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## SUDBURY, COBALT AND PORCUPINE

In this issue, Mr. A. G. Charleton writes on the three most prominent mining districts in Ontario, which he visited during the past summer.

This article is reproduced by kind permission of the "Financial Times" from a series of articles by A. G. Charleton, Sept. 15, 27, 29 and Oct. 6.

Mr. Charleton, who is a past president of the Institution of Mining and Metallurgy, visited Canada to attend the twelfth session of the International Geological Congress. He was a member of one of the excellently planned and carried out excursions to Northern Ontario mining districts. In letters to the Financial Times he pays fitting tribute to the Ontario Bureau of Mines and to W. G. Miller, the leader of the excursion, A. P. Coleman guide for the Sudbury district, C. W. Knight, A. G. Burrows, and P. E. Hopkins, who acted as guides in the Cobalt and Porcupine Districts, W. R. Rogers the secretary of the excursion, A. A. Cole, mining engineer of the Timiskaming and Northern Ontario Railway, and to many others to whom the success of the excursion was largely due.

Mr. Charleton was 30 years ago resident in Canada at Deloro, Ontario, where he was assistant manager of the Canadian Consolidated Gold Mines. After a long absence he found on his visit this year a startling improvement in the mining industry. On his return to England he contributed several articles on the mines of Ontario to the columns of the Financial Times. In this issue we present several extracts from these articles, together with a number of photographs, most of which were taken during the summer at the mines visited by the excursion of which Mr. Charleton was a member.

## ANNUAL REPORT OF T. W. GIBSON, DEPUTY MINISTER OF MINES, ONT.

The annual review of mining in Ontario, written by Mr. Gibson, and published in the reports of the Bureau of Mines, is one of the best reports issued by mining bureaus.

It is an accurate summary of mining activities. Statistics of production of the several metals and non-metals are presented in an interesting manner, and are, owing to the reliable information furnished by the mining companies under the act, to be considered as the final figures. The figures for production are for metal actually recovered, not for total metal contained in the ores.

In this issue we publish several pages from Mr. Gibson's report. The complete text can be obtained on application to the Department of Mines at Toronto.

## METAL MINING IN ONTARIO

Metal mining has become a great industry in Ontario. Gold, silver, nickel and copper are produced in large quantities.

For some years the nickel-copper mines of the Sudbury district have been widely known as the world's chief source of nickel and important producers of copper. The output this year is greater than ever.

Since the original discovery ten years ago the silver mines at Cobalt have placed Ontario in a prominent position as a producer of silver. The deposits are remarkably rich and the profit has been unusually large, amounting to about one-half of the value of the silver. The production is now at the rate of over 30,000,000 ounces per year. For this year to date there is a slight increase over last year both in quantity and in value.

Until quite recently Ontario had few successful gold mines. The discovery of gold in the Porcupine district, however, has resulted in the development of two large and profitable mines. A third, though small, is proving rich and there are others which, while so far not profitable, are looked upon as likely to become so.

There are many miles of territory in Northern Ontario concerning which scarcely anything is known. There are large areas which have been described by explorers as promising; but as yet unprospected.

There is every indication that many more important ore deposits will be found in the Province and that the mining industry will continue to grow.

## AGREEMENT BETWEEN DOMINION COAL COMPANY AND PROVINCIAL WORKMEN'S ASSOCIATION

The agreement covering wages and conditions of work between the Provincial Workmen's Association and the Dominion Coal Company which expires 31st December, 1913, has been once more renewed for a period of three years ending 31st December, 1916. The document on which this agreement was endorsed is now of almost historic importance. It is the original signed award of the Shortt Board of Conciliation, given in March, 1908, which was at that time accepted by the Coal Company and their workmen as the basis of a two years agreement ending 31st December, 1909. The agreement was renewed for a further period of two years ending 1911, and once again for two years ending 1913, and upon the present and last occasion for three years ending 1916. The successive renewals of the award are endorsed upon the original document, which has now become an interesting record of the permanence of the harmonious relations existing between the Dominion Coal Company and their workmen at the mines.

The new agreement continues in force the rate of wages and the conditions of work in existence at the end of 1913, together with an increase of six per cent. to all day-paid labourers in and about the mines whose rates at the end of 1913 were less than \$2.00 per day,

together with sundry local increases in contract rates to meet special local conditions. In 1907 the rate for common labour was \$1.38 per day. This rate was raised to \$1.45 in 1908, again to \$1.52 in 1910, to \$1.60 in 1912, and from 1st January, 1914, will be \$1.70 per day. The rate for shiftmen, which has been \$1.75 per day since 1908, is raised to \$1.85 per day. As previously stated, all day-paid men rated under \$2.00 per day will receive the six per cent. increase.

The satisfactory conclusion of the negotiations between the Coal Company and the P. W. A., and the extension of the agreement for another three years, has caused general satisfaction throughout the whole district. On one side it will enable the company to make sales contracts and lay out a programme of development without any fear of labour troubles interfering with their plans, and on the other side, it assures to the workmen a continuance of their present earnings, plus as great an increase as the industry can properly afford. It is the record of the relations between the Dominion Coal Company and the P. W. A. that these have never yet been interrupted by a serious strike, and yet since 1900 the P. W. A. have obtained a continuous series of increases in wages, all of which have been obtained by the same method of negotiating and bargaining and eventual mutual agreement, which the latest contract perpetuates for a further three years. It is hardly necessary to set forth the merits of this constructive and conserving policy as against the destructive and wasteful methods of those who for their own ends caused the deplorable strikes in 1909 and 1910 in the various coalfields of Nova Scotia.

## WORKMEN'S COMPENSATION

The Province of Ontario expects soon to have a new Compensation Act. Sir Wm. R. Meredith, Chief Justice of Ontario, and Special Commissioner of the Ontario Government on Workmen's Compensation, has drafted a bill for submission to the Provincial Legislature. It is proposed, among other things, that compensation last as long as the disability; that employers must contribute towards the expense of administration; that the Provincial Government will contribute to the fund; that contributory negligence is no bar to compensation; that the common law by which an employee takes upon himself risks incidental to his employment be abrogated; that wilful or serious misconduct shall be cause for declining compensation unless death or serious disability results.

Apparently there is no clause requiring that the employee contribute in some small way to the fund. Managers would like to see such a clause, not merely because the workers would be paying a share of the cost of accidents; but because the workers would then have a good reason for striving with the managers in an attempt to prevent accidents. An assessment, even a very small one, would be unwelcome to the worker. He could be expected to strive to keep it as small as possible. In doing this he would go out of his way to prevent accidents to himself and his fellow workers.

# THE DEVELOPMENT OF NORTHERN ONTARIO BY THE MINING INDUSTRY

By J. C. Ross, Editor Journal of Commerce.

It is a far cry from the struggling uncertain days of the Cobalt of 1905 and 1906 to the Cobalt of to-day. In the few years that Cobalt has been in existence, it has made good. The hundreds of mines, prospects and claims have dwindled to a score or more of carefully managed, dividend-paying properties. To date, Cobalt has produced upwards of \$100,000,000 in silver and paid back to shareholders almost \$50,000,000 in dividends. From the small district known as the Cobalt Area, mining activity has extended until to-day Porcupine, Gowganda and a number of other places far removed from Cobalt, give evidence of a great mineralized Hinterland.

Up to a few years ago, Ontario was regarded as an agricultural province. Some attention was paid to lumbering and to fishing, but the great basic industry was farming. It was with the idea of extending the farming area and tapping the great Clay Belt of Northern Ontario that the Government commenced the construction of the Timiskaming and Northern Ontario Railway. While constructing this road, one of the employees, a blacksmith named La Rose, discovered what proved to be silver about one hundred miles from North Bay. This later became the La Rose mine and the centre of the Cobalt camp. The discovery of silver was followed a few years later by the discovery of gold at Larder Lake, Swastika and Porcupine, and other places, and silver at Gowganda, South Lorrain, and Montreal River. The discoveries of these mineral areas added a new basic industry to agriculture, lumbering and fishing. In the decade from 1902 to 1912, the mineral production in Ontario increased from \$13,000,000 to \$47,471,000. Last year, the silver produced in Canada, which is practically all from Northern Ontario, amounted to \$19,425,000. The value of the Canadian nickel—also a Northern Ontario product—was \$13,452,000. The value of the gold produced in Northern Ontario was \$1,788,000. To-day, there are over 11,000 men engaged in metal mining in Northern Ontario who receive in wages an average of about \$800 per year. The amount of ore shipped out, the freight furnished the railroads, the establishment of smelters, concentrators and other features associated with mining, have all tended to make Northern Ontario an important factor in the economic and industrial life of the Province.

From an investment standpoint, Cobalt has been the surprise of the world. In the early days when veins were found on the surface and outcroppings occurred in the most unexpected places, the impression prevailed that this was but a surface camp and that it would not maintain values at depth. After several years of mining, many of the companies are yet making important discoveries on their properties. Altogether, Cobalt has paid out in dividends almost \$50,000,000. Nipissing alone has returned to shareholders over \$10,000,000, while Crown Reserve, Coniagas, Kerr Lake and La Rose have paid in the neighbourhood of \$5,000,000, and several others have paid out over \$1,000,000 in dividends. There has been taken out of the Cobalt camp over \$100,000,000 worth of silver, making it one of the most important silver producing areas in the world.

Farther north, Porcupine is making a very creditable showing as a gold producing district. Hollinger,

the most important mine, has paid out over \$1,000,000 in dividends during the past year. Other gold mines in the Porcupine district are making satisfactory progress, although expenses connected with the mining and milling of the ore are so heavy that it takes time to achieve results. Gowganda is looked upon by many mining experts as a promising district, but owing to the fact that this section has been without roads, development has been exceedingly slow. Some companies have found very valuable ore and it will only be a question of time until Gowganda becomes a heavy producer.

There is no reason to believe that the minerals of the North Land are confined to the three or four districts now being worked. Practically the same rock formation occurs throughout large areas of Ontario's Hinterland and traces of valuable minerals have been found in many outlying parts. Eventually the whole of Northern Ontario will become more or less of a mining district. As new railroads are built and the country opened up, areas, now inaccessible, will be more thoroughly explored and minerals found.

Metal mining in Ontario will doubtless continue to be an important industry. Any falling off in the production of minerals from the Cobalt and Porcupine districts will be offset by fresh discoveries in other parts of the Province. Already reports of new discoveries are being made in districts far removed from the present beaten tracks. Railroad development will doubtless open up many new mineralized areas. It was the construction of the Canadian Pacific Railway that gave us Sudbury with its nickel and copper mines. The building of the Algoma Central gave us the Helen mine, while other discoveries around the Lake of the Woods, Michipicoten, Seine River, Bruce Mines and many other parts of the country, as well as the great discovery of the Cobalt and Porcupine camps, have all been the result of railway construction. To-day, the National Trans-Continental Railway across Northern Ontario is nearing completion. Other roads are being projected through the new district of Patricia and other parts of Ontario's Hinterland. In a recent report, Thomas W. Gibson, of the Bureau of Mines, says: "The only key to the future is found in the past, and in the vast area of pre-Cambrian rocks yet unprospected in Northern Ontario—to which was added the principality of Patricia—it can hardly be doubted that many more deposits of mineral wealth will be found."

Any mining district which, in the course of a half dozen years can produce \$100,000,000 worth of silver and pay back to the stockholders \$50,000,000 in dividends, cannot be ignored. Cobalt has added a new industry to the life of Ontario. It has created a market for the farmers of the great Clay Belt. It has attracted the world's attention to the Ontario Hinterland and advertised it more quickly and thoroughly than would have been possible by years of ordinary advertising. It has attracted immense sums of money to itself and kindred industries in the Dominion. It has furnished traffic for the Government railway and made what was once regarded as a foolish venture a profitable enterprise. Ontario and Canada owe much in an industrial and economic sense to the mineralized area known as the Cobalt and Porcupine districts.

### MINING EXHIBITS AT PANAMA-PACIFIC EXPOSITION.

At the Panama-Pacific International Exposition to be held in San Francisco in 1915 there will be an impressive display of the mining industry. Charles E. van Barneveld, chief of the Exposition's Department of Mines and Metallurgy, is making every effort to gather under the roof of the great palace that will house the mining and metallurgic display a collection of object lessons that will show the mineral resources of every country and the methods of extracting them from the earth. The display will be a liberal education in the science of mining.

"It has been said that mining operations do not lend themselves readily to exhibition," said Chief van Barneveld recently, when questioned as to the difficulties that might be expected in his undertaking, "and that the legitimate mine-operator has little commercial incentive to exhibit because he has nothing to advertise, nothing to sell. Fortunately, the mining industry in the main is in the hands of public-spirited men, accustomed to taking a large view of things, men who will not allow the lack of commercial incentive, the lack of apparent direct individual benefit, to outweigh the decided indirect, collective benefits to be derived from the right sort of publicity. We hear much of the decadence of prospecting and mining, of the lack of security and stability of mining investments. The miner has suffered greatly from misunderstanding, from public ignorance, and, above all, from persistent misrepresentation. We all recognize, in a general way, the importance of education; it is the greatest remedy for prejudice, superstition and ignorance; it makes for greater all-round efficiency. A well planned exposition is of incalculable value as an educator of the public mind. Many important questions in which the miner is vitally interested are pressing for settlement. When not blinded by prejudice and ignorance, the public is essentially fair-minded; it only needs education. This exposition offers to the men at the head of the mining industry an opportunity which probably will not recur for a decade, to give the public an insight into the importance, the stability and the solidarity of the industry, its legitimate speculative and investment features, the need of capital, of fair treatment, of wise legislation, of public support and co-operation. Surely this is sufficient commercial incentive."

### CHISANA GOLD FIELD, ALASKA.

The following information relative to the Chisana or Shushanna gold field, Alaska, was recently printed in Vancouver, B.C.:

Extensive development work is to be carried on during the coming winter in the Chisana diggings, according to Capt. W. Turnbull, who operates a steamer for the White Pass & Yukon route between Whitehorse and Dawson, and has just come down to Vancouver from the Yukon. He said there are 700 men in the camp awaiting "freeze-up" in order to start operations.

Capt. Turnbull is interested in two claims in the new gold fields, and intends to spend the winter there. He is going into the camp shortly with a large consignment of supplies for the W. P. & Y. R. The transportation company is operating a regular service into the diggings, and has already taken in a large store of supplies for the winter trade.

Reference was made to the fact that several prospectors had recently returned from the north, and had declared the discovery to be greatly over-estimated, and the captain was asked for his opinion on the prospects.

"A lot of prospectors went into the camp without reserve supplies," he commented, "and, consequently, could not stay there very long, as there were few stores up there in the summer. Many of the gold-seekers never reached the diggings at all, as they hit the trail without adequate provision for the long trip. Conditions are different now since the transportation companies have been getting busy—there are ample supplies in the camp and the 'mush' can be made with light packs.

"A large number of prospectors intend going in this winter," he continued. "Many of the claims which were staked early in the rush will be available for re-locating on January 1, as the required amount of development work has not been done on them."

Navigation has been closed up north. The last boat from Carcross left for Atlin on October 28. The last trip on the Whitehorse-Dawson route was made on October 22.

### WEST KOOTENAY POWER & LIGHT CO.

The West Kootenay Power & Light Co., which owns hydro-electric power stations at Upper and Lower Bonnington Falls, on Kootenay River, 11 miles below Nelson, and near Cascade City, on Kettle River, Boundary District, and which supplies electric power to the larger mines and the several smelting works at Trail and Rossland and in the Boundary, recently held its adjourned annual meeting at Montreal, Quebec. Statements of accounts submitted showed that last year's gross receipts were \$415,413, an increase of \$82,549, while operating expenses were \$115,279, an increase of only \$5,022. Net profit for the year was \$300,134, which was an increase of \$77,527, as compared with the immediately preceding year. After paying dividends on preferred and common stock and providing for sinking fund in connection with the Cascade Co.'s bonds, a balance of \$74,919 was carried to credit of profit and loss account, which now stands credit \$248,473. The directors were re-elected with the addition of T. J. Shaughnessy to fill the vacancy caused by the death of W. M. Doull, of Montreal, late president. Chas. R. Hosmer, who succeeded Mr. Doull as president, was re-appointed to that office.

### GRANBY CO. BOUGHT ALASKA MINE.

The Spokesman-Review, Spokane, Washington, in which city the Granby Consolidated Mining, Smelting & Power Co. has for years had its general manager's office, recently published the following:

The Granby Consolidated Mining, Smelting & Power Co., with mines at Phoenix and Hidden Creek, B.C., a smelter at Grand Forks, B.C., and another under construction at Hidden Creek, which will be ready to be operated about the first of the year, has purchased the Midas mine, near Valdez, regarded as one of the most promising copper deposits in Alaska, and development is now under way, according to reports received from the Granby offices in New York. The consideration is not made public, but it is reported to be about \$250,000.

An electric haulage system is being installed at the Midas, together with necessary mining equipment, and it is planned to have the mine producing by July or August, 1914. Already approximately \$1,500,000 of ore has been blocked out, assays from which show value averaging better than 5 per cent. copper and several dollars in gold. Granby's present plans provide for an ore storage at tidewater near the Midas and the output is to be treated at Hidden Creek. It is said the company contemplates eventually arranging for a line of steamers to transport the ore to the smelter.

## MINING IN NORTHERN ONTARIO\*

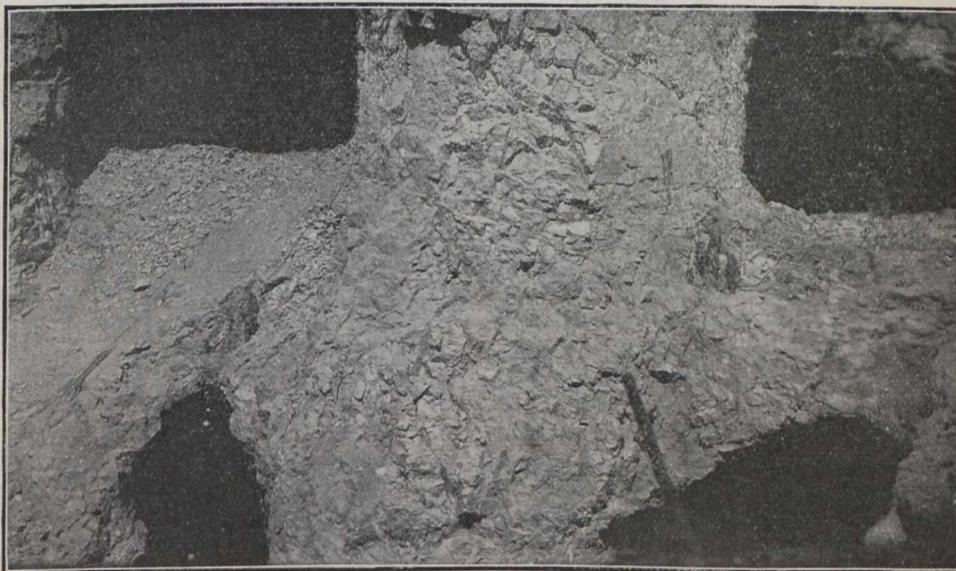
By A. G. Charleton, M. Inst. M.M., A.R.S.M.

The twelfth International Geological Congress, recently held in Toronto, Canada, which I had the privilege of attending as one of the delegates of the Institution of Mining and Metallurgy, was a remarkable gathering and proved an immense success.

It brought together geologists from all parts of the world; men of international reputation drawn from every civilized nation familiar with the geological conditions and mineral deposits of almost every habitable portion of the globe thus far explored and surveyed. The delegates of the Congress numbered close upon 500, and 23 tongues were spoken, although but three languages were officially recognized, namely, English, French, and German, in any of which addresses might be delivered. The members of the Congress formed a splendid body of alert, keen men; every type of brain was represented, long heads and round heads, but most of them possessing the clear, far-sighted eyes which generally distinguish men trained in science; whilst most of the members were endowed as well with that fine physique which can only be gained by a life largely spent out of doors, in striking contrast to men condemned to work all their lives confined in stuffy offices, studies and laboratories.

neering, as well as in connection with industrial enterprises, and questions constantly arise, not only in the investigations of ore deposits, but in matters of water supply and the foundations of structures, road construction, etc., upon which geology bears.

It is officially stated that over 40 per cent. of the mineral production of Canada is furnished by Ontario, and Northern Ontario possesses in Cobalt one of the most remarkable and productive silver fields, and in Sudbury the most valuable nickel mines in the world. An official excursion in which I took part afforded an opportunity for members of the Geological Congress to visit Sudbury, Cobalt and Porcupine. Sudbury lies about 35 miles north of Georgian Bay, the northeastern part of Lake Huron. It may be said to be a place of international importance, because it is the chief source of the world's supply of nickel, which is extensively used in steel armour-plate, for ordnance and other purposes in arts and crafts. New Caledonia is the only other locality from which any very considerable supplies are at present obtained. The geological features and the character of the ores of these two localities are, however, entirely different.



Breaking down nickel-copper ore, Creighton mine, Ont.

The Congress took place in Canada this year on the invitation of the Canadian Government, and although its proceedings proper are now over a number of the delegates have remained in Canada and are taking advantage of the specially arranged excursions, some of which are not expected to return to Toronto before the end of October. As has been well observed, these international meetings serve in a sense as "an international clearing house for geology," whilst, moreover, they focus attention upon the countries in which they are held, thus tending to aid in their development and promote their prosperity. The immense economic value of geological research is now widely appreciated in its application to mining, civil and other branches of engi-

**The Sudbury deposits** were first worked in 1887 by the Canadian Copper Company, and difficulties experienced in treating the ore for copper led to the discovery that it contained nickel. The early difficulties in separating the two metals were speedily overcome, but a more serious problem then presented itself, namely, to find a ready market for the large quantity of nickel available. Fortunately, about 1890, the valuable properties of nickel-steel began to be appreciated, and the industry became firmly established, larger profits resulting from the nickel in the Sudbury ores than from the copper it contained, and of late years nickel mining has become exceedingly profitable and has been conducted upon a very large scale.

\*Extracts from articles published in the Financial Times, London. Photographs by Reginald E. Hore.



Creighton nickel-copper mine, Ont.

The chief nickel-producing companies operating in the district during the past year were the Canadian Copper Company (controlled by the International Nickel Company) and the Mond Nickel Corporation. The formation of a new development company, the Canadian Nickel Corporation, Ltd., capitalized, it is reported, at \$30,000,000, has quite recently been announced.

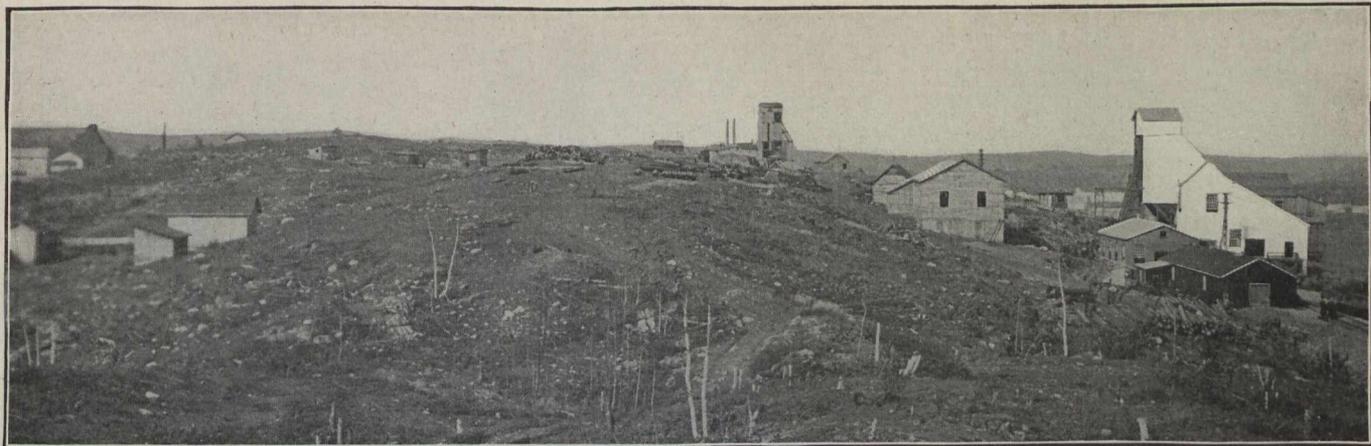
**The Sudbury ores** are not by any means of a complex character. They consist mainly of an intimate admixture of pyrrhotite, pentlandite and chalcopyrite in amorphous forms, but native gold, silver, platinum and palladium are occasionally found in them as well in appreciable quantities. The generally accepted theory of the origin of the ore bodies at Sudbury is that they are due to "magmatic segregation"—that is to say, the molten mass of eruptive norite was charged with the sulphides of iron, nickel and copper, which separated out before cooling completely; and it is a remarkable fact that nickel ore bodies are also found associated with norite in Norway. Some observers hold the view that the ores have been deposited by the agency of

water replacing the original constituent rock minerals. But the weight of evidence seems to be in favour of the first-named theory, which does not deny that there may have been subsequent rearrangement of some of the minerals present by water agency, which is quite probable.

The ore bodies of Sudbury are of several distinct types. 1. "Marginal," (a) dipping towards the axis of the basin consisting of ores with comparatively little rock and more than twice as much nickel as copper. (b) "Faulted marginal," irregular in shape and character—usually mixed with much rock and carrying as much copper as nickel, or sometimes more. 2. "Offsets," (a) columnar, roughly cylindrical bodies, nearly vertical, and going to great depths, usually rich in copper and the precious metals. (b) "Parallel offsets," not columnar, but sheet-like, dipping towards the basic edge, and carrying ore of a similar character to the "marginal deposits." Pentlandite and pyrrhotite form the major portion of the ore-bodies, intimately admixed with each other and with chalcopyrite. The latter mineral, while almost always present is more



Murray nickel-copper mine, Ont.



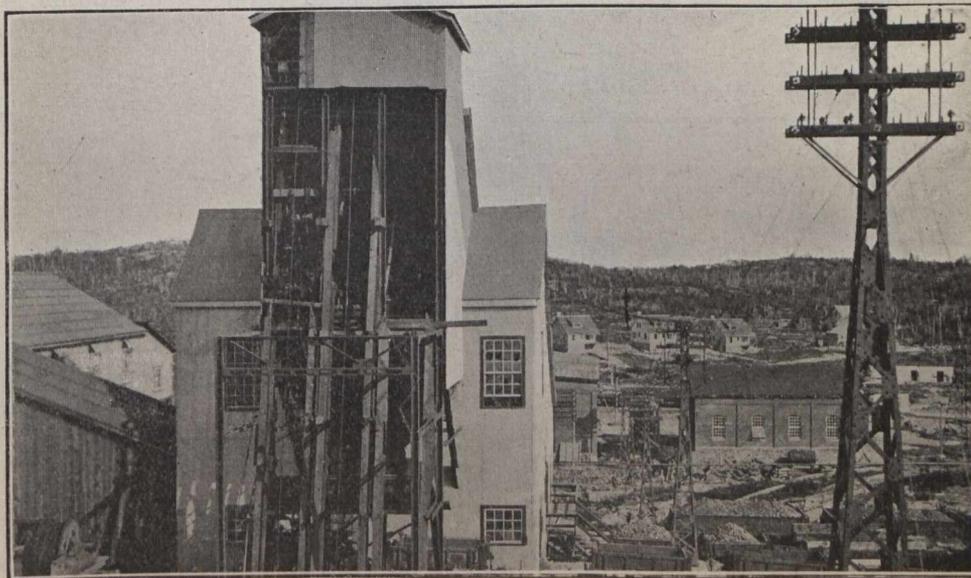
Looking along outcrop of ore body, No. 3 mine, Canadian Copper Co., Ont.

often found in pure masses, small in size, but free from the other minerals. Occasionally some very rich "patches" of ore have been found carrying some of the rare and precious metals, and in the early days several thousand dollars' worth of gold were obtained by means of a three-stamp prospecting mill whilst sinking the shaft of the Vermilion mine.

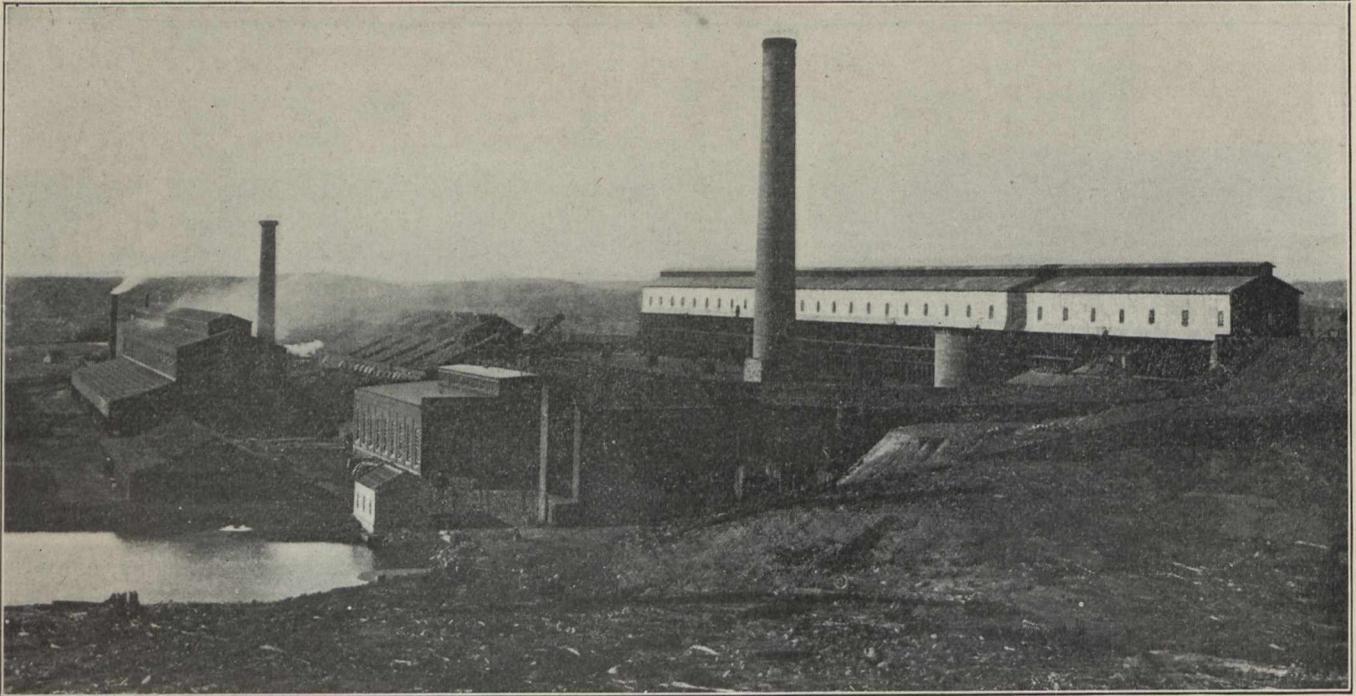
The Creighton mine supplies a good example of a typical Sudbury ore, although the average nickel and copper contents naturally vary somewhat in different mines. The ore contains about  $1\frac{1}{2}$  per cent. copper and 4 per cent. nickel, or 38 parts Cu to 100 parts Ni. Near the east end of this mine a characteristic contact of norite with the older gneiss may be seen, and the huge "open-cast," 300 ft. deep, traversed below by underground workings, reached by means of an underlie shaft sunk near the edge of the pit, is a sight not to be forgotten, reminding one of some of the immense open-cast workings in the copper mines in the South of Spain. These open-cast workings are quite a feature of the Sudbury district. The members of the Geologi-

cal Congress visited the Copper Cliff mine, one of the richest and most important of the early mines, which has now been abandoned. The ore body formed an irregular chimney, which has been followed for 1,300 ft. on an incline of 70 deg. to the east. The gossan-covered ridge at Frood, which was visited afterwards, is believed to contain the largest known nickel deposit in the world, estimated to contain between 35 and 100 million tons of ore. After testing it with diamond drills, the Canadian Copper Company has sunk two shafts and begun work on this deposit; and the Mond Nickel Company, which owns the "Frood Extension," taking in part of the centre of the ridge, is sinking a third shaft. At Murray, and in other parts of the field, explorations are in progress with diamond drills, and at Murray the nickel ore body is already known to reach a depth of 1,100 ft. and is estimated to include more than 10,000,000 tons.

And there are doubtless parts of the district, as yet unexplored, which will repay prospecting in this manner.



Rock-house No. 3 mine, Canadian Copper Co., Ont.



Canadian Copper Co.'s smelter at Copper Cliff, Ont.

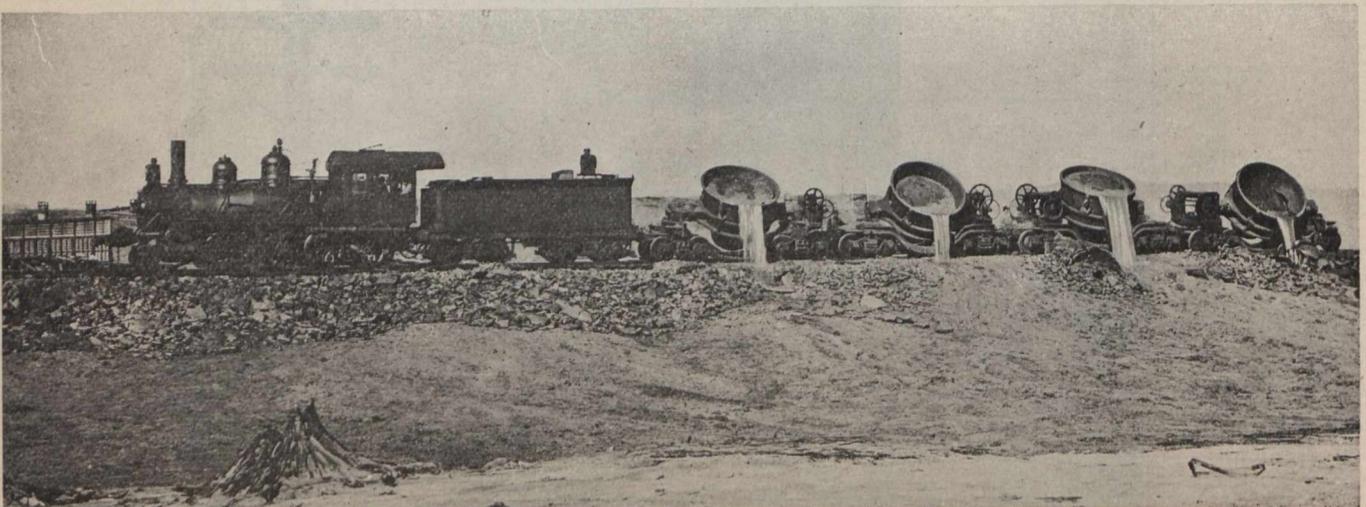
#### Treatment Method.

The general treatment of the Sudbury ores after hand sorting involves four distinct processes: (1) Roasting to remove part of the sulphur; (2) smelting in water-jacket furnaces, to produce furnace or standard matte; (3) re-smelting the standard matte in "converters," to enrich it up to 75 or 80 per cent. of nickel and copper; and (4) the separation and refining of the nickel and copper. Five companies at least, in addition to the Canadian Copper Company, have been engaged in the production of standard matte—the Drury Nickel Company, at the Chicago or Travers mine; the Mond Nickel Company, at Victoria mine (which possesses a remarkably fine plant), the Lake Superior Corporation, at Gertrude; the Vivians, at Murray mine; and the Dominion Mining Company, at Blezard mine—and their general method of treatment varies but little, though the size and equipment of the various plants

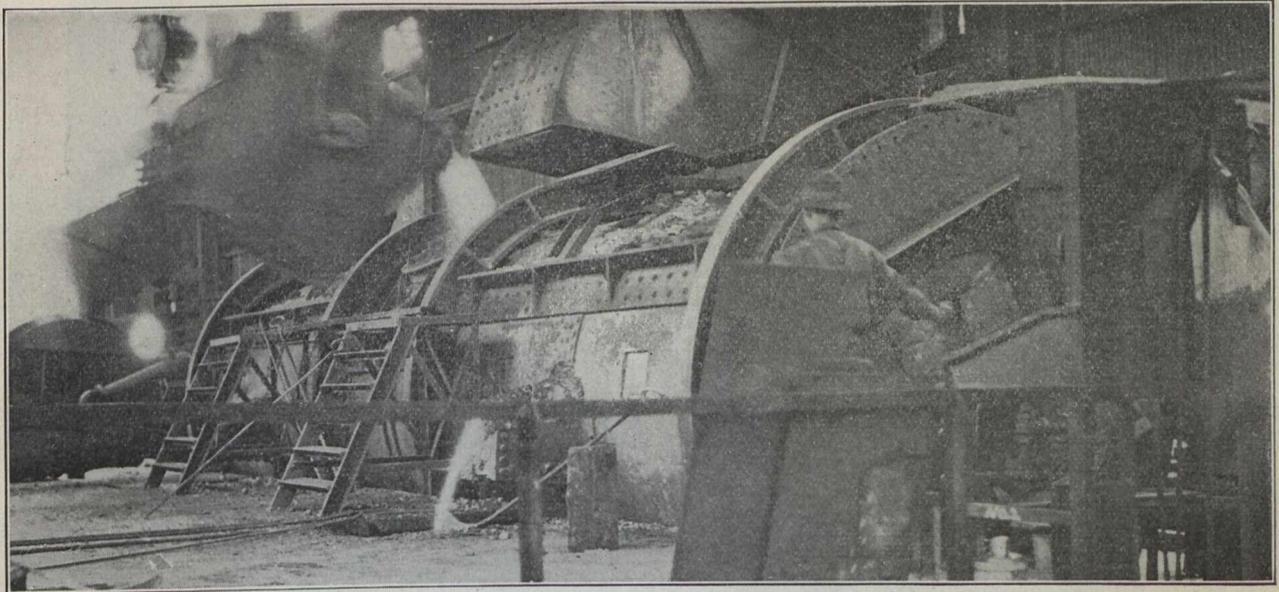
differs enormously. Canadian matte from Copper Cliff is treated by special methods at Bayonne, N.J., by the international Nickel Company, whilst matte from the Victoria mine is treated by the Mond process at Clydach, Wales; the reduced metals being acted on in the Mond process by carbon monoxide, and the nickel separated from the copper as a volatile compound.

Norwegian matte, obtained from Norwegian ores, is treated differently, and separated electrolytically by the Hybinette process, at Kristiansand, Norway. There are, therefore, three absolutely different ways of separating nickel and copper from the high-grade matte, all of which seem to be commercially successful in a greater or less degree, and able to compete with one another and with the different process used in the treatment of New Caledonian ores.

The Canadian Copper Company possesses a large power plant at High Falls, on Spanish River, about 23 miles west of Copper Cliff Station, which is a splendid



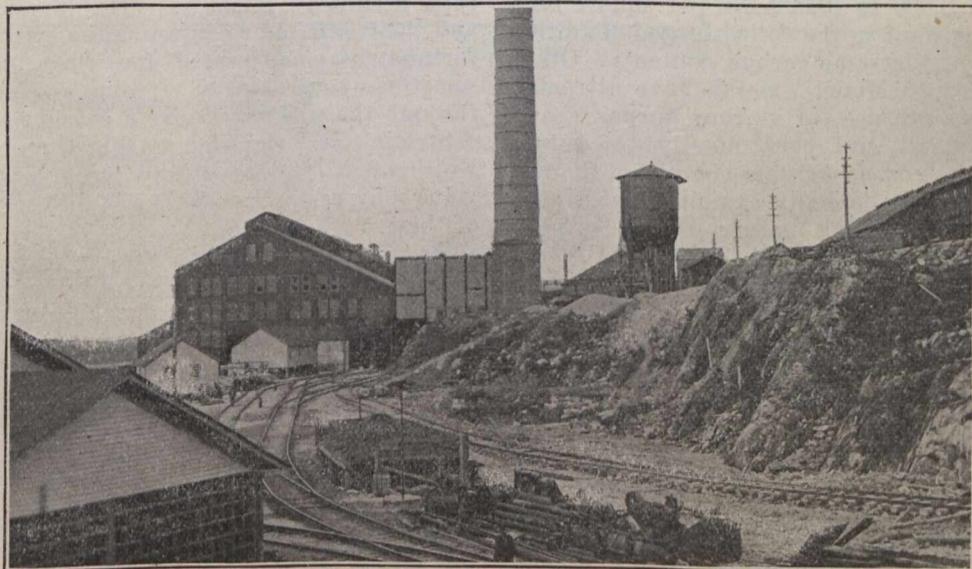
Train of slag pots, Canadian Copper Co., Copper Cliff, Ont.



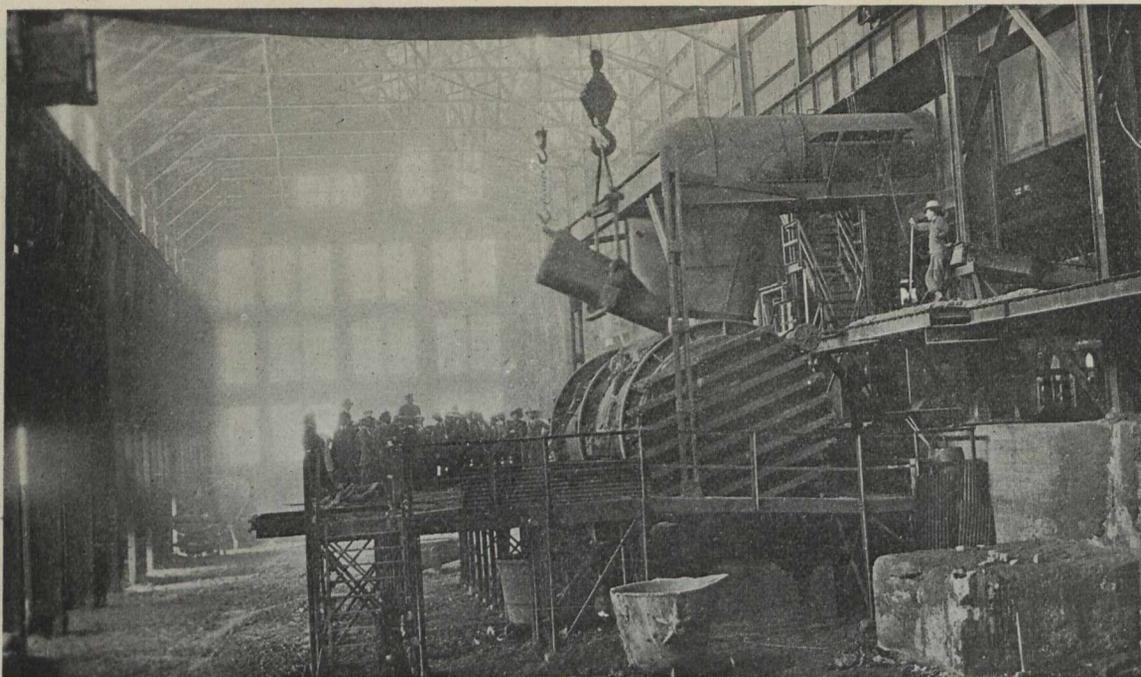
Pouring furnace matte into Converter, Canadian Copper Co.'s smelter



Views of basic converters, Canadian Copper Co., Copper Cliff



New smelter of Mond Nickel Co., Coniston, Ont.



Charging a basic converter, at new smelter of Mond Nickel Co., at Coniston, Ont.

installation. The smelter sub-station—the main distributing point of the system—supplies motors in the building itself and elsewhere, having a total capacity of 7,700 horse power, besides arc and incandescent lighting for the smelter, shops, etc., and the town of Copper Cliff. The Mond Nickel Company has hitherto smelted its ores at its works near the Victoria mines. Recently, however, new works have been erected at Coniston, near the crossing of the Canadian Pacific and Canadian Northern Railways, and the new smelters there when entirely completed will be a modern and magnificent plant. They are near the company's mine at Garson, from which the bulk of its ore is now obtained.

**Nickel steel**, possessing as it does both the qualities of strength and lightness, has afforded an opening for the use of large quantities of nickel, in the development of the automobile industry, flying machines, etc. A chrome-nickel steel made from Mayari ore, obtained from the Island of Cuba, is claimed to possess a greater tensile strength of 8,000 to 10,000 lbs. per square inch and a higher elastic limit in the rolled-forged condition than carbon steel of the same carbon contents. Other nickel alloys, such as "Monel" metal, have attracted attention and come into use for various purposes, and the future of the metal, and, consequently, the future of Sudbury, looks extremely bright. The nickel district of Sudbury has been geologically examined most minutely, and its many interesting features have been most carefully and graphically described by Dr. A. P. Coleman, Professor of Geology at Toronto University, who was one of the guides of our party.

#### Cobalt Silver Mines.

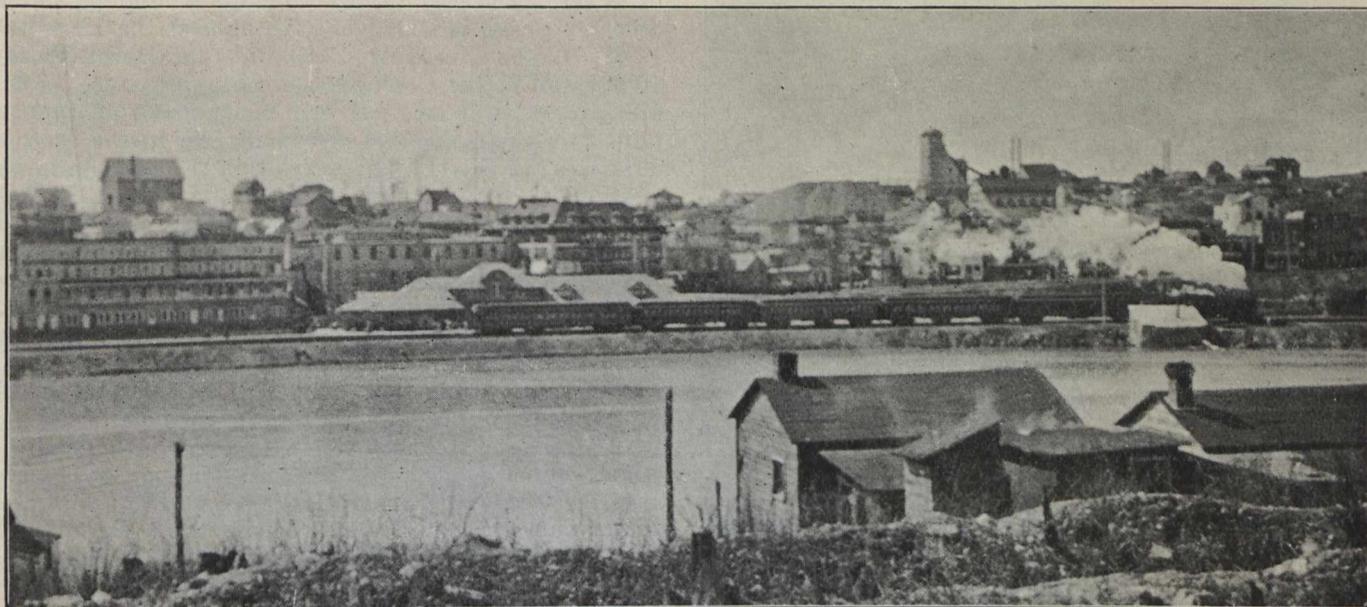
The Cobalt camp is situated about 90 miles northeast of Sudbury, and it is remarkable that copper and nickel are found so closely associated in the latter district, occasionally carrying a considerable amount of gold, with but little silver, whilst in the Cobalt field silver in large amount is associated with cobalt, nickel and arsenic, with but little gold present at any time. It was some time before the importance of the Cobalt discoveries were recognized. The district was, in fact,

condemned by engineers in the early days, who failed to appreciate its immense value, and, although it seems unlikely that mining will be carried on there to great depths, as in some other fields, this is compensated for in other ways.

The attitude of those who condemned the district at first was doubtless largely owing to the fact that the individual veins of rich ore are narrow, averaging not more than 4 ins. in width, which would be apt to prejudice many engineers, whose training naturally and very properly makes them liberal in their ideas, but cautious and conservative in business matters, and they argued from experience in other cases of a different kind that these narrow veins would speedily cut out. A good illustration that whilst it is frequently the case that men err on the side of undue optimism, they also sometimes miss good business opportunities through ultra-conservatism—in fact, you cannot divest mining of a speculative element, and it would be a dull and poor business if entirely robbed of its romance. The history of Cobalt has been peculiarly romantic. The large number of veins and their extreme richness, as the event has proved, has fortunately compensated for their small width, and sometimes several parallel veins and veinlets ramifying through the wall rocks give a considerable width of concentrating and rich ore, so that stopes are carried to a width of 25 ft. or perhaps more, and individual rich veins may carry 2 or 3 ft. of milling ore on either side of them.

In the early days Cobalt was a poor man's camp, and it was due to the enterprise and pluck of "the prospector" that it has acquired its world-wide renown. One of the earliest "adventures" is said to have extracted ore to the approximate value of \$250,000 at a total cost of \$2,500, and statistics, I believe, show that the dividends distributed by the mines represent over 50 per cent. of the value of the output of Cobalt.

Fortune, therefore, in this case has been on the side of the optimist and of far-sighted geologists like Dr. Willet Miller, Arthur A. Cole and others, whose confidence in the future of the district has been justified, and has led to its being opened up upon its present scale.



A view of Cobalt from Nipissing Hill

#### The Rapid Rise of the Cobalt Field.

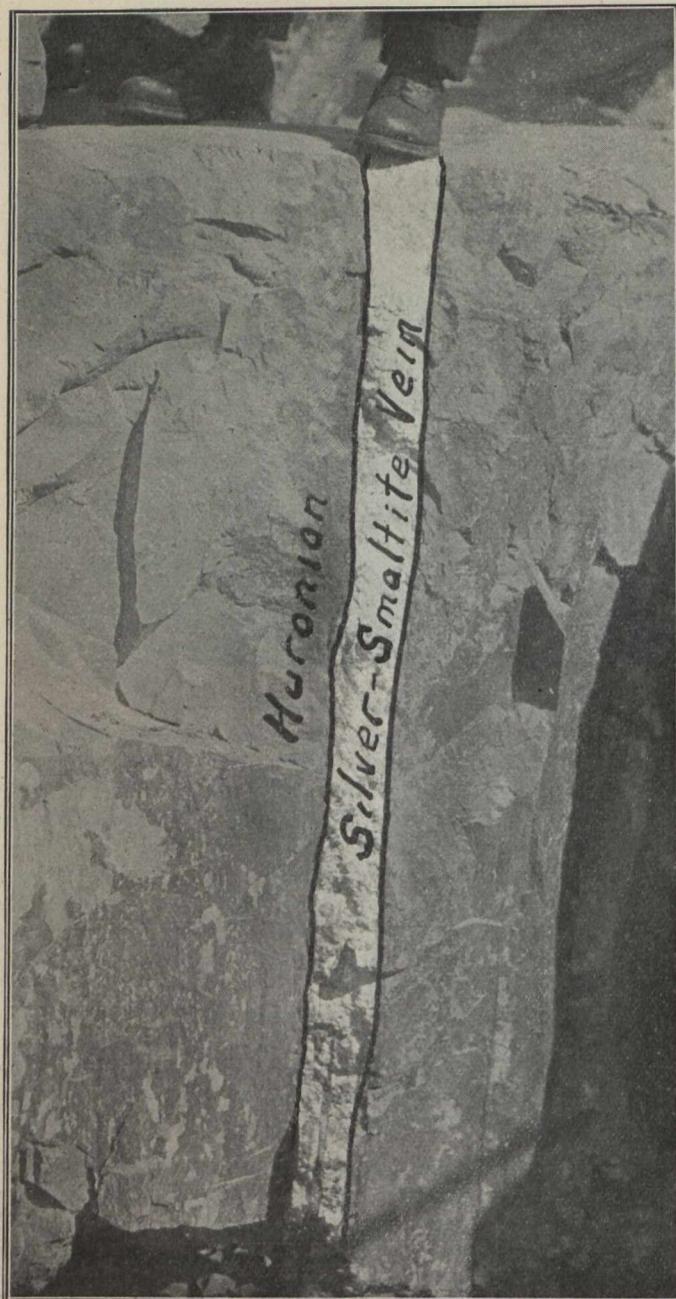
The output of Cobalt in 1904, it appears, only amounted to 158 tons of ore, worth \$136,217, averaging 1.309 ozs. of silver per ton, or 5.34 per cent.; cobalt, 10.21 per cent.; nickel, 8.86 per cent.; and arsenic, 45.56 per cent. To-day Cobalt is the greatest silver producer of any single field to the extent, it is said, of about 13 per cent. of the world's entire production, whilst the white arsenic produced from cobalt ores is estimated at 20 per cent. of its total output. The silver output for 1912 is given as 22,393 tons of ore, valued at \$17,455,080, and 5,449,732 ozs. of bullion, worth \$3,338,106, or a combined value of \$20,893,186—that is, well over £4,150,000. Upon the present basis of production a rise of 1 cent per ounce in the yearly average price of silver is calculated to increase the income of the producing mines by \$300,000. In 1912 the largest shipments of ore (2,000-lb. tons) were made from the following seven mines: La Rose, 3,511; McKinley-Darragh, 2,673; Coniagas, 2,119; Cobalt, Townsite, 1,944; Nipissing, 1,869; Buffalo, 1,251; and Cobalt Lake, 1,085. The largest bullion shipments last

year were from the Nipissing, 4,255,013 ozs., value \$2,607,734; Crown Reserve, 346,234 ozs., value \$210,634; O'Brien, 299,360 ozs., value \$141,765; Buffalo, 205,302 ozs., value \$124,895; and Kerr Lake, 171,645 ozs., value \$104,420. At the commencement of 1912 there were twelve dividend-paying companies. The Cobalt Townsite and Cobalt Lake Companies have since entered the dividend-paying list. At the end of 1912 six companies had more than repaid their shareholders the amount of their capitalization—namely, the Crown Reserve had paid 275 per cent.; the Nipissing 161 per cent.; the Buffalo 156 per cent.; the Kerr Lake 144 per cent.; the McKinley-Darragh 126 per cent.; and Coniagas 107 per cent.; whilst the Trethewey had reached 96 per cent., and the Right of Way 77 per cent.

Cobalt proper covers an area of about six square miles in Coleman Township, but isolated mines have been found outside of the central group, such as Casey, 19 miles northeast of Cobalt; the Wettlaufer, 20 miles southeast; and the Mann claims and Miller-Lake O'Brien, at Gowganda, 50 miles northwest. The Elk



Washing rock surface to expose veins, Nipissing mine, Cobalt



Silver vein in Huronian Greywacke, La Rose Mine, Cobalt

Lake discoveries also lie in this direction. It is, therefore, reasonable to expect that important new discoveries are likely to be made in this vast area, which is approximately 5,000 square miles in extent, much of which has been very superficially, if at all, "prospected" or examined. Even in Cobalt itself, owing to the surface being covered with much timber and drift material, in the early days contacts and outcrops were concealed and difficult to locate.

The Nipissing is the largest property at Cobalt and has the largest output of any individual mine at present. Up to the end of 1912 it had produced no less than 27,741,248 ozs. of silver, from ore, two-thirds or more of which averaged 1,500 ozs. per ton. The proved reserves are estimated to contain nearly ten million ozs., and there is a large portion of the company's area still unexplored.

#### Concentration of Low Grade Ores at Cobalt.

The richness of the ore in various mines is illustrated approximately by what it has cost to produce an ounce

of silver. The cost in 1911, including mining and all other expenses, is stated to have been at the Kerr Lake 14.69, at the Nipissing 13.95, at the Crown Reserve 10,761 and at the Coniagas 8.8 cents per ounce. There are several "Custom," as well as a number of company mills at Cobalt, and the only mill idle in the camp in 1912 was the Silver Cliff, which was reopened early this year. The concentration of low grade ores at Cobalt is becoming a matter of greater importance each year. In 1912 a new record was reached, 455,516 tons having been treated at different mills, and with enlargements either planned or carried out is likely to show further substantial increases. The "flow sheets" of the different water concentration mills show considerable variation in treatment at the different mills and considerable variety in the machinery employed for the purpose, as well as in the manner in which it is arranged, the details of which cannot be gone into here. But it may be observed that the "concentration ratio" varies within very wide limits, namely, from 130 to 1 downwards to 22 to 1. The most recent and interesting metallurgical innovation at Cobalt is the employment of aluminum dust in place of zinc dust for the precipitation of silver from cyanide solution at the Nipissing mill. Including the necessary alkali, the cost of aluminum precipitation is probably 30 per cent. higher than zinc, but the higher class "precipitate" resulting and the recovery of cyanide seems likely to render its use advantageous.

The bulk of the ore shipments from Cobalt go for treatment to (1) the works of the Canadian Copper Company at Copper Cliff; (2) the Canadian Smelting and Refining Company at Orillia; (3) the Coniagas Reduction Company at Thorold; and (4) the Deloro Mining and Reduction Company at Marmora, all in Ontario.



Compressed air pipe line, Gillies Limit, Cobalt

There are, however, several other smaller buyers. The arsenic in the Cobalt ores is a valuable by-product, and so is the cobalt to a less extent.

From an engineering standpoint, the Taylor plant of the Cobalt Hydraulic Power Company on the Montreal River is a most remarkable installation. This is for the compression of air carried down by a large volume of water into a large tunnel, and in its descent of 351 ft. becomes a mixture of water and compressed air, which is liberated at the lower end of the tunnel 1,021 ft. in length.

In the tunnel the air is compressed to 125 lbs. and is said to be remarkably free from moisture. The machinery for the collection, measurement and distribution of the air is contained in quite a small building, and it is delivered to Cobalt through nine miles of 20-in. pipe, 7½ miles of 12-in. pipe, and nine miles of 6-in. and smaller sizes, and sold at 25 cents per 1,000 cubic feet at about 100 lbs. pressure and atmospheric temperature.

#### Prospects of New Discoveries.

The value of the Cobalt veins is such that "intensive prospecting" is being carried on by the Nipissing Company on Nipissing Hill with a hydraulic monitor, which

gold field, which is situated on the Hudson Bay slope of Northern Ontario, close to the southern fringe of "the great clay belt," destined, it is believed, to become at some future time an important farming country. Porcupine lies 100 miles northwest of Cobalt, at an altitude of about 1,350 ft. above sea level. Little prospecting was done previous to 1909, when J. S. Wilson made a spectacular discovery of gold on what is now the Dome property. The disastrous forest fires which broke out in the middle of May and lasted until the middle of July, 1911, unfortunately gave the district a serious setback, as they swept over South Porcupine and Pottsville and the northern part of Porcupine (Golden City), besides destroying a number of surface plants, and were attended by a very sad loss of life. But with undaunted courage and faith in the district the mine owners set about reconstructing the mills, and gold to the estimated value of about \$1,800,000 was produced in 1912.

The two leading mines to-day are the Hollinger and the Dome. The outcrop of the first-named property is crossed by an old Hudson Bay trail, which scores of men must have traversed unsuspecting the wealth buried beneath their feet. Probably some of them camped on the very spot, where the main lode outcrops, where gold



Gold Quartz, Dome Mine, Porcupine, Ont.

sweeps away the surface soil and lays bare the rock below, so that it can be closely examined for silver streaks no thicker than a knife blade. And, no doubt, important new discoveries will be made in the district from time to time by more thorough prospecting. People on the spot have a marvellous faith in mining at Cobalt. Large prices have, I believe, been paid in a number of cases for properties upon which little, if any, actual prospecting had been done; and important concessions have been taken up under the lures merely upon geological probabilities, which have in some instances certainly repaid these apparently highly speculative ventures.

#### Porcupine Gold Mines.

My last excursion in connection with the International Geological Congress included a visit to the Porcupine

was afterwards discovered. The two premier mines differ, however, considerably in character, the Hollinger ore being comparatively rich and yielding a large profit per ton, whilst the Dome is a big deposit of ore of much lower grade on the whole. Other properties in the district include the McEnaney, Miller-Middleton and Dixon. In 1910 the ore treated at Porcupine only amounted to 1,060 tons, which yielded 1,947 ozs. of bullion, valued at \$35,539, whilst in 1912 the production of the district had risen to 88,466 tons, which yielded 50,633 ozs. of bullion, valued at \$1,032,313. The forest fires of 1911 destroyed the small experimental plants of the Dome, Hollinger and Vipond, but the new mills of these companies and of the McIntyre were in a position to treat the above-named tonnage in 1912, and the construction of two other mills, the Dome-Lake and McEnaney (Crown Reserve Mining



Gold quartz veins, Dome Mine, Porcupine, Ont.

Company) was also put in hand. With these mills in operation it appears reasonable to expect that the returns from this district in 1912 will be exceeded by its production in 1913.

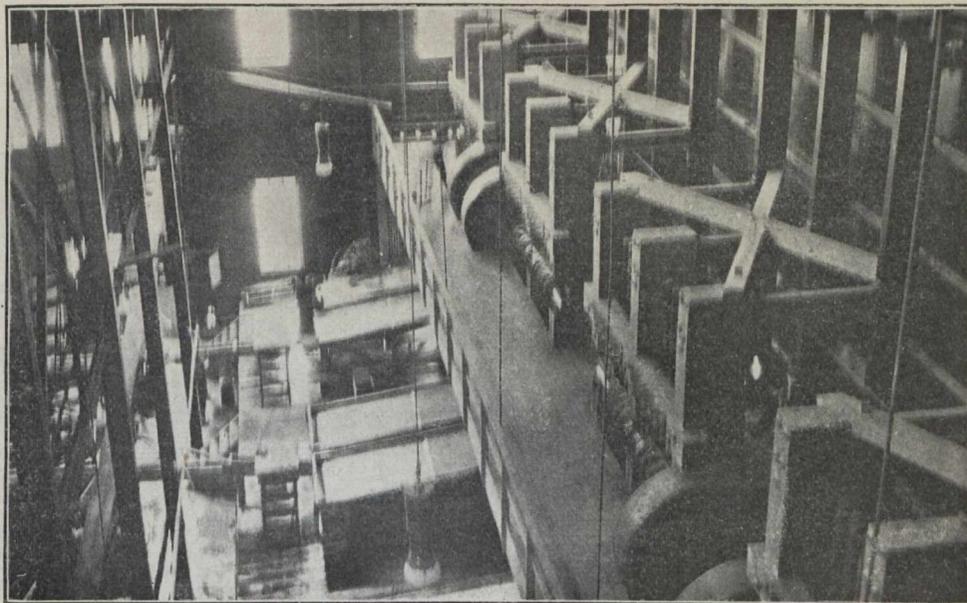
#### The Hollinger Mine.

At the Hollinger the ore reserves at the commencement of this year were estimated to amount to 644,540 tons, valued at \$11,271,400, and the profit made during the last half of the year was \$600,664.42. Up to the end of 1912 the company had paid three dividends of \$90,000 each, bringing the total dividend distribution up to that date to \$270,000. The reserves showed an

estimated increase in value at the end of last year of \$1,041,400, allowing for ore standing in reserve at the beginning of the year, to the value of \$970,304.89, which was subsequently milled, and the mine at the end of 1912 had only been partially opened up to the comparatively shallow depth of the 300 ft. level. There are stated to be forty-three veins upon the property, of which seven were discovered in 1912, and upon thirty-four of them no work has been done beyond sampling the outcrops. The three principal veins opened up are known as No. 1, No. 2 and No. 4, which showed reserves estimated to be worth \$6,026,100, \$2,648,250 and \$1,012,-



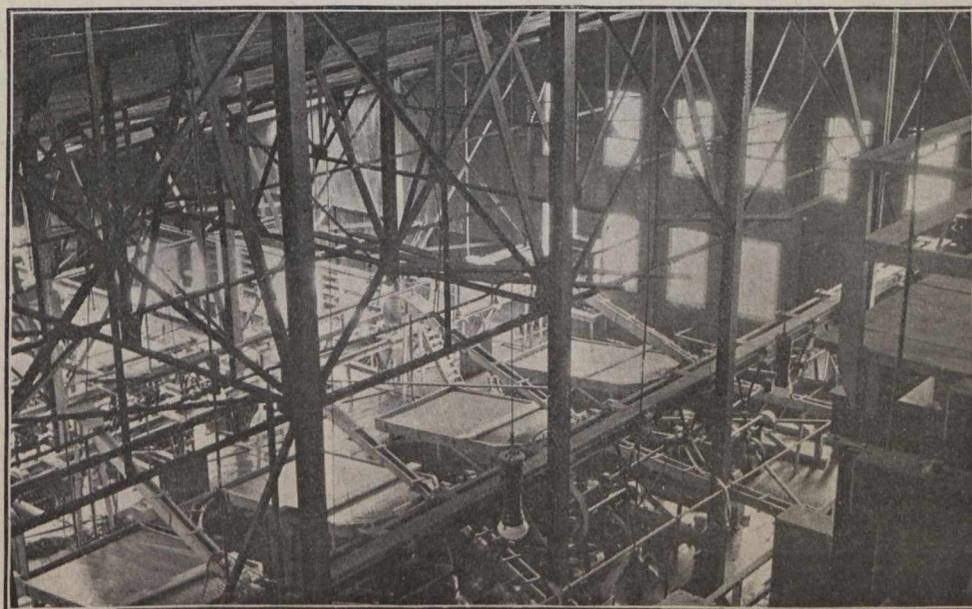
Mining gold quartz in open pit, Dome Mine, Porcupine



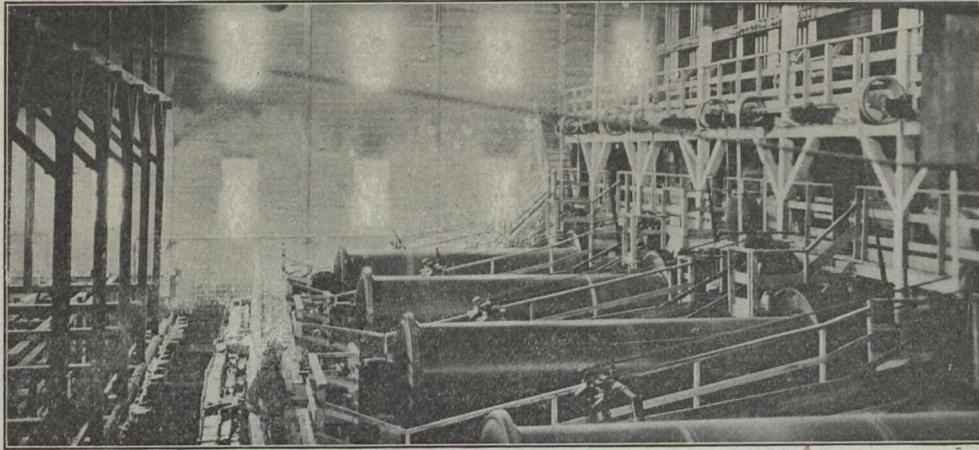
The Dome stamp mill (in 1912)

000 respectively at the commencement of 1913. But six other veins had been developed to some considerable extent, showing reserves varying in value from \$33,200 up to \$400,900 individually. The veins occur either in porphyry schist or near the contact, and development so far has been confined to veins in the porphyry. The strike of the schist is generally southwest to northeast, whilst the quartz veins cut across its strike at a small angle. No. 1 vein has a characteristic lenticular structure varying in width from 20 ft. down to a few feet, the lenses frequently overlapping. The average estimated value of all the ore treated in 1912 was \$21.40 per ton, including low-grade ore sent to the mill at the start of milling operations and during the strike, but the average of all the ore won up to 5th October, 1912, is figured at \$23.69 per ton and 5,777 tons of clean ore milled from the stopes yielded an average value of \$37.89 per ton.

The mine costs at the Hollinger in February, 1913, exclusive of several items of extraordinary expenditure, chiefly attributable to the strike and alterations to the mill and plant, are stated to have been: Mining, \$3,558; milling, \$1,493; administration, etc., \$0.407; operating camp, \$0.261; general charges, \$0.209; clearing surface roads, etc., \$0.015; total \$5.973 per ton of ore milled. But it is anticipated that, with uninterrupted work, the costs will be reduced approximately to \$5.50 per ton. Directly and indirectly, the strike is said to have cost the company \$100,000. The company employs about 500 men, and the working shifts are nine hours underground and eight hours on the surface. Skilled labour is paid \$3.25 to \$3.75 and unskilled labour \$2.50 to \$3.00 per day. Power is furnished from two independent sources at Mattagami River and Waiwaitan Falls. The new mill is said to be treating on an average 300 tons daily, with 30 stamps and making a 97 per cent. extrac-



Dome Mill, Porcupine, Ont.



Tube Mills, Hollinger gold mine, Porcupine, Ont.

tion from \$30.00 ore. With 40 stamps in operation its capacity is calculated to reach 450 to 500 tons per diem, as the stamp duty may be reckoned at 12 tons per stamp using coarse screens. The machinery comprises a gyratory crusher of large size, with trommel, Blake crusher and belt conveyor, stamps with tube mills, Dorr classifiers and spitzkasten, Deister slime tables, Door thickeners, Moore filters, Merrill presses and other auxiliary cyanide plant, with bullion furnaces, etc., and preliminary amalgamation is dispensed with altogether.

#### Conditions at the Dome.

At the Dome the ore bodies consist of veins and strings of quartz, much intermixed with schist, and the gold seems to occur along numerous small contact planes rather than in the quartz itself; very little sorting can, therefore, be done. Some rich specimen ore may be seen in the original discovery shaft a few feet from the surface at the end of a trench which follows along the back of a massive quartz outcrop. Two three-compartment shafts have been sunk—No. 1 to about 100 ft. in depth and No. 2 some 250 ft. or more—and the ore is carried from the mine to the mill by a double-tracked incline. The tonnage developed above the 45 ft. level is estimated at 315,528 tons, with a sampling value of \$7.53 per ton. The new mill constructed after the fire of 1911 is stated

to have treated from 23rd March, 1912, to 31st March, 1913, 101,812 tons of ore, which yielded \$1,043,995, and its duty has been brought up to 425 tons or more by increasing the tube mill and filter press capacity of the plant. The crushing machinery comprises gyratory crushers (40 1,250 lbs.), stamps and tube mills, whilst the gold-saving appliances comprise Dorr classifiers, amalgamating plates, concentrating cones, Dorr thickeners, Pachuca and mechanical agitators, cyanide solution tanks, Merrill slime presses and bullion furnaces. The works of the company are to be entirely operated by electricity, supplied by the Northern Canada Power Company, generated at Waiwaitan Falls, in place of using coal. The cost of power supplied to the mines at Porcupine in this way is stated to be \$50 per horse power per annum, calculated on peak-loads.

The different character of the two deposits makes the mining methods, as well as the mill practice, adopted at the Dome and Hollinger widely different. At the former mine most of the ore is won by the open-cast or "glory-hole" method, whilst at the latter mining is carried on either by ordinary stoping or by "shrinkage stoping" when the ore is wide (running as it does in No. 1 vein up to 20 ft. in width), and it is broken down in benches with long flat holes.



Pearl Lake, Porcupine, Ont.



A view from Tough-Oakes stamp mill towards Gull Lake. Tough-Oakes camp buildings in background

#### Kirkland Lake District.

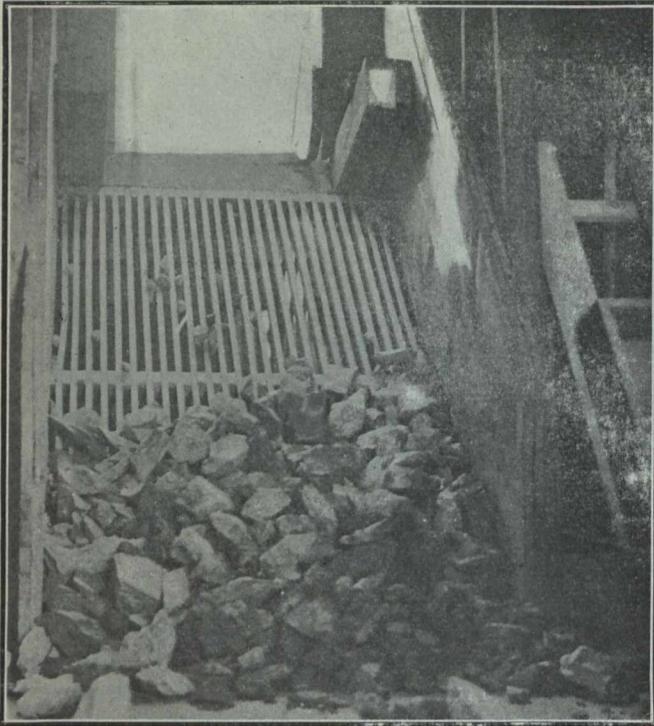
The writer, with several other members of the Porcupine excursion, made a branch visit to the Kirkland Lake district, in which several new discoveries were made last year. It is situated northeast of Swastika, which is about 61 miles north of Cobalt, on the Timiskaming and Northern Ontario Railway. Various gold claims have been opened up in this locality and one property, although only equipped with a small 5-stamp mill, is producing enough gold to pay running expenses. This claim is known as the Foster Tough-Oakes, and several veins have been located upon it. No. 2 vein is regarded as the principal one at present. It occurs in a grey and more or less banded conglomerate, a few feet north of the contact between the sedimentary series and grey feldspar porphyry. The conglomerate seems to dip nearly at the same angle as the vein. A main incline shaft was started

from the bottom of an open cast about 30 ft. deep, and had reached a depth of 175 ft. on 28th July last. The principal quartz vein seen at the surface and in the shaft, although narrow, appears to be persistent as well as rich, and the wall rocks are said to carry good values for a width of several feet, payable across the full width of the shaft, and apparently over a width of 15 ft. or more at the bottom. Gold telluride (apparently "calaverite") was first noticed about 18 ft. from the surface, and is stated to have increased in quantity in depth, as the proportion of silver to gold has also done. Two early shipments of picked high-grade ore, won from the open cast, each of about twenty tons, returned 19.6 to 22.5 ozs. in gold and 23.4 to 33.6 ozs. silver per ton, and were valued at \$9,235.60 and \$8,567.36 respectively. The Burnside is another new discovery in the same locality, and other properties are being opened up between



Teck-Hughes gold mine, Kirkland Lake, Ont.

Swastika and Kirkland Lake, which was formerly rather inaccessible; but this will shortly be remedied by a new road, under construction by the Government.



Gold Ore as received at stamp mill, Tough-Oakes mine,  
Kirkland Lake

### Conclusion.

Summing up, it is clear that Canada possesses in this little piece of Ontario alone, which the writer visited, immense deposits of mineral, comprising gold, silver, nickel, iron and other metals, that are being worked with large profit, and the old Hudson Bay territory to the north, which is as yet one of the almost unexplored corners of the globe, is said to be rich in copper and other deposits. Canada, it is true, cannot at the present time boast of many deep mines; but it is a mining country in the making, and the gross value of its metallic products alone came in 1912 to over \$61,000,000, silver contributing \$19,425,656, nickel \$13,452,463, copper \$12,709,311, and gold \$12,559,443. Neither does the Dominion at present possess many large mines encompassed in a small area, like those of the Rand, Broken Hill, Kalgoorlie, Charters Towers and other places, if one excepts Sudbury and Cobalt. But there are numerous mines, more or less scattered over Ontario and the West, and as railways and roads are pushed out into new, unexplored districts, one can scarcely doubt that many important individual discoveries will be made, and probably large new mining camps will be opened up, which will vastly increase its mineral production in a few years' time, and place it in the front rank amongst other mineral-producing countries.

And this brings me to the vital question whether these vast territories, with their potential mineral wealth, will lie idle for a time or will be left entirely to American and Canadian capitalists to explore and develop, or whether in the future, as in the past, British capital and British brains will take an active interest and an active part in co-operating in this important, beneficent and Imperial work, or will they leave it to Empire builders possessing greater enterprise and greater foresight?



On the Porcupine winter trail in 1910

## SAMPLING COBALT SILVER ORES

### Sampling High Grade in the Mines.

Owing to the richness and the irregularity of the distribution of silver in the veins, it has always proven difficult to get an accurate sample of an ore shoot at Cobalt. Some engineers have little faith in the samples however taken. Others believe that a reasonable approximation of value can be obtained; but that to do so the samples must be taken at very frequent intervals. In sampling along a drift at intervals of over 5 feet only a rough approximation is obtained. For a block sampled on all four sides it has been found that if the block is large—over 75x100 feet, a very inaccurate estimate is often obtained. For the smaller blocks it has been found that reasonably close approximation is possible; but that it cannot be considered a close estimate of contained values. Fortunately the latter is seldom necessary; but in many cases the mine managers have so little confidence in the regularity of ore shoots that they prefer to make no statement of the reserves blocked out. At some mines, however, the ore shoots are regular enough to allow reserves to be approximately estimated, and this is done by the managers in their annual reports.

### Sampling Low Grade in the Mines.

Most of the low grade ore that has so far been sent to the mills is ore that is broken along with high grade ore in following the veins. It is common practice to sample each breast, and to break as wide as the assays indicate the values to extend. It is usually the case that rock showing even occasional particles of native or ruby silver to the naked eye contains ore, and most of such material from the stopes is sent to the mill without assays being made. Where rock showing no visible silver is broken, a sample is sent to the assay office to determine whether it is ore or waste.

As much high grade ore had been removed before any attempt was made to treat low grade ore, the early workings on veins are now being extended to take out the milling ore. A large quantity of low grade is also being taken from the dumps where it was piled before concentrators were available.

In testing the walls of openings a common practice is to take the channel samples across the face at short intervals. At the Nipissing mine the walls are sampled by drill holes. In taking these samples, 6 holes are drilled horizontally from one set-up—3 holes in one wall opposite three in the other. The holes are placed in a vertical row and driven at right angles to the drift. The upper hole is 4.5 ft. deep, the middle 6 feet and the lower 3 feet. The hole is started with a diameter of 2½ inches, and a smaller size is drilled for each succeeding sample. When a depth of 18 inches has been drilled the holes are carefully cleaned out. The drillings give the first sample. Then another 18 inches is drilled and cleaned out, giving a second sample. This process is repeated every 18 inches, so that from upper holes there are taken three samples, from middle holes four samples, and from lower holes two samples. Where assays show good values for some distance in, the drilling is continued further.

The samples are all assayed and the results plotted. The construction of elaborate assay plans of the Nipissing property has thus been started.

In places where the samples show good values a further test will be made by breaking a sample for mill treatment. In doing this holes will be drilled at an angle with the holes made in sampling and the latter will then be used in breaking the ore. The assayed samples will thus be checked by a mill run before preparations are made for stoping on a large scale.

### Sampling Ore for Shipment.

By far the greater part of the silver shipped from Cobalt is in the form of ore or concentrates. There are large shipments of bullion from the Nipissing high grade plant and smaller ones from the cyanide plants treating low grade ore; but the camp is still largely dependent on the smelters. It is obviously necessary that an accurate sample must be made the basis for the sale of the ore.

The practice for some years was either to have the sampling done at the smelters in the presence of a representative of the seller, or to have the sampling done by independent assayers in the United States. Much of the ore has been sampled by Ledoux & Co., of New York.

To provide for accurate sampling of the ore at Cobalt, Messrs. Campbell and Deyell established a plant which has proven of great value to those who use it, and also, indirectly, to the other mines.

The plant and process of treatment have been recently described in a booklet issued by the owners. From this I will quote a few paragraphs describing the process and giving some notes on the characters of the ores that make sampling difficult. The accompanying figure gives the flow sheet. The authors of the booklet say:

“The sampling of high-grade Cobalt ore for either of the purposes outlined presents some difficulties owing to its extreme variability, its richness, and to the presence of large and small nuggets and flakes called ‘metallic silver.’ In the reduction of the ore to suitable sizes for sampling by the ordinary method these pieces of metallic silver would be caught on the necessary succession of screens and would involve extremely laborious calculations throughout the process.

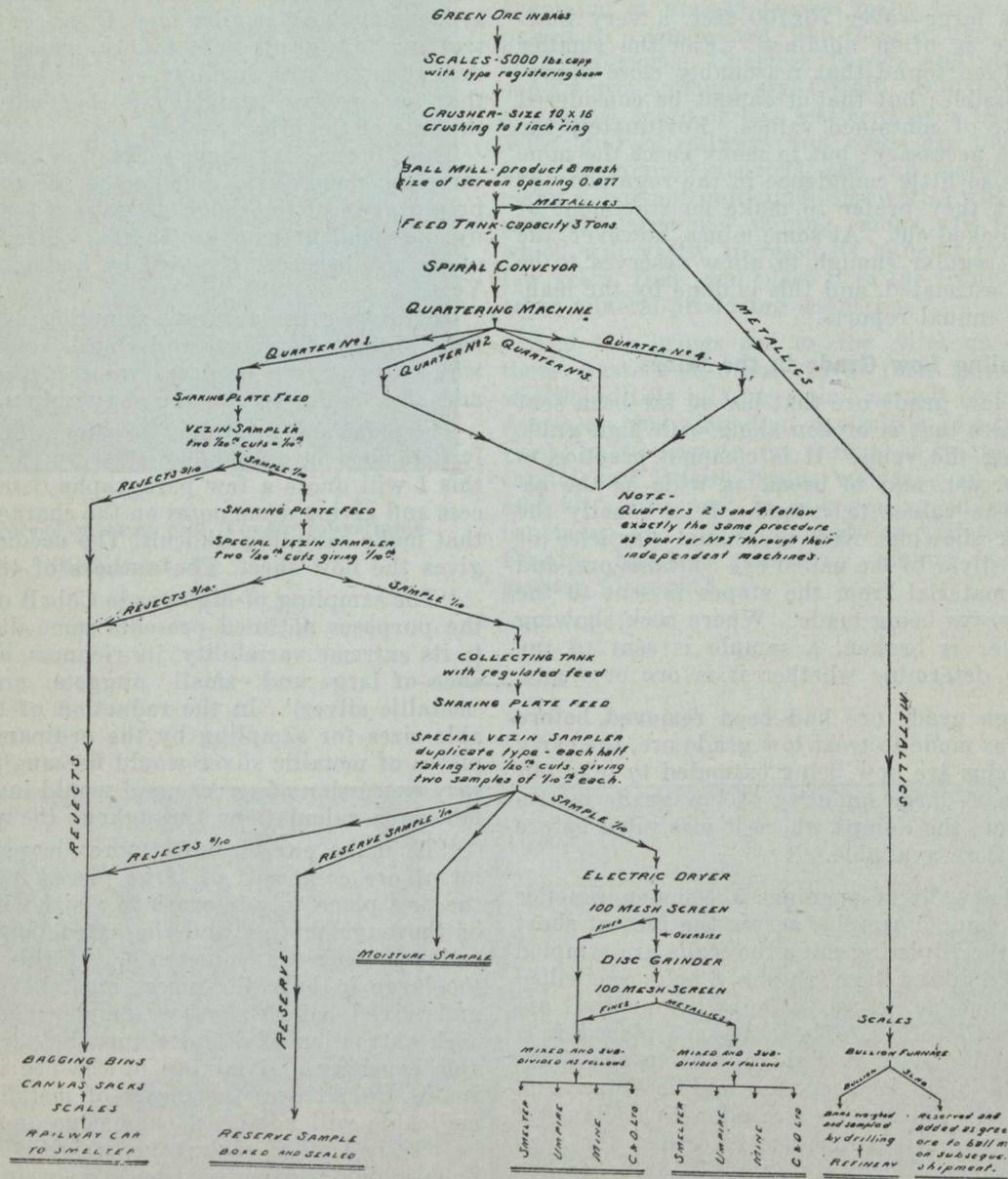
“To make our meaning more clear: In sampling a lot of ore composed of large pieces it is necessary in the first place only to crush to a size which will permit of thorough mixing and the extraction of a representative sample—say one-tenth. If this sample is still too large in bulk the pieces must be further crushed and mixed before another sample can be taken; and each extraction of samples must be paralleled by suitable crushing and mixing of the ore in this manner. In the Cobalt ores the pieces of metallic silver, being malleable will not crush, and consequently they must be screened off at each stage, weighed and the portion from which they were taken also weighed and finally the ‘metallics’ melted and their bearing on the rest of the ore-lot calculated separately by assay. This operation is necessary with each crushing, hence the laborious calculations as intimated above.

“However, by performing all the crushing in one or two consecutive operations at the very beginning the friable portion of the ore is reduced to fine powder and the uncrushable pieces of metallic silver are screened off for separate treatment, in one operation. The material passing through the screens is fairly homogeneous, and can be reduced, after mixing, to a very

small representative sample before further treatment. The sampling of this ground product can be done entirely by machines—which have no personal equation—while the handling of the metallics and the finishing of the small samples can be closely supervised by the mine or smelter representative.

“It now is proposed to give in more or less detail a description of the method employed at Cobalt for the sampling of Cobalt ores, but before passing from generalities it might be well for us to express our opinion regarding the attitude from which sampling should be regarded.

“The bags are trammed from car or wagon into the mill, being weighed at the door on a Canadian Fairbanks type-registering scale. The car and ore-sacks are subsequently weighed and this tare deducted, giving the net green, or receiving weight of ore. The ore is either placed in locked bins, or, if to be sampled immediately, is carried by electric elevators to the second, or ‘crusher’ floor. Here the bags are opened and the ore shovelled over a one-inch grizzly, the oversize going to a 10-inch by 16-inch Buchanan crusher, which reduces it to 1½-inch ring.



Flow Sheet of Campbell-Deyell Sampler

“The company’s chief works are situated in Cobalt immediately beside the line of the Timiskaming and Northern Ontario Railway, with a special siding leading to the mill entrance. From the mine, therefore, most of the ore is delivered to the plant in railroad cars, a certain proportion, however, being sent in by wagon. In all cases the ore is contained in jute or canvas sacks which weigh from 80 pounds to 150 pounds each.

“The discharge from both crusher and grizzly pass to a cylindrical steel tank with conical bottom, and is thence discharged automatically to the ball mill by an adaptation of the Challenge feed. The ball mill reduces the 1½-inch product continuously and passes it over a spiral screen (8-mesh), thereby discharging the ‘throughs’ into a steel hopper-bottom car and returning the over-size to be reground. Necessarily each lot

of ore has to be crushed and sampled separately, and requires a complete clean up of the mill and the machinery after each lot has passed.

"After the ball mill receives the last portions of ore from the crusher tank, the presence of metallics becomes evident from the nature of the ball mill discharge. When it is adjusted that the metallics have been freed from the brittle ore and the mill is discharging a product composed mostly of pellets of silver, a section of the screen is removed allowing the metallics to be discharged in their unreduced form, into a suitable receptacle. These metallics are, at the discretion of the mining company, either bagged, weighed, and shipped to the smelter; or else they are taken to the bullion department and are there melted and cast into ingots. Samples are taken by drilling the ingots. It is usual to ship the bullion by express to the London or United States markets.

"To return to the No. 8 mesh product that has been discharged from the ball mill into hopper bottom cars; this is occasionally held in reserve in a steel hopper tank until required for further treatment; rarely it is bagged; usually the car is trammed, directly it is full, to the elevator, elevated to the top of the mill, and there discharged into the sampler feed-tank.

"From this point the ore is treated entirely by machines until four separate samples, of about 15 pounds each, are obtained.

"The sampler tank discharges its burden into a steel pipe fitted on the inside with a spiral band of steel. This spiral conveyor is rotated by a chain drive, the ore having the combined motion of advancing in the pipe and being tumbled over. This last motion, which gives a mixing action, while not equalizing the whole tenor on the ore passing through, cuts out the sharp lines of difference and enables the sampling machines following to have a uniform product discharged to them during each of their revolutions.

"From the spiral the stream of ore is fed by a spout to the quartering machine, which in each of its revolutions takes four equal sections of the ore stream. Each of these quarters is separately led by a pipe to a shaking plate, which equalizes the intermittent discharges and delivers a constant stream to the No. A Vezin sampler which takes a one-tenth cut from the stream (21-20 cuts per revolution). The reject falls directly by a pipe to the reject bin. The sample (1,500 pounds) is taken continuously by a second shaking plate and thence to No. B Vezin sampler, which, as before, takes one-tenth cut. The second reject is also led to the reject bin; and the sample (150 pounds) caught in a sealed sample safe. At the completion of the run all the machines are brushed down and the samples taken to No. C Duplicate Vezin Sampler.

"Here a shaking plate delivers a stream of ore to two double revolving vanes that extract, each, one-tenth sample (15 pounds) depositing each into a separate receptacle and the reject into a third. One 1/20 sample is boxed, sealed, and stored as a reserve; the other is taken to the finishing room; the reject goes to the bagging bin, or is held over until the next shipment from this particular mine, as are also the mill sweepings and the rejects from the finishing room. These operations are carried out with each of the four quarters from the quartering machine.

"From the bagging bin the ore is drawn off into canvas bags, which are tied, weighed, and shipped to the smelter.

"Up to this point the fine product from the ball mill has been automatically mixed, quartered and each of

the quarters independently sampled by machines until eight samples of the lot (two from each quarter) are obtained.

"To follow the samples further; on reaching the finishing room the sample is weighed and dried in an electric oven for six hours at a temperature of 110 deg. C.; the moisture is thus incidentally ascertained—this method has been checked against the theoretical method with no practical difference resulting. The dried product is screened through a 100-mesh and the oversize ground in a Braun disc pulverizer to pass the same mesh.

"It is at this point that the metallic silver in the ore is again in evidence. The small pellets that pass through the ball mill screen are flattened out, or are rolled into spheres by the discs. These metallics, No. 2, are disced until clean as required, or are freed from impurities on the buckboard; the product from all operations either passing through the 100-mesh or being held on it as clean metallics. The metallics are mixed by coning on glass, divided into the requisite number of packets, and sealed. The fines are placed in an Abbe pebble mill, from which the pebbles have been removed, and the jar rotated slowly for half an hour. After mixing, the fines are carefully removed from the jar, placed on the glass table, flattened out with a spatula, and sections taken, packeted, and sealed for each of the parties interested.

"In this way, the ore after passing the ball mill screens is divided into four equal portions, each quarter after treatment resulting in a sample each of fines and metallics. The combined assay values of these two products give one valuation on the ball mill fines. The mean of the four samples is considered to be a fair valuation of this product.

"If now this number of ounces per ton is multiplied by the weight in tons of the ball mill fines, it gives the total silver content, in ounces, of this product. Adding to this the total fine ounces in the ingots obtained from the ball mill metallics, the total number of ounces in the shipment is arrived at. Multiplying this product by the current market price of silver gives the present value in silver of the shipment.

"The flow sheet will serve to give material aid to an appreciation of the above description. It shows in a graphic form every stage in the sampling of the ore.

"It must be understood that the foregoing is descriptive only of the method employed in dealing with high-grade Cobalt ore. As has been explained, there are certain difficulties in connection with Cobalt ores which call for more lengthy and elaborate treatment than is needful with many others. Still, as the greater includes the less, so this plant, equipped for this elaborate method, is capable of dealing, all the more readily, with less complicated processes."

#### MANGANESE.

Ores of manganese found in Canada comprise pyrolusite, manganite, psilomelane and wad or bog manganese, and these are found principally in the eastern provinces of Nova Scotia and New Brunswick.

Mining operations have been conducted at Loch Lomond, Cape Breton, Tennycape, Walton and Cheverie in Hants County, East Onslow and Londonderry in Colchester County in Nova Scotia. In New Brunswick there are numerous occurrences and production has been obtained from Markhamville and Jordan Mountain in Kings County; Ouaceo head, St. Johns County; Shepody Mountain and Dawson Settlement, Albert County.

## MINING IN ONTARIO IN 1912\*

By Thomas W. Gibson, Deputy Minister of Mines.

The mining industry of Ontario continues to expand, not only in the quantity and value of the annual production, but also in the area embraced within its operations.

The beginnings of the industry were on the shore of Lake Erie, where a hundred years ago the settlers smelted the bog iron ores of the locality into stoves and potash kettles. In the eastern part of the Province the rocky areas proved to contain iron, gold, mica, and many other useful metallic and non-metallic minerals on which have been established industries of local, and in some cases more than local, importance. The shores of the great lakes, being accessible by water, lay open

to the early prospectors, who were rewarded by the finding of copper at Bruce Mines, and silver at Silver Islet and on the mainland of Lake Superior.

The period of railway building set in, and wherever a pathway was opened in the forest, it became a base, sometimes indeed the actual site, of fresh discoveries. In a cut of the Canadian Pacific Railway, near Sudbury, in the year 1883, the first copper ores of that region were found, which soon proved to contain nickel, and so led to the opening up of the world's chief source of supply of that metal. The building of the C.P.R. enabled prospectors to ply their calling on Lake of the Woods and to penetrate to the valley of

### Mineral Production of Ontario, 1912.

Product.	Quantity.	Value.	Employees.	Wages.
<b>Metallic—</b>				
Gold, ounces .....	*102,278	\$2,114,086	1,183	\$1,254,361
Silver, ounces .....	†30,719,883	17,671,918	3,746	3,543,419
Cobalt, tons .....	936	315,781		
Copper, tons .....	11,126	1,584,310		
Nickel, tons .....	22,850	4,736,460		
Platinum, ounces .....	‡2,366	80,736	2,881	2,404,889
Palladium, ounces .....	¶4,316	147,235		
Iron ore, tons .....	117,357	238,884	687	550,744
Pig iron, tons .....	589,593	8,054,369	846	636,420
Lead (concentrates), tons .....	26	1,290	19	3,074
		\$34,945,069	9,362	\$8,392,907
Less Ontario iron ore smelted into pig iron (71,589 tons) .....		145,326		
Net metallic production .....		\$34,799,743		
<b>Non-metallic—</b>				
Arsenic, tons .....	4,166	79,297	§	§
Brick, common, No. ....	385,000,000	3,178,250	2,582	1,012,469
Tile, drain, No. ....	16,463,000	279,579		
Brick, paving, etc., No. ....	8,082,000	221,986	732	386,627
Brick, pressed, No. ....	65,598,000	634,169		
Building and crushed stone .....		953,839	829	371,041
Calcium carbide, tons .....	1,998	120,000	44	27,697
Cement, Portland, bbl. ....	2,993,367	3,365,659	1,551	876,722
Corundum, tons .....	1,960	233,212	197	123,465
Feldspar, tons .....	13,633	28,916	60	21,257
Graphite, tons .....	1,246	65,076	84	24,201
Gypsum, tons .....	31,331	50,246	140	49,823
Iron pyrites, tons .....	20,744	71,043	170	115,342
Lime, bushels .....	2,297,525	281,672	379	113,344
Mica, tons .....	570	57,384	79	35,116
Natural gas, million cubic feet .....	12,414	2,268,022	277	184,351
Peat, tons .....	175	725	15	520
Petroleum, Imperial gallons .....	8,432,730	344,537	¶699	¶436,852
Pottery .....		52,445	34	17,630
Quartz, tons .....	94,758	179,576	112	68,506
Salt, tons .....	90,986	450,251	219	151,218
Sewer pipe .....		464,627	230	140,398
Tale, tons .....	6,726	61,358	79	32,396
Non-metallic production .....		13,541,869	8,512	4,198,975
Add metallic production .....		34,799,743	9,362	8,392,907
Total production .....		48,341,612	17,874	12,591,882

\*See under "Gold." †See under "Silver." ‡See under "Platinum." ¶See under "Palladium." §Included under "Silver" and "Cobalt." §In refining works only.

the Seine River, where they found gold indeed, but failed to open up a permanent gold field. The rumours of placer gold drew a crowd of prospectors into the wilds of Michipicoten in 1897. They found no golden sands, but in 1898 there was discovered the Helen mine, which brought about the building of the Algoma Central Railway. A stretch of fertile land at the head of Lake Timiskaming had called for years for connection with older Ontario, but not even the standing promise of a substantial bonus by the Government induced private capital to undertake the construction of a railway. The Government itself set about the task, and Cobalt was discovered, one of the richest silver camps ever made known. Gowganda, South Lorrain and Casey followed, and in 1909 Porcupine, now getting into its stride as a producer of gold.

The only key to the future is found in the past, and in the vast area of pre-Cambrian rocks yet unprospected in Northern Ontario—to which was added last year the principality of Patricia—it can hardly be doubted that many more deposits of mineral wealth will be found, some of them perhaps as rich as any that have yet been brought to light.

For the year 1912 the returns made by mining companies and mine owners show the aggregate production of minerals and mineral products to have had a value at the point and in the form produced of \$48,341,612. In 1911 the value was \$41,976,797, so that the increase for the year was \$6,364,815, or 14.9 per cent.

The increase in production as compared with 1911 was largely in the metals, the value of which was greater by \$5,696,876, or 19.5 per cent. Non-metallic substances advanced in value by \$667,939, or 5.1 per cent. Of the entire output, the metalliferous list provided 72 per cent., and the non-metalliferous 28 per cent., as against 70 per cent. and 30 per cent. respectively in 1911.

Among the metals decided gains were made in gold (\$2,071,449), silver (\$1,718,023, or 10 per cent.), nickel \$1,071,986, or 29.2 per cent.), copper (\$303,192, or 23.6 per cent.), and cobalt (\$144,891, or 84.7 per cent.). The gold production given for 1912 includes a considerable output really belonging to the six years beginning with 1907, of which no report has been made until now. The item for cobalt also obtains some advantage from the fact that much of the mixed oxides of cobalt and nickel which are produced in the process of refining the ores from Cobalt are shipped without being separated from each other. Cobalt predominating, both in quantity and value, the whole is credited to cobalt alone. There was a moderate advance in pig iron (\$338,055, or 4.3 per cent). The single decrease was in iron ore (\$207,046, or 46.1 per cent.).

In the non-metallic substances, the chief increases were in common brick (\$376,279, or 13.5 per cent.), paving and fancy brick (\$135,301, or 156 per cent.), pressed brick (\$69,539, or 12.1 per cent.), stone (\$61,212, or 6.8 per cent.), corundum (\$86,054, or 5.8 per cent), quartz, \$115,171, or 17.8 per cent.), and sewer pipe (\$54,563, or 13.3 per cent.). The largest decreases were in Portland cement (\$274,983, or 7.5 per cent.), feldspar (\$22,694, or 43.9 per cent.), iron pyrites (\$47,414, or 40 per cent.), and drain tile (\$69,966, or 20 per cent.).

**An Accelerating Production.**—During the five years beginning with 1908, the products of the mines, quarries and mineral works of the Province have increased in value by 88 per cent. It is in the metalliferous materials that the more notable increases have taken place. The entire list of products of this kind participates in the increase save one—iron ore, the output of which has of

late shown a tendency to diminish. Gold remained stationary at a small production until 1912, when the effect of the opening up of the Porcupine deposits began to be seen. Silver, notwithstanding a reduction in the quantity produced, brought a greater return in 1912 than in any previous year, because of the higher prices which prevailed. Nickel expands steadily, and carries along with it its by-product, copper. Cobalt is also a by-product, the figures for which are assuming more importance as the business of refining and especially of marketing it is being mastered. Among the rarer metals platinum and palladium reappear in 1912, after an absence of some years.

The changes in the production of the non-metallic materials have not been so marked. There has been a steady growth in the output and value of brick of all varieties, also of stone both for building purposes and crushed for road material and use as a flux. Portland cement shows a rapid growth until 1912, when for the first time since the manufacture began in 1891, there was a check in the output, the figures falling below those for 1911. Lime alone among the materials of construction seems to be losing ground, possibly because of partial displacement by cement. The decline in the yield of petroleum, remarked on in this report annually for a number of years, shows no symptom of abatement. Natural gas continues to advance, but the increase in 1912 over 1911 is comparatively small. Salt maintains an annual production of less than half a million dollars in value, and shows little fluctuation from one year to another. Sewer pipe made in Ontario appears to be coming into better demand, for the production has been for some years rising in value; but another clay product, drain tile, shows an unusual falling off in 1912. Pottery, too, remains stationary. Notwithstanding private and governmental effort, the manufacture of peat makes little headway, measured at any rate by quantity of actual output. The milling of talc is becoming more important yearly; mica barely holds its own against competition from India; the feldspar quarries on the Kingston and Pembroke Railway were active during the later part of the five-year period, but less so in 1912, and iron pyrites also failed to maintain in that year the advances successively made for several years before. Graphite and gypsum have both increased, the latter markedly so; this is true also of corundum, though the destruction by fire of the only operating plant for treating this mineral may cause a temporary stoppage of production. Quartz for flux and converter linings is being raised in large quantities; white arsenic, made from the ores of Cobalt, has of late found a good market; carbide of calcium, though higher in 1912 than in 1911, did not attain to the level of the earlier part of the five-year term. The production of apatite, or phosphate of lime, has practically ceased, and fluorspar, though appearing in the tables for 1910 and 1911, has not yet been produced in quantity.

**Total Production of Metals in Ontario.**

Product.	Value.
Gold . . . . .	\$4,734,713
Silver . . . . .	97,176,289
Platinum and Palladium . . . . .	290,755
Cobalt . . . . .	1,072,141
Nickel . . . . .	41,012,763
Copper . . . . .	17,239,531
Iron ore . . . . .	6,724,385
Pig iron . . . . .	57,246,101
Lead . . . . .	117,290
Zinc ore . . . . .	92,410

The footing of the valuation column in the above table is \$225,706,378. The only item in which there is any duplication or overlapping is iron ore, a considerable proportion of which was smelted into pig iron, and so included in the latter. Making ample deduction for this, it would appear that up to the end of 1912, the selling value at the mine or works of the metals and metalliferous substances produced in this Province was \$220,000,000 at least. If the nickel and copper were valued at the prices of the refined metals in New York, according to the method employed by the Mines Department at Ottawa, the total would be about \$290,000,000.

**Gold.**—For the first time in the history of Ontario, there was in 1912 a substantial production of gold. The largest previous yield was in 1899, when a number of stamp mills were operating in the Lake of the Woods and Seine River districts. The output that year amounted to \$423,978, but the performance of these fields not proving equal to their promise, the production fell off in 1900 to \$297,861. Last year the actual yield of gold within the limits of the Province was 86,603 ounces, worth \$1,790,087, or over four times as much as in 1899. To this is added 15,675 ounces, valued at \$323,999, recovered at the Orford works of the International Nickel Company, New Jersey, in refining the nickel-copper mattes from the Canadian Copper Company's mines in the Sudbury district. This extraction extended over the six years from 1907 to 1912, but no part of it has hitherto been included in the Bureau's statistics, since no returns of it were made. Though the effect is to swell the figures for the twelve months beyond their strict limits, it seems proper to incorporate this production in the official record at the first opportunity. The total number of ounces stands therefore at 102,278, with a value of \$2,114,086.

The feature of the year was the coming into production of the Porcupine camp. The Dome and Hollinger mines both suffered the destruction of their milling plants, then well on their way to completion, by the unprecedented fires of 1911, which were also accompanied by so lamentable a loss of human life. It was not until April and June, respectively, 1912, that the new mills at the Dome and Hollinger were ready to begin work, so that the output for last year by no means represents a full twelve months' operations.

**At the Hollinger mine,** the plant went into commission July 1st, with the full complement of thirty stamps, and during the remainder of the year it treated 45,195 tons of ore and rock, from which a recovery was made of \$933,682, or an average of \$20.33 per ton. Of this, \$972,135 was in gold, and \$6,547 in silver. The mill and process have proven satisfactory, but after a short time experience led to the abandonment of amalgamation in favour of cyanidation of the concentrates. This necessitated no change in the apparatus, the substitution of cyanide of potassium for mercury in the grinding pans being all that was required. At the end of the year, the underground workings amounted to 8,918 feet, distributed as follows: 5,039 feet of drifts, 2,764 feet of crosscuts, 451 of winzes, 232 of raises, and 432 of shafts. There are levels at 100, 200 and 300 feet. The reserves of ore are placed at \$10,230,000, of which \$7,560,000 is credited to No. 1 vein, and \$1,200,000 to No. 2. In computing the reserves, no allowance is made for ore which may exist beyond a depth of 50 feet below the deepest working of any vein. The total operating profits up to 31 December, 1912, were \$600,664, and a monthly distribution of dividends at the rate of 3 per cent. per month was begun in November. Three such dividends

of \$90,000 each were declared before the close of the year.

Operations here and at the Dome and other mines of the Porcupine camp were much interfered with by a strike of the miners, which began early in November, the men refusing to accept a reduction of wages. The strike was unsuccessful, for the companies were able to procure labour enough to operate the mines and mills, though for a time only partially so, and not a little of the help obtained was of an indifferent character.

**The Dome mine** also operates thirty stamps, and crushed a large tonnage of ore from the date at which work began. The workings of the Dome Company are open cut, and both the quartz and the schist in which it occurs are put through the mill.

**Other mines** which turned out bullion at Porcupine in 1912 were the Vipond and McIntyre. In Eastern Ontario, the Cordova; in Lake of the Woods, the Olympia; and in Sturgeon Lake, the Northern Gold Reef, Limited (St. Anthony) contributed to the output. Of the total production of \$2,014,126, Porcupine supplied \$1,730,628, and the remainder of the Province, \$452,656, including the gold obtained in refining the Canadian Copper Company's mattes during the last six years, as above set forth.

• Other mines at Porcupine, such as Jupiter, McEnaney, Pearl Lake, etc., may be expected to become producers ere long, and it is now evident that this camp is destined to make a substantial contribution to the gold output of Canada, and to break the long record of disappointment which so far has been the chief result of gold discoveries in Ontario.

There are other districts where development has been going on with more or less activity for some time, including Larder Lake, Swastika, Munro Township, Long Lake, etc., but none of them have yet reached the stage of permanent production.

**Kirkland Lake.**—A find of more than ordinary interest has been made at Kirkland Lake, in the Township of Teck. On the Tough-Oakes claims, some very rich ore occurs in small stringers. Since the beginning of 1913, several carloads of ore have been taken out by open-cut methods and shipped in bags, the ore realizing \$448 per ton. The property is being opened up by Mr. C. A. Foster, of Haileybury, discoverer and first owner of the Foster silver mine at Cobalt.

**A New Find in Michipicoten.**—Towards the close of last season, a discovery of gold was made in township 34, Range 24, Michipicoten. During the fall and winter a number of mining claims were staked out, but no work has yet been done to test their value. The locality of the discovery is about 55 miles southward of White River station on the Canadian Pacific Railway, and about 10 miles north of Lake Superior. A good canoe route, with only two difficult portages, leads up White River, across Pokay Lake, down the Dog River, and over a number of small lakes into Lake Michi Biju. The more promising of the two main outcrops is a 3-foot silicified zone cutting a well-mineralized green schist, and ramified by numerous small stringers of quartz. At the discovery post the hanging wall of the zone is exposed to a height of 12 feet above the adjoining small valley. On the wall, the gold occurs in small blebs and scales and again is heavily intermixed with arsenical pyrites, which occurs in patches. A sample of the pyrites was assayed by the Provincial Assayer and showed a high gold content. This sample was taken from the wall only, and covered but 15 feet of the best material then showing, conse-

quently the result cannot be considered as that of a fair average sample. It is as yet uncertain whether or not the gold-bearing arsenical pyrites is confined to the hanging wall or, what seems more likely, whether it is associated with the numerous small enclosed quartz stringers that follow the trend of the zone.

The other gold-bearing formation occurs a mile farther north. Here, on the edge of a small lake, a quartz vein having a width of at least 20 feet at the discovery post, outcrops prominently for a distance of 200 feet. The only sample taken, from the hanging wall, showed a gold content of \$1.20. The quartz looks promising, and it is possible that systematic sampling may prove the vein to be worthy of exploitation.

Owing to the closeness of the freeze-up, nothing in the way of sampling or actual testing of either of the two main outcrops could be undertaken. It is intended to prospect the formations during the coming season. The geological conditions are in general favourable, and resemble those obtaining in other Ontario gold-fields. The thick forest growth and the heavy overburden, however, combine to make prospecting in this but little explored part of the Province difficult, tedious and expensive.

**Gold Mining Companies.**—Following is a list of the gold mining companies in operation during 1912, distinguishing between those which produced bullion and those which did not:

**Silver.**—The production of silver last year amounted to 30,719,883 ounces, which was 787,997 ounces less than in 1911. Owing to the higher price of silver, however, the value was greater by \$1,718,023, or \$17,671,918 in all. Cobalt, of course, was the preponderant source of supply, others being the gold obtained from Porcupine and elsewhere, and the nickel-copper mattes of Sudbury. These sources contributed respectively as follows:

	Ounces.
Cobalt proper .....	28,859,764
Gowganda .....	549,976
South Lorrain .....	834,119
	30,243,859
Gold ores .....	16,776
Canadian Copper Company's mattes .....	459,248
	30,719,883

The explanation of the last item is similar to that already given regarding the gold obtained from the same material; the quantity mentioned was recovered at the Orford works of the International Nickel Company in New Jersey during the last six years. It has not been included in any of the statistics previously published by the Bureau of Mines for the reason that it was omitted in the returns for the years in question.

From the year 1904 when the first silver was obtained from the mines of Cobalt, the production of the camp has amounted in all to 15,815,839 ounces, the sum received by the mining companies for which was \$81,731,115.

**Ontario Gold Mining Companies.**

Name of Company.	Name of Mine.	Locality.	P. O. Address of Manager, etc.
<b>Producing Companies—</b>			
The Dome Mines Company Limited .....	Dome .....	Porcupine .....	South Porcupine.
Hollinger Gold Mines, Limited .....	Hollinger .....	Porcupine .....	Timmins.
Vipond Porcupine Mines, Company, Limited .....	Vipond .....	Porcupine .....	Schumacher.
McIntyre Porcupine Mines, Limited .....	McIntyre .....	Porcupine .....	Schumacher.
Northern Gold Reef, Limited .....	St. Anthony .....	Sturgeon Lake .....	Toronto.
Cordova Mines, Limited .....	Cordova .....	Peterboro county .....	Cordova Mines.
Olympia Gold Mining Company, Limited .....	Olympia .....	Shoal Lake .....	9 Reaney Street, St. Paul, Minn.
<b>Non-producing Companies—</b>			
Ore Chimney Mining Company, Limited .....	Ore Chimney .....	Frontenac county .....	335 Brisbane Bldg., Buffalo, N.Y.
Crown Reserve Mining Company, Limited .....	McEaney .....	Porcupine .....	Cobalt.
Canadian Exploration Company, Limited .....	Long Lake .....	Long Lake .....	Naughton.
Lucky Cross Mines of Swastika, Limited .....	Lucky Cross .....	Swastika .....	Swastika.
The Swastika Mining Company, Limited .....	Swastika .....	Swastika .....	18 Toronto Street, Toronto.
The Gilmour Mining Company, Limited .....	Gilmour .....	Hastings county .....	Gilmour.
Jupiter Mines, Limited .....	Jupiter .....	Porcupine .....	Schumacher.
Dome Lake Mining & Milling Company, Ltd. ....	Dome Lake .....	Porcupine .....	Schumacher.
Pearl Lake Gold Mines, Limited .....	Pearl Lake .....	Porcupine .....	Schumacher.
Plenaurum Mines, Limited .....	Plenaurum .....	Porcupine .....	Schumacher.
Goldfields, Limited .....	Goldfields .....	Larder Lake .....	Larder Lake.

Among the non-producing companies, stamp mills were in course of erection about the beginning of 1913 by Crown Reserve, Lucky Cross, Swastika, Dome Lake. Canadian Exploration Company and Goldfields, Limited, are already equipped, having made extensive alterations during the year, including the installation of hydraulically generated electric power. The former derives current from the Wahnapiatae River, and the latter from the falls at Raven Lake.

The producing mines numbered 30 as against 34 in 1911, those whose output was a million ounces or more being—

	Ounces shipped in 1912.
Nipissing .....	4,719,578
Coniagas .....	3,703,942
La Rose .....	2,920,344
Crown Reserve .....	2,714,766
McKinley-Darragh-Savage .....	2,704,868
Kerr Lake .....	1,895,309
Buffalo .....	1,890,150
Cobalt Townsite .....	1,505,396
Timiskaming .....	1,242,243
Cobalt Lake .....	1,123,146
O'Brien .....	1,091,631

The other producing mines were Penn-Canadian, Hargrave, Bailey, Hudson Bay, Casey-Cobalt, Colonial, General, City of Cobalt, Trethewey, Right of Way, Chambers-Ferland, Beaver, Cobalt Provincial, Drummond, Seneca-Superior, Miller Lake-O'Brien, Mann, Wettlaufer-Lorrain. New-comers on the producing list are Bailey, Seneca-Superior and Mann. The following yielded more or less silver in 1911, but none in 1912: Silver Cliff, Standard Cobalt, Green-Meehan, Beleden, Nancy-Helen, Wyandoh, King Edward. The name of the Cobalt Central mine is now Penn-Canadian, and Seneca-Superior partially takes the place of Peterson Lake, being situated on part of the bed of that lake, or rather of Cart Lake which at the time of making the grant was thought to be an extension of the former, instead of a separate body of water.

The producing mines in Gowganda were Miller Lake-O'Brien, Millerett and Mann, and in South Lorrain, Wettlaufer-Lorrain.

**Shipments.**—Shipments of ore and concentrates from Cobalt can no longer be taken as indicating the tonnage raised from the mines, since the tendency towards absolute refinement of the silver on the spot is becoming more marked year by year. For instance, two of the leading mines, Nipissing and Buffalo, are now equipped for reducing their entire output, both of high grade and low grade ore, to merchantable bars, which leave the camp in an express car. In consequence, the quantity of bullion produced at Cobalt is steadily increasing, being 5,080,127 ounces last year, as compared with 3,122,976 ounces in 1911. The shipments by freight were smaller than in the previous year, the ore shipped out amounting to 10,719 tons, as against 17,278 tons in 1911, and concentrates to 11,214 tons, as against 9,393. The several classes of material sent out of the camp and their silver contents, respectively, were as follows:

Product.	Quantity. (tons)	Silver. (ounces)
Ore .....	10,719	15,395,504
Concentrates. ....	11,214	9,768,228
Bullion .....	11,214	5,080,127
Total .....	21,933	30,243,859

**Ore Concentration.**—In all, 456,167 tons of ore were put through the concentrating plants, of which 101,338 tons were treated at the several custom concentrators now working in the camp, namely, those of the Nipissing Reduction Company, the Dominion Reduction Company, and the Northern Concentrators, Limited. The remainder, 354,829 tons, were manipulated by the mining companies in their own plants. The average ratio of concentration works out there-

fore at 39 tons of ore to one ton of concentrates. The silver contents of the concentrates were 9,768,228 ounces, an average of 871 ounces per ton. The quantity of ore or rock subjected to concentration being 456,167 tons, the recovery was at the rate of 21.4 ounces per ton. Assuming that 85 per cent. of the original silver was contained in the concentrates, the silver contents of the concentrating material as it went into the mill would be 25.1 ounces per ton. These results correspond closely with those obtained in 1911, when the concentrates carried 858 ounces per ton, the silver recovered averaging 21.6 ounces per ton, and the concentrating ore 25.4 ounces per ton.

Four refineries were in operation in Ontario on ore and concentrates from Cobalt last year, namely, those of the Canadian Copper Company, at Copper Cliff, the Coniagas Reduction Company, at Thorold, the Deloro Mining and Reduction Company, at Deloro, and the Canadian Refining and Smelting Company at Orillia. Of these, the one at Copper Cliff worked for part of the year only, and is still idle, while the Orillia works have since been burned down. The total quantity of ore and concentrates treated at these establishments was 8,111 tons, which yielded 15,675,218 ounces of silver. Bullion produced at Cobalt itself amounted to 5,080,127 ounces, so that not less than 67.5 per cent. of the total silver yield of the mines was refined in the Province, as compared with 66 per cent. in 1911.

The Dominion Refineries, Limited, have established a plant at North Bay, for the treatment of Cobalt ores low in silver. A new refinery is being built at Kingston, by the Buffalo and Ontario Smelting and Refining Company, Limited. The Metals Chemical Company, Limited, have also erected a plant for the production of cobalt and nickel oxides at Welland.

A summary of the operations of the silver refineries of Ontario for 1911 and 1912, so far as silver is concerned, is as follows, the by-products being dealt with under their respective headings:

#### Operations of Ontario Silver Refineries.

	1911.	1912.
Silver refineries in operation..	4	4
Silver-cobalt ore received, tons	9,142	8,274
Silver-cobalt ore treated, tons	9,330	8,096
Silver recovered, fine ounces..	17,756,651	15,675,218
Value of ditto .....	\$9,248,829	\$9,094,156

**Markets and Prices.**—There was a good demand for the silver-cobalt ores during the year. The refining companies in Ontario have, through their efforts to keep their plants supplied, no doubt assisted in maintaining the prices of ore, but in view of the diminution in their number, and the fact that one of them, the Coniagas Reduction Company, is now sufficiently occupied with ore from the Coniagas mine, their influence in this direction is likely for the time being to be less than in the past. New Jersey, Pennsylvania and Colorado smelting works took most of the ore that went to the United States, much of it is low grade, but being silicious, it is found highly useful for mixing with basic material.

Prices of silver are fixed by influences which find their stage largely in the Orient. The requirements for coinage and the arts in the commercial and manufacturing nations of America and Europe absorb considerable quantities, but production continues at a rate which would inevitably depress the price of silver to lower levels were it not for the capacity which India and China have, almost from time immemorial, shown to buy a large share of the world's output. Thus in

1912 the production of silver is estimated to have been 229,569,903 fine ounces, worth at the average price for the year in New York, say, \$139,658,850. The imports of India during the year amounted in value to \$59,975,802, and of China, to \$20,971,423, or together to \$80,947,225, a good deal more than one-half the entire output for the year. The explanation of the movement of silver to these countries is two-fold—the medium of exchange is silver, and in India the habit of generations has been, and still is, to use silver in the form of bars, personal ornaments, objects of art, etc., as a means of hoarding the savings of the people. The preliminary market is London, whose control of trade with the East remains unshaken, and to which all the silver mines of the world send their bars of silver, whose size, dimensions and weight are determined by the preferences of the silversmiths of the Indian bazaars. The intercourse between the Pacific coast of the United States and China has led, of late years, to the export of a certain amount of silver to that country from San Francisco. This export last year was in value \$11,503,620, as against \$9,234,000 in 1911.

The actual price throughout the year was much higher than 1911, the average for fine silver in New York being 60.835 cents per ounce, as against 53.304 cents in 1911. The market steadily advanced from the beginning of the year, and recessions were few and slight. The year closed with silver at 63.365 cents as the average for December. The settlement of the new Republican Government in control of China, and the anticipated reforms in the currency system of that country with their accompaniment of large loans and heavy purchases of silver, the requirements of the Indian Government for coinage purposes which were met by the purchase of £6,000,000 worth of silver in London, and favourable monsoon rains in India, all tended to raise prices, which even the outbreak of the Balkan war in October did not materially check.

The increase in the price of silver over 1911, say 7.531 cents per ounce, applied to the production for the year, meant \$2,313,514 additional return to the mining companies of Cobalt.

It may be remarked in connection with the causes which affect the prices of silver that the preference for silver for hoarding purposes which has for so long a time characterized the people of India, seems now to be yielding to a liking for gold. Gold bars, to the value of \$39,482,640, were imported into India during 1912, as against \$37,699,020 in 1911. How much of this went into the banks for coinage reserve purposes, and how much into the pockets of the people, there are no certain means of determining, but it seems probable that a larger proportion of the savings of the peasants of India are now being invested in gold than formerly, and that the incidence of this tendency will have some effect upon silver prices in the future.

**The other constituents of the Cobalt silver ores** made use of industrially are cobalt, nickel and arsenic. For some time past these elements have not been of interest to the mine owners, since they add nothing to the value of their ore, and for this reason it is impossible to procure exact figures showing the quantities produced. The ores are not assayed for nickel or cobalt or arsenic and it is undoubtedly the case that only a percentage of these substances ever reaches the market in the finished form or in a condition to be made use of industrially. All three constituents are recovered by the Canadian refiners, who treat the ores from Cobalt

without admixture of other kinds of ore, and who produce white arsenic, cobalt oxide, nickel oxide, and also a mixture of the oxides of cobalt and nickel which they ship without final separation principally to English and European manufacturers of cobalt oxide. In the case of refineries situated in the United States, the ores from Cobalt are mixed in the smelting charge with ores of lead and copper, etc.; and little or no attempt is made to save the arsenic, nickel or cobalt.

**Health and Labour.**—So far as epidemic diseases are concerned, health conditions were satisfactory during the year at Cobalt. There was an almost complete absence of typhoid, which indeed has not been prevalent in the district since 1909.

As regards labour, the relations between employers and employed have on the whole been tolerably good. The Cobalt miners took no action when their fellow-workmen at Porcupine went out in November, but the question of an eight-hour working day has been the subject of considerable discussion. In several of the leading mines nine hours from bank to bank had for some time constituted a day's labour, and in February, 1913, the mining companies voluntarily made this general.

It will be remembered that a measure to restrict the working hours to eight in every twenty-four for underground employees was introduced into the Legislature by the Government in the session of 1912, but was subsequently withdrawn in order to admit of a fuller investigation of all the conditions not only at Cobalt, but in the other mining districts of the Province. Mr. S. Price, late Mining Commissioner, was appointed to make the investigation, and he reported in favour of an eight-hour day from face to face. An Act was passed in the session of 1913 limiting the hours of underground labour accordingly, and fixing the first day of January, 1914, as the time for the change to take effect.

**The wage scale at one of the leading mines at Cobalt** is as follows per day of nine hours:

**Surface.**—Surface boss \$3.75, carpenters \$3.25, carpenters' helpers \$2.25, mechanics \$3.25, pipe-fitters \$3.00, head blacksmith \$3.75, blacksmiths \$3.25, blacksmiths' helpers \$2.75, engineers \$3.60, firemen \$3.00, head ore-sorter \$2.75, ore-sorters or cobbers \$2.50, hand-miners \$2.75, teamsters \$2.50, hoistmen \$2.75, cage or bucket-tenders \$2.50, other surface labour \$2.25.

**Underground.**—Timbermen \$3.25, machinemen \$3.25, machinemen helpers \$2.75, cage or bucket-tenders \$2.50, other underground labour \$2.50.

The foregoing scale is about 25 cents per day less than the rates paid at Porcupine at the present time. Much of the labour is non-English-speaking and inexperienced. Skilled miners are in good demand.

**Profits and Dividends.**—The high price of silver made the year 1912 a good one for shareholders in the producing companies, and the sum distributed in dividends was large, being \$9,324,049.24, or \$590,091.08 more than in 1911. The total amount paid out as dividends and bonuses since the inception of the camp up to the end of 1912 was \$39,834,740.54, not including the profits made by private owners, which would increase it by nearly five million dollars more.

The following table gives a statement of the dividends paid by the silver-mining companies of Cobalt, and also other particulars, such as the date of incorporation, amount of capital, etc.

## Dividends and Bonuses Paid and Declared by Silver-Cobalt Mining Companies to December 31st, 1912.

Name of Company.	Date of Incorporation.	Authorized Capital.	Capital Stock issued	Par value per share.	Declared to end of 1911.	Declared during 1912.	Total Declared to Dec. 31, 1912.
Beaver Consolidated Mines, Ltd.	Mar. 5, 1907	\$2,000,000	\$2,000,000	\$1.00	\$170,000 00	\$180,000 00	\$350,000 00
Buffalo Mines, Ltd.	Apr. 27, 1906	1,000,000	1,000,000	1.00	1,377,000 00	500,000 00	1,877,000 00
City of Cobalt Mining Company, Limited.	Oct. 5, 1906	500,000	500,000	1.00	139,312 42	75,000 00	139,312 42
Cobalt Central Mines Company	Jan. 7, 1909	1,500,000	1,500,000	1.00	192,845 00	192,845 00	385,690 00
Cobalt Lake Mining Company, Ltd.	Dec. 13, 1906	5,000,000	5,000,000	1.00	315,000 00	315,000 00	630,000 00
Cobalt Silver Queen, Ltd.	Dec. 22, 1906	*4,070,834	3,929,166	1.00	192,845 00	192,845 00	385,690 00
Cobalt Townsite Mining Co., Ltd.	Apr. 1, 1906	1,500,000	1,500,000	1.00	315,000 00	315,000 00	630,000 00
Coniagas Mines, Ltd.	May 6, 1906	100,000	45,011	1.00	125,000 00	346,000 00	471,000 00
Crown Reserve Mining Co., Ltd.	Nov. 24, 1906	4,000,000	4,000,000	5.00	2,840,000 00	1,440,000 00	4,280,000 00
Poster Cobalt Mining Co., Ltd.	Jan. 16, 1907	2,000,000	1,999,957	1.00	3,714,509 46	1,061,288 40	4,775,797 86
Kerr Lake Mining Company, Ltd.	Feb. 14, 1906	1,000,000	915,588	1.00	45,000 00	670,000 00	715,000 00
La Rose Mines, Ltd.	Aug. 9, 1905	740,000	40,000	100.00	3,940,000 00	1,000,546 84	4,940,546 84
McKinley-Darragh-Savage Mines of Cobalt, Ltd.	Feb. 21, 1907	16,000,000	6,000,000	5.00	2,672,000 00	1,000,546 84	3,672,546 84
Nipissing Mining Company, Ltd.	Apr. 9, 1906	2,500,000	2,247,692	1.00	2,156,791 38	1,123,846 00	3,280,637 38
Right of Way Mining Company, Ltd.	Dec. 16, 1904	\$250,000	250,000	100.00	8,325,797 25	1,842,500 00	10,168,297 25
The Right of Way Mines, Ltd.	July 13, 1906	500,000	500,000	1.00	324,643 93	324,643 93	649,287 86
Timiskaming and Hudson Bay Mining Co., Ltd.	Sept. 11, 1909	2,000,000	1,685,500	1.00	202,260 00	209,547 00	411,807 00
The Hudson Bay Mines, Ltd.	July 29, 1903	25,000	7,761	1.00	1,521,156 00	209,547 00	1,730,703 00
Timiskaming Mining Company, Ltd.	July 16, 1909	3,500,000	3,200,050	5.00	394,903 42	192,003 00	586,906 42
Trethewey Silver Cobalt Mine, Ltd.	Nov. 16, 1906	2,500,000	2,500,000	1.00	1,009,156 00	300,000 00	1,309,156 00
Wettlaufer-Lorrain Silver Mines, Ltd.	Jan. 1, 1908	1,000,000	1,000,000	1.00	761,993 50	100,000 00	861,993 50
	May 30, 1906	2,000,000	1,000,000	1.00	283,318 00	283,318 00	566,636 00
	June 1, 1911	1,500,000	1,416,590	1.00			
	Nov. 30, 1908						
<b>Total</b>					<b>\$30,510,691 30</b>	<b>\$9,324,049 24</b>	<b>\$39,834,740 54</b>

\* Reduced by shares purchased for cancellation from \$5,000,000.

† Kerr Lake Mining Company, incorporated under the laws of the State of New York, capital \$3,000,000.

‡ La Rose Consolidated Mines Company, incorporated under the laws of the State of Maine, capital \$7,500,000.

§ Nipissing Mines Company, incorporated under the laws of the State of Maine, capital \$6,000,000.

Below is given a list of the mines producing silver in 1912, with the post office address of the manager or other officer in charge of the property. The order of arrangement is alphabetical:

## Ontario Silver Producing Mines.

Name of Company or Owner.	Name of Mine.	Locality.	P. O. Address of Manager, etc.
Bailey Cobalt Mines, Limited	Bailey	Cobalt	Giroux Lake.
Beaver Consolidated Mines, Limited	Beaver	Cobalt	Cobalt.
Buffalo Mines, Limited, The	Buffalo	Cobalt	Cobalt.
Casey Cobalt Silver Mining Company, Ltd.	Casey-Cobalt	Casey Township	New Liskeard.
Chambers-Ferland Mining Company, Ltd.	Chambers-Ferland	Cobalt	Cobalt.
City of Cobalt Mining Company, Limited	City of Cobalt	Cobalt	Cobalt.
Cobalt Lake Mining Company, Limited	Cobalt Lake	Cobalt	Cobalt.
Cobalt Provincial Mining Company, Limited	Provincial	Cobalt	Cobalt.
Cobalt Townsite Mining Company, Limited	Townsite	Cobalt	Cobalt.
Colonial Mining Company, Limited	Colonial	Cobalt	Cobalt.
Coniagas Mines, Limited, The	Coniagas	Cobalt	Cobalt.
Crown Reserve Mining Company, Limited	Crown Reserve	Cobalt	Cobalt.
Drummond Mines, Limited	Drummond	Cobalt	Cobalt.
Hargrave Silver Mines, Limited	Hargrave	Cobalt	Cobalt.
Hudson Bay Mines, Limited	Hudson Bay	Cobalt	Cobalt.
Kerr Lake Mining Co., Limited	Kerr Lake	Cobalt	Cobalt.
La Rose Mines, Limited	La Rose, Lawson, Princess, etc.	Cobalt	Cobalt.
McKinley-Darragh-Savage Mines of Cobalt, Limited	McKinley-Darragh & Savage	Cobalt	Cobalt.
Millerett Silver Mining Company, Limited	Millerett	Gowganda	Gowganda.
Nipissing Mining Company, Limited	Nipissing	Cobalt	Cobalt.
O'Brien, M. J.	O'Brien	Cobalt	Cobalt.
O'Brien, M. J.	Miller Lake-O'Brien	Gowganda	Gowganda.
Penn-Canadian Mines, Limited	Penn-Canadian	Cobalt	Cobalt.
Right-of-Way Mines, Limited	Right-of-Way	Cobalt	Cobalt.
Ryckman, E. B.	Mann	Gowganda	Gowganda.
Seneca-Superior Silver Mines, Limited	Seneca-Superior	Cobalt	Cobalt.
Timiskaming Mining Company, Limited	Timiskaming	Cobalt	Cobalt.
Trethewey Silver Cobalt Mines, Limited	Trethewey	Cobalt	Cobalt.
Wettlaufer Lorrain Silver Mines, Limited	Wattlaufer	South Lorrain	Silver Centre.

**Cobalt.**—The opening of the silver mines of the Cobalt district has changed the course of the world's trade in cobalt. The chief use of cobalt is as a colouring material in the manufacture of fine chinaware, and the largest users are the great porcelain makers of Germany, France, and England. For this purpose it is employed in the form of cobalt oxide, CoO, the

theoretical composition of which is 78.66 per cent. by weight of cobalt, and 21.34 per cent. of oxygen. Commercially, however, the proportion of cobalt is considerably lower. The commoner form is black oxide, which contains from 68 to 71 per cent. of cobalt; some manufacturers prefer the gray oxide, which may contain 73, 74, or even 75 per cent. of cobalt. A small percent-

age of nickel, or of the other constituents of the original ore, is not considered deleterious.

**Nickel.**—There are now three sources of nickel supply in Ontario:—(1) The mines of the Sudbury district, (2) the Alexo mine in Dundonald township, (3) the ores of the Cobalt silver camp. The last-named is of little commercial moment; the second is significant as indicating the possibility of nickel in quantity being found outside of the recognized area; while the first is the chief source, and one rapidly growing in output and importance.

There were raised from the mines of Sudbury in 1912, 735,656 tons of ore and from the Alexo mine (treated at the Mond Company's works) 1,792 tons, or 737,656 tons in all. The ore was taken from the following deposits:—

Canadian Copper Company:	Tons.	Tons.
Creighton mine .....	518,417	
Crean Hill mine .....	33,507	
No. 2 mine .....	66,372	
	————	618,296
Mond Nickel Company:		
Victoria No. 1 mine .....	34,287	
Garson mine .....	83,281	
Alexo mine .....	1,792	
	————	119,360
Total .....		737,656

There was charged into the smelting furnaces 725,065 tons, the product of which was 41,925 tons of Bessemer matte, containing 22,421 tons of nickel. The value of nickel contents was returned as \$4,722,040, or about 10.5 cents per pound. As compared with 1911, the production of matte was greater by 9,318 tons and of nickel by 5,372 tons, being in fact the largest output of any year since the industry was established. The nickel contents of the ore, computed on the basis of the quality of matte produced, were 61.8 pounds per ton of 2,000 lb., or 3.09 per cent., exclusive of the losses in roasting and smelting.

**Progress of Nickel Mining.**—The demand for nickel was active throughout the year, and the two producing companies—the Canadian Copper Company and the Mond Nickel Company—were fully employed. Both indeed have had to increase their facilities for production. The Copper Company has enlarged and improved its plant at Copper Cliff, and the Mond Company has for some time had under construction a new smelter at Coniston, near the point where the Canadian Northern railway crosses the line of the Canadian Pacific, east of Sudbury. When these works are completed, which will probably be in the spring of 1913, the company will abandon their present site at Victoria mines, and move their entire plant to Coniston, which has the advantage of greater proximity to their Garson mines, now the main source of the company's ore supply.

The indications are that a third company will soon be producing nickel. The holdings of the Dominion Nickel Copper Company, of which company Mr. J. R. Booth, of Ottawa, and Mr. M. J. O'Brien, of Renfrew, were leading members, have been bought by interests represented by Messrs. Holmes and Wilson. These holdings included the Whistle and other properties on the northern nickel range and the Murray mine, the first deposit discovered in the Sudbury district, formerly owned and worked by the Vivians, of Swansea,

but idle for many years; also the Gertrude and Elsie mines, formerly held by the Lake Superior Corporation. The new concern proposes to erect a smelter at the Murray mine capable of treating 1,500 tons of ore per day, so constructed as to admit of ready enlargement to 5,000 tons capacity. Bessemer matte of the type produced by the companies now operating will be turned out, and there is a possibility that the nickel may be refined in Ontario by the Hybinette process, the rights of which for the American continent are owned by the newcomers.

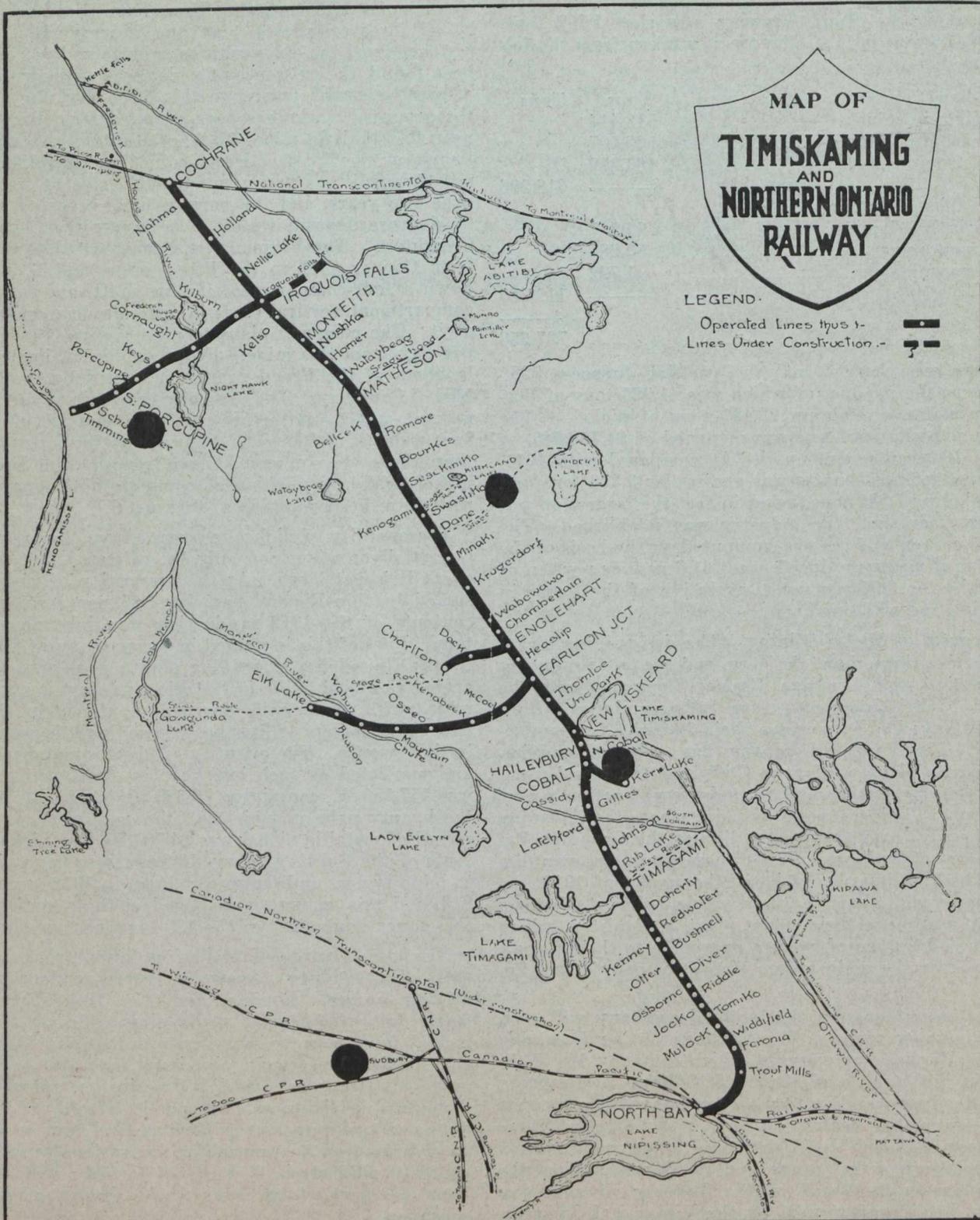
Results of much significance have been obtained from extensive exploration of the Sudbury nickel fields by diamond drill borings. These have been carried on by all three companies. At the Murray mine, some distance from the old workings, a large body of ore has been found, the existence of which was unknown to the original owners. Owing to this discovery, the site of the proposed works has been changed from Blue lake, near the Whistle mine, to the Murray. At what is known as the No. 3 or Froid mine, the Canadian Copper Company has had a number of drills at work for over two years, and the borings have revealed an extensive ore deposit, stated to be larger than even the Creighton. The company has constructed a railway from Copper Cliff to the Froid mine, and is putting down a four-compartment incline shaft and a three-compartment vertical shaft in order to develop the deposit. The company plans to extract some 10,000 tons per day from this mine. Froid extension, immediately north of the Froid proper, is owned by the Mond Nickel Company. The ore body crosses into the Mond ground, and the latter are sinking a shaft to intercept it at a depth of 800 feet. It is hardly too much to say that these developments have placed the Sudbury nickel field in a position of complete dominancy with regard to the production of this metal.

The quantity of nickel recovered from the ore of the Cobalt silver mines can only be estimated, but in any event it is not large. At the proportion of nickel assumed in this Report, namely, 1.47 per cent., nickel contents of the 1912 production would be about 429 tons. Part of this is wasted in the smelting of the ores by the United States refining plants, part of it is separated as nickel oxide in Ontario, and part is exported mixed with cobalt oxide for final treatment by the cobalt oxide makers of Europe, and no doubt is recovered in their works. The quantity of nickel oxide produced and marketed as such last year by the home refiners was 117,160 lb., containing 78,392.20 lb. metallic nickel, the bounty paid on which at the rate of 6 cents per pound of metallic nickel was \$4,703.53. The nickel contents of the Cobalt ores would appear to have yielded to mine-owners and Ontario refiners in 1912 some \$14,220, and this amount is reckoned in these statistics as the money equivalent of the 429 tons mentioned above.

New uses for nickel are being found from time to time. The Sydney (Australia) correspondent of the Mining Journal (London, Eng.), of 10th May, 1913, states that specimens of a new alloy called "Ormiston metal" have recently been shown in that city. The composition is 90 per cent. aluminum and 10 per cent. nickel. "Ormiston metal" is described as approaching aluminum in lightness. It can, it is said, be turned out as soft as copper or as hard as steel; can be soldered or brazed on another metal; in tensile strength it is equal to mild steel; it does not tarnish; and a piece kept in sea-water for many weeks showed no sign of corrosion.

The course of the nickel industry during the five years beginning with 1908 is shown by the following table:—

Schedule.	Nickel-Copper Mining in Ontario, 1908 to 1912.				
	1908	1909	1910	1911	1912
Ore raised, tons .....	409,551	451,892	652,392	612,511	737,656
Ore smelted, tons .....	360,180	462,336	628,947	610,788	725,065
Bessemer matte produced, tons .....	21,197	25,845	35,033	32,607	41,925
Nickel contents, tons .....	9,563	13,141	18,636	17,049	22,421
Copper contents, tons .....	7,501	7,873	9,630	8,966	11,116
Value of Nickel .....	\$1,866,059	\$2,790,798	\$4,005,961	\$3,664,474	\$4,722,040
Value of Copper .....	\$1,062,680	\$1,122,219	\$1,374,103	\$1,281,118	\$1,581,062
Wages paid .....	\$1,286,265	\$1,234,904	\$1,698,184	\$1,830,526	\$2,357,889
Men employed, number .....	1,680	1,796	2,156	2,439	2,850



Map showing location of Sudbury, Cobalt, Porcupine and Kirkland Lake, Ontario

The nickel mining concerns carrying on active work in Ontario are:—

Name of Company.	Name of Mine.	Location.	P.O. Address of Manager, etc.
Canadian Copper Company	Creighton, Crean Hill, No. 2, etc.	Sudbury	Copper Cliff
Mond Nickel Company, Ltd.	Victoria, Garson	"	Coniston
Holmes and Wilson	Murray, Whistle, etc.	"	Toronto
E. F. Pullen	Alexo	Dundonald Tp.	Cochrane

**Copper.**—The copper product of Ontario for 1912 was 11,126 tons, all of which save 10 tons was from the nickel-copper mines of Sudbury. A quantity of copper ore containing about 7 tons of metal was encountered in the workings of the Timiskaming silver mine at Cobalt, and the remaining 3 tons of non-Sudbury origin was obtained by the Dane Mining Company from a prospect near the station of that name on the T. and N. O. railway.

According to the figures supplied the Bureau by the nickel companies, the 41,925 tons of Bessemer matte turned out by the blast furnaces and converters of Sudbury contained 33,537 tons, or 80 per cent. of nickel and copper. Of this 1,069 lb. per ton or 53.45 per cent. was nickel, and 530 lbs. or 26.5 per cent. copper. Calculated on the quantity of ore smelted, 725,065 tons, the resulting matte showed the ore to contain 3.09 per cent. nickel and 1.53 per cent. copper. These figures, of course, take no account of losses of metal at any stage of the process of treatment. There is probably an appreciable loss of copper during heap-roasting of the ore in the open air, due to the leaching action of rain or snow falling upon the heaps; also a loss in the smelting itself.

**Platinum and Palladium.**—It is known that the Sudbury ores carry not only nickel and copper, but also a proportion of the precious and rarer metals, including gold, silver, platinum and palladium. Cobalt is likewise a constituent, but since the opening up of so prolific a source of supply of this metal in the silver mines of Cobalt, there is no inducement to recover the small proportion of cobalt contained in the Sudbury pyrrhotites. The rare metal rhodium, which is almost invariably contained in crude platinum to the extent of about 2 per cent., and which is at present worth \$5 per gram, or \$155 per ounce, is also present in these ores, and a little is said to be produced in the United States, partly from platinum sand, and partly from Canadian and other copper bullion.\* Another rare metal, ruthenium, an accompaniment of the mineral iridosmine, is also said to occur in the copper ores of Sudbury.†

The platinum is present in the unaltered ores of Sudbury as sperrylite, or arsenide of platinum, and it has been definitely ascertained by T. L. Walker and Charles W. Dickson, to be associated with the chalcopyrite. The increasing demand for platinum, due to its extensive use for laboratory utensils, and also to its employment of late in the manufacture of jewellery, has caused a very decided rise in price, which went up from \$21.27 per ounce in 1908, to \$43.62, in 1911, remaining at about the same figure in 1912. There has been little or no increase in the supply, the bulk of which, about 300,000 ounces annually, comes from the Ural mountains in Russia. Colombia, with 11,750 ounces in 1912, ranks second as a producer, and smaller quantities are recovered in the placers of northern California, western Oregon, and British Columbia. Under these circumstances any source of supply is important.

Through the courtesy of the International Nickel Company, it is learned that during the six years, 1907

to 1912, inclusive, 2,366.47 ounces of platinum, and 4,216.482 ounces of palladium were recovered at the Orford refining works of that company in New Jersey, while refining the mattes produced by the Canadian Copper Company from the nickel-copper ores of the Sudbury district. No part of this production was previously reported to the Bureau, and hence it has not been covered by statistics previously issued. Under these circumstances, and although not strictly correct, the figures for the six years have been included in those for the year 1912, as the only practicable method of incorporating them in the official record of production. The platinum has been valued at the average price for the several years, and the palladium has been accorded the same figure. The former amounts to \$80,736, and the latter to \$147,235.

Palladium is a white metal, intermediate in colour between platinum and silver. In hardness it is about equal to platinum. It is malleable, ductile, sectile, and dissolves in nitric acid. Palladium finds a use in parts of astronomical instruments, in watch-making, dental work, and in soldering platinum metals. Not being altered or discoloured by exposure to air or hydrogen sulphide, it is often used for plating metal ware. The demand is greater than the supply.

It should be added with regard to this production of platinum and palladium, and also gold and silver from the same sources, that owing to certain residues from ores from other districts and of different character, which form part of the smelting charge at the Orford works, along with the nickel-copper mattes, it cannot be stated with absolute definiteness that the elements in question are wholly derived from the Sudbury ores; it is, however, believed that they are largely traceable to the latter.

**Iron Ore.**—Iron ore was shipped from three mines during the year 1912—Moose Mountain, Bessemer, and Helen—amounting to 117,357 tons. The Moose Mountain and Bessemer ore is magnetite, while the Helen ore is hematite. The production was considerably smaller than in 1911, when it was 175,631 tons. The Algoma Steel Corporation was actively engaged in developing the Magpie mine, and in installing the roasting plant for the treatment of the sideritic ore of which the deposit is composed. Complete success has not yet been achieved by the process, and the works are not at present in full commercial operation. The Atikokan Iron Company operated the Atikokan mine (magnetite) for a time, but shipped no ore, and the old Belmont or Ledyard mine, in the township of Belmont, Peterborough county, has been taken over by the Buffalo Union Furnace Company, who are carrying out a systematic development of the property. At the Moose Mountain a Grondal plant for magnetic concentration of the leaner portion of the ore body, and the production of briquettes has been installed, and it is expected that both ore and briquettes will be placed on the market during the present year. Of the shipments from the Moose Mountain about 35,000 tons were taken from the stock pile, the remainder being mined during the last four months of the year. Some

\*The Production of Platinum and Allied Metals in 1911, by Waldemar Lindgren, U. S. Geol. Survey, p. 19.

†Ibid, p. 19.

45,000 tons were sent to the Columbus Iron and Steel Company, Cleveland, Ohio; 5,000 to the Standard Iron and Steel Company, Deseronto, Ont., and 1,263 tons of briquettes were forwarded to Key Harbour, and held there, as against sales for 1913. Mr. J. W. Evans, of the Tivani Electric Steel Company, Limited, did considerable development work at the Orton mine in Hastings county, the ore of which carries 1 to 3 per cent. of titanium. It is Mr. Evans' intention to utilize this ore in the manufacture of steel by means of an electric furnace, which he has himself devised.

The following is a list of the iron mining companies at work last year:—

Producing Iron Mines in Ontario.			
Name of Company.	Name of Mine.	Locality.	P.O. Address of Manager, etc.
Moose Mountain, Limited	Moose Mountain	Hutton township	Sellwood.
The Canada Iron Mines, Limited	Bessemer	Hastings county	Trenton.
The Algoma Steel Corporation, Limited	Helen	Michipicoten	Helen Mine.
The Algoma Steel Corporation, Limited	Magpie	Michipicoten	Magpie Mine.
Buffalo Union Furnace Company	Belmont	Peterboro' county	Cordova Mines.
Atikokan Iron Company Limited	Atikokan	Thunder Bay	Port Arthur.
Tivani Electric Steel Company, Limited	Orton	Hastings county	Belleville.

**Pig Iron and Steel.**—From the blast furnaces of Ontario last year there was turned out 589,593 tons of pig iron, having a value of \$8,054,369, the pig being worth at the furnace on an average \$13.66 per ton. Of the product, 567,892 tons were coke iron, and 21,701 tons charcoal iron, the latter being made at the Standard Iron Company's furnace at Deseronto. Of the nine furnaces in the Province, eight were in blast as follows:—Algoma Steel Corporation, Limited, Sault Ste. Marie, 3; Canada Iron Corporation, Limited, Midland, 2; Steel Company of Canada, Limited, Hamilton, 2; Standard Iron Company, Limited, Deseronto, 1. The Atikokan Iron Company's furnace at Port Arthur was idle throughout the year. Steel to the amount of 457,817 tons, valued at \$8,071,339, was made by the Algoma Steel Corporation and Steel Company of Canada, in the manufacture of which pig iron, produced by these companies, to the extent of 312,709 tons, was utilized, besides 17,372 tons of pig iron purchased from other makers. The number of workmen employed in the making of pig iron only was 846, to whom wages were paid aggregating \$636,420. This does not include employees in the steel-working departments, who numbered 2,179. Bessemer and basic steel are made at Sault Ste. Marie; basic open hearth at Hamilton. Electro Metals, Limited, Welland, carry on the manufacture of ferrosilicon in electric furnaces, of which they had five in operation during the year. They employed one hundred men and paid out in wages the sum of \$70,000.

To produce the above quantity of pig iron, 1,133,660 tons of iron ore were charged into the furnaces, along with 22,252 tons of scale and mill cinder. Of this quantity of ore only 71,589 tons were the product of Ontario mines, all the rest being ore imported from the

United States. The proportion of Ontario ore used in making pig iron in this Province is not increasing. On the contrary, it is decreasing steadily. In 1901 it amounted to 56 per cent.; in 1903 it fell to 22.5 per cent.; in 1905 to 19.3 per cent.; rose in 1907 to 23.6 per cent.; in 1909 to 28.7 per cent., and fell again in 1910 to 17.4 per cent.; in 1911 to 7.3 per cent., and in 1912 to 6.3 per cent.

The development of the iron mines of the Province is not keeping pace with the expansion of the iron smelting industry. For this there are several reasons. One is the ease with which supplies of iron ore of known quality and required composition can be pro-

cured from the Lake Superior region south of the line, and another is the comparatively small number of mines which have yet been opened in this Province. There are many iron ranges in Ontario, and if the conditions in Michigan and Minnesota afford any analogy there must be numerous bodies of workable ore contained in these iron-bearing rocks. The fact remains, however, that only a few have yet been located, and it seems as if much energy, skill and money must be expended in the search for ore bodies before the iron ore resources of the Province will be placed in a position to respond to the requirements of the smelting trade.

Particulars of the pig iron and steel manufacture for 1912 are given in the following figures, and for the sake of comparison, for the year 1911 as well:—

	1911.	1912.
Ontario ore smelted, tons	67,631	71,589
Foreign ore smelted, tons	848,814	1,062,071
Scale and mill cinder, tons	18,476	22,252
Limestone for flux, tons	275,628	305,509
Coke for fuel, tons	577,388	660,248
Value of ditto	\$2,367,704	\$2,584,766
Charcoal for fuel, tons	1,666,897	1,886,748
Value of ditto	\$158,354	\$157,597
Pig iron product, tons	526,610	589,593
Value of ditto	\$7,716,314	\$8,054,369
Steel product, tons	361,581	457,817
Value of ditto	\$9,505,013	\$8,071,339
Workmen employed, number	3,633	2,925
Wages paid	\$2,927,573	\$2,383,029

The steady growth of the pig iron and steel making industry the past five years is sufficiently shown by the following table:—

**Production of Iron and Steel in Ontario, 1908 to 1912.**

Schedule.	1908	1909	1910	1911	1912
Ontario ore smelted, tons	170,215	220,307	143,284	67,631	71,589
Foreign ore smelted, tons	342,747	543,544	678,890	848,814	1,062,071
Limestone for flux, tons	179,741	226,991	248,750	275,628	305,509
Coke, tons	322,817	436,707	471,493	577,388	660,248
Charcoal, bush.	.....	973,413	1,133,419	1,666,897	1,886,748
Pig iron, tons	271,656	407,013	447,351	526,610	589,593
Value of pig iron	\$4,390,839	6,301,528	6,975,418	7,716,314	8,054,369
Steel, tons	172,108	296,031	331,321	361,581	457,817
Value of steel	\$4,397,082	6,759,960	7,855,407	9,505,013	8,071,339

From the figures given for the operations of 1912 it would seem that, disregarding scale and mill cinder, 1.92 tons of ore were required to produce one ton of coke pig iron, also .53 ton of limestone, and 1.16 tons coke. For a ton of charcoal pig, the materials were, 1.90 tons ore, .114 ton limestone, and 8.35 bushels charcoal.

Following are the blast furnace companies producing pig iron in Ontario:—

**Blast Furnaces in Ontario.**

Name of Company.	No. of Furnaces.	Fuel Used.	Location.
Algoma Steel Corporation, Limited .....	3	Coke .....	Sault Ste. Marie.
Steel Company of Canada, Limited .....	2	" .....	Hamilton.
Canada Iron Corporation, Limited .....	2	" .....	Midland.
Atikokan Iron Company, Limited .....	1	" .....	Port Arthur.
Standard Iron Company, Limited .....	1	Charcoal .....	Deseronto.

**Materials of Construction.**—Building operations in the towns and cities of Ontario were again active, and there was an increased production of brick and stone. At the same time, however, the output of Portland cement fell off slightly, and there was a decrease in the quantity of lime produced.

**Brick.**—Returns to the Bureau show that the brick kilns of the Province turned out 385,000 M common brick in 1912, valued at \$3,178,250, as against 354,546 M in 1911 worth \$2,801,971—an increase in number of 30,545 M or 8.58 per cent., and in value of \$376,279, or 13.42 per cent. It will be seen that the increase in cost was considerably greater than the increase in number, and this is further brought out by a comparison of the price per M which in 1911 was \$7.90 and in 1912 \$8.20. It is a truism now to state that the cost of living has gone up of late years; but common building brick, which in this country and climate may fairly rank as a necessary of life, well illustrates the tendency to higher levels of cost. In 1901 ordinary brick were worth \$5.73 per M.; in 1905 the price had risen to \$7.75; in 1909 it was \$7.78; in 1911, \$7.90, and in 1912, \$8.20.

The manufacture of paving brick does not seem to be increasing in Ontario. Objection is taken to them because of their noisiness, and if they are not well made of suitable material, they fail to provide a durable pavement. The value of their production last year was \$78,195, as against \$86,685 in 1911. Terra cotta, worth \$137,239 and fancy brick valued at \$6,552, made up a total of \$221,986.

Pressed, or re-pressed, brick is highly esteemed for its colour and finished appearance, and the number made rose to 65,598 M in 1912 valued at \$634,169, as compared with 52,764 M in 1911 valued at \$564,630.

About 40 per cent. of all the brick in the Province is manufactured in the yards on the outskirts of Toronto, which is a city of brick, and in which many millions of dollars have been spent during the last few years in building operations. In capacity these plants range upwards from two million brick per annum. Some turned out five million in 1912, some eight million, one fifteen million, and one—the Don Valley Brick Works—upwards of forty-three million. The average output of 23 yards was 6,900,000 brick. The local supply was insufficient last year to meet the demand, and quantities were shipped in from outside points.

**Sewer Pipe.**—Three sewer pipe manufacturing companies turned out a total of \$464,627 worth of pipe last year. This was an increase of \$54,563 over the pro-

duction of 1911. The rapid growth of the towns and cities of Ontario provides a good market for the output.

**Pottery.**—The manufacture of pottery from Ontario clays is not keeping pace with the expansion experienced by other branches of the clay-working industry. Only the coarser and commoner articles, such as flower-pots, hanging baskets, jardinières, etc., are made from the native clay, any finer varieties of ware

requiring the use of imported material. It is not to be wondered at that in a region such as Ontario where there are no coal beds with their seams of fire-clay, and where glaciation has been so active a force in the formation of the present surface, there should be a scarcity of clays sufficiently free from fluxing agents to be suitable for fine porcelain and chinaware. Kaolinic clays have been reported from the valleys of several of the rivers running down the James Bay slope, but in the absence of transportation facilities no attempt has yet been made to test their adaptability for pottery purposes. The value of the pottery turned out by the half dozen potteries reporting their production in 1912 was \$52,445, as compared with \$50,500 in 1911.

**Lime.**—The output of lime in 1912 was apparently less than in 1911, being 2,297,525 bushels, worth \$381,672, as against 2,469,773 bushels, valued at \$402,340. Little difficulty is experienced in obtaining lime for any purpose in the older parts of the Province, where limestone occurs abundantly and in strata of various ages and differing composition. Nearly pure carbonate of lime can be procured in some parts; elsewhere the rock contains magnesia from small quantities up to proportions sufficient to constitute a dolomite. All varieties are used for burning into lime, the idea once prevalent that magnesia injured the quality of the product being now no longer generally held. Formerly, much of the production was from small kilns operated by farmers and their sons during their spare time, or when other work was not pressing; now the number of kilns is smaller, but the individual output has increased. In short, the modern tendency towards concentration of industrial effort has made itself felt in lime-making, as well as in nearly all other kinds of manufacture.

**Stone.**—The stone quarried in Ontario is varied in character, and is used for widely different purposes. For construction material, limestone, sandstone and marble are employed; for use as a flux, limestone is required; for roadmaking, limestone and so-called "trap." Granite and gneiss are also used both in blocks and crushed for building and other work. Limestone, however, largely preponderates. An industry is being developed on the basis of the marbles found in the neighbourhood of Bancroft in the county of Hastings. The serpentines of Darling township, of varying shades of green, are also capable of producing very handsome effects. In value, the stone raised last year amounted to \$953,839, an increase of \$61,212 over 1911. For an account of the limestone deposits of Ontario, arranged by counties, reference should be had to Part II. of the Thirteenth Report of the Bureau of Mines, 1094, by Prof. W. G. Miller, Provincial geologist.

**Portland Cement.**—The Portland cement plants of Ontario last year produced 2,993,367 barrels of cement, worth, at the factory, \$3,365,659, being a decrease in production as compared with 1911 of 17,482 barrels, and in value of \$74,893. This check is the first which the industry has experienced since it was established in 1891, every year hitherto having shown a decided advance over the preceding one. The average price per barrel also fell from \$1,200 to \$1,124. A feature of the year was the action of the Dominion Government in reducing the duty by one-half on cement imported from June 1 to October 31, inclusive. The reason assigned for this step was the inability of the plants in Ontario and Quebec to supply the urgent demand for cement from Saskatchewan, Alberta and the west generally, arising not so much from shortness of supply as from the congestion of freight traffic on the railways.

**Arsenic.**—From the silver-cobalt ores treated in Ontario refineries there was produced and shipped 3,927,347 pounds of white arsenic, which realized \$79,297, or a little over two cents per pound. The theoretical percentage of arsenic in these ores is assumed to be 14.28, which, on the quantity of ore raised from Cobalt in 1912, would give 8,332,000 pounds of white arsenic. The difference between this quantity and the product actually marketed, must be set down for the greater part as waste. Little or no attempt to save the arsenic is made in the smelters of the United States to which much of the lower grade ore is shipped for treatment. The production of 1911 was 4,234,000 pounds, worth \$74,609, the average value per pound being 1.75 cents. Since the close of 1912 there has been a marked advance in the price of arsenic, which is chiefly a by-product of the ores of other metals. There are large deposits of arsenical ore in Hastings county, which at one time were worked for their gold contents, but which have remained untouched since experience showed the values to have fallen below the profit line.

Arsenic is a most useful substance in the arts, being employed as a preservative of skins, as a pigment, in the manufacture of glass for the purpose of imparting brilliancy, but chiefly as the active agent in insecticides. As a constituent of Paris green and arsenate of lead, it plays an important part in controlling the insect pests which annually work havoc amounting to tens of thousands of dollars among the potato fields and apple orchards of Ontario.

**Iron Pyrites.**—No deposits of native sulphur, such as are found in Sicily and Louisiana, occur in this Province, yet there are very large supplies of sulphur locked up in the pyrrhotites of Sudbury and the iron pyrites of many other parts of Ontario's mineral regions. No attempt is being made, or in the present state of the metallurgical arts perhaps can be made, to recover the immense quantities of sulphur annually scattered to the winds in the fumes which ascend from the roast heaps of the nickel-copper companies of Sudbury. This sulphur is worse than wasted, because these acrid fumes blast and wither every green thing within their range, and when carried by contrary winds to centres of population are certainly objectionable. So long, however, as it costs more to entrap the sulphur and convert it into sulphuric acid or some other article of commerce than the price it would bring when sold, this waste is inevitable.

Five deposits of pyrite were worked last year, but from three only were shipments made. These were the mines of the Canadian Sulphur Ore Company of

Queensboro, in Hastings county; Nichols Chemical Company at Sulphide, and the Buffalo-Brockville Mining Company at Brockville. The output from the last-named was small, and work ceased about the middle of July. No shipments were made by the Northern Pyrites Company, from their mine on Big Vermilion lake, near Graham, nor from the Helen mine by the Algoma Steel Corporation. The quantity shipped was 20,744 tons, valued at \$71,043. This was considerably less than the output for 1911, which was 43,629 tons, worth \$118,457.

The Nichols Chemical Company operate an acid-making plant at Sulphide, at which is used not only the ore from the company's own mine at the same place, but also ore purchased from other deposits worked in the neighbourhood. The ore from the Northern Pyrites and Helen mines when shipped goes to the United States for the manufacture of sulphuric acid, or for use in pulp and paper mills.

**Mica.**—The amber mica of Ontario and Quebec has long been highly esteemed by manufacturers, especially those of electrical apparatus, for its flexibility and high insulating efficiency. Nevertheless, mica mining in Ontario shows comparatively little progress from year to year. Its product is meeting with strong competition in the markets of the United States from the white mica of India, where wages are low, and whose mica finds much favour from the form in which it is placed on the market, namely, in small circular boxes or cartons of mica films. These are used in building up the micanite or board mica in sheets of any desired size, which has practically taken the place of the large natural sheets formerly regarded as indispensable, and for which a high price was demanded. The irregular and pocketty nature of the mica deposits here, too, has a tendency to deter systematic exploitation or the expenditure of large sums in development.

**Salt.**—The production of salt from the wells situated on the eastern shore of Lakes Huron and St. Clair and Rivers St. Clair and Detroit, remains at pretty much the same figure from year to year. In 1912 it amounted to 90,986 tons, valued at \$450,251. The year previous the output was 88,689 tons, worth \$430,835. Besides the ordinary uses of salt in the preparation of food products, a beginning has been made in its utilization as the raw material for a large and varied list of chemical manufactures. The Canadian Salt Company has begun the operation of a plant on the Detroit river, near the eastern boundary of the town of Windsor, having good railway connections and a shipping dock on the Detroit river channel bank. The products at present made are bleaching powder and caustic soda. The former is used for bleaching paper and fabrics and also for sterilization of water and sewage; the latter mainly in the manufacture of soaps, also in the refining of certain grades of oil and glue, and in the manufacture of lye. It is proposed to add other products to the list. The market for the company's goods is found in Canada, the rate of duty preventing export to the United States. There is no protection on these articles in Canada. The number of hands employed last year was thirty-eight, and the wage bill amounted to \$23,859.

**Petroleum.**—A steady drying up of the sources which feed the petroleum wells of the Province has been in progress for a number of years. That the influences which cause this diminution are still in operation is manifest from the fact that the output of crude petroleum last year fell to 8,432,730 imperial gallons, or 240,-

935 barrels, as compared with 10,102,081 gallons, or 288,634 barrels in 1911, a reduction of 16.5 per cent. The production of 1912 was only 24 per cent. of that for 1904, when the yield was 34,912,360 gallons, or 997,496 barrels.

**Natural Gas.**—The natural gas field of the Province last year yielded 12,414 million cubic feet of gas, which is valued in the returns made to the Bureau at an aggregate of \$2,268,022, being at the rate of more than 18 cents per thousand cubic feet. In 1911 the output was valued at \$2,186,762. The retail price of gas is on an average nearly double this figure, but the valuation is

not based on the cost to the ultimate consumer, but on the price obtained by the producer, for the most part at the mouth of the well. Naturally, the users of gas in the towns and cities of southwestern Ontario must pay for the cost of piping and distribution, hence the price varies according to distance from the point of production, and other circumstances. As has been remarked before in these Reports, gas is a most desirable fuel, and it would be highly in the general interest if it could be confined to domestic purposes, and not expended on such operations as the burning of lime and brick, or for the generation of steam.

## ONTARIO PRODUCTION OF METALS DURING FIRST NINE MONTHS OF 1913

Returns made to the Bureau of Mines under the Mining Act show that the production of metals and metalliferous substances from the mines and works of Ontario during the 9 months ending 30th September, 1913, was as follows. The changes as compared with the corresponding period of 1912 are also noted:

Product.	Quantity.	Value.	Increase* or
			Decrease†.
Gold, ozs. ....	159,962	\$3,281,027	*\$2,163,692
Silver, ozs. ....	23,171,536	12,967,138	*259,312
Copper, tons ....	9,237	1,311,681	*169,605
Nickel, tons ....	18,233	3,825,633	*457,196
Iron Ore, tons ...	143,979	314,590	*213,306
Pig Iron, tons ...	440,954	5,792,022	†259,956
Cobalt Ore, tons ..	71	12,917	†44,697
Cobalt and Nickel Oxides, lbs. ....	740,089	290,597	*113,811
Lead ore, tons ...	740,089	3,000	*3,000

**Gold.**—The production is chiefly from Porcupine where the Hollinger and Dome are the leading mines. The latter is adding 40 stamps which will double its milling capacity. Porcupine Crown and McIntyre Porcu-

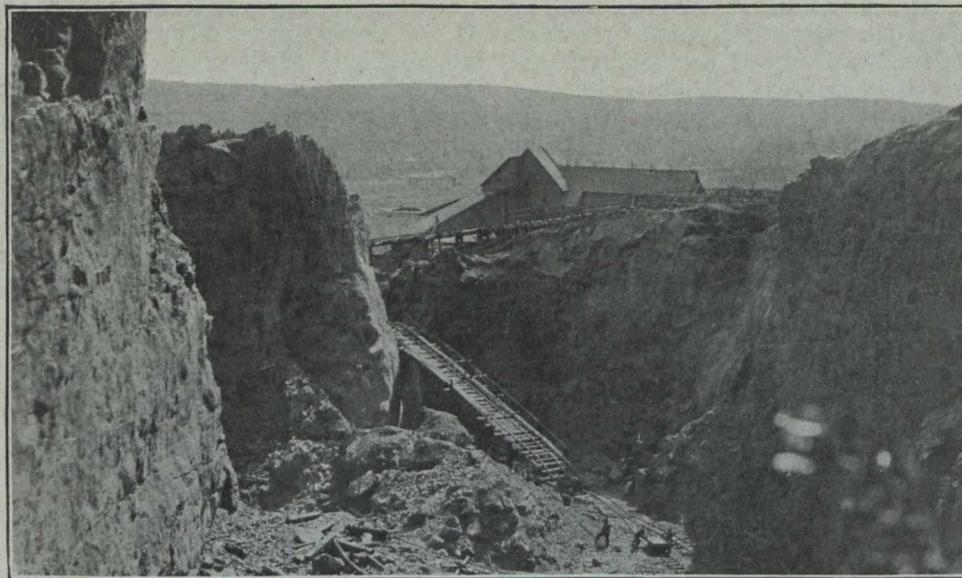
pine also contributed considerable bullion. The total yield from the Porcupine mines was \$3,106,250, leaving \$174,777 as the product of outside areas. These were Long Lake (Canadian Exploration Co.), Swastika (Swastika Mining Co.), Kirkland Lake (Tough-Oakes), Larder Lake (Goldfields, Limited), and Sturgeon Lake (Northern Gold Reef).

**Silver.**—The production was slightly greater, both in ounces and value, than for the same period last year. The number of producing mines was 31; 27 being in Cobalt proper, 1 in Casey Township, 2 in Gowganda, and 1 in South Lorrain. Nipissing led with a total output of 4,387,765 ounces, followed by Coniagas with 2,662,678 ounces, LaRose with 1,903,345 ounces, and Cobalt Townsite with 1,826,422 ounces. Kerr Lake, McKinley-Darragh, Buffalo, and Crown Reserve were also well up. Of the product, 10,512,396 ounces was in the shipments of ore, 6,184,271 in concentrates, and 6,444,099 in bullion. By camps, Cobalt proper yielded 21,956,561 ounces, Casey 607,212 ounces, Gowganda 342,380 ounces, and South Lorrain 234,613 ounces; silver in auriferous ores 30,770.

**Nickel and Copper.**—The production was in excess of that of any previous 9 months. There were raised 535,-



Moose Mountain Iron mine, Ont.



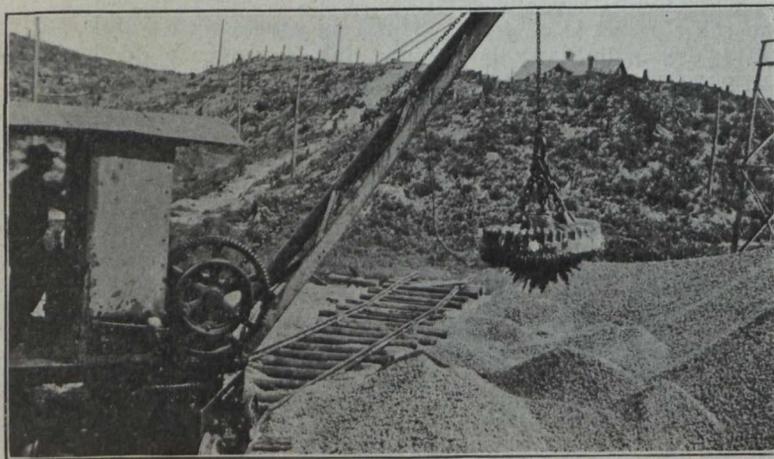
Moose Mountain Iron Mine, Ont.

265 tons of ore and smelted 569,898 tons. The Bessemer matte product was 34,243 tons, the estimated contents of which were 18,233 tons nickel and 9,237 tons copper. The Canadian Copper Company remains the principal producer, but the new and well-equipped smelter of the Mond Nickel Company at Coniston which is now in operation, will doubtless increase that company's output.

**Iron.**—There were five iron ore mines in operation, namely, the Helen, Magpie, Moose Mountain, Bessemer and Belmont. The Canada Iron Corporation concentration plant at Trenton is now at work on ore from the

furnace of the Canadian Furnace Co., a subsidiary concern of the Buffalo Union Furnace Co., was blown in on 27th September. The plant has a capacity of 300 to 325 tons of pig iron per day.

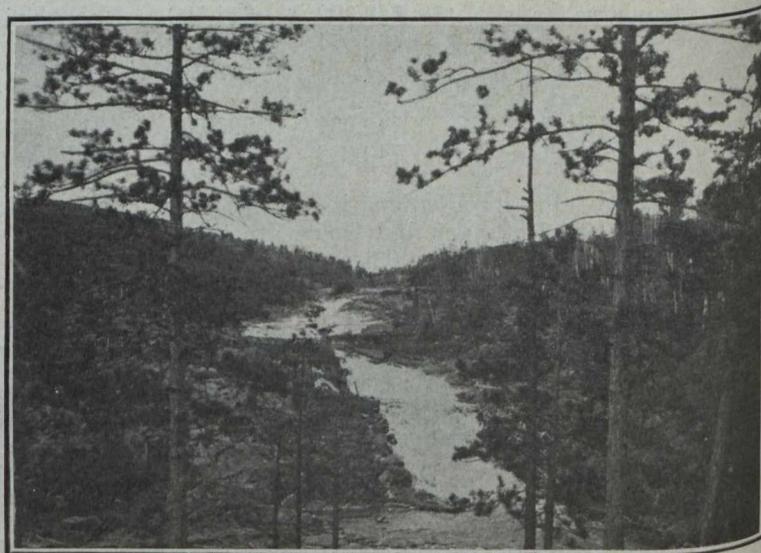
**Cobalt Oxide, etc.**—The output of cobalt and nickel oxides, being refined by-products of the Cobalt silver ores, is steadily increasing, and had a value of \$176,786 greater than in the first 9 months of last year. A bounty is paid by the Ontario Government of six cents per pound on the metallic contents of refined cobalt oxide and nickel oxide.



Handling magnetite concentrate by electro-magnet  
Moose Mountain, Ont.

Bessemer and Childs mines. At the Magpie mine the roasting plant is treating siderite, from which it expels the carbonic acid gas and sulphur, thus producing a first rate article for the blast furnace. If the process proves commercially successful, it will turn to account an immense quantity of sideritic material, hitherto but little regarded as a possible source of iron.

Four blast furnace companies produced 11,967 tons less pig iron than was made during the corresponding term of 1912, and the average value per ton declined from \$13.36 to \$13.16. At Port Colborne the new



Onaping Falls, Sudbury District, Ont.

#### MANAGEMENT OF THE GEOLOGICAL CONGRESS

Mr. R. A. F. Penrose, jr., in an article published in the Journal of the Franklin Institute, says: "The management of the Congress by the Canadians was excellent. Everything was done that could add to the comfort, interest, and pleasure of the members. The people of Toronto and of Canada in general were most hospitable and kind, and no member of the Congress could have left Canada without the pleasantest recollections of its people and their boundless hospitality."

**USES OF NICKEL\***

An alloy of copper, nickel and zinc, called packfong, has been known to the Chinese since time immemorial, and it is stated that an alloy containing 77.58 per cent. of copper, 20.04 per cent of nickel and 1.72 per cent. of impurities was used for coinage by Ethydemos, who reigned over Bactria about 235 B.C.; so that alloys of nickel were used long before the pure metal had been separated from its ores. It is interesting to note that the Bactrian alloy is closely like that now used for subsidiary coins in the United States.

Pure nickel is employed in small amounts for a number of purposes because of its strength and durability and its white colour, which resists tarnishing. For these reasons several nations have introduced it for coinage, e.g., France, Switzerland and Turkey, and its cleanness and hardness contrast very favourably with copper or bronze, on the one hand, and silver on the other. It is rather surprising that Canada, which produces two-thirds of the nickel of the world, should still retain its ugly bronze cents and troublesomely small silver five cent pieces. These and the ten cent piece should certainly be replaced by pure nickel coins.

One might expect also that iron kitchen utensils, which constantly grow black and rusty, might well be made of the clean and white, and untarnishable metal nickel. For many purposes steel is now plated with nickel to preserve it from rusting.

Though the importance of pure nickel is likely to grow, the chief use of the metal is in the production of alloys, particularly nickel steel, in which the greater part of the nickel now refined is employed.

By the kindness of Dean Galbraith, of the Applied Science Department of the University of Toronto, and of Mr. C. R. Young, the following data bearing on the use of the alloy may be given:

points. Peary, with his supplies of modern steel tools and weapons, put an end to this industry, at least for the present, and removed the largest masses of telluric iron to the United States.

Steel containing from 2½ to 3½ per cent. of nickel has certain of its properties greatly improved, so that for many purposes it is replacing ordinary structural steel. Its value for armour plate has long been known, and the rivalry of the great maritime nations in the building of Dreadnoughts is one of the causes for the recent increased demand for nickel. It is stated by Mr. Monell, president of the International Nickel Company, that the growth of the motor vehicle business is important in this respect also; and its value for bridge building is shown by the selection of nickel steel for the rebuilding of the Quebec bridge, which fell so disastrously some years ago.

**Approximate Saving in Weight and Cost of Bridges Effected by Use of Nickel Steel.**

- Mixed Nickel and Carbon Steel—
- Saving in weight up to 25 per cent.
- Saving in cost up to 17 per cent.
- Nickel Steel throughout—
- Saving in weight 10 to 30 per cent.
- Saving in cost up to 12 per cent.

Alloys much higher in nickel are employed for special purposes, such as Invar, steel with 36 per cent. of nickel, which has the property of varying very little in length with change of temperature, making it of great value for tapes to be used in the accurate chaining necessary in geodetic surveys.

**Monel Metal.**—Next to nickel steel the most important alloy is monel metal, so named for Mr. Ambrose Monell, of the International Nickel Company, consisting of 68 to 72 per cent. of nickel with the balance copper, except for trifling impurities (0.5 to 1.5 per cent. of iron, 0.073 to 0.15 per cent. of carbon, and 0.014 per cent. of sulphur). The proportions of nickel

**Comparison of Carbon and Nickel Structural Steels.**

Based upon Average Present Practice (1912).

	Medium Carbon Steel.	Medium Nickel Steel.
Percentage of Carbon .....	0.20	0.38
Percentage of Ni .....	0	3.50
Elastic limit (lbs. per sq. in.) .....	30,000 (Min.)	60,000 (Min.)
Ultimate tensile strength (lbs. per sq. in.).....	60,000 (Min.)	105,000 (Min.)
Modulus of elasticity .....	29,000,000	30,000,000
Safe working stress in tension (lbs. per sq. in.).....	16,000	28,000

The alloy of nickel with iron is no novelty, since all native iron of terrestrial as well as meteoric origin contains nickel. The telluric iron from Ovivak and elsewhere in Greenland contains, according to Dana, from .34 to 6.50 per cent. of nickel, with an average of 2.11 per cent.; and meteoric iron from various sources runs much higher, containing, according to the same authority, from 3.81 to 59.69 per cent. In Greenland such iron was long ago utilized by the Esquimo, who used to hammer off flakes of it from the large masses left on the surface by the weathering of the parent basalt, making from them knives and spear

to copper are those of the ores now worked by the Canadian Copper Company, so that the alloy may be produced directly from the matte, at a cost not much greater than that of copper. The alloy is silver white and takes a brilliant polish, which slowly turns greyish on exposure. It melts at 1350 degrees C., has the same specific gravity as copper and can be cast or rolled and treated in various ways like copper or steel, but is distinctly stronger than ordinary steel or than manganese bronze. The Orford Copper Company in a circular to the trade makes the following statements as to strength, etc.:

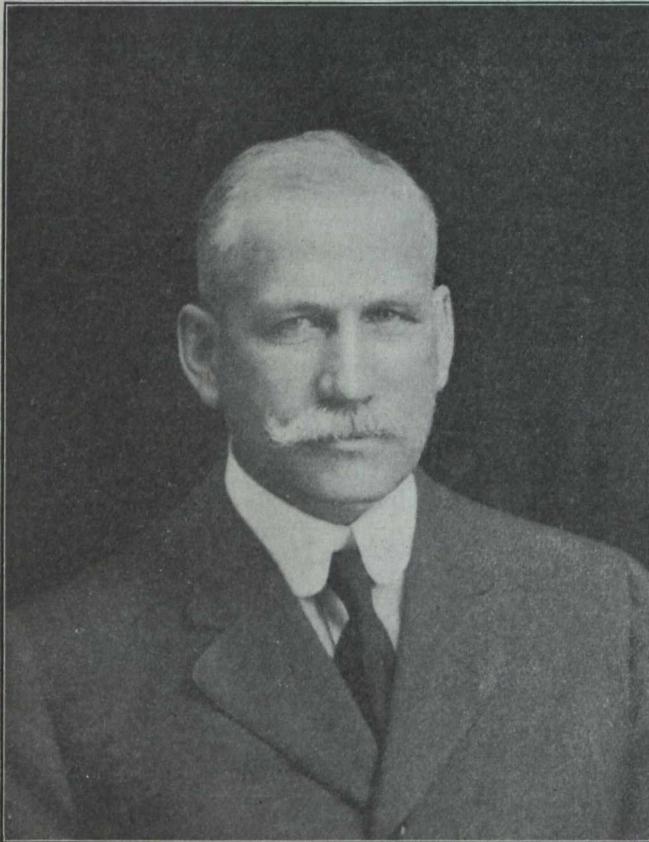
	Castings.		1 inch rods.	
	Grade C.	Grade D.	annealed and cold drawn.	1/8 inch plates.
Tensile strength (lbs. per sq. in.) .....	70,000	85,000	110,000	90,000
Elastic limit (lbs. per-sq. in.) .....	27,000	40,000	80,000	45,000
Elongation in 2 in. (per cent.) .....	30	25	25	30
Reduction in area (per cent.) .....	35	25	50	60

\*From report on Nickel Industry, by A. P. Coleman, published by Mines Branch, Ottawa, 1913.

They are prepared to furnish ingots, sheets, rods, bars, castings, tubes, and wire of this alloy; and it is stated that the sheets are as flexible and malleable as copper, and that wire may be drawn of all sizes down to 0.004 in., the finest being as soft and pliable as silk thread.

It is not alone strong but resists corrosion, and so may be used for many purposes for which steel is unfitted, such as propellers, boilers, and roofs exposed to acid fumes. During 1908 about 300,000 square feet of monel metal sheets were used to roof the Pennsylvania tunnel station in New York City.

Because of its great power nickel has long been alloyed with copper, zinc, etc., to produce a white metal imitating silver, and called by various names such as German silver, Britannia metal, or argentan. These alloys are familiar from their use in household articles, such as spoons, forks, etc., which are generally plated with silver.



T. W. Gibson, Deputy Minister of Mines, Ont.

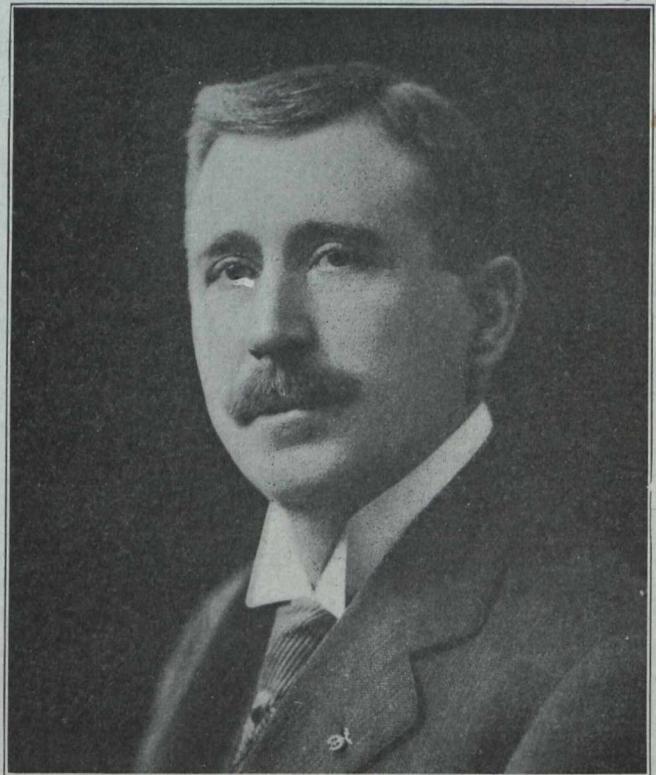
#### MOND NICKEL CO. BUYS LEVACK PROPERTIES.

According to the Financial Times, the Levack nickel properties in the Sudbury district have been purchased from Messrs. R. J. Tough, Rinaldo McConnell and Jas. Stobie, by the Mond Nickel Co. for \$750,000. The property has an area of 1,600 acres and is 30 miles west of Sudbury.

"The Mond people secured an option of this group of properties some months ago and have since had six diamond drills constantly proving up the ore bodies. It is learned that they have over two million tons of ore proven in the bodies drilled. The sum of \$40,000 was paid by the Mond Company when the option was granted them and under the terms of the agreement the balance and final payment of \$500,000 is due in December, unless amended arrangements are entered into. Singularly, the Mond people secured an option of the same properties, ten years ago for a much

smaller amount, and at the time paid \$10,000 on account. The big Levack properties were discovered and located about the year 1882, by one of the present owners, James Stobie, at that time of Sudbury, but now of Portlock. Associated with Mr. Stobie now in the ownership of the property is Rinaldo McConnell, of Ottawa, and R. J. Tough, of Toronto.

"The Mond is one of two big nickel producing companies in Canada, the other being the International. A third company was organized this year, the Canadian Nickel Corporation, backed by Dr. Pearson and other interests identified with him in the Brazilian Traction and other enterprises. The company acquired a number of mines, among them the Murray, and was capitalized at \$10,000,000 debenture stock, and \$20,000,000 common stock. Plans for flotation of the company's securities in London, however, have been held up by the disturbed condition of the market, and little has been heard of the enterprise lately."



W. H. Hearst, Minister of Mines, Ont.

#### DIVIDENDS PAID BY ONTARIO MINING COMPANIES IN PERIOD JAN. 1 to NOV. 1, 1913.

Company.	Amount.
Buffalo . . . . .	\$820,000
Cobalt Lake . . . . .	165,000
Cobalt Townsite . . . . .	144,000
Coniagas . . . . .	1,080,000
Crown Reserve . . . . .	879,982
Hollinger . . . . .	900,000
Kerr Lake . . . . .	450,000
La Rose Consolidated . . . . .	936,941
McKinley-Darragh-Savage . . . . .	1,033,937
Nipissing . . . . .	1,800,000
Seneca-Superior . . . . .	251,412
Timiskaming and Hudson Bay . . . . .	116,415
Timiskaming . . . . .	150,000
Trethewey . . . . .	100,000
Wettlaufer-Lorrain . . . . .	141,758
(U.S. company controlling Canadian Copper Co.)	
International Nickel, preferred . . . . .	405,000
International Nickel, common . . . . .	3,230,000

# SMELTING THE COBALT SILVER ORES\*

By A. A. Cole.

The shipments of Cobalt ores during 1912 were mostly treated by the same smelters as received the production of the previous year. In Canada the bulk of the output went to the—

1. Canadian Copper Company, Copper Cliff, Ont.
2. Canada Smelting & Refining Company, Orillia, Ont.
3. Coniagas Reduction Company, Thorold, Ont.
4. Deloro Mining & Reduction, Company, Deloro, Ont.

A few consignments were also made to three new plants which commenced operations during the year, viz.:

5. Buffalo and Ontario Smelting and Refining Co., Kingston, Ont.
6. Dominion Refineries, North Bay, Ont.
7. Metals Chemical Company, Welland, Ont.

Of the foreign shipments, all went to the United States with the exception of a few high grade shipments from the Crown Reserve mine to the Saxon Government. The American smelting companies in this market were:

8. American Smelting and Refining Company, at their works at Perth Amboy, Omaha, and Denver, and
9. The Pennsylvania Smelting Company, Carnegie, Pa.

While occasional consignments were taken by the

10. Balbach Smelting and Refining Company, Newark, N.J., and the
11. United States Metals Refining Company, Chrome, N.J.

As most of the Canadian plants produce refined cobalt oxide the disorganized state of the market for this material has made it impossible at times to profitably dispose of their output, and they therefore welcomed a betterment of the market towards the end of the year.

When the smelters started treating Cobalt ores, cobalt oxide was selling at \$2.50 per pound, but the consumption was so limited that the production from the Cobalt district soon glutted the market. Now the retail price quoted in New York is about 90c. per pound, with an import duty of 25c. per pound. It is selling in England and Europe at from 2s. 2d. to 3s. per pound, or about 68c., and the price paid to the smelters is necessarily still lower.

The Canadian smelters now supply practically the entire world's market with cobalt oxide of excellent grade, and if new uses are found for cobalt they are ready to increase the output and supply the demand.

The Canadian Copper Company decided to close down its Cobalt plant and received its last shipment of cobalt ore towards the end of October. Since that time operations have been continued simply as a final

clean up to recover the values tied up in ore on hand, residues, furnace bottoms, etc.

The small smelting plant at North Bay is bidding for ore rich in cobalt and low in silver.

The smelting schedules were practically unchanged from those in effect in 1911.

The ores shipped to the smelters will average about 1,000 ozs. silver per ton, between the limits of 75 ounces and 7,000 ounces. A few exceptional shipments are known to have assayed even above this latter figure, the highest shipment recorded being one of 20 tons from the Crown Reserve mine, which assayed 8,903 ounces silver per ton.

### Coniagas Reduction Company, Ltd.

The Coniagas Mines, Limited, of Cobalt, Ont., owns the issued capital stock of the Coniagas Reduction Co., Ltd., except six shares issued to directors to qualify.

The head office of the company is at St. Catharines, Ont., but the smelter is situated at Thorold, six miles west of Niagara Falls. The company's property comprises 160 acres, of which the smelter occupies about four, with a frontage of 1,500 feet on the Welland Canal. It is also served by the Grand Trunk, and Niagara, St. Catharines and Toronto Railways.

Construction of the smelter started March, 1907, and actual smelting commenced May, 1908. Erected originally for the treatment of ores from the Coniagas mine, Cobalt, Ont., its capacity is sufficient to allow of the smelting of a certain amount of other silver ore from the same district.

The products of the smelter are silver, white arsenic, and the oxides of cobalt and nickel, either combined or separated.

**Treatment.**—The ore is first crushed, then ground in a Krupp ball mill, and sampled by a Vezin automatic sampler, two independent samples being made. The fine ore is smelted with limestone, iron ore, and other substances. The separated silver is cast in anodes and refined electrolytically, while the nickel and cobalt are recovered as speiss, which is worked up for nickel and cobalt oxides. These are put on the market either combined or separately.

The combined oxides will assay 40 to 50 per cent. metallic cobalt, and 15 to 25 per cent. metallic nickel, depending on the grade of the ore treated. The oxide of cobalt will run from 60 to 76 per cent. metallic cobalt according to the call of the market, the only impurity being nickel which will run from .5 to 1.15 per cent.

The arsenic fume from the fume and dust flues and collectors is worked up for refined white arsenic, which will assay over 99 per cent. pure.

The actual output from the smelter since the commencement of operations has been as follows:

### Operations of Coniagas Reduction Co.

Year.	Ore Treated,		Cobalt Oxide,	Nickel Oxide,	White Arsenic,
	Tons.	Silver, Fine, Ozs.			
1908	266.8	360,683	5.5	1.5	13.5
1909	1,116.9	1,659,604	.9	..	100.0
1910	2,017.25	3,485,243	53.8	13.2	557.7
1911	2,821.50	5,770,271	60.5	17.3	766.1
1912	2,288.77	4,824,632	129.0	50.7	636.7
	8,511.22	16,100,433	249.7	82.7	2,074.0

\*Extract from report of mining engineer T. & N. O. Ry. Commission.

Power used at the plant is transmitted from Niagara Falls, and the plant requires from 200 to 300 horse power. The smelter has a monthly capacity of 450 tons of raw ore.

The limestone flux is obtained from Port Colborne, 20 miles distant, and the iron ore from Michigan.

The capacity of the arsenic works is about 1,000 tons per year.

The smelting schedule of the Coniagas Reduction Co., on the 1st January, 1913, was the same as has been effected since November 1st, 1911, and is in condensed form as follows:

**Schedule.**—Percentages of silver to be paid for on commercial assay of silver content per ton of 2,000 pounds as follows:

55 per cent. for 50 ounces and proportionate increase in percentage up to

73 per cent. for 200 ounces and proportionate increase in percentage up to

78 per cent. for 300 ounces and proportionate increase in percentage up to

84 per cent. for 500 ounces and proportionate increase in percentage up to

91.5 per cent. for 1,000 ounces and proportionate increase in percentage up to

92.5 per cent. for 1,500 ounces and proportionate increase in percentage up to

93.5 per cent. for 2,000 ounces and proportionate increase in percentage up to

95 per cent. for 3,000 and over.

Sampling to be at vendor's expense.

All ore purchased to be at a refining charge of  $\frac{3}{4}$  cent per ounce of silver content.

75 per cent. of amount 30 days after date of weighing and sampling reports.

25 per cent. of amount 90 days after the date of said report.

Price of silver to be determined by New York quotation as given by Messrs. Handy and Harman to Western Union Telegraph Company on dates of settlement.

#### Deloro Mining and Reduction Co.

The Deloro Mining and Reduction Co. is a close corporation, controlled by Mr. M. J. O'Brien, owner of the O'Brien mine, Cobalt.

The smelter is located at Deloro, Hastings County, Ont.,  $1\frac{1}{4}$  miles by road from Marmora station, on the Canadian Northern Ontario Railway. The construction of a railway spur is contemplated early in 1913.

The plant was originally built and operated as an arsenic producer by the Canadian Goldfields, but was entirely remodelled in 1907 by the present owners, to smelt ores from the Cobalt camp, particularly those of the O'Brien mine. During the year 1908 a separate and extensive plant was added for the manufacture of cobalt and nickel oxides, and this has been in successful operation since May, 1910.

**Treatment.**—The ore is first ground fine and sampled by Snyder sampler and hand quartering. It is then charged in a 42 in. Allis-Chambers cupola furnace producing metallic silver, speiss, slag and argentiferous arsenic fumes. The fuel used is a good grade of coke and when flux is required a local limestone is used with an occasional addition of a little scrap iron.

The silver button, which is about 850 fine, is charged in a refining furnace, which brings it up to 996 fine.

The speiss is crushed and roasted in mechanically worked roasters, part going to an intermediate treatment and the other part direct to the oxide plant. In the intermediate treatment silver (999 fine) is ex-

tracted with cyanide, the residue reverting to the cupola.

The speiss going to the oxide plant is treated so that the cobalt and nickel go into solution. The liquor and residues are separated in filter presses, the latter being returned to the cupola. The cobalt and nickel are precipitated either separately or together. The cobalt oxide (black oxide) after washing, contains 70 per cent. metallic cobalt and under 1 per cent. nickel, while the combined oxides run from 40 to 45 per cent. cobalt, and 10 to 15 per cent. nickel.

The crude arsenic from the cupola and roasting furnaces is caught in arsenic chambers and bag houses from which it is transferred to the arsenic refining furnaces. After refining it is ground ready for commerce as the oxide, white arsenic. The silver-bearing residue is returned to the cupola.

There is usually a considerable slag revert, not only for the purpose of removing any contained silver, but also to assist in the fluxing of the ore.

The smelter has a daily capacity of from 12 to 14 tons of raw cobalt ore. The capacity of the oxide plant is 20 tons per month, but the enlargements that are nearing completion increase this capacity by one-third.

Power is supplied to the smelter by the Seymore Power Co., from Campbellford, over a 22-mile transmission line, at \$20 per horse power. The operation of the plant requires from 300 to 400 horse power. There are 120 men employed at the works.

#### Operations of Deloro Smelter.

Ore treated .....	11,065 tons.
Silver Produced .....	20,339,860 fine ozs.
Cobalt and Mixed Oxides .....	500 tons.
Refined Arsenic .....	3,275 tons.

The smelting schedule of the Deloro M. & R. Co., in force on the 1st January, 1913, is as follows:

**Schedule.**—Pay for 98 per cent. of the silver contents of the ore determined by commercial assay, on the following terms and conditions:

Treatment charge—\$25.00 per ton of ore.

Refining charge— $\frac{3}{4}$  of a cent per ounce of silver contents on ore assaying 3,000 ounces and over per ton. One cent per ounce of silver contents on ore assaying 2,000 to 3,000 ounces per ton.  $1\frac{1}{2}$  cents per ounce of silver contents on ore assaying less than 2,000 ounces per ton.

Terms of payment—Seventy-five per cent. of net proceeds at Handy and Harman's New York quotation, 30 days after completion; twenty-five per cent. of net proceeds at Handy and Harman's New York quotation, 90 days after completion of sampling.

Ore to be delivered in carload lots f.o.b. Marmora Station, C. O. Railway, and to be at shipper's risk until sampling is undertaken.

(To be continued.)

#### DOMES.

In our issue of November 1 we printed a list showing tonnages treated during each of several months. The figure for August should have been 10,720 tons instead of 12,720. Previous to October the largest tonnage treated in one month was 11,300.

Our readers will regret to learn of the death of Major R. G. Leekie, of Sudbury, well-known among mining men and for years one of the most enthusiastic members of the Canadian Mining Institute.

## SWASTIKA AND KIRKLAND LAKE GOLD AREA

The geological map of Swastika and Kirkland lake gold areas, prepared for the Ontario Bureau of Mines by Messrs. A. G. Burrows and P. E. Hopkins, has been completed and is ready for distribution.

Accompanying the map are notes on the general geology and the ore deposits. The following paragraphs are extracts from these notes:

The rocks of the area are all referred to the pre-Cambrian.

**Keewatin.**—The oldest rocks recognized are the greenstones and their schistose derivatives. Their original constituents have generally been altered to secondary minerals. In the less disturbed parts they have the characteristic light greenish weathering surface of the typical Keewatin greenstone. Ellipsoidal and amygdaloidal structures are frequently shown. The predominating rock is a basalt, which can be seen along the railway cuttings east of Swastika and on the shores of Amikougami lake. A diabase is prominent on the north parts of Teck and Lebel townships.

Quartz-porphry and other acid rocks occur less abundantly than the greenstone.

**Timiskaming Series.**—The Keewatin is overlain by a series of sedimentary rocks which have been folded in the older rocks. Owing to the similarity of these rocks to certain sedimentary rocks of Cobalt and Porcupine, they have been classified as Timiskaming. At two localities excellent unconformities have been found between the Timiskaming and the underlying Keewatin, namely on mining locations L. 1824 on Kirkland lake and on L. 2796 in the northwest part of Lebel township. The series occurs as a narrow band having a crescent shape, extending from Eby and Grenfell townships on the west to McVittie township on the east. Its greatest width of nearly three miles is near the line between Teck and Lebel townships.

The beds of the series are nearly always highly inclined and approximate an east and west direction, while the schistosity is often nearly northeast and southwest. The lower beds include quartzite, graywacke, slate and conglomerate, which have at times been altered to schists. There are also less altered rocks of the same type which are considered to be the upper portion of the series. The highest exposures are generally a hard conglomerate carrying abundant pebbles which often readily separate from the matrix. The pebbles are frequently stretched and the matrix rendered schistose. There is considerable variety in the pebbles, which include various greenstones, porphyries, an occasional granite, and numerous fragments of a bright red jasper, which give the conglomerate a striking appearance.

The series has been greatly impregnated with carbonate, which sometimes forms the major part of the rock. The weathering of the iron in the carbonate has given a rusted surface to much of the rock.

While it has not been definitely proved, it is thought that the series probably forms a syncline, with the older sediments altered to schist at the north and south of the fold, whereas the more readily recognized quartzite, graywacke and conglomerate are toward the centre. To the east of Mud lake the series is represented by the older schistose members with less conglomerate.

Very schistose sediments can be seen one-half mile south of the five-mile post on the line between Teck and Lebel townships. Easily recognizable graywacke oc-

curs just south of No. 3 vein and conglomerate at No. 2 vein of the Tough-Oakes mine. A conglomerate, which is made up of a mass of pebbles closely packed together, can be seen one-half mile north of Gull lake on L. 2452.

**Light-Coloured Intrusives.**—There are several areas of light-coloured igneous rocks which occur in large volume. In the south part of the township of Otto there is a reddish hornblende or augite syenite. In the south part of Lebel township and the north part of Boston township there is a grey hornblende syenite. In the northwest part of Teck township there is a reddish hornblende granite. All these rocks intrude the Keewatin, but only the hornblende syenite in Lebel township was observed in contact with the Timiskaming, which it appeared to intrude.

**Lamprophyre.**—Lamprophyre dikes are common in the Keewatin and Timiskaming series. Narrow dikes of this rock, usually dark-coloured, cut the Keewatin along the railway southeast of Dane. Some reddish minettes can be seen north of Boston creek crossing.

**Feldspar Porphyry.**—There are dikes of reddish and greyish porphyry throughout the area which are believed to be the latest acid rock. These are sometimes only 20 or 30 feet wide; but occasionally the porphyry occurs over somewhat broad areas, as round the east end of the southeast bay of Kirkland lake.

### Veins of Swastika Area.

Two types of veins have been observed in the mapped area. Of these the earliest discovered are those near Swastika. These veins, which are of white quartz, are sometimes several feet wide. The gold occurs along line of contact of quartz and schist, or in fracture planes in the quartz along with iron pyrites. Calcite and crushed quartz occur in the fracture planes. Some molybdenite has been observed in the veins on the Lucky Cross property. These productive veins occur in the Keewatin near the contact with feldspar-porphry.

Two mills have been in operation near Swastika, there being a five-stamp mill at the Swastika mine and a ten-stamp mill at the Lucky Cross mine. There has been considerable underground development at both these properties.

### Veins of Kirkland Lake Area.

About six miles northeast of Swastika is the Kirkland lake area. The principal rock is graywacke and conglomerate of the Timiskaming series. These have been intruded by lamprophyre and later by feldspar-porphry. Gold-bearing veins have been found in the conglomerate and graywacke near the contact with the porphyry, and in the porphyry. Veins have also been found which have been traced from the conglomerate or graywacke into the porphyry.

A well defined zone containing several veins has been recognized. It extends in a northeast-southwest direction through Kirkland lake. The veins, especially those in the conglomerate which are narrow and lenticular, have been subjected to secondary processes. Much of the vein material is of a dark grey colour, differing from the white quartz veins of the Swastika area. The vein filling has been crushed, and fragments of white quartz of the early vein are now enclosed in darker material. The wall rock has also been crushed into the veins, different veins showing conglomerate or porphyry inclusions. Calcite occurs as a later filling in many of the veins.

In addition to a main vein, there may be parallel lenticular structures with impregnations of the intervening country rock by quartz veinlets, giving a ribboned appearance to a cross-section of the deposit. In this case the main vein may carry rich ore with a width of low grade ore on either side of it.

The gold usually occurs finely disseminated in the veins, but occasionally quite coarse gold is found. Iron pyrites and tellurides occur in the ore, but the chemical composition of the tellurides, which are found in small particles, have not been definitely determined. One sample examined qualitatively at the Provincial assay office showed lead, silver and tellurium. Molybdenite occurs in fine fracture planes, along which there has been a concentration of gold. There has been a later movement, and molybdenite and gold have been slickensided. Calcite also occurs in the veins, and gold is sometimes seen in the calcite.

A sample of material from a vein, enclosed in porphyry, from the Wright-Hargrave north of the south-east bay of Kirkland lake, was examined in thin section. There has been much crushing of the quartz and considerable calcite has been deposited in the crushed areas. Along the crushed areas, and in cracks between the quartz grains there is telluride with some gold in grains. Fragments of porphyry occur in the vein, and molybdenite has been deposited in fracture planes. A section of vein material from the No. 2 vein of the Tough-Oakes mine showed a grain of telluride encased in gold.

#### Development.

There has been extensive trenching on many veins in the area and shafts have been sunk on several of them.

**Burnside.**—(L. 1823).—A number of veins have been discovered by trenching. A vertical shaft is being sunk on a recently discovered vein in the conglomerate which showed rich ore on the surface.

**Oakes.**—(L. 1557).—A forty-foot shaft has been sunk on an altered portion of a porphyry dike, somewhat greenish in colour, which is intersected by quartz veinlets. Visible gold can be observed at several places on the surface.

**Robbins.**—(L. 2100).—Trenching has shown numerous veinlets of quartz intersecting the reddish porphyry, while gold and tellurides occur chiefly in the minute slip planes in the porphyry adjacent to the veinlets.

**Teck-Hughes.**—(L. 1238).—This property is being developed from two vertical shafts, one of which is on a vein in the conglomerate and the other on one in the porphyry.

**Tough-Oakes.**—(H. R. 1441, etc.)—The principal development has been done on No. 2 vein. From an open cut two shipments of high-grade ore were made. A shaft has also been sunk from this open cut to the 200-ft. level. The shaft inclines to the south at 60 degrees, which is the dip of the vein. A station and ore pocket have been cut at the 100-ft. level. Part of the ore from development is being treated in a temporary five-stamp mill by simple amalgamation, while the tailings are being retained for future treatment. The mill treats about 12 tons daily, while about the same tonnage is added to the stock pile of milling ore per day. About 72 tons of high grade ore have been shipped from the mine. One average shipment of 19.98 tons assayed 22.5 oz. gold and 23.4 oz. silver per ton.

**Wright-Hargrave.**—(T.C. 709).—A shaft is being sunk on a quartz vein in the porphyry, in which some

high grade gold ore with telluride has been observed on the surface.

Shafts are being sunk on other properties, including the Wettlaufer (L. 16626), Wood (L. 1236) and Hutton (L. 16621).

## PERSONAL AND GENERAL

Dr. C. M. Carson, a graduate of the University of Toronto, has been appointed head of the department of chemistry at the Michigan College of Mines. He has had experience in teaching at several colleges, and was recently lecturing at Columbia University. Dr. Carson succeeds the late G. A. Koenig, who was for several years in charge of the department.

Mr. Edw. J. Albert, district manager for Cobalt and Porcupine territory for Canadian Allis-Chalmers, Ltd., has been appointed manager of the mining department of the company and transferred to the head office, Toronto.

Dr. H. C. Cooke, of the Geological Survey of Canada, left Vancouver Island, B.C., for Ottawa, about November 7.

Mr. Geo. Watkin Evans, of Seattle, Washington, who spent the field season of last year examining the Groundhog mountain coal basin, in the northern part of Skeena district, British Columbia, has returned to Seattle from the Matanuska coal field in Alaska, where he has this year been superintending coal mining operations for the United States Bureau of Mines which has arranged for a test of coal from that field on a ship of the U. S. navy.

Mr. E. Jacobs, secretary of the Western Branch of the Canadian Mining Institute, attended a joint meeting of the Spokane and Montana local sections of the American Institute of Mining Engineers, held at Wallace, Idaho, on November 15 and 16.

Mr. Robert Keffer, son of Mr. Frederic Keffer, of Greenwood, B.C., has been appointed assistant mining engineer at the Stewart mine, Kellogg, Idaho.

Mr. F. J. Longworth has succeeded Mr. F. R. Weekes as resident engineer at Copper mountain, Similkameen district, for the British Columbia Copper Co., which is developing a large group of copper claims in that camp.

Mr. G. C. McKenzie, of the Mines Branch, Canada Department of Mines, is in charge of the work being done at Nelson, B.C., in connection with the departmental experiments in the metallurgy of complex lead-zinc ores.

Mr. J. P. McFadden, superintendent at the Surprise mine, Slocan, B.C., was on the Pacific coast lately.

Mr. J. W. D. Moodie, vice-president and general manager of the Britannia Mining & Smelting Co., recently returned to Britannia Beach, B.C., from an extended trip in the Eastern States.

Mr. P. L. Naismith, of Calgary, Alberta, superintendent of the Canadian Pacific Railway Co.'s Natural Resources Department, was at Hosmer, Crowsnest Pass, in November.

Mr. E. H. Nutter, of San Francisco, California, chief engineer for the Minerals Separation American Syndicate, was at the Silverton Mines Company's concentration mill, Four-mile creek, Slocan lake district of British Columbia, a few weeks ago, one unit of the syndicate's flotation plant having been put in there.

Mr. Conrad Wolfe, of Spokane, Washington, has again been to a group of copper claims in the northern part of Vancouver island.

## SPECIAL CORRESPONDENCE

### PORCUPINE, SWASTIKA AND KIRKLAND LAKE

**Hollinger.**—Work in the mine continues to show satisfactory progress, 517 feet of drifting having been added to development work during the four weeks ending October 7. Approximately a hundred feet of this has been done upon the 425-ft. level upon No. 1 vein and the values and widths encountered are extremely gratifying showing as they do that there is no falling off in grade or width of ore. Work was started upon the winze which will be carried to 550 feet with as little delay as possible.

**Tough-Oakes.**—It is understood that Mr. C. A. Foster has been successful in floating the Tough-Oakes gold mines of Kirkland Lake, in which he has a controlling interest, in London. The report goes that the three claims which constitute the Tough-Oakes gold mines and two others have been disposed of and that a company will be formed to take them over. Stock is to be offered to the public.

Another high grade shipment has been made from the Tough-Oakes mine. After being sampled at Campbell and Deyell's 30 tons of high grade gold ore has been sold to the United States Metals Company for their smelter at Chrome, New Jersey. It is supposed that the ore will run about the same grade as former shipments, namely, about \$400 to the ton.

**McIntyre.**—During October, 3,900 tons were treated in the McIntyre mill, as compared with 2,800 tons during the previous month. With this increased tonnage costs were slightly reduced. The ore ran \$9.75 to the ton, 15 cents higher than in September. While the exact cost has not been determined it is expected to be slightly lower than in the previous month when it was \$6.60. The extraction was 96.1 per cent., with a total bullion shipment of \$38,600. At present 150 tons daily is going through the mill, but this will be increased before the end of the year. The aerial tramway is now in full operation, bringing 60 tons daily to the mill from No. 5 shaft. This working is down to the 300-ft. level where the vein has been developed for 100 ft. Work will be started this month on the new three compartment shaft to be situated midway between the office and the mill. From the 300-ft. level of the mine a raise will be put through to the surface. While this working is under way sinking operations will be commenced. The new work will be connected with No. 1 and 4 shafts on the 300-ft. level, while at 400 ft. connections will be made at No. 5 shaft by means of a lengthy crosscut under the lake. By an evident miscalculation the McIntyre No. 5 vein was cut from the 600-ft. level of the Pearl Lake shaft by the latter company some months ago. Where cut it was 112 feet in on the McIntyre ground and showed a 20-ft. ore body. The deepest point proven by the McIntyre was from the 300-ft. level. A new plant is now being installed at No. 5 shaft consisting of a 12-drill compressor and accessories.

**Dome.**—The October statement of the Dome mine shows that 12,365 tons were milled. The value of gold produced was \$118,300, the largest amount produced since May. During the month the mill ran 96 per cent. of the working time, while the value of ore treated is shown as \$9.50.

**Schumacher.**—The new shaft at the Schumacher property has been completed and work will start at this point this month. Before the work can be started the compressor plant must be moved to the new point of operations. Recent development on the Dixon property has proven a good ore body within a few feet of the Schumacher line.

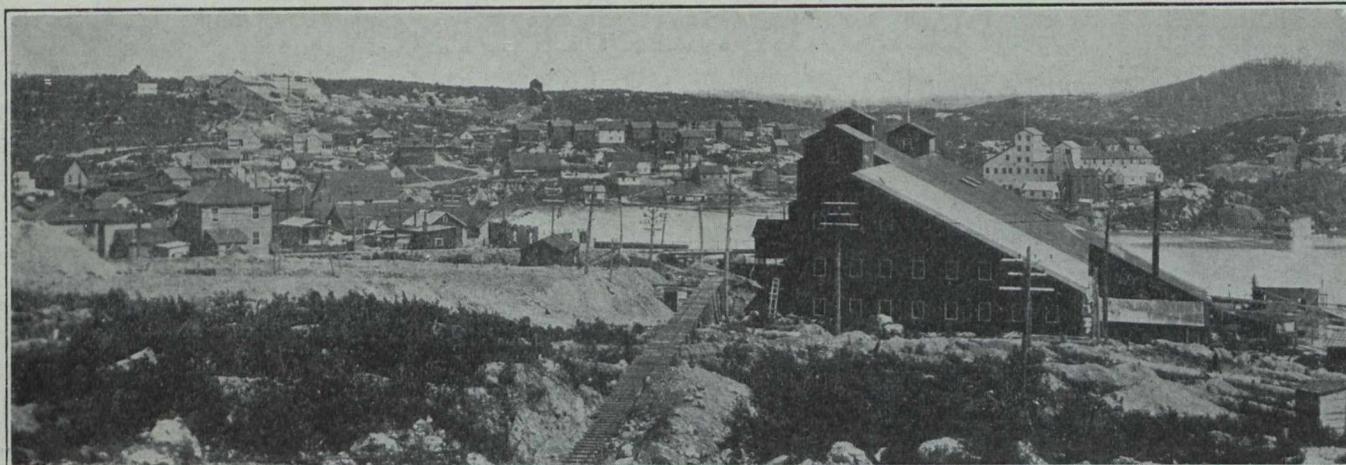
The taking up of the option on the St. Paul-Hewitt claims in Bartlett Township by a syndicate of Cobalt and Haileybury men has caused a considerable influx of prospectors into this outlying section of the gold camp. Mr. Robert Bryce, formerly in charge of the Silver Cliff, went south to McArthur with fifteen men to do work on the St. Paul claims. Temporary camps have been erected. In the next few weeks before the option expires in order to ascertain the value of the claims considerable surface work will be done.

The township of Bartlett was first staked two winters ago, but no finds of importance were made. Upon the St. Paul a good showing was uncovered the following summer. The Crown Reserve Mining Company has already had an option on these claims, but allowed it to lapse. As soon as the sleighing is good the road which the Government has cut should be in fair shape.

### COBALT, ELK LAKE, GOWGANDA AND SOUTH LORRAIN

**Cobalt Townsite and City of Cobalt.**—The Northern Customs concentrator sold by the company in which Mr. A. J. Young was a dominant factor for about \$250,000, has passed into the possession of the Cobalt Townsite Mining Company. The new owners took charge on November 1st. Of the 120 stamps in the mill 70 are treating Cobalt Townsite ore so that about 175 tons per day are being put through the mill from that mine. This is not yet enough for the mill wants of the Townsite, as is evidenced by the fact that the company is shipping out a large tonnage of low grade ore every week to the smelters. When the new Northern Customs concentrator is ready at mileage 104, the La Rose contract, which required the remainder of the stamps, will be taken there. Until then the La Rose contract must be taken care of and the City of Cobalt cannot yet get access to the mill. When it does it is proposed to treat 50 tons per day. The covered tramway which runs from the top of the shaft house at the City of Cobalt mine to the Northern Customs mill has now been completed. It is expected that the Northern Customs will be able to treat ore between the first and the last of December. The whole of the old mill will then be free for the use of the Cobalt Townsite and allied interests.

**The Chambers-Ferland Mining Company** which is now controlled in England has signed a contract with the Northern Customs concentrator for the use of forty stamps from May 1st next for a period of five years. This will mean the treatment of about 120 tons per day. A writ was issued by Mr. Henry Cecil to block the contract, but it has been signed notwithstanding. The Chambers-Ferland has not been shipping ore since the early months of the year and probably will not until concentrates can be obtained from the mill. It is known that there is a good tonnage of mill rock in the old workings between the La Rose



View across south end of Cobalt lake

and O'Brien. There is some good prospective territory in which a shaft is now being sunk to the west of the 64 shaft of the Nipissing.

**The Alladin Cobalt Mining Company**, which took over the old Silver Queen, made its first shipment of the year this week. Thirty-two tons of concentrates were shipped from the old Nipissing Reduction mill which has been leased for a period of two years.

**Casey Cobalt.**—Arising out of a lawsuit in the High Court at Haileybury, some interesting details of the sale of the Bucknell claims to the Casey Cobalt Mining Company appeared. It appeared that Mr. Fred. Connell, the plaintiff in the case, sold the claims through a man named Mitchell to the present English company, who are operating it for \$120,000, of which \$60,000 was in cash and 12,000 shares of the par value of one dollar. In December, 1906, Mr. Connell received \$100 as his commission on the amount paid to date, \$100 having been paid down on the deal, and \$900 paid within thirty days. In June, 1907, he received \$5,000 in full commission of the cash payments as a discount in the selling price he had been granted by the owners. Later that year he received 500 shares of stock of the Casey Cobalt Mining Company.

Last month the Casey Cobalt shipped 30 tons of high grade ore, and already this year has despatched 393.59 tons, all of high grade ore concentrates.

Dr. Willet G. Miller, Provincial Geologist, spent some time last month examining the Casey Cobalt mine and the area in which it is situated.

**Nipissing.**—During the month of October the Nipissing mined ore of an estimated net value of \$218,772 and shipped bullion from the Nipissing and Customs ore of an estimated net value of \$348,612. Favourable developments were met with at the fourth level of shaft No. 73. A crosscut was started to encounter possible extensions of several branch veins which showed considerable ore at the third level. This crosscut has encountered what is thought to be the first of those branches. It is 1 to 1½ ins. wide and assays 3,000 ounces. This opening is within a few feet of the Keewatin contact. It is expected that the vein will become more favourable as to widths and values as soon as it is developed further away from the Keewatin.

Preparations for sinking No. 64 shaft from 650 ft. to 900 ft. have almost been completed. A pentice has been put in and sinking has been resumed. At the third level of No. 64 shaft a crosscut is being driven

to connect with the third level of vein No. 73. During the month three veins were encountered, one of them assaying several hundred ounces over a width of one inch.

At shaft No. 63 the Little Silver stope at the 245-ft. level continues to produce high grade ore. The stope is about 100 feet long and will average one and a half inches over the entire length. The silver content is 3,000 ounces to the ton.

**The Seneca-Superior** has cut its main vein at the 100-ft. level. From the No. 2 shaft a crosscut run at the 100-ft. cut the main vein at 110 ft. It proved to be 6 ins. wide of 1,000-ounce ore.

At the 200-ft. level there is now a shoot of ore for 400 ft. upon which little stoping has been done. The vein averages from three to four inches of very high grade ore. Below this level a winze was put down for 131 ft. all in the conglomerate. Two levels have now been opened up, one at 262 ft. and one at 335 ft. There is the usual high grade in each working. Already on the upper level 100 ft. of drifting has been done, while on the 335 ft. level the drills are working 80 ft. from the winze.

**Penn-Canadian.**—The production during October from the Penn-Canadian mine amounted to 60,015 ounces. This was a considerable increase over any previous month, the largest previous being 45,050 ounces. The new vein has now been developed for a distance of 35 feet, and it is still good in the face. This is at the 305-ft. level where it is in the conglomerate.

## NOVA SCOTIA

**Loss of the s.s. "Bridgeport."**—The loss at sea of the s.s. "Bridgeport" with forty lives and 10,000 tons of coal, is the worst disaster that has yet occurred in the St. Lawrence coal-freighting trade. No particulars can be given of how this fine steamer and her crew came to their end, but it is known that when she was approaching the vicinity of the Bird Rock Island—an outlier of the Magdalens—a full hurricane was blowing accompanied by blinding snow flurries. A piece of wreckage, probably a portion of a steamer's wheelhouse, was picked up on the Bird Rock Island, and it can only be inferred that the "Bridgeport" was endeavouring to clear the Bird Rock by standing out to sea to the eastward, but driven out of her course by the combined force of a northeast gale and the cur-

rents, and blinded by the snow flurries, she struck and sank immediately.

There has been irresponsible talk in the newspapers, as there has been in the case of every similar happening in Nova Scotian waters, that the "Bridgeport" went to sea with insecure hatches, or that she foundered owing to the inability of the vessel to ride out the gale. It is not fair to make such loose assertions, as the "Bridgeport" was classed A1 at Lloyds, and she was specially constructed for the service she was in. The "Bridgeport" and the "Glace Bay" were two sister ships, taking 10,000 tons of coal cargo, and were especially adapted and designed for the St. Lawrence trade. The "Glace Bay" ran ashore and broke up near Trepassey Bay, on the Newfoundland coast, last spring, and it is now only too probable that the "Bridgeport" met the same fate, but, unfortunately, with the loss of her entire crew.

The two steamers were under charter to the Dominion Coal Company, but that company does not suffer any monetary loss beyond the loss of the cargo, and the difficulty of chartering vessels as suitable as these specially constructed steamers. As soon as there was reason for anxiety about the "Bridgeport," the Coal Company despatched their own steamer, "Louisburg," to sea and kept her searching for a week.

The freighting of coal in large quantities between Sydney and Montreal has been reduced to an exact science. All the summer long the colliers load and sail, discharge and return, with the regularity of a railway train service, and it has become difficult to realize that such a happening as the loss of the "Bridgeport" was possible. That last accident of a similar kind was the loss of the "Turret Bay" on St. Paul's Island, about nine years ago. She also was loaded with coal and sank with all her crew. When, however, it is remembered that some two million tons of coal will be freighted from Cape Breton ports to St. Lawrence ports during the summer of 1913, and that similarly large quantities of coal have gone up the river for many years past, the record of the coal-freighting vessels is a good one, and will compare favourably with those of other trades plying in the same waters. Such a record infers careful seamanship and stout vessels, because the shores of northern Cape Breton, the Magdalens, the Gaspé Peninsula and Anticosti are not hospitable coasts, and the Lower Gulf can be very nasty in a northeast gale.

## BRITISH COLUMBIA

As the close of the year approaches some guessing is being done as to what the total value of the mineral production for 1913 will prove to be. In most cases the figures published should be regarded as perhaps not dependable, and where the expectation is given expression to of a higher total than, or even as high as that of last year being reached, it may safely be regarded as nothing more than a guess. To anyone well informed as to the position it is evident that it is unlikely last year's record will be equalled, while to suggest that it will be exceeded indicates a lack of knowledge of some of the conditions that have militated against an increase in 1913 over the value of the production in 1912 which compared so favourably with that of 1910 (labour difficulties having so interfered with mineral production in 1911 as to make a comparison with that year not a fair one). When it is remembered that the total of \$32,440,800 in 1912 was \$6,063,734, or 23 per cent., greater than that of 1910

(it was \$8,941,728 higher than that of 1911), it will be seen that only a continuation of exceptionally favourable conditions would have warranted expectation of a further increase in total value of output, and since that essential has in an important degree been lacking, there does not seem to be sufficient justification for the optimism that has characterized some of the forecasts made. However, it will not be long to the time when, with a fair proportion of the production figures obtainable, an estimate more likely to be near the actual value of production will be practicable, so it does not appear to be wise to go into detail just now to show what the total may be. Meanwhile it will be said here that a somewhat lower total than that of 1912 may be looked for.

Mention was made last month of the receipt of favourable news from the chief placer-gold mining districts, namely, Cariboo and Atlin. Since then newspaper accounts of interviews with several men from the latter district have been printed and these have included statements that seem to be wide of facts. For instance, to suggest that Atlin has this year made an output of more gold than in any other year calls for a prompt response that as the output of that camp in 1912 was \$290,000, there is no known reason why it should be believed that in 1913 it has exceeded the \$800,000 total of 1899, or even the \$530,000 total of a later year. Indeed, there were several other years which reached a total of \$400,000 or higher, so, bearing in mind that 1912 is credited with a yield of only \$290,000, it seems reasonable to think, under the circumstances that no unusually rich new ground of considerable extent is known to have been worked in 1913, that the district will have done well to have reached even half the total of that of the highest year on record, or say \$400,000.

Just one other reference to last month's news notes will now be made. It was then mentioned that there had been a considerable increase in the quantity of ore received at the Consolidated Mining and Smelting Co.'s smeltery at Trail, the figures for the week ended October 30 having been 9,460 tons, and for the immediately preceding week 9,197 tons. No doubt there is a good reason for the decrease—indeed, it has been stated in print that owing to a breakage of the crusher at Trail, shipment of ore from Rossland had to be suspended for two days—but the fact remains that the total for the week ended November 6 was 6,302 tons. At the time of writing figures for the week ended November 13 are not available, but it will be seen that the considerable decrease for the first week in November offsets the increase in the latter half of October. There is this satisfaction, though—it is to be expected that the total of ore receipts for the year will show a gratifying increase.

## EAST KOOTENAY.

**Fort Steele Division.**—News from Moyie is to the effect that recently more silver-lead ore of good grade has been found in the upper workings of the Society Girl mine and that sufficient for a carload has been hauled to the railway for shipment to Trail smelting works. The St. Eugene, which for years was the largest producer of lead in Canada, is now but a small shipper, all its known large bodies of ore having been exhausted. Receipts at Trail of St. Eugene ore in October were 122 tons, and for the week ended November 6, 110 tons. The only other metalliferous mine in this division of East Kootenay is the Sullivan, which as well as the St. Eugene is operated by the Consolidated Mining and Smelting Co. During October, more

than 3,000 tons of Sullivan lead ore was received at Trail, and for the week ended November 6, 950 tons.

#### WEST KOOTENAY.

**Ainsworth Mining Division.**—The work of sinking the main shaft of the Silver Hoard to the 200-ft. level will be completed during November. Good progress is being made with other underground development. It is estimated that there is approximately 3,000 tons of ore of shipping grade blocked out on the 100-ft. level. During two recent months the quantity of ore shipped to Trail has averaged 55 tons a week; preparations are being made to increase the output, by the first of the coming year, to about 20 tons a day. An electrically operated hoist will be installed by the end of December, and it is planned to shortly put in a two-drill combination Temple-Ingersoll compressor. A new cookhouse, with accommodation for 50 men, is being erected and the camp generally put in good condition for the winter. Some 30 men are employed at the mine, and the intention is to add to the number as soon as this can be done with advantage.

**Slocan.**—Late reports from the Rambler-Cariboo state that mine and concentrating mill are in better condition for production than for some time past, and that it is expected an output of ore up to capacity will be maintained from now on. A stope recently opened from the 1,200-ft level is in an ore shoot including from 9 in. up to 3 ft. of clean shipping ore. In addition, there is blocked out in different parts of the mine sufficient ore of milling grade to keep the mill fully supplied for many months. A new cable for the aerial tramway from mine to mill is being placed; this will shortly be available for use and it will increase the carrying capacity of the tramway to 17 tons an hour, or nearly twice as much as under former conditions. A pebble mill is being put in at the concentrator, to facilitate saving the zinc associated with silver and lead in the ore. Twelve cars of zinc concentrate, consigned to Bartlesville, Oklahoma, were shipped lately, and shipment of zinc as well as silver-lead ore is to be continued regularly. The mill is running satisfactorily, and there is general improvement in the mine. The number of men on the company's payroll, including those at both mine and mill, is 65.

A reorganization of the Lucky Jim Zinc Mines, Ltd., which has for several years been operating the Lucky Jim mine, in Slocan district, is proposed. The president told a meeting of shareholders held in Winnipeg, Manitoba, on October 28, that all the known high-grade zinc ore had been exhausted, so nothing remains but to exploit the bodies of low grade lead-zinc ore. A second mortgage of the property had been given. The liabilities of the company total \$81,000. Foreclosure proceedings have been commenced by the first mortgagee. In addition to present liabilities, \$25,000 is needed to provide for new work proposed. A meeting of shareholders is to be held in Victoria, B.C., during November, and proxies were asked for by the directors to support the proposed reorganization, and an assessment of five cents a share, the proceeds to be used for paying off existing liabilities and providing funds for further development of the mine.

Wm. Thomlinson, who for the last six months has been engaged in collecting for the Provincial Department of Mines samples of ores from numerous mining properties in Slocan and Ainsworth mining divisions, has contributed for publication the following comment: "An effective method of treating economically the zinc-silver ores of Kootenay is very desirable

and would be of much commercial importance. In the district lying between the north half of Kootenay lake and Slocan lake there are more than 20 developed mining properties which contain, either entirely or in addition to other ores, large quantities of zinc-silver ore containing from 20 to 55 per cent. zinc and 15 to 250 ozs. silver a ton. Thousands of tons of such ore is on the dumps or in the stopes of Kootenay mines awaiting shipments to metallurgical works where penalties on zinc content of the ore and heavy losses in silver could be avoided."

The report of the Van Roi Mining Co., Ltd., for September from its Van-Roi mine, in Silverton camp, has been received from the company's head office in London. Development work was done, with a small force of men employed, to a total of 98 ft., in drifts on level 9 and in raises from that level. The best showing of ore was in a raise in the main vein where for 33 ft. the ore averaged 16.6 oz. of silver a ton, 3.4 per cent. lead, and 8.7 per cent. zinc across an average width of 60 in. in the western half. The mill was run for 96 hours on accumulations of material produced by recent developments. The total quantity crushed was 587 tons, which yielded 10 tons of lead concentrate assaying 100.2 oz. silver a ton, 53.2 per cent. lead, and 11.7 per cent. zinc, and 20 tons of zinc concentrate assaying 27.2 oz. silver a ton, 3.1 per cent. lead, and 37.8 per cent. zinc.

#### ROSSLAND.

The report of the Le Roi No. 2, Ltd., for September from its Josie mine, in this camp, has been received from the company's head office in London. Ore shipments to Trail totalled 1,729 tons, this including 85 tons of concentrate. Receipts from the smeltery were \$33,404. Estimated costs for corresponding period were: For development, \$8,000; ore production, \$7,000; milling, \$1,100; total, \$16,100. Development work done totalled 230 ft.; this was on the 600, 700, and 900-ft. levels and the shaft tunnel in what is known as the Josie drift. Of 56 ft. advanced in this last-mentioned working, for 40 ft. the average value of the ore across an average width of 13 in. was: Gold 12 dwt. a ton, and copper 5 per cent. On the 600-ft. level, in the Hamilton vein west, 20 ft. advanced was in ore of an average width of 25 in. and containing gold 9 dwt. a ton, and copper 0.9 per cent.

#### HEDLEY.

After nearly four months' diamond-drilling on a group of mineral claims on Twenty-Mile creek, Camp Hedley, Similkameen, the New York Syndicate No. 2 has suspended work for the ensuing winter. These claims were bonded last winter by Mr. T. Walter Beam, of Denver, Colorado, for New York principals, among them men largely interested in the Hedley Gold Mining Co. Deep snow and the steepness of the side of the Twenty-Mile canyon made the arrangement of preliminaries slow work, so that it was not until early summer it was practicable to commence drilling. Two pipe lines, one for water and the other for compressed air, were laid a distance of rather more than a mile, from the Nickel Plate mine over the mountain to the canyon, and camp was made as well. With three shifts of men employed and full time worked until cold weather set in and necessitated a stoppage, three holes were drilled, two of them deep ones, but no large ore-body was found. The cost of this undertaking was approximately \$40,000. Conditionally that suitable arrangements shall be made regarding time of payments on purchase price of claims, it is stated that the

syndicate will do more drilling next summer. Mr. Beam was engineer in charge and Mr. G. P. Jones, of the Hedley Gold mining Co., superintended operations during the past season.

**OBSERVATORY INLET.**

The Granby Consolidated Co., which is developing a large copper mine and erecting a smelter at Anyox, Observatory inlet, British Columbia, is evidently determined to treat its men well, and is erecting cottages for them. The rental is \$3 per month per room, with electric light, bath in every house, even with two rooms. At the mine there are fourteen 4-room and four 5-room cottages completed. The old bunkhouse has been renovated and will house 35 men. A two-storey bunkhouse, 30 by 120 ft., with basement containing lockers, showers, and tubs, is ready for 110 men. The mess has a capacity of 250 men, with cold-storage plant. All buildings are connected with water and sewer systems sufficient for present and future needs.

**PORTLAND CANAL.**

Supplies sufficient to last until next spring have been sent to the camp of the Indian Mines, Ltd., situated in the vicinity of Cascade creek, a tributary of Salmon river, and distant from the head of Portland canal about 14 miles. No. 1 adit is now in about 350 ft.; this is being driven to open the ground under an ore deposit 19 ft. wide where a prospect shaft has been sunk in it from the surface at about 160 ft. above the adit. At 100 ft. in the adit exposed what is thought to be the top of a blind lead; at 300 ft. in a shoot of ore 5 ft. in width was encountered, this being at a depth of 125 ft. from the surface. No. 2 adit is a drift at a vertical depth of 160 ft. below No. 1; it is now in about 60 ft. and has been in ore all the way running about 3 ft. in width. On the whole, the ore opened is concentrating, though there is a fair proportion that could be sorted out for shipment to the smelting works as crude ore. Assays of samples from the blind lead above mentioned gave returns up to \$17 a ton, chiefly in gold; others, from the orebody at 200 ft. in from the portal of No. 1 adit returned on an average about \$12 in gold and 4 oz. silver a ton. That from the surface opening gave 40 per cent. lead, 20 ozs. silver a ton, and a little gold.

**GENERAL NEWS.**

The Granby Consolidated Co.'s production figures for ten months to the end of October, 1913, are as follows: Granby ore smelted, 1,023,766 tons; custom ore, 12,614 tons; total ore treated, 1,036,380 tons. Blister copper produced, 18,115,987 lbs.

The report that an application had been made to the Minister of Labour for the appointment of a board of investigation and conciliation in connection with the strike of coal-mine employees on Vancouver island has been contradicted. No progress had been made by the middle of November toward a settlement of the trouble. There is little doubt that the main point at issue now is the recognition of the United Mine Workers of America, which is a serious difficulty and one not likely to be overcome since the coal-mining companies affected have hitherto shown no signs of making such a concession.

**LA ROSE IN OCTOBER.**

The October production of the La Rose Consolidated Mines Company was as follows:

Production of silver, 203,454 ozs., of value.. \$120,329  
 Plus sundry income ..... 3,724  
 \$124,053

Less—  
 Marketing, concentration and operating expenses ..... 56,126

Profits for October, 1913 ..... \$67,927  
 The cash surplus as of October 31st amounts to \$1,709,579, made up as follows:

Cash surplus ..... \$1,445,713  
 Outstanding shipments and ore on hand at mine ready for shipment ..... 292,407

\$1,738,120  
 Less current liabilities ..... 28,541

\$1,709,579

**COBALT ORE SHIPMENTS.**

The ore shipments from the Cobalt camp for the week ending November 22 were:

Mine.	High grade.	Low grade.	Total lbs.
Townsite .....	158,700	168,000	326,700
McKinley-Darragh .....	63,410	.....	63,410
La Rose .....	87,200	160,000	247,200
Dom. Reduction .....	64,500	.....	64,500
Cobalt Comet .....	75,138	.....	75,138
Right of Way .....	80,520	.....	80,520
Seneca Superior .....	79,334	.....	79,334
Cobalt Lake .....	103,570	.....	103,570
Penn-Can. ....	81,450	56,110	157,560

713,832 384,110 1,097,942

The bullion shipments for the week ending November 22 were:

	Ounces.	Value.
Nipissing .....	180,879.61	\$108,075.56
Dom. Reduction .....	12,441.00	7,371.29
	193,320.61	\$115,426.85

**McINTYRE.**

Official returns from the McIntyre Porcupine mines for the month of October showed that while ore ran \$9.57 a ton, costs amounted to \$6.133. Total production amounted to \$41,098.64.

Detailed figures are.

Ore milled, 4,131 tons at \$9.57 ..... \$39,551.80  
 Concentrates milled, 26 tons at \$59.494 ..... 1,546.84  
 Total ore milled—4,157 tons.  
 \$41,098.64

Production—Bullion shipped—  
 Bar No. 24 ..... \$13,502.52  
 Bar No. 25 ..... 10,171.25  
 No. 26 ..... 13,393.99  
 Bullion on hand, and slag ..... 2,174.90

\$39,242.66

Extraction ..... 95.5 p.c.

Running time—720 hours or 96.77 p.c. of the possible running time. Expenditures for permanent additions to buildings:

Plant and equipment ..... \$7,079.67

Operating costs per ton milled—

General charges ..... \$ .964  
 Mining ..... 1.806  
 Mine development ..... 1.938  
 Milling ..... 1.425

Total ..... \$7.133

# MARKETS

## STOCK QUOTATIONS.

(Courtesy of J. P. Bickell & Co., Standard Bank Bldg., Toronto, Ont.) November 24, 1913.

### New York Curb.

	Bid.	Ask.
Alaska Gold	18.50	19.50
British Copper	2.25	2.30
Braden Copper	6.62	6.87
California Oil	198.00	205.00
Chino Copper	37.37	38.00
Giroux Copper	.75	1.25
Green Can.	6.00	7.00
Miami Copper	21.00	21.50
Nevada Copper	14.75	15.00
Ohio Oil	132.00	134.00
Ray Cons. Copper	17.12	17.50
Standard Oil of N. Y.	157.00	159.00
Standard Oil of N. J.	375.00	377.00
Standard Oil (old)	118.00	...
Tonopah Mining	5.00	5.25
Tonopah Belmont	7.25	7.50
Tonopah Merger	.55	.58
Inspiration Copper	14.00	14.50
Goldfield Cons.	1.43	1.50
Yukon Gold	2.00	2.12

### Porcupine Stocks.

	Bid.	Ask.
Apex	.00½	.01
Dome Extension	.06	.06½
Dome Lake	.18	.18½
Dome Mines	12.75	13.25
Eldorado	.00½	.01
Foley-O'Brien	.18	.18½
Hollinger	17.00	17.10
Jupiter	.06	.06½
McIntyre	1.90	2.00
Moneta	.02	.04
North Dome	...	.40
Northern Exploration	.75	1.25
Pearl Lake	.10	.10½
Plenaarum	..	.70
Porcupine Gold	.11½	.11¾
Imperial	.01	.02
Porcupine Reserve	...	.06
Preston East Dome	.01¼	.01¾
Rea	.12	.16
Standard	..	.01
Swastika	.02¾	.03
United	...	.01
West Dome	.05	.10
Porcupine Crown	1.24	1.25
Teck Hughes	.20	.30

### Cobalt Stocks.

	Bid.	Ask.
Bailey	.05¾	.06
Beaver	.33½	.34
Buffalo	1.75	2.00
Canadian	.14	.16
Chambers-Ferland	.15½	.16
City of Cobalt	.30	.35
Cobalt Lake	.55	.60
Coniagas	6.75	7.20
Crown Reserve	1.67	1.70
Foster	.07	.08
Gifford	.01¾	.02
Gould	.03	.03¾
Great Northern	.10¾	.11
Hargraves	.03	.04

Hudson Bay	65.00	67.00
Kerr Lake	4.55	4.60
La Rose	1.87	1.91
McKinley	1.20	1.21
Nipissing	7.90	8.00
Peterson Lake	.25½	.26
Right of Way	.04	.05
Rochester	.03	.04
Leaf	.01¾	.02
Cochrane	...	.40
Silver Queen	.03	.05
Timiskaming	.14	.14½
Trethewey	.29	.32
Wettlaufer	.07	.09
Seneca Superior	2.50	2.75

## TORONTO MARKETS.

Nov. 24.—(Quotations from Canada Metal Co., Toronto):

- Spelter, 5 cents per pound.
- Lead, 5½ cents per pound.
- Tin, 42 cents per pound.
- Antimony, 8½ cents per pound.
- Copper, casting, 16 cents per pound.
- Electrolytic, 16 cents per pound.
- Ingot brass, 10 to 15 cents per pound.

Nov. 24.—Pig Iron—(Quotations from Drummond, McCall & Co., Toronto):

- Summerlee No. 1, \$26.00 (f.o.b. Toronto).
- Summerlee No. 2, \$25.00 (f.o.b. Toronto).

Nov. 24.—(Quotations from Elias Rogers Co., Toronto):

- Coal, anthracite, \$8.00 per ton.
- Coal, bituminous, lump, \$5.25 per ton.

## GENERAL MARKETS.

Nov. 21.—Connellsville coke (f.o.b. ovens):

- Furnace coke, prompt, \$1.85 to \$1.90 per ton.
- Foundry coke, prompt, \$2.50 to \$2.75 per ton.

Nov. 21.—Tin, straits, 39.80 cents.

- Copper, Prime Lake, 15.00 to 15.50 cents.
- Electrolytic Copper, 14.75 to 15.00 cents.
- Copper wire, 16.00 to 16.25 cents.
- Lead, 4.35 cents.
- Spelter, 5.30 to 5.35 cents.
- Sheet zinc (f.o.b. smelter), 7.50 cents.
- Antimony, Cookson's, 7.40 to 7.50 cents.
- Aluminum, 19.00 to 19.50 cents.
- Nickel, 40.00 to 45.00 cents.
- Platinum, soft, \$43.00 to \$44.00 per ounce.
- Platinum, hard, 10 per cent., \$46.00 to 47.50 per ounce.
- Platinum, hard, 20 per cent., \$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.
Nov. 11.	59⅞	27⅞
" 12.	59¾	27⅞
" 13.	59½	27½
" 14.	59½	27½
" 15.	59⅝	27⅞
" 17.	59	27¼
" 18.	59¼	27⅞
" 19.	59	27¼
" 20.	58⅝	27
" 21.	58¼	26⅞
" 22.	57⅞	26¾
" 24.	58¼	26⅞