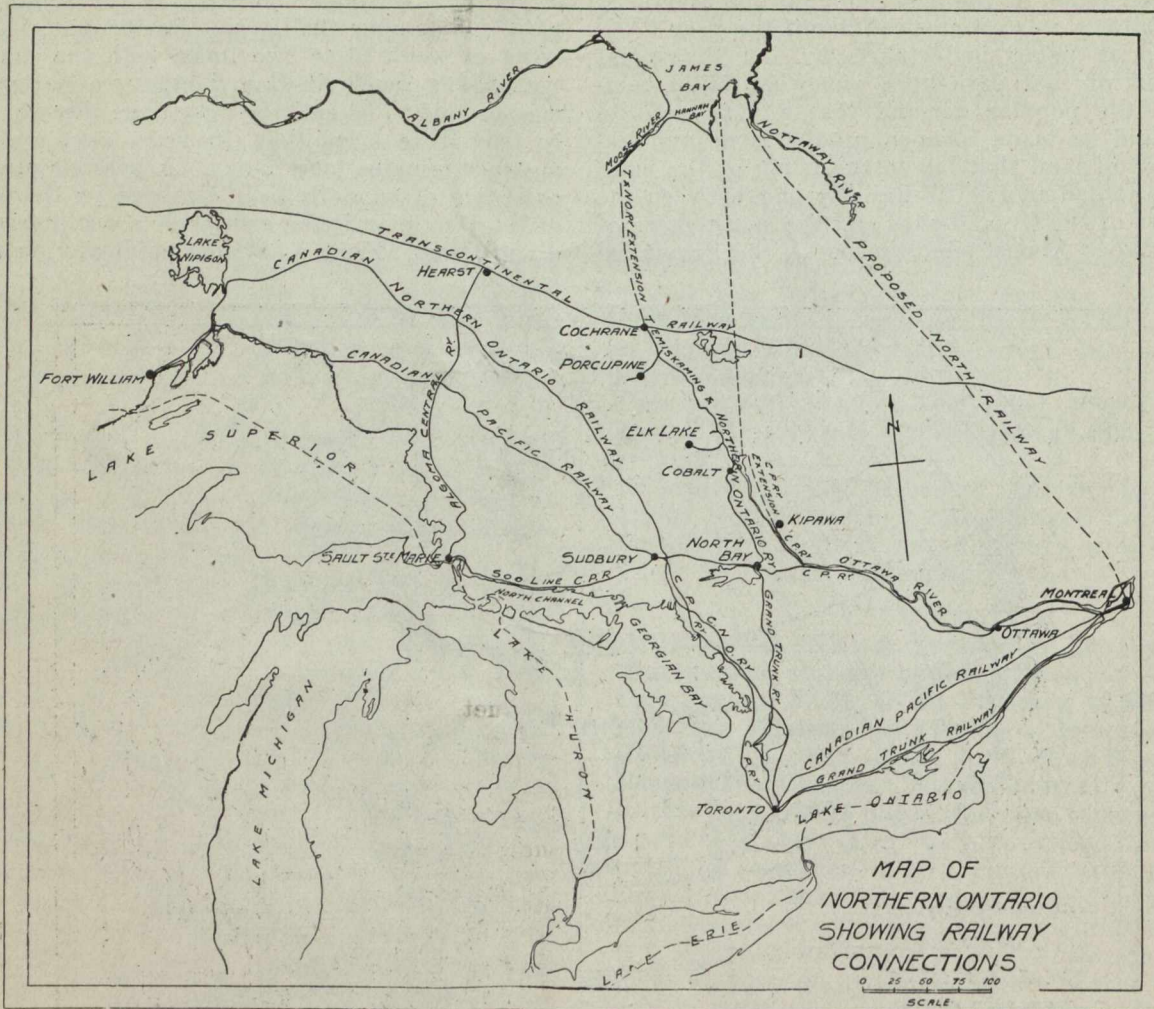


Fig. 2

and that the natural movement of traffic will be along the line of these tributaries with a natural point of concentration at the harbor. Geographically speaking, Moose Harbor is not an isolated point and does not lie in an extreme corner of the possible confines of civilization. If on Fig. 1 a half circle is drawn with the harbor as centre it will be found that, without very material change of radius, Winnipeg, Port Arthur, Toronto, Ottawa, Montreal and Quebec can be reached, and it may reasonably be expected that in the not-distant future a commercial centre of some importance will exist near the harbor, and that this centre will transact business directly and independently with each of the cities that have just been mentioned.

A journey from Toronto to Moose Harbor after the completion of the railway extension will not be an

though there is every reason to believe that natural resources abound from which an important traffic can be created.

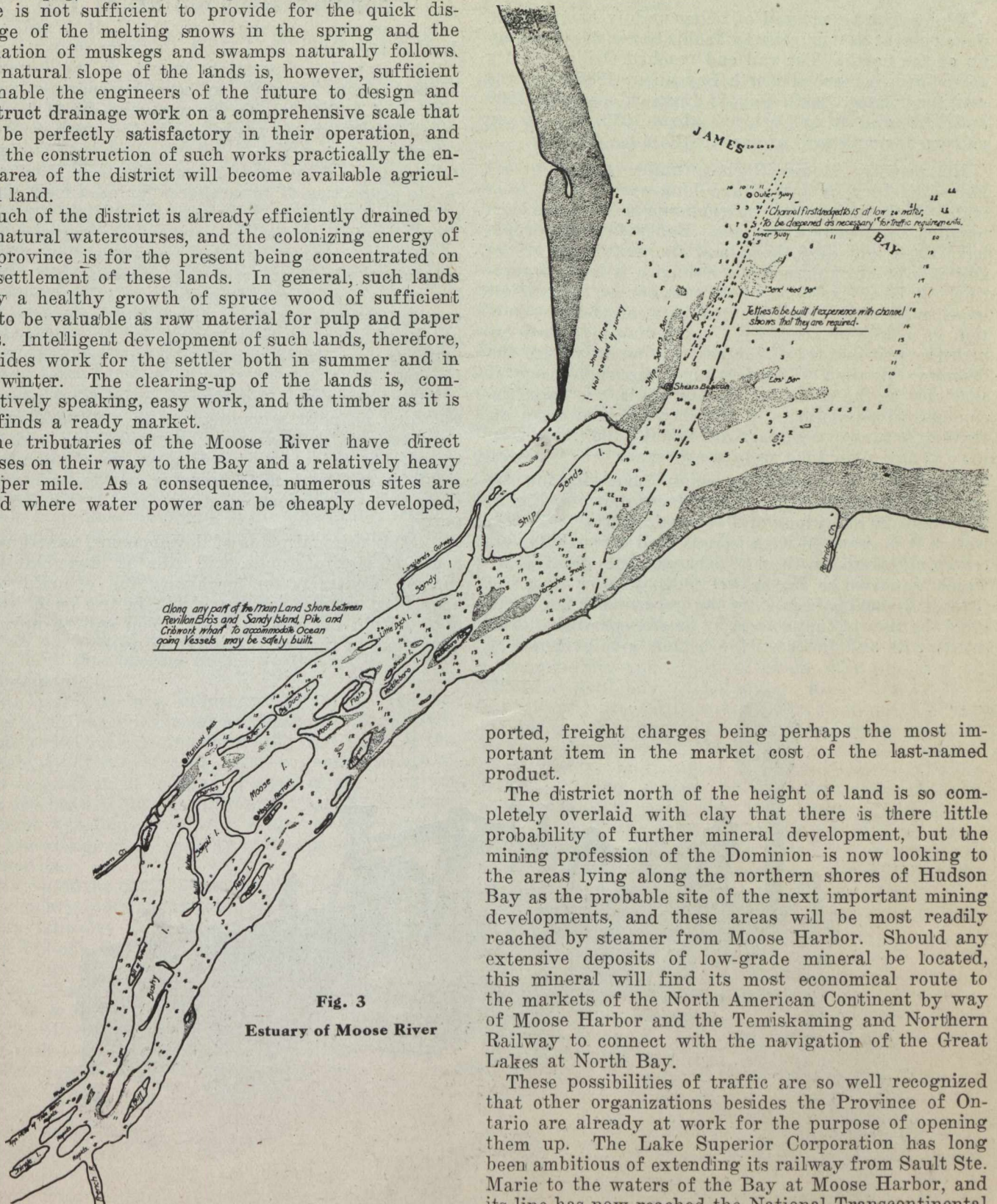
The tributary district to the railway will consist not only of the Clay Belt, but also of the well-defined area of clay lands lying along the shores of James Bay, and geologically known as the Coastal Plain. The soils of this Plain bear much resemblance to those of the Clay Belt, and their development presents in a larger degree the same problems that have to be dealt with in the development of the Clay Belt. Where satisfactory means of drainage exist, the growth of the various species of northern timber proves the fertility of the soil, but the geologists regard the whole district, and particularly the Coastal Plain, as being of very recent creation. The drainage system is, therefore, quite imperfectly developed and large areas of land are buried

under muskeg and moss. The condition is indeed very similar to that which exists on the prairies to the east of Winnipeg, the lands being so flat-lying that their slope is not sufficient to provide for the quick discharge of the melting snows in the spring and the formation of muskegs and swamps naturally follows. The natural slope of the lands is, however, sufficient to enable the engineers of the future to design and construct drainage work on a comprehensive scale that will be perfectly satisfactory in their operation, and with the construction of such works practically the entire area of the district will become available agricultural land.

Much of the district is already efficiently drained by the natural watercourses, and the colonizing energy of the province is for the present being concentrated on the settlement of these lands. In general, such lands carry a healthy growth of spruce wood of sufficient size to be valuable as raw material for pulp and paper mills. Intelligent development of such lands, therefore, provides work for the settler both in summer and in the winter. The clearing-up of the lands is, comparatively speaking, easy work, and the timber as it is cut finds a ready market.

The tributaries of the Moose River have direct courses on their way to the Bay and a relatively heavy fall per mile. As a consequence, numerous sites are found where water power can be cheaply developed,

brought in without excessive freight charges and such low-grade materials as groundwood pulp can be ex-



**Fig. 3**  
**Estuary of Moose River**

ported, freight charges being perhaps the most important item in the market cost of the last-named product.

The district north of the height of land is so completely overlaid with clay that there is there little probability of further mineral development, but the mining profession of the Dominion is now looking to the areas lying along the northern shores of Hudson Bay as the probable site of the next important mining developments, and these areas will be most readily reached by steamer from Moose Harbor. Should any extensive deposits of low-grade mineral be located, this mineral will find its most economical route to the markets of the North American Continent by way of Moose Harbor and the Temiskaming and Northern Railway to connect with the navigation of the Great Lakes at North Bay.

These possibilities of traffic are so well recognized that other organizations besides the Province of Ontario are already at work for the purpose of opening them up. The Lake Superior Corporation has long been ambitious of extending its railway from Sault Ste. Marie to the waters of the Bay at Moose Harbor, and its line has now reached the National Transcontinental Railway. The Dominion of Canada is building its grain railway to the waters of the Bay at Port Nelson and the Province of Manitoba is planning to reach the same point by an independent line along the east shore of Lake Winnipeg. The Province of Quebec, following its customary policy, is granting heavy subsidies to the North Railway, which is intended to establish a connection between the south end of the

and one of the early industries of the district will be the manufacture of pulp and paper. This has been already undertaken on a large scale at Iroquois Falls which itself is not distant more than 200 miles from the Bay.

In this development the opening of a port on the Bay must play a considerable part, providing a route by which such necessary materials as coal can be

Bay and the Port of Montreal. It seems proper, therefore, that action on the part of the Province of Ontario should not be long delayed.

We cannot be accused of being unduly hasty in the development of our railway facilities for the opening-up of the north. The rail end reached Orillia shortly after 1870, it reached North Bay about 1886, and was continued from North Bay to Liskeard between 1900 and 1905, and on to Cochrane about 1910, an average movement northward of perhaps 10 miles per year.

Historically, Moose Harbor, under the name of Moose Factory, is an old and long-settled port, from which the business of the surrounding country has been handled for nearly 250 years. Generations of people have lived and died there, and the suitability of the site as a point of permanent residence is beyond question. It is interesting to note that one of the earliest experiences of this settlement was its complete destruction in a time of peace by a marauding, overland expedition sent out from Montreal—apparently with the definite intention of maintaining the supremacy of that city as the centre of the fur trade. In fact, the commercial possibilities of the Bay received more attention between the years 1670 and 1700 than they have at any other time up to the present.

Moose Harbor provides a magnificent site for the creation of a great port. The estuary, shown in Fig. 3, is perhaps 20 miles long and varies from  $1\frac{1}{2}$  to 3 miles wide. It is crowded with islands, and through the intervening channels there discharges the great river which is never, so far as we know, smaller than the Ottawa River has been since the government has regulated the flow of that stream by its storage works. The settlements and fields on the islands give evidence of

long occupation, and the flat-lying shores provide an ideal site for a rail and water terminal.

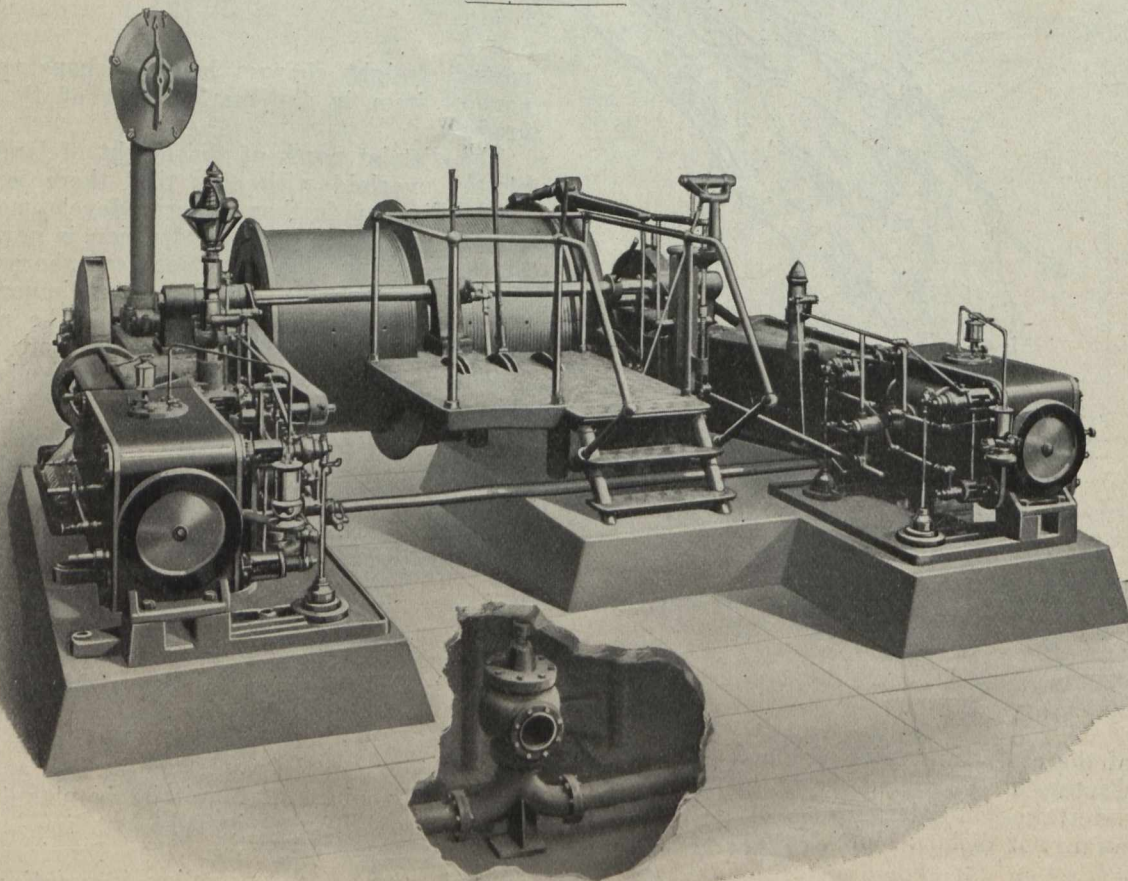
#### PORCUPINE VIPOND MINES, LTD.

In a circular to stockholders, Mr. H. H. Ward, president of Porcupine Gold Mines Co., says in part:

"An Ontario corporation, known as the Porcupine Vipond Mines, Limited, has been incorporated with a capital of \$1,500,000, shares par value at \$1 each, of which 750,000 shares are placed in the treasury for development purposes, and 750,000 shares will be given to the holders of the present Porcupine Gold Mines stock in the proportion of three shares for each eight shares they now hold in the Porcupine Gold Mines Company. Three hundred thousand shares of the treasury stock of the new company have been underwritten under an agreement which provides that shareholders of the Porcupine Gold Mines Company may subscribe for the same at 30 cents per share, all stock not subscribed for by shareholders to be taken up by the underwriters under their contract with the Porcupine Vipond Mines, Limited.

"The arrangement concluded as set forth above, is regarded as most advantageous to shareholders, not only because their existing interests have been protected, but because they are given such subscription rights as enable them to preserve at a favorable price their full proportionate interest in the Vipond property.

"Our original plans of development, halted on account of lack of funds, will now be immediately resumed. Contracts for machinery for cyanide plant have been signed, and work will be resumed at the mine within the coming week. You will be informed from time to time of the progress made."



HOIST RECENTLY INSTALLED AT BEAVER MINE, COBALT, ONT.

# THE VERTICAL RANGE OF METALS DEPOSITED BY SECONDARY PROCESSES

By William Harvey Emmons, Professor of Geology, University of Minnesota, U.S.A.

The theory of sulphide enrichment announced independently in 1900 by S. F. Emmons, W. H. Weed and C. R. Van Hise, has been successfully utilized in the exploration of so many mineral deposits that it has become an accepted tenet of applied geology. The processes involved are assumed to include, (1) solution of the valuable metals in an oxidizing acid environment in advance of the removal by erosion of the outcrop of the ore body; (2) transportation by descending meteoric waters of the metals dissolved; and (3) precipitation of the valuable metals in depth where the environment is reducing and perhaps alkaline.

Although our knowledge concerning the details of the chemistry of the processes is inadequate, the general nature of these chemical processes is fairly well understood. Few geological processes lend themselves more readily to experimental study. The mineral waters, as shown by study and comparison of numerous analyses of mine waters, may reasonably be assumed to be dilute solutions of sulphates and chlorides. The conditions of temperature and pressure which prevail are not very different from those obtaining in the laboratory. Hence the behaviour of the various minerals and ores in the presence of solutions like mine waters may easily be determined. By close correlation of field observations and laboratory experiments, it appears probable that in the near future we will know many of the details of the processes as well as we now know the nature of the general laws that operate in the weathering of a body of sulphide ore.

These processes are influenced by many factors. Among those of environment are temperature, rainfall, altitude and relief. An important physical factor is the permeability of the deposits. And so many geological events may affect, in one way or another, the operation of the processes of enrichment that the use of the theory is fraught with danger unless it is applied with an adequate knowledge of the geology of the region containing the deposits.

A review of the distribution of sulphide deposits having secondary zones shows that they are present at high and low latitudes, at high and low altitudes, in moist and in dry climates. They are present also in hot and in cold countries, although they are less numerous in high latitudes, especially in countries where Pleistocene glaciation has removed much of the surface.

On the other hand, many mining regions contain deposits with rich secondary zones, while other sulphide deposits that have weathered in the same region and under similar physiographic conditions, exhibit no evidence of appreciable enrichment. In general, such differences in the behavior of deposits, under approximately similar conditions have been attributed to differences in their permeability; and very correctly so, for in impermeable deposits the solutions cannot descend, and the valuable metals that may be dissolved in the upper portions of a deposit cannot be precipitated in the impermeable lower regions. Permeability is, however, a relative term and it is doubtful whether any deposits are altogether impermeable.

Another factor that influences the depth at which metals may be deposited is the chemical and mineralogical environment. If the conditions in the oxidizing zone

are favorable to solution, the metals will be dissolved; if they are unfavorable to solution the metals will remain to enrich the outcrop or to be carried away by processes of erosion. If the chemical environment in the lower unoxidized regions is favorable to rapid precipitation, the valuable metals will be precipitated before the downward moving solutions have migrated to great depths. The secondary zone may contain very rich ore, but the vertical extent of the latter will be less in consequence. On the other hand, if the minerals that compose the primary ore are those that react but slowly with the downward moving secondary solutions, precipitation of the metals will not be accomplished so readily, and the metals dissolved in the higher oxidizing environment may be carried downward to considerable depths. In deposits composed of such minerals the vertical extent of the secondary ores will be much greater than in deposits containing minerals that quickly precipitate the valuable metals.

If the behavior of solutions like mine waters containing gold, silver and copper in low concentration, toward each of the minerals of an ore and toward mineral associations were known, from experiment, and if the permeability of the deposit were ascertained, some estimate might be hazarded, perhaps in advance of extensive exploration, as to whether the secondary ores of a deposit would extend downward to considerable depths or whether they would be restricted vertically.

Examination and study of about fifty analyses of waters of gold, silver, and copper mines indicate that mine waters are fairly constant in composition. Near the surface they are acid sulphate and ferric sulphate waters. At greater depths they are acid ferrous sulphate waters, and deeper still they become alkaline ferrous sulphate waters. If the behaviour of such waters toward a given ore were known, and if the rate at which the solutions, under the several conditions of acidity and alkalinity, attack the primary ore were determined by experiment, much light might be thrown upon the superficial processes and upon the rate at which they operate under a known set of conditions.

**Gold.**—Gold, silver and copper are nearly related chemically and stand apart as metals in the concentration of which the processes of sulphide enrichment are most clearly expressed. They are dissolved in an oxidizing sulphate or chloride environment and are readily precipitated in a reducing, less acid, environment. Any one of them is readily precipitated by calcite, siderite, pyrrhotite, and probably by several sulphides. Under conditions that prevail in the oxidizing zones of ore deposits, gold is dissolved probably only in the presence of a chloride and oxidizing agent. The most important oxidizing agents in gold enrichment are doubtless manganese oxides, for these not only supply nascent chlorine by reaction with chlorides in solution, but inhibit the accumulation of ferrous sulphate that immediately precipitates gold from chloride solutions. In the deeper regions where oxides are reduced or acids are removed to form inert salts, gold is precipitated. Ferrous sulphate is doubtless an important precipitating agent, but many common ore and gangue minerals are also effective. As

stated by Brokaw, the list includes many native metals, sulphides, sulph-arsenides, sulph-antimonides, etc. Of the gangue minerals calcite, siderite, and some other carbonates throw down gold at once. Even comparatively stable minerals, like the feldspars and micas, give a distinctly alkaline reaction, and, given time enough, an auriferous sulphate and chloride solution would be neutralized and gold would be precipitated by many minerals of the gangue and of the wall rock.

Thus secondary gold ores might form in any deposit where conditions are favorable to solution of gold, but in a deposit composed of minerals that precipitate gold quickly, any gold dissolved would not be carried to great depths and the secondary ores would remain at least temporarily near the surface. One would not suppose that gold deposits containing much pyrrhotite or calcite or siderite would have as deep secondary zones as deposits containing only pyrite, quartz, feldspar, mica, and other minerals that react but slowly with the solutions.

**Silver.**—Like copper, silver dissolves readily in dilute sulphuric acid, and silver sulphate is dissolved by sulphuric acid if a little ferric sulphate is present. Unlike gold, the solution of silver does not require the presence of a chloride, and unlike copper silver forms stable chlorides in the oxidized zone. If the descending mineral waters carry much chloride, silver tends to accumulate as cerargyrite, but silver chloride is itself somewhat soluble in water and more soluble in concentrated solutions of alkaline chlorides. Thus silver, even in deposits where the chlorides form, may be carried downward in solution and be precipitated at depths where conditions are reducing. Acid sulphate, reacting on pyrrhotite and some other minerals, as shown by Wells, will generate hydrogen sulphide, and hydrogen sulphide precipitates silver sulphides even from highly dilute solutions. Silver is precipitated also from sulphate solutions by stibnite, realgar, and orpiment.

Solutions of ferric sulphide reacting with hydrogen sulphide give powdery sulphur, and as shown by Cooke, amorphous sulphur unites with silver sulphate to form silver sulphide, probably argentite.

The downward migration of silver in sulphide deposits is delayed not only by formation of the chloride, but also by precipitation of the native metal. Some recent experiments by Palmer and Bastin have a bearing here. Several minerals treated with silver sulphate precipitated native silver. The reaction was rapid with chalcocite, covellite, enargite, bornite, and tennantite; less rapid with smaltite, pyrrhotite, chalcopyrite, and arsenopyrite; and weak or inactive with stibnite, pyrite, galena, millerite, and sphalerite.

Mr. F. F. Grout has shown that these relations will hold approximately where the solutions have acid in excess, and that carbonates,—calcite, siderite, rhodochrosite, and several others—precipitate silver rapidly after the acid is used up.

In deposits of ores of silver that contain abundance of the minerals that readily form the native metal in the presence of silver sulphate, one would suppose that the zone of secondary native silver would be rich, but that it would not have such great vertical extent as in deposits composed only of quartz, pyrite, and other less active minerals. Even in deposits composed of relatively inert minerals, precipitation of silver would take place ultimately if the deposits were sufficiently permeable to permit a downward migration of solutions. Silver would be precipitated even on feldspars or other

minerals of the wall rock, for, as Sullivan has shown, this reaction takes place with surprising rapidity.

But the migration of silver is not permanently delayed by precipitation in the form of halides and native metal, for dissolving again in ferric sulphate solutions, it passes downward to form argentite and the complex antimony and arsenic sulphides. In many deposits, as in the Comstock Lode and at Tonopah, Nevada, these are the most important minerals. But little is known concerning the chemistry of their genesis. It is known, however, that many deposits of secondary silver sulphides are bottomed by sphaleritic ores, the zone of transition from rich to poor ore being at many places comparatively narrow. In view of Wells' experiments showing that sphalerite reacts readily with dilute acid to yield hydrogen sulphide, one might suppose that the decomposition of sphalerite had released compounds that were effective in precipitating silver. On the other hand, some sphaleritic deposits have relatively deep secondary zones.

Some recent work by Mr. F. F. Grout indicates that these salts are probably precipitated in an alkaline environment, where alkaline sulphides accumulate, will form in depth silver sulphides and complex silver salts instead of the native metal. The bottom of the zone of native silver does not indicate, therefore, the lower level of the zone of superficial alteration.

**Copper.**—Like gold and silver, copper is dissolved in acid sulphate and chloride solutions, in an oxidizing environment. Unlike gold, the presence of chlorine is not necessary for its solution, and unlike silver, it is rarely precipitated as chloride in the oxidizing zone. The native metal and its oxides, silicates, carbonates and sulphates may form directly from solution, but much of the rich oxidized ore composed of these minerals has doubtless resulted from the oxidation of a relatively rich sulphide ore that by processes of erosion has been exposed to oxidizing conditions. In ores containing abundant calcite, as pointed out by Bard, there is a strong tendency to delay the downward migration of copper by the formation of relatively insoluble copper carbonates in the upper regions.

The secondary sulphide zones in copper deposits are more clearly expressed than in the deposits of precious metals. This, I believe, is because the copper sulphides dissolve in acid sulphate very readily in an oxidizing environment, but are highly insoluble in acid in the absence of oxygen. In many districts, pyrite, pyrrhotite, sphalerite, or galena have been replaced by chalcocite. Acid waters reacting on some of these minerals liberate hydrogen sulphide, and since copper sulphide has an exceedingly low solubility, hydrogen sulphide will precipitate copper from dilute solutions. It is not certain that hydrogen sulphide is an intermediate product where the primary sulphides are replaced by copper, yet it is believed that the rate at which those minerals are attacked affords a kind of index to the rate at which they will reduce a copper sulphate solution. If so, pyrrhotite which yields hydrogen sulphide more rapidly than pyrite and chalcopyrite in acid solution, should bring about the precipitation of copper more readily than pyrite and chalcopyrite. The same relation holds also in alkaline waters, for pyrrhotite treated with alkaline carbonate, alkaline silicate, etc., yields alkaline sulphides much more rapidly than pyrite or chalcopyrite. Thus, in ore containing abundant pyrrhotite, the secondary sulphide zone, although it might be richer, would not extend to such great depths as it does in ores composed of pyrite and chalcopyrite and little or no pyrrhotite.

## PERSONAL AND GENERAL

Mr. J. W. Astley is in Vancouver, B. C., on a business trip.

Mr. G. G. Gibbins has returned to Vancouver from Haileybury and will be this summer in charge of a party in N. W. Canada.

Mr. R. B. Lamb, consulting engineer, and Mr. G. F. Morrison, secretary of the Peterson Lake Mining Company, have returned from a trip to England on the business of the company.

At the New York Convention of the American Chemical Society, held in New York April 16, Mr. Robert Turnbull, of Welland, Ontario, presented a paper on "The Thury Electric Furnace Regulator."

Mr. H. H. Johnson is at the Tough-Oakes Mine, Kirkland Lake.

Mr. A. E. Formis has been appointed Superintendent of the Bates Mine, Iron River, Mich.

Mr. Andrew W. Baxter, formerly of Lethbridge, Alberta, is now at the Extension Colliery of the Canadian Collieries (Dunsmuir) Limited, Vancouver Island, B. C.

Mr. W. Buchanan, Superintendent of the Yankee Girl Mine, has returned to Ymir, B. C., from a week's visit to Spokane, Washington, in which city is the head office of the company working that mine under option of purchase.

Mr. Herbert Carmichael, who some time ago voluntarily retired from the position of Provincial Assayer for British Columbia, after 20 years' service, recently returned to Victoria, B. C., having made a somewhat extended stay in Ireland.

Mr. Patrick Clark, of Spokane, Washington, prominent for many years as a mining operator in the Northwest, both in the United States and across the International Boundary line in Kootenay and Boundary districts of British Columbia, was at the Standard silver-lead mine, near Silverton, B. C., during the latter part of April.

Mr. W. J. Elmendorf, of Stewart, B. C., general manager for the Portland Canal Tunnels, Ltd., made a trip to Seattle, Washington, recently, to accompany Mrs. Elmendorf north to spend the summer with him in Portland Canal district.

Mr. James Findlay, formerly manager of the Sullivan Mine, in Fort Steele mining division, East Kootenay, B. C., but latterly manager of the Maple Leaf Coal Mine, in the Blairmore-Frank district, Southwest Alberta, recently resigned.

Mr. Samuel S. Fowler, of Riondel, Kootenay Lake, B. C., has been nominated for election as chairman of the Western Branch of the Canadian Mining Institute. Mr. Fowler, who for several recent years has been general manager for the new Canadian Metal Co., operating the Bluebell Lead Mine (discovered by Douglas, a Scottish botanist, in 1825), was a councillor of the Institute in 1898 and 1899 and president in 1900.

Mr. Chas. Hussey, of Spokane, Washington, one of the executive officials of the Standard Silver-Lead Mining Co., late in April spent several days at the company's mine and concentrating mill near Silverton, B. C.

Mr. Walter Renton Ingalls, of New York City, editor of The Engineering and Mining Journal, was at Nelson, B. C., four or five days about the middle of April.

Mr. Oscar Lachmund, general manager for the British Columbia Copper Co., has returned to Greenwood, Boundary district, B. C., after having been at the

company's head office, in New York City, for a short time.

Mr. Frank E. Lathe, chief chemist for the Granby Consolidated M. S. and P. Co., at its smeltery at Grand Forks, B. C., has been spending a fortnight's vacation at Anaconda, Montana.

Mr. Paul Lincoln, who lately arrived in British Columbia from Chihuahua, Mexico, has been making an examination of the Coronation Gold Mine, on Cadwalader Creek, Bridge River, Lillooet district, B. C., for the chief owners, who are moneyed men of Victoria, B. C.

Mr. J. Ralph Lockard, who was for some time general superintendent of the Comox Mines of the Canadian Collieries (Dunsmuir) Limited, is now general manager of that company, following Mr. W. L. Coulson, who resigned several months ago.

Mr. Arthur Lockwood is returning to the B. C. Oil and Coal Development Co.'s property, on Sage Creek, Flathead Valley, in the extreme Southeastern part of British Columbia, to supervise putting down a larger and deeper well than any bore heretofore made by the company, latest developments having caused the directors to undertake a further expenditure of money in proving the existence of oil there in commercial quantity. Mr. Lockwood has been in Victoria conferring with the directors relative to future operations.

Mr. Frank W. MacLennan (B. Sc. McGill 1898 and 1900) who some time ago was general superintendent for the mining company of that name at Cerro de Pasco, Peru, is now assistant manager in charge of mining at the Miami Mine, Arizona.

The first appointment to the faculty of the new University of British Columbia, the president of which is Dr. F. F. Wesbrook, late of the University of Minnesota, has been announced by the Board of Governors. It is of Douglas McIntosh, B. A., B. Sc., (Dalhousie, N. S.); (Cornell); D. Sc., (McGill); F. R. S., Can., as associate professor of chemistry and acting head of the department. Dr. McIntosh began his work as a university teacher in 1901, when he was appointed demonstrator in chemistry at McGill University, Montreal. He became lecturer in 1905, assistant professor in 1907, and associate professor in 1909, which last-mentioned office he now fills and will continue to do so for some time longer.

Mr. D. W. McNabb, inspector for the International Bureau of Explosives, was at Fernie, Crows Nest Pass, B. C., during the latter part of April.

Mr. Alex. Selater, of Los Angeles, California, general manager of the Union Oil Co., has been on a business visit to the Coast cities of British Columbia.

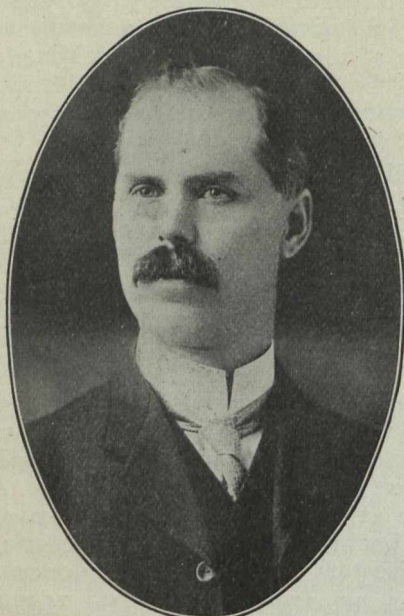
Mr. G. B. Wilson, manager of the Marblehead Quarries, eight miles up the railway from Lardo, at the head of Kootenay Lake, B. C., has returned from the United States, and is now directing the quarrying and finishing of a lot of marble for shipment to various places.

Fraser & Chalmers, of Canada, Limited, Montreal, have been awarded a contract by the Nova Scotia Steel & Coal Company, Limited, for a 2,000 kilowatt steam turbine, direct connected to an alternator of Vickers manufacture.

The Buffalo Foundry & Machine Co., of Buffalo, N. Y., announces that they have terminated the arrangement whereby Mr. H. E. Jacoby has been representing them in New York City. They are now handling direct all inquiries covering vacuum apparatus, castings, patterns, and machine work.

## OBITUARY

Mr. A. B. Willmott died Friday, May 8, after a long illness. For some time he had been gradually getting weaker and finally was reluctantly forced to discontinue his professional work. A few days later he passed away.



THE LATE A. B. WILLMOTT

The late Mr. Willmott was in his forty-eighth year, and had been connected with various mining interests since his graduation from the University of Toronto in 1887.

Mr. Willmott was especially interested in the iron ore industry, and was for some time manager of mines for the Clergue interests at Sault Ste. Marie. After the re-organization of the Clergue companies, Mr. Willmott settled in Toronto and developed a practice as consulting engineer.

He is survived by a widow, one son, Roy, a daughter, Eleanor, and his father, Rev. J. C. Willmott, Milton, Ont., to them the mining men of Canada extend their sympathy.

Colin A. Campbell, assistant electrician at the Granby Consolidated Co.'s big copper mines at Phoenix, Boundary district, B. C., died in the local hospital on April 20, following an operation for appendicitis. He had been in the company's employ at Phoenix for ten years. He was born at Glencoe, Nova Scotia, 35 years ago. He leaves a widow and three children.

James H. Trafford, who died recently at Rossland, B. C., had been in that mining camp for 13 years. He was head hoist engineer at the Consolidated Mining and Smelting Co.'s Centre Star Mine and had charge there of the Nordberg hoist, which is the largest hoisting engine in British Columbia. His mother and other near relatives live at Le Mars, Iowa, U. S. A.

The Canadian Westinghouse Company has issued a bulletin on watt hour meters.

We have just received from the Herbert Morris Crane & Hoist Company, Limited, a copy of the newly issued bulletin B5, which is entirely devoted to the various types of traveling trolleys made by that company. These Morris trolleys are of many patterns to run either on a flat-bar track, or on the lower flange

of an ordinary steel I beam. Some of them are prepared for short straight runways, while others, containing suitable swivels, are flexible in a horizontal direction, and thus permit of the use of curves or "bends" in the track. The bulletin contains a great deal of practical information of immediate interest to all users of this kind of equipment. The illustrations, diagrams and tables of dimensions and prices are arranged in a handy and useful form.

## SPECIAL CORRESPONDENCE

## BRITISH COLUMBIA

According to newspaper reports, the Standard Silver-Lead Mining Co. last month declared an extra dividend, which will make \$100,000 the total distribution among shareholders in either April or May. Assuming that the regular monthly dividend was declared payable on May 10, the grand total of dividend since a beginning was made by a payment of \$25,000 in April, 1912, is now \$1,375,000 on capitalization of \$2,000,000.

News from Nelson at the end of April was to the effect that the experiments in the electric smelting of lead-zinc ores that have been carried on at that place during several recent months, have been discontinued by the Mines Branch of the Canada Department of Mines; also that prominent local residents are endeavoring to induce Mr. W. McA. Johnson, of Hartford, Connecticut, who has been experimenting in electric zinc-lead smelting for a number of years, to give his attention to Kootenay ores and to operate his continuous electric zinc furnace at Nelson. Doubtless the Provincial Government, into whose possession the zinc smeltery at Nelson has passed, will readily do anything in reason to facilitate experiments by Mr. Johnson and his associates, or anyone else whose bona fides and financial standing would entitle him to be shown such consideration.

## Slocan and Slocan Lake.

The deep level adit being driven on the Noonday, near Cody, is now in about 150 ft.

Mr. Alex. Ferguson, who holds on lease the Coronation claim, on Silver mountain, above New Denver, is preparing to resume work.

Mr. W. R. Will has returned to New Denver after having spent the winter in Ontario, and is about to commence the season's work on his Capella property, on Goat mountain.

**Slocan Star.**—Ore has been found in the east cross-cut from No. 10 level on the Slocan Star mine at 700 ft. from the main adit. The vein has been drifted on for 50 ft., and there is 3 ft. of concentrating ore. Finding ore there proves that there is stoping ground from No. 10 up to No. 8 level, 200 ft. above. The west drift from the deep level adit is also in ore.

Other properties in Slocan on which work was done in the winter are the Richmond-Eureka and Ruth, near Sandon; the Payne and Rambler-Cariboo, east of that town; the Noble Five and Surprise, above Cody; and the Cinderella and Lone Bachelor, near Three Forks. With the exception of the Payne and Noble Five, which are doing deep development work, all shipped ore during recent months.

The first car of ore shipped from the Lucky Thought, on Four-mile creek, to Trail, has been reported to have given returns as follows: Silver, 120.8 oz. to the ton; lead, 46.8 per cent.; zinc, 17.5 per cent. This is the first return from ore in quantity from this property,



which is owned by Thos. J. Lloyd, and is being worked by the Consolidated Mining and Smelting Co. under option of purchase.

**The Standard Silver-Lead Mining Co.** has donated to the University of Alberta, Edmonton, an excellent and representative set of mineral and rock specimens from its Standard mine, which is now the largest producer of ore in Slovan district. Mr. Wm. Thomlinson, ore sampler at the mine, selected and prepared the specimens, which include various kinds of silver bearing galena, zinc-blende and milling ores, characteristic of this mine; also specimens of gangue minerals, altered wall rocks, enclosing sedimentary rocks, and the dike rock found in or near the ore-bearing fissure.

Shipments of silver-lead ore and concentrate from the Standard mine and concentrating mill, near Silverton, Slovan lake, during four months to the end of April, have totalled approximately 5,000 tons. Beside this silver lead product, which was shipped to the Consolidated Mining and Smelting Co.'s smeltery at Trail, silver-zinc concentrate has been sent to Bartlesville, Oklahoma. There is still much ore available in the mine, the quantity in the big stope between levels Nos. 4 and 5 being large, including a shoot of fine looking galena that runs high in silver and lead. No. 7 adit is now in more than 3,000 ft. from its portal, with fully 1,000 ft. more to be driven before the face of this working will be under the productive ore shoot occurring in No. 6 level, and on up to Nos. 5 and 4. No. 8 level is being driven, and this working has already opened some zinc ore, but the adit will have to be advanced the greater part of a mile before its face will be in the silver-lead zone opened in the levels above.

**The Van-Roi Mining Co.** has sent out from its office in London, England, the cabled report for the month of March received from the managers of its silver-lead-zinc mine and concentrating mill in Silverton camp. The mill report shows that the total quantity of ore crushed during the month was 2,445 tons of an average assay of silver 19.3 oz. to the ton, lead 3.1 per cent., and zinc 5 per cent. This yielded 10 tons of picked ore averaging 300 oz. silver to the ton, 52 per cent. lead, and 12 per cent. zinc; 120 tons of lead concentrate assaying 231.3 oz. silver to the ton, 51.2 per cent. lead and 13.4 per cent. zinc; and 105 tons zinc concentrate assaying 83 oz. silver to the ton, 3.5 per cent. lead, and 37 per cent. zinc. The mill was operated 582 hours. The total approximate value of the products was \$21,889. The expenditure during the month was: On development \$3,541, ore production \$9,077, milling, \$3,660, and capital and other expenditure \$1,545; total, \$17,823. These figures compare with two previous months, thus: January, total value of products, \$18,329; expenditure, \$14,194. February, total value of products, \$15,776; expenditure, \$12,729. The balance of value of products over expenditure for the three months ended March 31 was \$11,248. There was done in March 241 ft. of development work. In one raise the average value of 36 in. of ore for a length of 30 ft. was silver 42 oz. to the ton, lead 5.5 per cent., and zinc 27 per cent.; while in a drift above level No. 5, along 21 ft. advanced, 11 in. of ore averaged 150 oz. silver to the ton, 18 per cent. lead, and 13 per cent. zinc.

#### Tete Jaune Cache.

**Mica claims** in the neighborhood of Tete Jaune Cache are expected to receive more attention next summer than they have had in past years. It is known that 27 claims have been staked; some of these are

owned by New York men, others in New Brunswick, and still others in Calgary, Alberta. The claims are situated on McLennan river, Sand creek, and Mica or Swanson creek, tributaries of Fraser river flowing from the south. For more than 20 years it has been known that mica occurs in this neighborhood, but as the outlet from the district was via Kamloops, the nearest accessible railway point, distant fully 300 miles, and much of it by pack trail, transportation costs were too high to allow of mining on a commercial basis being undertaken. Now, however, the construction of the Grand Trunk Pacific Railway through the district has changed conditions, so that the cost of bringing in supplies and machinery and taking out mineral is not prohibitory.

Official information relative to mica published by the Provincial Department of Mines, includes the following: Sand creek flows from the west and empties into Fraser river about one mile west of Tete Jaune Cache. The sand in this creek was found to be exceedingly micaceous; in fact, all the surface wash in this neighborhood is highly impregnated with mica. Ascending Sand creek in a south-westerly direction, it was found that the creek had cut deeply through the surface wash, leaving precipitous banks, and, at 7 miles from Fraser river, flows through a rocky canyon, with the McLennan range and Mica mountain to the south. At about 1,000 ft. elevation above the creek, on the south side, some claims have been staked, but the mica is reported to be of poor quality. Rising abruptly from Sand creek is the McLennan range, which is a high mountain-ridge running south-west and north-east, having peaks 8,500 ft. high, or 5,500 ft. above Fraser river; a continuation of this range to the east is called Mica mountain. Some of the best mica showings are reported to be on this mountain at an altitude of 8,300 ft. The claims have been located on a series of pegmatite dikes, from 3 to 10 ft. wide, in which mica has been formed in small pockets. Mica sheets, 8 x 10 in., have been taken out. South-east of the McLennan range and one mile and a half distant is Nigger Head mountain, where 12 mica claims have been taken up on a pegmatite dike 30 ft. wide and fairly well exposed by a series of open cuts; plates 8 x 10 x 3 in. of clear muscovite mica are reported to have been obtained. The altitude of the claim is more than 8,000 ft. A few miles south-east of Nigger Head mountain is Cranberry lake, in which Canoe river takes its rise, flowing southeast to the Columbia river. Occurrences of mica are reported from the headwaters of Canoe river. Opposite the McLennan range, and three miles north of Sand creek on a range of mountains, the Kelly group of mica claims has been staked, but no information could be obtained about them. It would appear that the pegmatite dikes referred to occur over a fairly wide area.

#### Portland Canal.

At the beginning of April the main crosscut adit of the Portland Canal Tunnels, Ltd., was in 3,010 ft. from its portal, and was being advanced in argillites with some quartz. The object of its extension is to reach the Green vein, which the company's general manager, Mr. W. J. Elmendorf, believes to be the footwall vein of what is known locally as the "fissure zone." It was from this vein, which at the surface on the O. K. Fraction claim, shows strongly on both sides of Glacier creek, that ore giving comparatively high assay returns in gold and silver was taken. The largest exposure is in the crosscut adit of the Stewart mine, 1,000 ft. above Glacier creek, where it was drifted on

for 350 ft., and was found to be more than 20 ft. wide, almost all quartz, but generally completely leached out. Where not deprived of its mineralization by leaching, stringers of ore showed high value, samples assaying gold 1.9 oz. and silver 264.1 oz. to the ton. As the depth of the low level adit now being driven is approximately 700 ft. below the surface, there is little likelihood of leaching having taken place so deep as that. The distance yet to be driven is estimated at 250 to 400 ft., according to the dip of the vein, which is not known—if 60 deg. then 400 ft., but if only 55 deg. about 250 ft. At present, ventilation not being good, only one shift is employed at the face of the main adit. Two shifts are driving about 4 ft. a day in the Lucky Boy drift on No. 1 vein, in which is the most promising showing yet found to the north of the main crosscut. Scattered mineralization occurs throughout this drift, and in one part there was exposed 6 in. of solid galena and pyrite of fair grade. Further extension of this drift will be the shortest course to ore known to exist in the property of the Glacier Creek Mining Co. and of the Stewart Mining and Development Co. No work is being done at present in the Melba drift, which extends 238 ft. south from the main crosscut, on No. 2 vein, into the Melba claim, owned by the Tunnels Co. This vein is remarkably strong and regular, is about 40 ft. wide, and consists of argillite breccia, with a large proportion of quartz and a scattered mineralization of pyrite and pyrrhotite. Apart from its lack of mineralization, this vein is the best showing in the mine, and a large ore shoot may reasonably be expected when ore shall "make" in it. The Richard drift is in the Portland Canal Mining Co.'s Richard II. claim. It is on No. 3 vein and extends 141 ft. south from the main crosscut; it shows ore all the way, and at one place there is a width of 10 in. of solid galena and pyrite lying on 30 in. of mineralized porphyry. Some chalcopyrite was found—the first in these workings and unusual in the "fissure zone." The vein is 3 to 4 ft. wide, and it persistently follows a porphyry dike. Samples of fairly clean ore from this drift assayed as follows: Selected copper ore: Gold 0.16 oz. and silver 16.6 oz. to the ton and copper 7.5 per cent. Selected lead ore: Gold 0.04 oz. and silver 28.8 to the ton, and lead 46.7 per cent. The three veins—Nos. 1, 2 and 3—approach each other on their southerly course; taking the courses as now shown by the various workings, Nos. 1 and 2 will join at about 450 ft. south from the present face of the Melba drift, and No. 3 approximately 500 ft. beyond that. Generally, the outlook is regarded as encouraging, both as regards developments in the mine and for financing operations throughout the ensuing summer.

### PORCUPINE, KIRKLAND LAKE AND MUNRO TOWNSHIP

**Reaume.**—Considerable interest has been aroused by the discovery in Reaume township, about seven miles from the Transcontinental railway and about 20 miles north of Porcupine, of an ore body containing microscopic diamonds, chrome iron ore and about \$1.50 a ton in platinum. The specimen which has been submitted to a thorough examination, was taken from an ore body on Mr. O'Connor's claims. This is the first authentic discovery of diamonds in the Province, and although the diamonds are of absolutely no economic importance, it confirms the opinion that geologists have long entertained that some day economic diamonds will be found in the great and for the most part

unexplored portion of Northern Ontario. The rock in which the ore was found is peridotite and weathers readily to serpentine, and is widespread and near the Porcupine area. There are not many exposures of rock in Reaume township, so that so far it has been considered an agricultural rather than mineral bearing township.

**Ogden.**—The compressor plant at the Lally gold mines in Ogden township was turned over for the first time this month. The shaft has reached a depth of 50 ft. and diamond drilling is in progress.

**Vipond.**—The Vipond mine is working again. A new company, to be called the Porcupine Vipond Mines, Limited, with a capitalization of \$1,500,000, has been formed. Of this 750,000 shares will be issued to the old shareholders at the ratio of 8 shares of the old company for 3 shares of the new. Of the remainder of the stock 450,000 shares will be left in the treasury and 300,000 will be offered to present shareholders.

**Dome.**—The extension to the Dome mill will be completed by the end of the present month, and the 80 stamps should be dropping. The main shaft is now down 90 ft. below the 424 ft. level, and will be carried down to 525 ft. before a station is cut. Costs, which are now running between \$3 and \$3.50 a ton, will be cut down materially when the addition to the present mill is in operation.

### COBALT, GOWGANDA, SOUTH LORRAIN

**Crown Reserve.**—The decision of the Privy Council in London last week settled finally a famous law suit, which has engaged the attention of Crown Reserve shareholders for six years, or since the Crown Reserve showed any promise of developing into a mine. The suit was brought by several original members of the syndicate, among them Messrs. Fowler, Ross, John Black and others, to recover 231,000 shares of Crown Reserve stock. As altogether \$70,000 had been paid in dividends upon these shares, the suit was one of considerable dimensions. It has been fought from court to court in Canada, and was finally taken over the seas, where the decisions of the Canadian courts were ratified by the conclusion that the plaintiffs had failed to make good their case against the Crown Reserve Mining Company. The plaintiffs will also have to pay the heavy costs of the proceedings.

**Coniagas.**—The Coniagas Mining Co. has received permission from the town of Cobalt to run a trestle across Silver street, so that they may dump rock from a shaft in the centre of the town on to some land rendered vacant by a recent fire. The matter has aroused a good deal of interest, owing to the fact that the proposed location of the shaft is right in the centre of the town, and the rock will have to be dumped on to ground already occupied by various dwellings. The proposed shaft, which was sunk to the 50 ft. level about three years ago, is on the west side of Silver street, and it is proposed to carry the rock over to the other side, where it will not cause so much damage to existing property. The intention and aim of the work from the new shaft is to explore the ground under this portion of the town, and with the specific intention of cutting the vein or veins found on the City of Cobalt near the Coniagas boundary.

**Peterson Lake Mining Co.** has declared its maiden dividend of  $1\frac{3}{4}$  per cent., payable quarterly, or 7 per cent. a year. On the outstanding capital of the company this will amount to \$42,032 a quarter, or \$168,128 a year, an amount which the Peterson Lake should

have no difficulty in meeting. Another shoot has been picked up by the company in their drift at the 200 ft. level of their Kerry lease on Peterson Lake. After being drifted upon for about 110 ft. the vein went out of the drift and could not be picked up again, so the original drift was continued ahead. About 31 ft. from the point where the vein was lost, it has again been picked up, and appears to be as good as ever.

A high grade car of ore will be shipped early this month. At the other shaft of the company, near the narrows between the two lakes, development is being continued with great vigor, but so far without any tangible result.

**Chambers-Ferland.**—After a very stormy meeting the by-law confirming the transfer of Chambers-Ferland stock to Alladin Cobalt stock at a ratio of 20 to 1, was left over for final ratification until the annual meeting on June 10. The meeting was held in Cobalt, and a vigorous opposition developed from minority shareholders of the Chambers Ferland, who were represented by Mr. A. A. Amos, of the firm of Vickery & Amos, of Toronto. It was known before the meeting was held that Captain Jorgenson, president of the Alladin Cobalt, held two-thirds of the stock for himself and his English associates, and could force the by-law through if he so wished. It also transpired that in addition to the control he had purchased from individual shareholders, he had proxies from 300 shareholders of Chambers-Ferland stock, which had not been transferred to the Alladin Cobalt. The opposition protested against the transfer, that the ratio of exchange, 20 to 1, was altogether too high for the relative value of the properties held by the two companies. Mr. Amos said that the lease on the Silver Queen, which was the only asset the Alladin Cobalt had apart from the control of the Chambers-Ferland, was worth nothing, since that property was regarded as being entirely without future. Chambers-Ferland shareholders were quite ready to develop the Chambers-Ferland property with the money in the treasury, which amounted to \$140,000, and should be enough to develop the property to a paying basis. Captain Jorgenson stated that the Silver Queen had produced 70,000 oz. and 50 tons of ore a day was being milled from the workings there. If the amalgamation were effected a good market could be created in London, which was not available at present. The exchange was based on a market value of 25 cents a share for Chambers-Ferland, which was more than the stock was selling at at present. Finally, on the motion of Mr. T. R. Shillington, who supported Captain Jorgenson, it was decided to postpone the meeting until June 10th, the date set for the annual meeting, when the matter will again come up.

**Cobalt Lake.**—It is now definitely stated that the pumping of Cobalt lake will not be commenced until August or September. It is now anticipated that the dam on Short lake will take three months to complete, and it has been discovered that the scope of preparations for the draining is of necessity so wide that it will be impossible to actually commence the pumping of the lake until the fall. The deepening of the outlet will, however, commence almost at once, and when this is completed the water will fall from 6 to 7 ft.

**Buffalo.**—The March mill report of the Buffalo shows a considerable increase above the preceding month of February. The increase in the amount of silver recovered was almost 40,000 oz. The mill report for March reads: Mill ran (hours) 642, ore milled (tons)

7,015, average assay 25.43 oz., ozs. recovered 142,786, ozs. paid for 150,164.

**Timiskaming.**—The report of the new directorate of the Timiskaming mine makes it clear that more ore will have to be put in sight before further dividends can be thought of. Mr. Frank L. Culver, who is the new president, states that on the levels above the 400 ft. there is no ore in sight, and from the 400 ft. to the 650 ft. levels there is no actual high grade in sight, but there is enough low grade to keep the mill running and maintain current expenses. The shaft has been carried down to the 750 ft. level, where a cross-cut will be made and an attempt made to pick up the known veins in the diabase formation. The company's cash balance on March 31st, was \$77,173.

**The Crown Reserve** is this month shipping 20 tons of ore to the Kingdom of Saxony smelter, which will run 5,500 oz. to the ton. Roughly estimated, it will be worth over \$50,000. Six tons of the ore was remarkable, running between 8,000 and 10,000 oz. to the ton, and was stoped from a pocket of ore found near the Carson vein on the first level.

**The Otisse mine** at Elk Lake has been taken over by a syndicate of shareholders, who advanced the money necessary to carry on development and who took a mortgage as security.

**McKinley-Darragh.**—The Bureau of Mines in Toronto has refused the application of Mr. T. R. Finucane, manager of the McKinley-Darragh Mining Co., in regard to his staking of four acres of Cart Lake. The department ruled that the four acres were included in the original sale by the Government to the Peterson Lake Silver Mining Co.

**COBALT SHIPMENTS.**

The ore shipments from the Cobalt camp for the week ending May 8th were abnormally high, no less than fourteen mines contributing over a million lb. The Peterson Lake Co. made its first shipment. The Chambers-Ferland also made a shipment of about 43 tons of concentrates. Although ore has gone out under the seal of the company for the past three or four years, it was all from leases.

The Crown Reserve shipped a bonanza car to Hamburg and the excellent progress of the Penn-Canadian was reflected in a high-grade shipment from the old Cobalt Central mine. The City of Cobalt, will also be in a better position financially when the high grade car shipped this week from the workings under the town has been marketed. In bullion the Nipissing alone was prominent.

The shipments from the Cobalt camp for the week ending May 8th were:

	High.	Low.	Pounds.
Trethewey .....	47,850	56,230	104,080
Peterson Lake .....	51,700	.....	51,700
Cob. Townsite .....	72,040	.....	72,040
McKin.-Dar. ....	66,090	.....	66,090
Cham.-Ferland .....	87,960	.....	87,960
Dom. Reduction .....	.....	87,000	87,000
Cobalt Lake .....	64,430	.....	64,430
Temiskaming .....	70,130	.....	70,130
City of Cobalt .....	77,360	.....	77,360
Crown Reserve .....	40,000	.....	40,000
Penn-Canadian .....	71,190	.....	71,190
O'Brien .....	61,270	.....	61,270
Nipissing .....	.....	76,270	76,270
Hudson Bay .....	.....	85,910	85,910
	710,020	304,410	1,015,430

# MARKETS

## STOCK QUOTATIONS.

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

May 8, 1914.

### New York Curb.

	Bid.	Ask.
Alaska Gold	26.50	27.00
British Copper	1.62	1.87
Braden Copper	7.87	8.12
California Oil	300.00	304.00
Chino Copper	40.75	41.12
Giroux Copper	1.00	1.37
Green Can.	30.00	35.00
Granby	79.00	80.00
Miami Copper	21.37	21.50
Nevada Copper	13.75	14.00
Ohio Oil	170.00	172.00
Ray Cons. Copper	20.75	21.00
Standard Oil of N. Y.	212.00	214.00
Standard Oil of N. J.	410.00	413.00
Standard Oil (old)	950.00	1036.00
Standard Oil (subs)		
Tonopah Mining	6.37	6.50
Tonopah Belmont	7.12	7.50
Tonopah Merger	.57	.59
Inspiration Copper	16.75	17.00
Goldfield Cons.	1.37	1.43
Yukon Gold	2.50	2.75

### Porcupine Stocks.

	Bid.	Ask.
Apex	.02½	.03
Dome Extension	.08	.08¼
Dome Lake	.35	.36
Dome Mines	9.75	10.00
Eldorado		
Foley-O'Brien	.19	.21
Hollinger	15.40	15.60
Jupiter	.10	.10½
McIntyre	.23	.24
Moneta	.02	.03
North Dome		.05
Northern Exploration	2.25	2.75
Pearl Lake	.06	.07
Plenaurum	.50	.60
Porcupine Gold	.08¾	.09¼
Imperial	.01¾	.02
Porcupine Reserve		
Preston East Dome	.01½	.02
Rea	.10	.20
Standard	.00½	.01
Swastika	.02	.02¼
United		
West Dome	.08	.10
Porcupine Crown	.80	.85
Teck Hughes	.08	.10

### Cobalt Stocks.

	Bid.	Ask.
Bailey	.02¾	.02⅞
Beaver	.24	.24½
Buffalo	1.20	1.40
Canadian	.06	.08
Chambers Ferland	.15	.17
City of Cobalt	.45	.52
Cobalt Lake	.45	.50
Coniagas	7.20	7.40
Crown Reserve	1.33	1.37
Foster	.04	.06
Gifford	.02½	.03

Gould	.02	.02½
Great Northern	.09	.09¼
Hargraves	.01½	.02
Hudson Bay	75.00	80.00
Kerr Lake	4.35	4.50
La Rose	1.40	1.43
McKinley	.62	.65
Nipissing	6.00	6.13
Peterson Lake	.42	.42¼
Right of Way	.04	.05
Rochester	.02	.03
Leaf	.01	.02
Cochrane	.45	.55
Silver Queen	.01½	.02
Timiskaming	.13½	.14
Trethewey	.20	.25
Wettlaufer	.05	.06
Seneca Superior	2.70	3.00

## TORONTO MARKETS.

May 11—(Quotations from Canada Metal Co., Toronto).

- Spelter, 5¼ cents per lb.
- Lead, 5¼ cents per lb.
- Tin, 36 cents per lb.
- Antimony, 8½ cents per lb.
- Copper, casting, 15 cents per lb.
- Electrolytic, 15 cents per lb.
- Ingot brass, 10 to 15 cents per lb.

May 11—Coal—(Quotations from Elias Rogers Co., Toronto).

- Anthracite, \$7.50 per ton.
- Bituminous, lump, \$5.25 per ton.

## GENERAL MARKETS.

May 8.—Connellsville Coke, (f.o.b. ovens).

- Furnace coke, prompt, \$1.85 to \$1.95 per ton.
- Foundry coke, prompt, \$2.35 to \$2.50 per ton.

May 8.—Tin, straits, 33.45 cents.

- Copper, Prime Lake, 14.37½ to 14.50 cents.
- Electrolytic copper, 14.00 to 14.10 cents.
- Copper wire, 15.25 cents.
- Lead, 3.90 to 3.95 cents.
- Spelter, 5.15 to 5.25 cents.
- Sheet zinc, (f.o.b. smelter), 7.00 cents.
- Antimony, Cookson's, 7.25 to 7.35 cents.
- Aluminum, 17.75 to 18.00 cents.
- Nickel, 40.00 to 45.00 cents.
- Platinum, soft, \$43.00 to \$44.00 per ounce.
- Platinum, hard, 10%, \$46.00 to \$47.50 per ounce.
- Platinum, hard, 20%, \$49.00 to \$51.50 per ounce.
- Bismuth, \$1.95 to \$2.15 per pound.
- Quicksilver, \$38.00 per 75-lb. flask.

## SILVER PRICES.

	New York cents.	London pence.
April 25	59	27½
" 27	59⅞	27⅞
" 28	59¼	27¼
" 29	59	27⅞
" 30	59¼	27¼
May 1	59⅞	27⅞
" 2	59⅞	27⅞
" 4	59⅞	27⅞
" 5	59⅞	27⅞
" 6	59	27½
" 7	58¾	27
" 8	58⅞	27⅞