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CIRCULATION.

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CONTENTS.

GOVERNMENT ROADS IN ONTARIO MINING DISTRICTS

Those who have opened up mining properties in Northern Ontario have as a rule little cause to be pleased with the roads built by the government. Very poor roads have been built and these generally after much delay. It is therefore of much interest to note that the government is now building good roads and building them quickly. In the Porcupine and Gowganda districts the prospectors are by no means satisfied with the treatment they have received. In the Kirkland Lake district, however, there is more cause to commend than to criticize the government's road builders. Under the direction of Mr. J. F. Whitson, a roadway was cut from Swastika to Kirkland Lake a distance of six and a half miles, in three weeks, and grading is now being rapidly and well done. If the present rate of progress is kept up there will soon be a good road on which it will be possible to transport heavy machinery. It is planned to dress and roll the road next summer and thus make a permanent highway that will be useful at all seasons of the year.

It is to be hoped that the work now being done on the Kirkland Lake road can be taken as an indication that better treatment is to be accorded the men who are opening up New Ontario.

GEOLOGICAL MAP OF GOWGANDA MINING DIVISION

The Geological Survey has just published what promises to be a very useful map covering twenty-eight townships in the vicinity of Gowganda, Nipissing district. Mr. W. H. Collins worked in this area during 1908-1910, and the information gathered by him has thus been made accessible. The maps made by Mr. A. G. Burrows for the Ontario Bureau of Mines, have also been an important source of information. The map is colored to show subdivisions of the Keewatin as well as of the Huronian. The succession is given as Keewatin, Huronian, Keweenawan and Pleistocene. Masses of granitic and gneissic rocks are called Laurentian Rhyolite and rhyolite tuff is colored separately and placed in the legend, below the Huronian.

The map includes the district from Shining-tree Lake on the west, to Elk Lake on the east. Gowganda, Hangingstone, Everett, Duncan, Bloom and Stony lakes and the connecting canoe routes travelled by many prospectors in the Gowganda rush, are in the area mapped.

GEOLOGICAL GUIDE BOOKS

For use of those attending the Geological Congress in Canada this year, the Geological Survey has prepared a very remarkable set of guide books. All the producing mining districts and areas presenting interesting structural features are described and mapped. The country along the whole length of the transcontinental railroads is described briefly, and illustrated by maps that illustrate the noteworthy features, without being encumbered with a maze of unimportant detail. The guide books contain 140 such maps, and will for years be a valuable source of information. The maps of the whole country have been brought up to date and published in attractive and convenient form.

The undertaking was a gigantic one; but it has been very successfully accomplished. Director R. W. Brock and the whole staff of the Geological Survey have made a splendid success of the work, and the Government printer has shown that Canada has facilities for turning out such work in a remarkably short time. To publish such a large number of maps and accompanying text without taking several years for the work was only a few years ago considered quite impossible. It is therefore very creditable to find that Canada has prepared for our European visitors the best set of guide books yet issued by any country.

The Congress will supply guide books to all those who take part in the excursions. Complete sets will be furnished at a very nominal price.

To non-members the price for the set will be about $7.50.

COAL RESOURCES OF THE WORLD

The volumes on Coal Resources being printed by Morang and Co. for the Geological Congress, like the guide books, are very creditable to Canada. The maps are unusually good, and the general make-up of the volume is a source of pride to both editor and publisher. The Journal will publish a review of the work after the Toronto meeting.

THE LOGAN MEMORIAL

Mining men and geologists in Canada owe much to the work of Sir Wm. Logan, first Provincial Geologist of Canada. On a very small grant Mr. Logan in 1843 began the work of the Canadian Geological Survey. His early investigations of the Pre-Cambrian in Ontario and Quebec resulted in the first systematic subdivision of these ancient formations, in which nearly all the metallic wealth of the provinces occurs.

An arrangement is now being made to erect suitable memorials to Canada's pioneer geologist. A subscription list has been started, and you are cordially invited to subscribe. Subscriptions should be made payable to the Secretary, 12th International Geological Congress, Ottawa.

KEELEY MINE HAS GOOD ORE

As a result of development work undertaken by Messrs. Ehrlich and associates, two good veins of ore have been discovered at the Keeley mine, which of late has received much notoriety. The credit for the discovery is due to Dr. J. McIntosh Bell, the company's agent, and former director of the Geological Survey of New Zealand. After a careful study of the mine, on which an option was taken only a few months ago, Dr. Bell planned the operations which have resulted so satisfactorily. It is stated that there is already enough ore blocked out to assure the company a very quick return of the money invested.

SEVENTH ANNUAL REPORT OF THE BUFFALO MINES LIMITED

The annual report for the year ending April 30th, 1913, shows that the company was very successful. The recovery of silver was 710,591 ounces greater, and the net receipts were $440,038.80 larger. The recovery by the cyanide plant was much greater. The new amalgamation and refining plant was successfully operated, and enabled the company to market the silver more quickly. The ore reserves developed during the year were slightly less than the ore extracted.

The income from operations totalled $1,252,432. The expenses of operation amounted to $310,279.80, and expenses of administration $57,391.55. The net income was $891,192.99. There was paid in dividends $650,000, and surplus for the year was $233,450.49, making the total surplus April 30, 1913, $623,028.16.

The report by Superintendent Tom R. Jones says, under the heading of "Ore Reserves":

"There is no decrease in the stock piles on surface and a slight decrease in the amount of milling ore broken in the mine of 3,224 tons, making a total of 25,767 tons of ore broken in the stopes ready for milling, the mining charges of which have already been paid and no credit is taken for this work in the costs submitted.

"There is still on surface an accumulation of untreated slime tails from the previous year, for further treatment, approximately 12,000 ounces.

"The ore reserves developed were approximately 57,330 tons of about 30-ounce ore, or 1,719,900 ounces. This is about equal to the tonnage removed during the year, but slightly less in ounces. The development has been mainly along branch veins on third level No. 5, with the additional ore developed in the Nancy-Helen workings, also on the first level No. 7. This is new development, as no work has been done previously on this vein. There are several branches of this series of veins and during the coming year they should develop into considerable tonnage of milling ore."

INTERNATIONAL GEOLOGICAL CONGRESS

During the three years since the last meeting of the Congress, the officers have been preparing for this meeting in Canada. The Dominion and Provincial Governments have contributed liberally, and the railroads have made very low rates for members attending. During the past year a very large number of Government geologists have been working on maps and descriptions of the centres to be visited. The mining companies have given much assistance and will offer the members unusual opportunities of seeing the properties.

Among those who will visit us this summer will be many of the most prominent geologists in the world. It means much that these men by their visit will obtain some idea of the wonderful possibilities of Canada as a mineral producing country.

The first excursion, A1 in charge of Dr. G. A. Young, leaves Montreal July 13. A visit will be made to Quebec and vicinity on July 14, and the following day will be spent on the south shore of the St. Lawrence. Then two days will be spent studying the formation at the eastern extremity of Gaspe Peninsula. On July 19, iron deposits of Bathurst, New Brunswick, will be examined. On July 20 the party will be in Halifax. Visits will be made to the gold and coal mines and the industrial plants at Sydney, Antigonish, Joggins, Moncton, and St. John will be starting points for several local excursions to study geological structures. The party will return to Ottawa Friday, August 1st.

On July 24 Dr. F. D. Adams and Dr. A. E. Barlow lead a party to points of interest in the Haliburton-Bancroft area, Eastern Ontario. The area lies to the north of Lake Ontario, on the margin of the Laurentian Protaxis of the continent. In this district is exposed the most notable section of the Grenville Series in Canada. The strata show to a remarkable degree the results of progressive metamorphism, as a consequence of the intrusion of extensive batholiths of granite, producing various types of amphibolite, etc. This district is also interesting by reason of the very extensive development of nepheline and other alkaline syenites, some of which are of the rarer types. In certain localities these rocks contain an abundance of corundum, while elsewhere sodalite, of a fine depth of colour, is conspicuous. The excursion will also include an inspection of the corundum mines and mills at Craigmont. This party will visit Craigmont on July 30 and arrive in Ottawa July 31.

The guides for the first excursion of members of the Congress to Sudbury, Porcupine and Cobalt will be: Dr. W. G. Miller, C. W. Knight and A. G. Burrows, of the Ontario Bureau of Mines; Professors A. P. Coleman and T. L. Walker, of the University of Toronto; Mr. J. B. Tyrrell, consulting mining engineer, Toronto; and Mr. Arthur A. Cole, mining engineer of the T. and N. O. Ry. Commission, Cobalt.

Dr. W. G. Miller, Provincial Geologist, who is leader on this trip, has arranged to open quarters at his office in the Parliament Buildings for the convenience of the excursionists. The start will be made from Toronto Wednesday evening, July 23, and from Montreal Wednesday morning.

Among those who will make the trip are: J. Stansfield, McGill University; A. W. G. Wilson and G. C. Mackenzie, Mines Branch, Dept. Mines, Ottawa; Alfred C. Lane, Tufts College, Mass.; J. Barrell, Yale University, New Haven; F. L. Ransome, U. S. Geological Survey, Washington, D.C.; H. Eckfeldt, South Bethlehem, Penn.; Miss C. A. Raisin, Bedford College, London, Eng.; A. E. Kitson, London, Eng., delegate of University of Glasgow; S. W. Beyer, Iowa State College, Iowa; H. F. Bain, Editor Mining and Scientific Press, San Francisco, Cal.; G. A. J. Cole, Director Geological Survey of Ireland, Royal College of Science, Dublin, Ireland; Bedford McNeill, president Inst. of Mining and Metallurgy, London, Eng.; Mrs. Bedford McNeill; Dr. Jules Szadeszky de Szadecsne, Kolozsvar, Hungary; Guiseppe Mercial, Pisa, Italy; Fred Searls, Jr., Goldfield, Nevada; Eugenisz Romer, Lemberg, Austria; William H. Emmons, professor of Geology, University of Minnesota, Minneapolis, Minn.; Serafino Cerruli-Irelli, Rome, Italy; Ettore Matirolo, Ingeniur en Chef des Mines, Torino, Italy; George W. Graham, Government Geologist, Khartoum, Anglo-Egyptian Soudan; Annie Enbank, Toronto; Arthur G. Charleton, London, Eng.; Reginald E. Hore, Canadian Mining Journal; H. Sjogren, Sweden; Charles McDermid, Secretary Institute of Mining and Metallurgy, London, Eng.; Prof. E. Wherry, Lehigh University, South Bethlehem, Pa.; E. Ordonez, mining geologist, Mexico City, and Mrs. Ordonez.

LOGAN MEMORIAL.

At the meeting of the Organization Committee of the Twelfth International Geological Congress, held at the Chateau Laurier, Ottawa, on Tuesday, March 4th, 1913, it was moved by Mr. W. Fleet Robertson and seconded by Mr. W. F. Ferrier and carried:

"That the Logan Memorial Committee, consisting of Messrs. Barlow, Brock, Coleman and Miller, be instructed to proceed with the arrangements for the erection of suitable memorials to the late Sir William Logan, the locations and characters of the memorials to be left to the named committee and that the Organization Committee guarantee the expenses up to the sun of Five Hundred Dollars."

In agreement with this motion the Logan Memorial Committee have asked Mr. Henri Hebert to design and execute a bronze tablet measuring 25 by 30 inches, with a suitable inscription and a bust of Sir William Logan in relief. The original of this tablet will be placed in a suitable and conspicuous place near the entrance of the Victoria Memorial Museum at Ottawa. A duplicate will be securely fastened in position on the southern face of a conspicuous exposure of limestone breccia near the village of Perce, (Gaspe Peninsula), Quebec.

Subscriptions may be handed to any of the members of the Logan Memorial Committee or sent direct to the Secretary of the Twelfth International Geological Congress, Victoria Memorial Museum, Ottawa.

You are cordially invited to subscribe.

The following is a list of the subscribers to the Logan Memorial to date: J. A. Bancroft, $10; A. E. Barlow, $25; R. W. Brock, $5; C. Camsell, $5; C. H. Clapp, 5; J. M. Clarke, $50; D. B. Dowling, $5; J. A. Dresser, $20; C. Drysdale, $5; D. A. Dunlap, $20; W. F. Ferrier, $20; Abbe R. Guimont, $5; E. Haanel, $5; R. Harvie, $5; R. E. Hore, $5; M. L. Hersey, $10; E. Jenkins, $5; W. A. Johnson, $10; E. D. Kindle, $2; O. E. LeRoy, $5; G. G. S. Lindsay, $5; A. P. Low, $10; Jas. McArthur, $10; W. McInnes, $10; D. S. McIntosh, $5; J. McLeish, $5; G. F. Matthew, $5; W. H. Merrill, $5; Mussens Ltd., $10; M. Nordegg, $10; W. A. Parks, $5; M. E. Purcell, $1; T. W. Racey, $5; J. C. Sutherland, $2; J. B. Tyrrell, $10; T. G. Wait, $2; J. White, $5; A. B. Willmott, $5; A. G. Wilson, $5; M. E. Wilson, $10.

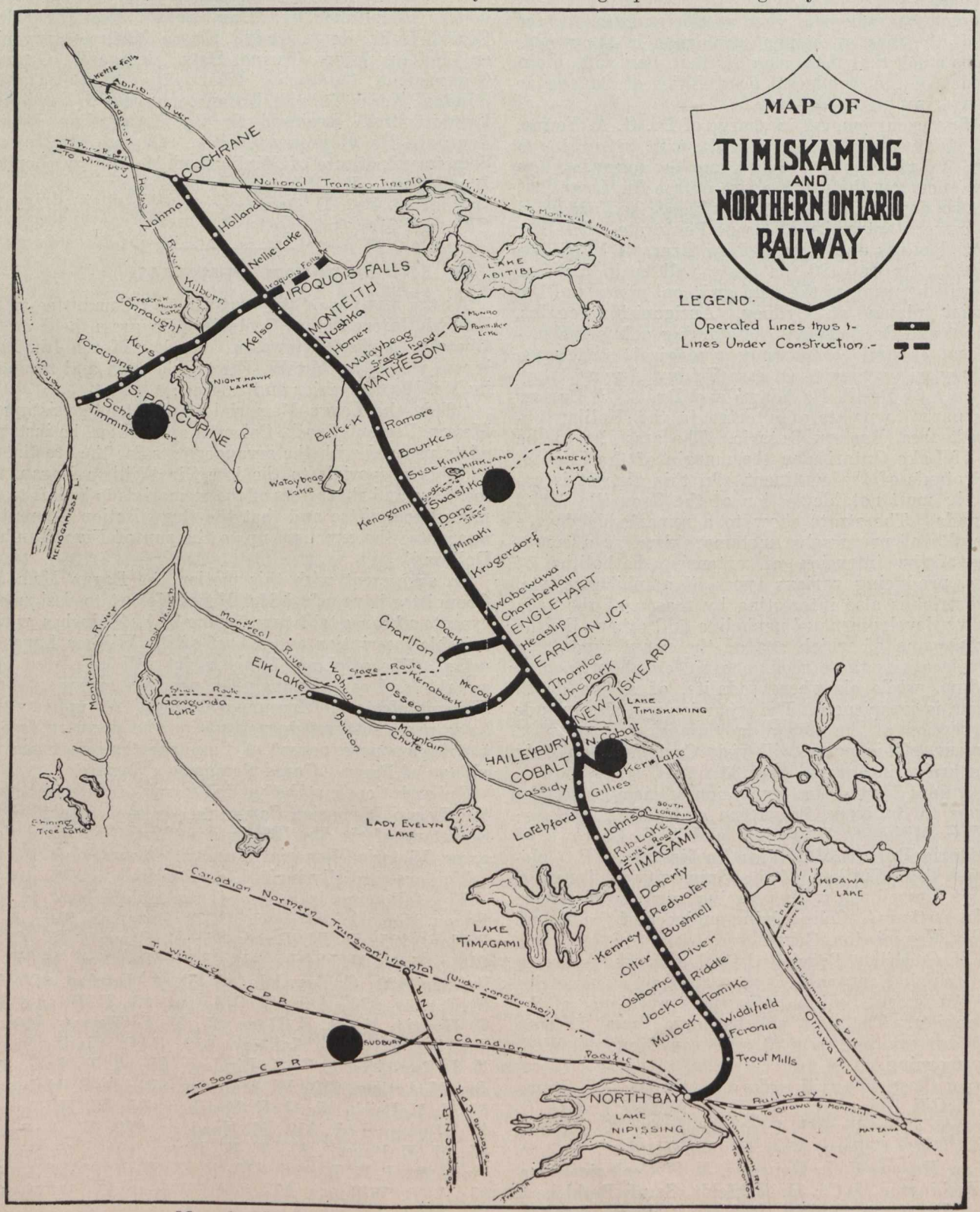
KIRKLAND LAKE GOLD DEPOSITS

By Reginald E. Hore.

During the past year the development of prospects in the vicinity of Kirkland Lake, Ontario, has resulted in the discovery of important gold deposits. One property, although only equipped for exploratory work, is producing enough gold to pay all running expenses, while a shaft is being sunk on the vein.

Location of the Goldfield.—Kirkland Lake is situated in Teck township, close to the main line of the Temiskaming and Northern Ontario Railway. The nearest station is Swastika, which is 164 miles from North Bay and 61 miles north of Cobalt. At Swastika there are two small producing mines, Lucky Cross and Swastika. North and east of Swastika a trail leads to Kirkland Lake and Gull Lake, passing on the way across several properties, including the Wettlaufer, Oakes, Teck-Hughes, Robbins, and Foster, on which work is being done.

From the Foster mine to Swastika the owners have cut temporary roads and now the Ontario Government is building a permanent highway.



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

Discovery of Gold.—The claims in this district were first staked in the Larder Lake rush of 1906 and 1907. For a few years very little was discovered, however, and it was not until 1912 that much of promise was found. During last summer gold was discovered on several claims; but the veins in which it occurred were small and not very continuous. Repeated testing, however, showed that gold occurs in considerable quantity in the rock enclosing thin quartz veins and numerous samples show good values to extend over a width of several feet.

The most extensive development work in the district has been done on claims now owned by Messrs. Foster, Tough and Oakes. The Foster property consists of six claims, four in Lebel and two in Teck township. The total area is about 210 acres. At present the exploration is all being done on one claim.

The Foster-Tough-Oakes Claims.—The chief gold deposits at the Foster property are designated as veins No. 1, No. 2 and No. 3. The No. 1, or discovery vein, is a narrow brecciated quartz vein enclosed in a reddish-gray feldspar-porphyry. From it some fair assays have been obtained, but in the opinion of the management it is not as promising as the No. 2 and No. 3.

Tough-Oakes Mine, tramway and mill, Kirkland Lake, Ont.

The No. 2 vein is also a very narrow quartz vein; but the ore is rich and there are good values in the wall rocks for a width of several feet. The vein is in a gray conglomerate a few feet north of the contact between the sedimentary series and gray feldspar-porphyry. The contact and the strike of the vein run nearly parallel east and west. So far as can be judged from the arrangement of the pebbles in the conglomerate, this rock dips steeply to the south and, therefore, under the porphyry. According to Mr. Foster, the data so far obtained indicate that the conglomerate dips nearly at the same angle as the vein. So far as the workings have gone the dip is about 60 degrees to the south. The vein has been stripped as far as the rock surface could be easily cleaned—a few hundred feet—and a shaft on the vein is on July 28th, 175 feet deep, on the dip. From an open cut about 30 feet deep, shown in the accompanying photographs, two carloads of high grade ore were shipped. The shaft was then started in the bottom of the open cut. The surface exposure and the shaft excavation show the vein always thin and irregular in thickness and often branching into very thin seams of quartz. The main vein in several places is split down the middle and presents a graphite covered smoothed surface, as may be seen in the accompanying underground photograph, taken by Manager Chas. O'Connell and A. M. Hotchkins.

So far as the development has progressed, and it is being pushed as rapidly as the temporary equipment will allow, the vein shows very high values and the wall rocks contain pay values for the thickness mined. There is no waste rock being broken.

The shaft is sunk in the footwall and if the hanging wall proves as rich as the footwall there will be an ore-body of 15 to 20 ft. in thickness.

Foster No. 3 Vein.—Running about parallel to No. 2 vein and a few hundred feet north of it is another important deposit. This one is chiefly enclosed by porphyry; but towards the east traverses a fine grained gray ferrodolomite, and is further east enclosed by conglomerate. Some of the richest ore as determined by sampling is said to be that in the portion enclosed by the gray ferrodolomite. An analysis of this rusty weathering carbonate rock shows that it is highly siliceous. The following analysis is of a dense hard portion, silica 58.80, lime 4.50, magnesia 2.02, iron 3.62, carbon dioxide 6.03. The composition is much like that of an alkali porphyry which has been weathered. Compare this analysis with the one below.

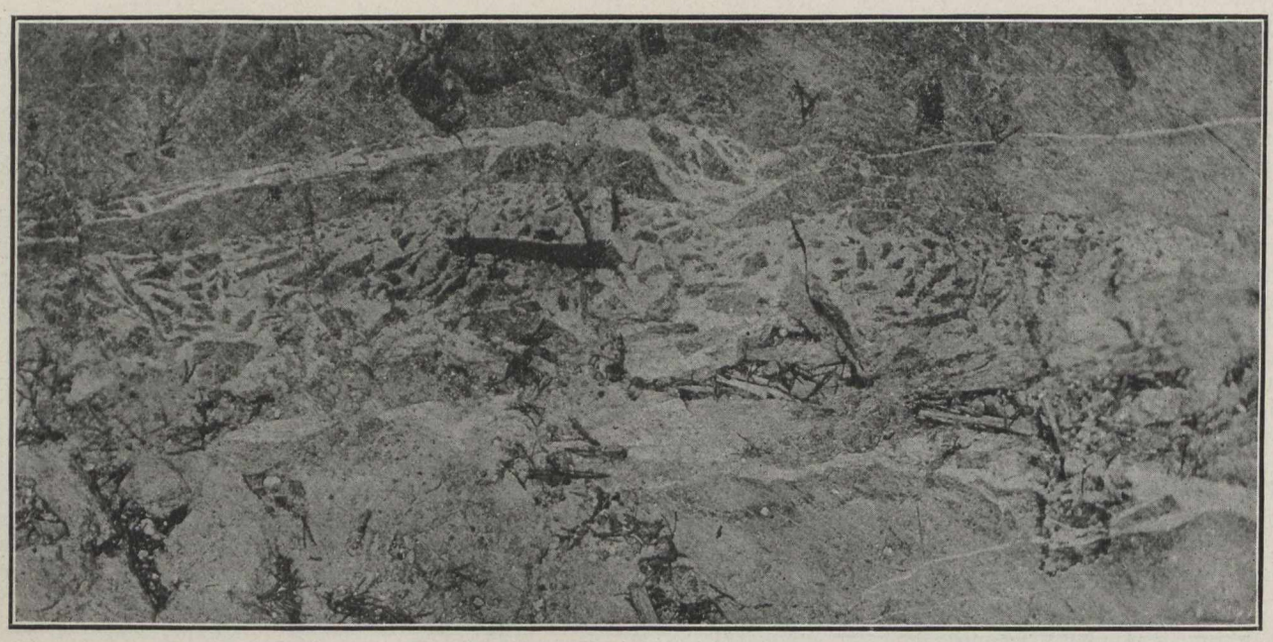
This vein has not been tested to any extent since it was stripped and sampled, and nothing is yet known as to its continuity with depth.

Tough-Oakes Mine and Mill.—The shaft on No. 2 vein is a two compartment inclined one measuring 6 x 10 ft. inside timbers. It has been broken considerably larger than necessary as the opening is all in ore and no endeavour is made to keep it very small.

In sinking, two one-man hammer drills and hollow steel are used. The drillers have one helper between them. In the first month of sinking the miners made 100 ft.

The conglomerate rock is rather easily drilled and in one shift enough is broken to keep two shifts busy

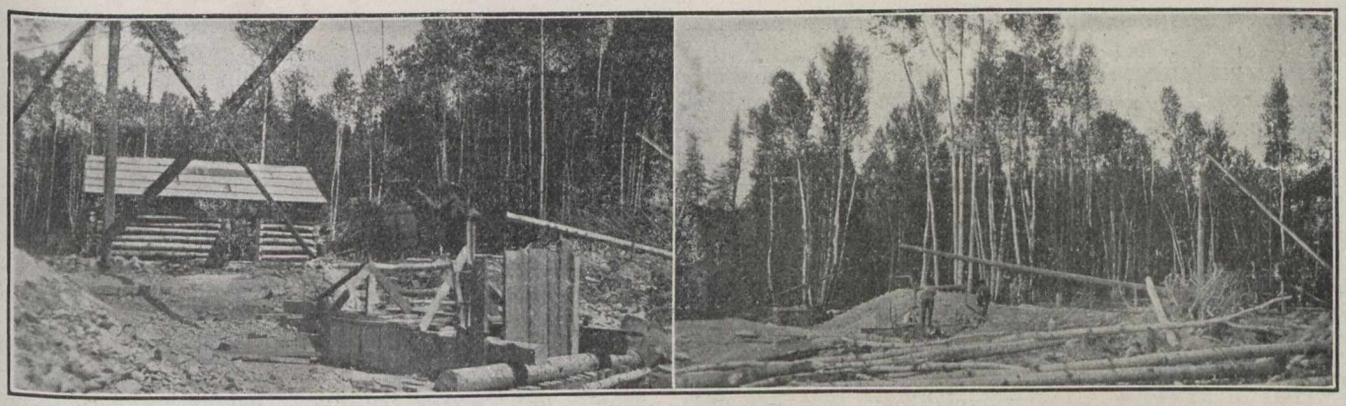
Ed. Note.—Just as we go to press we are advised that the name Tough-Oakes Mines, Ltd., has been chosen as the official name of the property referred to in this article as the Foster or Foster-Tough-Oakes.



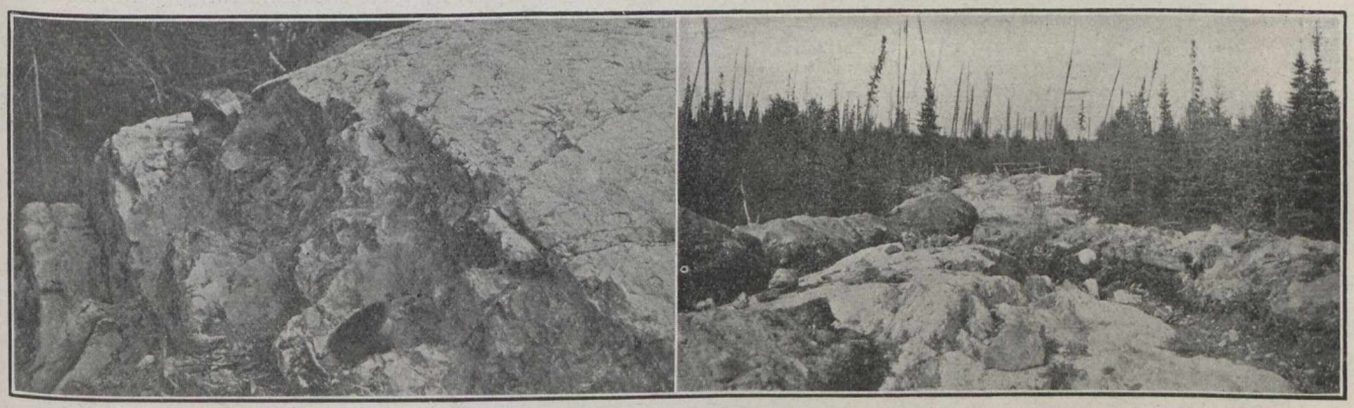
No. 1. vein, Tough-Oakes Mine. Gold quartz in brecciated porphyry

Conglomerate in which gold quartz veins occur, Tough-Oakes Mine, Kirkland Lake, Ont.

Two views of No. 2 vein, a gold quartz vein in conglomerate, Tough-Oakes Mine.



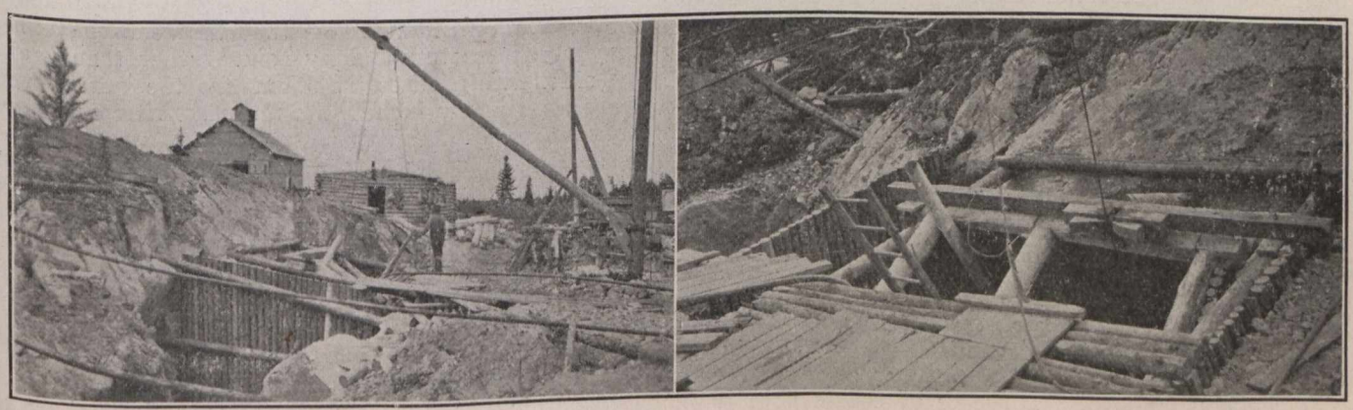
Two views of Wettlaufer property, Kirkland Lake, Ont.



Two views of gold bearing porphyry. Wright-Hargraves property

Gold quartz vein in porphyry. Wright-Hargraves property

No. 3 vein, Tough-Oakes property



Tough-Oakes Mine, looking west.

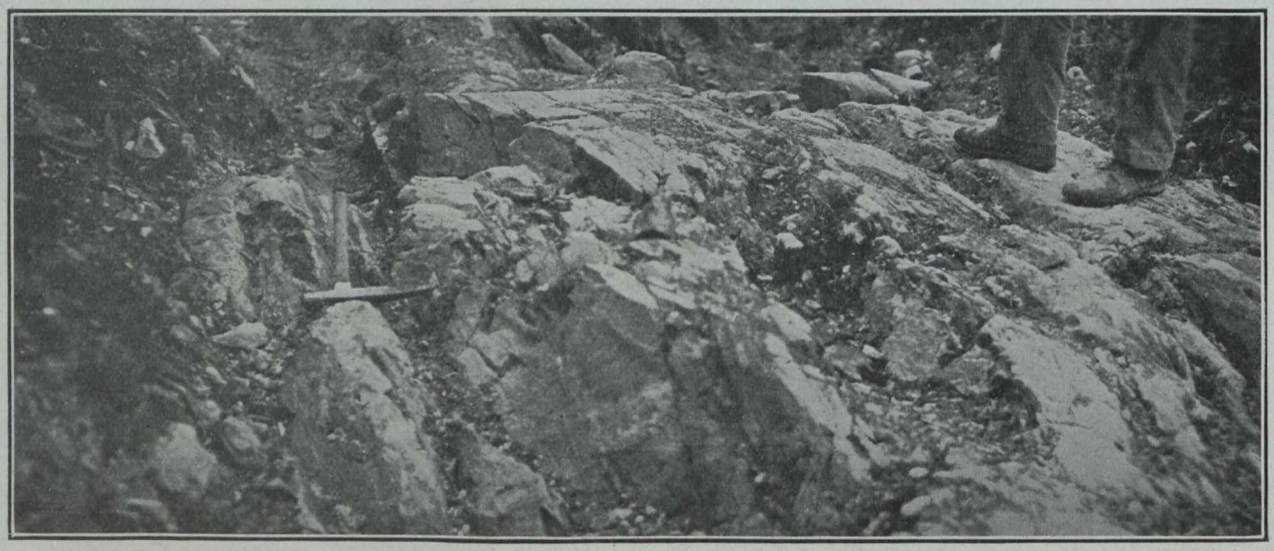
Tough-Oakes Mine, looking towards hanging side

mucking. The men work 8 hours, and there are three shifts.

The rock broken is hoisted by bucket to surface and there loaded in a tramcar and elevated to the mill or piled on the stockpile. There is excavated in sinking about 25 tons per day and the 5-stamp mill can only treat 11 or 12 tons of this. In blasting, 40 per cent. dynamite is used. The holes for the cut are drilled about 7 ft. and for the bench about 6 ft.

The Mill.—The mill is an Allis-Chalmers 50 B battery, 5 stamps of 1,050 lbs. It is driven by a 30 h.p. slide valve engine. The crusher is a 7 x 10 Blake. The mortar block is of wood set in solid rock. The screen is a Toncap 40 mesh. The mill cost $6,000, and was erected in 28 days. It treats about 11 tons per day, making a recovery of about 75 per cent. of the values. About 65 per cent. is recovered inside the mortar, and about 10 per cent. on the outside plates. The mill tails contain about $11 per ton, and are being ponded for future treatment.

The mill was started May 14, 1913, and has been in continuous operation since. Two bars have been melted one weighing 231 ozs. and the second 122.5 ozs. The first bar was 821.7 fine, and the second 868, so the total value was about $6,000. These two bars were shipped on June 27.



No. 3 vein, Tough-Oakes property, Kirkland Lake, Ont,

Mode of Occurrence of the Gold.—The gold occurs as native metal and as telluride. Particles of coarse gold are very common in the fracture planes in the quartz veins. The telluride has not been isolated and analyzed, but is supposed to be calaverite. It occurs with the native gold in rather poorly crystallized grains of a greenish bronze colour. The native gold and telluride while most abundant in the quartz veins occurs also in the wall rock. Native gold in coarse grains is, however, generally found in the veins rather than in the rock.

A very remarkable feature of the deposit is the abundance of black graphitic mineral in the gold bearing portions. Nearly all the rich ore contains much graphite, and, according to Mr. Chas. O'Connell, it has been found that graphite is a very good indication of values. In some of the veins nearly all the samples of quartz showing graphite contained gold.

A common mode of occurrence of coarse gold is on fracture faces or walls of quartz veins which are black with graphite. In several cases there are slickensided black walls spotted with small flakes of gold. The main longitudinal fracture in No. 2 vein at the Foster mine has afforded numerous specimens of such ore. Quite as common, though not so peculiarly characteristic of these deposits, is the occurrence of abundant pyrite with the gold. Much of the pyrite is in very small grains, and the microscopic examination of wall rocks shows that there are a very remarkable number of small pyrite crystals. Most of these are not in contact with one another; but scattered throughout the rock as single grains.

Some specimens show a little copper pyrites and others arsenopyrite. With these sulphides there is usually much secondary quartz, calcite and sericite, and in some cases chlorite.

Some specimens show gold grains wholly enclosed in calcite, and most specimens containing gold show some calcite.

All the observations are of a nature to make one conclude that the gold is much younger than the wall rocks. These have been remarkably fractured, and their minute particles crushed and broken before the deposition of the gold.

It has been noticed that where gold occurs in porphyry wall rock the latter is much decomposed. Fresh unaltered porphyry is regarded by the experienced prospectors as less promising than the altered zones.

A peculiar feature of some of the deposits is the considerable content of gold, despite the meagre size of the quartz veins. It seems that the rocks have been very much fractured along zones rather than broken by extensive fissures. Seldom are the quartz veins more than a few inches in width, but narrow veinlets are remarkably numerous.

It is very difficult to determine the nature of the deposits without doing considerable work. Stripping must be followed by much breaking of the rock and panning of all showings of quartz however small. As the quartz is not readily distinguished from the light colored porphyry, the small veins are easily overlooked.

The Porphyry Wall Rock.—The igneous rock in which many of the veins occur is a light coloured, very feldspathic porphyry. Some thin sections show the chief constituents to be feldspar phenocrysts, in a fine

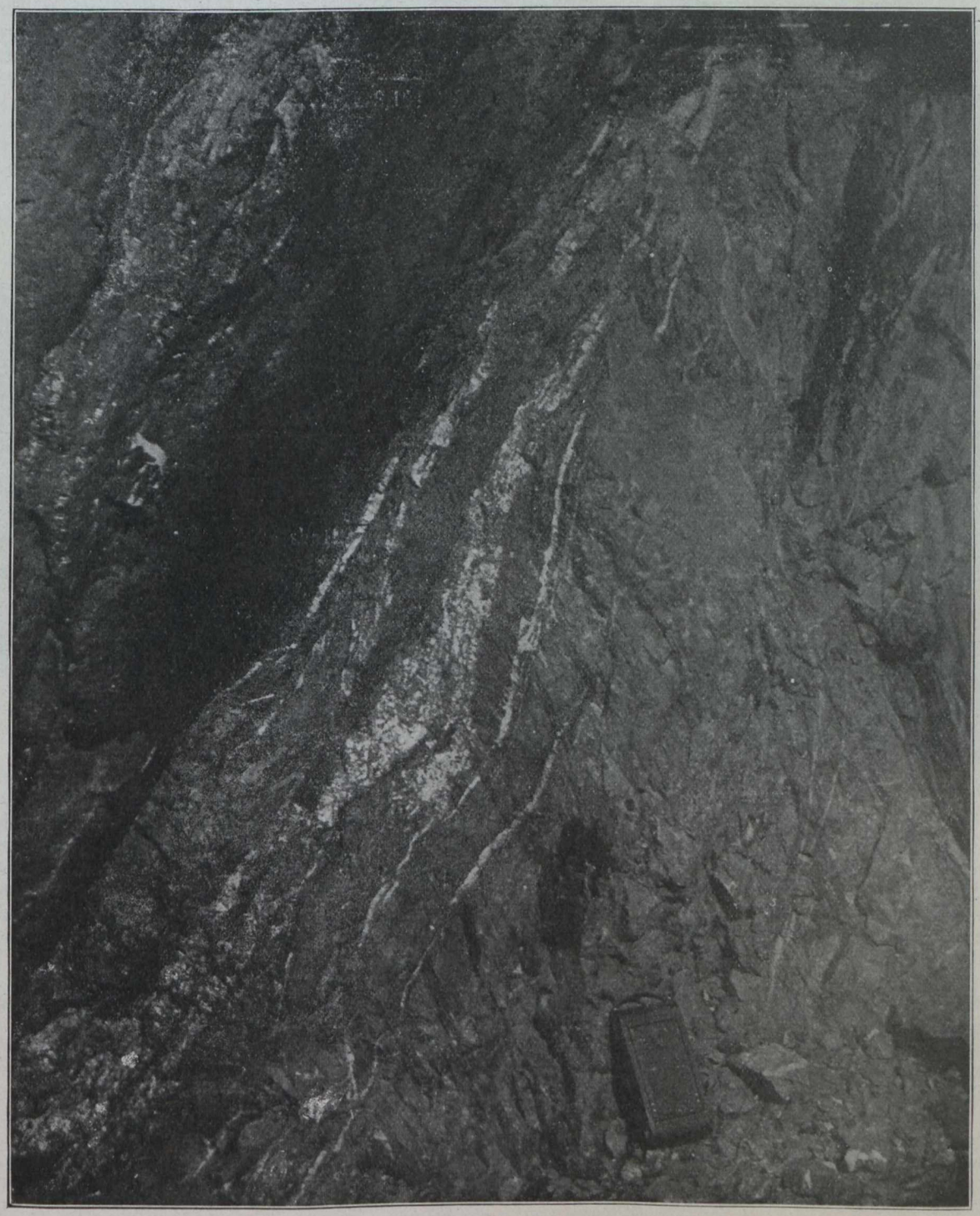
grained siliceous ground mass. Other specimens examined microscopically show numerous greenish colored micaceous and chloritic patches, which have probably resulted from the alteration of ferromagnesia silicates, such as biotite and hornblende.

In some sections, notably one taken from near No. 1 vein on the Foster property, the phenocrysts are chiefly orthoclase. Other specimens, including some from the same property, show the chief feldspar to be one of the plagioclases, of rather basic composition. There are evidently varieties of porphyry to be distinguished by different names; but they can all be conveniently referred to as feldspar-porphyry, as some member of the feldspar series is generally the most conspicuous mineral in the rock.

The porphyry is very hard and dulls the drills quickly. Slow progress is made, therefore, in excavating it, and this is one of the reasons why at the Foster mine the No. 2 vein in the conglomerate was chosen for development before No. 3, which at the outcrop is also very promising.

An analysis of a specimen of porphyry from the Foster property showed, silica 59.10, alumina 23.59, iron 2.25, lime 4.13, magnesia 1.56, K_2O 3.31, N_2O 4.23. This analysis shows the rock to be very high in alkalies.

The Conglomerate Wall Rock.—The rock in which the No. 2 vein occurs, as may be seen by the accompanying photographs, is a conglomerate. It is in some respects similar to that at the Dome mine, being a gray schistose conglomerate, with numerous pebbles of

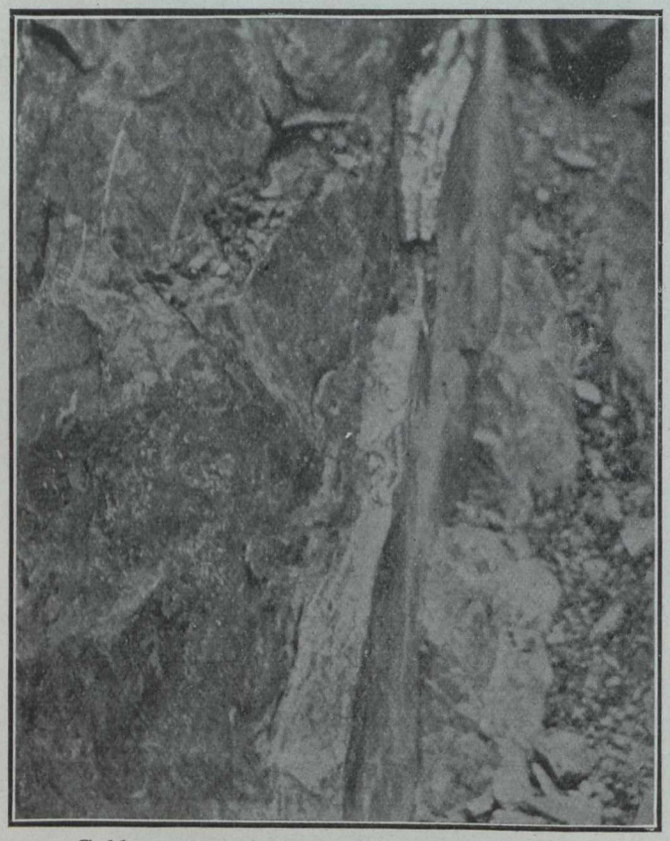


Gold quartz vein in conglomerate, 100 foot level, Tough-Oakes mine, Kirkland Lake, Ont.

porphyry, greenstone and chert. It differs somewhat, however, in other respects, notably in containing a large number of red jasper pebbles and being more extensively fractured. The rock contains remarkably numerous fractures, large and small, many of which have been filled by quartz or calcite.

Microscopic examination of thin sections of this rock —sections and microscope were placed at the writer's disposal while at the property by Chas. Spearman, superintendent of operations for the adjoining property owned by the Burnside syndicate—show that the fracturing is not confined to large cracks, but that many of the individual grains of the rock, especially the quartz grains, have numerous minute fractures.

By the naked eye it is readily noted that individual pebbles of the conglomerate have been broken into many pieces. The hard jasper pebbles show numerous cracks. Secondary minerals are common on the fracture faces, and several jasper pebbles examined show



Gold quartz, vein in porphyry, Robbins claim, Kirkland Lake

pyrite. One of the miners reports having found a jasper pebble which showed free gold on the fractured surface.

Microscopic examination of the ground mass of the conglomerate reveals a poorly sorted aggregate, largely composed of quartz, sericite and carbonates. In addition to the fractured and evidently older quartz grains, there are patches and veins of younger quartz and of calcite.

A small jasper pebble in one section shows numerous fractures, which have been filled with secondary silica. The jasper has somewhat of an oolitic structure, the red coloring matter being in circular bands.

The rock at a depth of 170 feet is quite like that at the surface. The bottom of the last cut, when examined by the writer, showed coarse conglomerate, numerous grey and greenish pebbles and occasional red jasper pebbles.

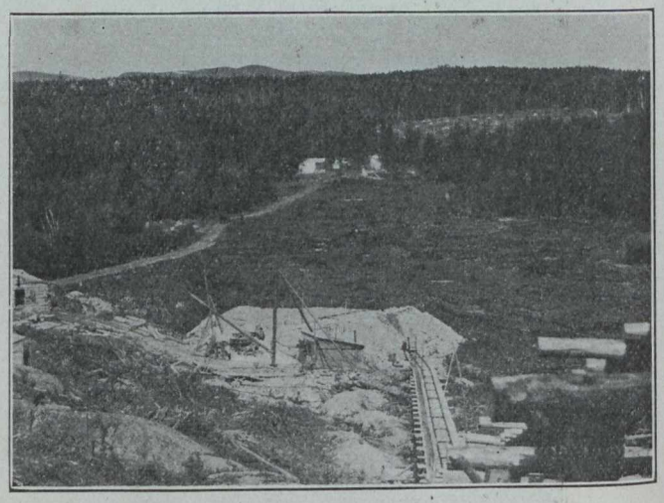
According to Mr. Foster's observations, the conglomerate shows quite distinct banding of coarse and fine portions. In some places there is just a single line of pebbles; but more commonly the conglomeratic portion is thick. Mr. Foster states that in sinking the shaft it was noticed that the vein follows the coarse pebbly portion. It left this for a short distance, and was enclosed in fine grained sediment; but after a few feet it was found to run into the conglomerate again. The pebbly layers are less strong than the fine-grained and have been more fissured.

Charles Spearman states that on the adjoining property of the Burnside Syndicate, the conglomerate is standing nearly vertical.

Character of the Ore.—It will be noticed from the record of shipments that the proportion of silver to gold has increased somewhat with depth. It has also been observed that the proportion of tellurides is greater at depth than at surface. Tellurides were first noticed at a depth of about 18 feet, but may have occurred nearer surface also.

The ore is rather easily broken in the mine and in the mill. About 75 per cent. of the gold is recovered by amalgamation, and the tails are being ponded for future treatment.

The graphite presents no serious difficulty in the mill, as it floats off very readily when the ore is crushed.



Vein from mill looking over shaft, Tough-Oakes mine

Gold Production of Foster Mine to Date.—It was in July 15, 1912, that Mr. Foster took over the controlling interest in the Tough-Oakes properties. At first considerable attention was devoted to No. 1 vein; but soon it was found that No. 2 and No. 3 were much more promising. After the preliminary exploration by stripping, it was decided that the further development work should be first done on No. 2 vein. A small shipment, A, about two tons of ore, broken from the outcrops of several veins, was made in September, 1912.

Work at No. 2 vein was carried on at first by an open excavation about 30 feet deep. From the ore broken the high grade portion, or vein material, was picked out and bagged for shipment. Two cars, known as lots B and C, were obtained in this way. The weight and value of the high grade ore is indicated in the accompanying table of shipments.

The open cut work was discontinued at a depth of 30 feet, and equipment was installed for sinking. A shaft was put down on the vein. The ore broken in sinking the shaft was sorted, and when a depth of 100

feet had been reached, another car load, lot D, of high grade ore had been produced. Since that time no shipments have been made, though a few tons of high grade has been bagged. D shipment is expected to yield fully as high returns as B and C, but settlement for the shipment has not yet been made and the actual figures are therefore not published here.

In picking the ore for shipment, the high grade was not all saved. The high grade fines were hoisted with the lower grade ore, and will be treated in the mill.

According to Mr. Foster the high grade shipments made correspond in volume to a thickness of about 4 inches of vein material. The records indicate the average thickness of vein material to be about double this width, so it is evident that a considerable portion of the high grade is mixed with the wall rock now on the stock pile.

The production of gold from milled rock is given above—about $6,000 being obtained in the first two melts.

Gold Ore Shipments From Foster-Tough-Oakes Claims.

Shipment.	Source.	Date.	Weight Tons.	Yield per Ton Ounces Gold.	Yield per Ton Ounces Silver.	Total Yield Ounces Gold.	Total Yield Ounces Silver.
A	From outcrops of 5 veins other than No. 2.....	Sept. 1912	2.	18. 2	24. 8		
B	Open cut, No. 2 vein.....	Feb. 15	19.985	22. 5	23. 4	448.04	465.77
C	Open cut, No. 2 vein.....	Mar. 19	21.527	19.688	33.665	403.67	690.93
D	Shaft above 100 ft.....	June 4					

Value of Shipment.

	Gold.	Silver..	Gold and Silver.
A			
B	$8,960.80	$274.80	$9,235.60
C	8,073.40	493.96	8,567.36
D			

On the ore shipments the charges for freight, sampling and treatment amounted to $26.50 per ton. When ore was being stoped, the total cost per ton was about $68.00.

The stock pile of milling ore on June 28 is estimated by Mr. O'Connell, manager of the property, to contain about 2,500 tons. This is being added to from development work at the rate of about 12 tons per day.

Plans for Increasing Production.—If the development work continues to give such results as have been obtained to date, a large mill will be erected. A considerable production is already assured and mining and milling equipment will be hauled in as soon as the road is made ready for heavy traffic.

It is hoped that hydro-electric power may be obtained. Otherwise a Deisel engine unit may be installed at Swastika. A metallurgical expert will be employed to work out a process of treatment of the ore.

While the lack of roads prevents the installation of machinery, preparations are being made for production on a large scale.

Mr. Chas. O'Connell, formerly manager of the Trethewey mine, is now manager of the Tough-Oakes. Mr. A. M. Hotchkin is assistant manager, J. A. Murphy, mine superintendent, and Fred Jost, mill superintendent.

Government Geological Maps.—The Ontario Bureau of Mines has a party in the district making a geological map. Mr. A. G. Burrows is in charge of this work, and Messrs. P. E. Hopkins and M. E. Smith are assisting him. Six townships are being surveyed, and it is hoped that the map will be ready in August Last year the Bureau of Mines published a geological map prepared by E. L. Bruce which shows the distribution of the rocks in the neighbourhood of Swastika. Mr. Burrows' map will show the contiguous area.

SUDBURY, COBALT AND PORCUPINE

The mineral production of Canada is increasing rapidly and the future of the mining industry in this country is generally conceded to be more promising than in any other country in the world. The developments of the last decade have proven that our mineral resources are greater than anyone could have hoped, that there are rich deposits of precious metals a few hundred miles from our chief centres of population and that we have vast areas of promising territory awaiting exploration.

Mineral Production During the Year 1912—As shown by the report of Mr. John McLeish, chief of the Division of Mineral Resources and Statistics, Department of Mines, the total value of the mineral production in Canada in 1912 was $133,127,489, an increase over the preceding year of 29 per cent. or $29,906,495. The per capita production in 1912 was over $18.00.

Of the total production, $61,177,989 or about 46 per cent. is credited to the metals, and $71,949,500 or about 54 per cent. to non-metallic products.

Of the several provinces Ontario was the largest contributor to the total, being credited with $51,023,134; British Columbia second, with $29,555,323; Nova Scotia third, with $18,843,324; Alberta fourth, with $12,110,960 and Quebec fifth, with $11,675,682.

The production of the more important metals and minerals is shown in the following tabulated statements:

The Mineral Production of Canada in 1912.
(Subject to Revision)

Non-Metallic.

Product.	Quantity.	Value.
Actinolite, tons	92	1,000
Arsenic, white, tons	2,045	88,726
Asbestos, tons	106,520	2,959,677
Asbestic, tons	24,740	19,707
Coal, tons	14.699,953	36,349,299
Corundum, tons	1,960	239,091
Feldspar, tons	12,233	25,416
Fluorspar, tons	40	240
Graphite, tons	2,060	117,122
Grindstones, tons	2,912	44,290
Gypsum, tons	576,498	1,320,883
Manganese, tons	75	1,875
Magnesite, tons	1,714	9,645
Mica, tons	.....	104,393
Mineral pigments—		
Barytes, tons	464	5,104
Ochres, tons	5,654	30,410
Mineral water	.....	169,467
Natural gas	.....	2,311,126
Peat, tons	700	2,900
Petroleum, value at $1.418 per bbl., bbls.	243,336	345,050
Pyrites, tons	79,702	348,026
Quartz, tons	100,242	195,216
Salt, tons	95,053	459,582
Talc, tons	8,270	23,132
Tripolite	38	230
Total	.....	$45,171,607

Products	Quantity	Value
Metallic.		
Copper, value at 16.341c. per lb., pounds.	77,775,600	$12,709,311
Gold, ounces	607,609	12,559,443
Pig iron from Canadian ore, tons	36,355	450,886
Iron ore sold for export, tons	118,129	382,005
Lead, value at 4.467c. per lb., pounds	35,763,476	1,597,524
Nickel, value at 30c. per lb., pounds	44,841,542	13,452,463
Silver, value at 60.835c. per oz., ounces	31,931,710	19,425,656
Cobalt and nickel oxides	.....	319,785
Zinc ore, tons	6,723	280,886
Total	.....	$61,177,989
Structural Materials and Clay Products.		
Cement, Portland, barrels	7,120,787	9,083,216
Clay products—		
Brick, common, pressed, paving	.....	7,601,380
Sewerpipe	.....	887,641
Fireclay drain tile, pottery, etc.	.....	854,140
Kaolin, tons	20	160
Lime, bushels	7,992,234	1,717,771
Sand and gravel (partial record only)	.....	1,066,326
Sand-lime brick	.....	882,469
Slate, sq.	1,894	8,939
Stone—		
Granite	.....	1,257,770
Limestone	.....	2,820,832
Marble	.....	272,236
Sandstone	.....	325,013
Total structural materials and clay products	.....	$26,777,893
All other non-metallic	.....	$45,171,607
Total value, metallic	.....	$61,177,989
Grand total, 1912	.....	$133,127,489

The subdivision of the mineral production in 1911 and 1912 by provinces was approximately as follows:

	1911		1912	
Province.	Value of production.	Per cent. of total.	Value of production.	Per cent. of total.
Nova Scotia	$15,409,397	14.93	$18,843,324	14.15
New Brunswick	612,830	0.59	806,584	0.61
Quebec	9,304,717	9.01	11,675,682	8.77
Ontario	42,796,162	41.46	51,023,134	38.33
Saskatchewan	636,706	0.62	909,934	0.68
Manitoba	1,791,772	1.74	2,314,922	1.74
Alberta	6,662,673	6.46	12,110,960	9.10
British Columbia	21,299,305	20.63	29,555,323	22.20
N.-W. Territories	4,707,432	4.56	5,887,626	4.42
Dominion	$103,220,994	100.00	$133,127,489	100.00

In Ontario the mineral production is largely metallic. Silver, gold, nickel, copper, iron and cobalt are the metals produced. Of non-metals, brick, cement and natural gas are the leaders. There are about 11,000 men employed in the metal mining industry in Ontario and they receive in wages an average of about $800 per year.

The chief source of silver is the Cobalt district, of nickel and copper the Sudbury district, and of gold the Porcupine district.

The Sudbury Nickel-Copper Industry.—The Sudbury district is the world's chief source of nickel. The deposits were originally worked for copper by the Canadian Copper Co. in 1887. Cars of picked ore were shipped to eastern refiners and the difficulty experienced in treating the ore for its copper contents led to the discovery of the presence of nickel with the copper. There was at that time no available method of separating nickel from the copper, and a period of experimentation followed. A process was finally found and it then became necessary to find a market for the large quantity of nickel available, for the amount then used was very small.

Fortunately about this time, 1890, the valuable properties of nickel-steel became known and the nickel industry was then established on a substantial basis. The profit from nickel in the Sudbury ores soon became greater than that from the copper, and in late years the operating companies have been very successful.

The known ore reserves are very large and there are numerous promising properties yet undeveloped. Increased yield in future years is therefore to be expected.

In the recently issued report of the International Nickel Co., which derives most of its profits from mining and treating Sudbury ores, President Ambrose Monell says:

"During the fiscal year just closed the business of the company has shown a substantial and satisfactory growth. The improved conditions in the steel industry resulted in a greatly increased demand for nickel from the steel makers, and in all other industries in which the company's products are used the demand has been the best in the history of the company. All indications point to a very satisfactory business for the coming year.

"We are continuing our policy of keeping our plant up to date in every respect, of increasing its efficiency wherever possible, and of enlarging its capacity."

The following table from the report of Thos. W. Gibson, Deputy Minister of Mines, Ontario, summarizes the operations during the years 1907 to 1911. The final figures for 1912 have not yet been published; but it is known that they will show a large increase over previous years.

The nickel producing companies in the past year were the Canadian Copper Co., (controlled by the International Nickel Co.), and the Mond Nickel Co. The formation of a third company to develop has quite recently been announced. This is the Canadian Nickel Corporation, Limited, capitalized at $30,000,000. Among those interested in the new venture are Dr. F. S. Pearson, President of the Brazilian Traction, Light, and Power Co., and of many other South American corporations; Mr. J. Frater Taylor, Vice-President and Managing Director of the Lake Superior Corporation; Mr. J. E. McAlister; Mr. B. B. Lawrence, Consulting Engineer, New York; Mr. E. R. Wood; Mr. Walter Gow and Mr. Miller Lash.

The Cobalt Silver Mining Industry.—The development of the Cobalt district has been so spectacular that the general public has heard much of this wonderful storehouse of silver. The recent progress has been very satisfactory.

Nickel-Copper Mining in Ontario, 1907 to 1911.

Schedule.	1907.	1908.	1909.	1910.	1911.
Ore raised, tons	351,916	359,076	409,551	451,892	652392
Ore smelted, tons	359,076	360,180	462,336	628,947	610,783
Bessemer matte produced, tons	22,041	21,197	25,845	35,033	32,607
Nickel contents, tons	10,602	9,563	13,141	18,636	17,049
Copper contents, tons	7,002	7,501	7,873	9,630	8,966
Value of nickel (dollars)	2,270,442	1,866,059	2,790,798	4,005,961	3,664,474
Value of copper (dollars)	1,020,913	1,062,680	1,122,219	1,374,103	1,281,118
Wages paid (dollars)	1,278,694	1,286,265	1,234,904	1,698,184	1,830,526
Number of men employed	1,660	1,660	1,796	2,156	2,439

The First Discovery of Silver at Cobalt.

During the summer of 1903 men were working west of Lake Temiskaming on the construction of the Temiskaming and Northern Railway. This road was built by the Government to open agricultural land beyond the district now known as the Porcupine gold field in Northern Ontario. In the vicinity of a narrow unnamed lake, later known as Cobalt Lake, some of these railroad men noticed peculiar minerals in the rocks. Fred La Rose, blacksmith of the gang, spent considerable of his spare time in examining the mineral-stained rocks at the edge of a little swamp, where he

found some loose ore and subsequently a deposit in place. He mistook niccolite for a copper mineral, and continued his prospecting without realizing that he had found a rich vein of silver-bearing ore.

At the south end of Cobalt Lake, James McKinley and Ernest J. Darragh found the first specimens of native silver which were recognized as such. These men were lumbermen engaged in getting out ties for the railroad, and they made a practice of prospecting whenever opportunity afforded. While making their way around the south end of one of the numerous lakes skirted by the railroad, their attention was attracted by the colour and weight of some loose pieces of rock in the shore gravel. These they found on washing to be rich ore, and on August 14 they applied for a mining location. Their affidavit of discovery, sent in on October 6, states that on August 7, 1903, they found rock containing "a goodly percentage of free or native silver," and assays of samples sent to Montreal showed several thousand ounces per ton. Their claim of 32 acres is now the chief holding of the McKinley-Darragh-Savage Mines Co.

In the meantime LaRose had been digging away at his pink-stained ore, and on September 15 he found a vein of solid "copper," which he showed to his employer, Duncan McMartin. Together they staked out two claims, and on September 19, 1903, applied for a location at the 103 mile post, a quarter mile north of Cobalt Lake. The claim of 40 acres containing the original discovery is the chief producer of the LaRose Con. Mines Co., while the second claim has been known as the LaRose Extension. LaRose apparently did not recognize the native silver, which was abundantly disseminated through the niccolite, until it was pointed out to him by Dr. W. G. Miller, who visited the camp in November.

On October 8, 1903, Neil A. King, a fire ranger on the T. and N. O. Railway, filed a claim for 160 acres, including the LaRose property. In the suit which followed LaRose was given a clear title to his claim, while King's supporters, J. B. O'Brian and M. J. O'Brien, received the adjoining property on agreeing to pay to the province a royalty of 25 per cent. of the gross value of ore raised to the surface.

Considerable prospecting was done in the vicinity of Cobalt Lake by those who recognized the richness of the deposits. Messrs. A. Ferland, Thos. Hebert and R. R. Galbraith made two important finds in October. One of these—the Cobalt Hill vein—was a vein of solid cobalt ore on the east shore of the lake. The second was a narrow vein in the cliff south-east of the lake. It was very rich in native silver, and became known as the "Little Silver" vein. These properties were located on October 22, and subsequently called the Chambers-Ferland claims. They are now part of the holdings of the Nipissing Mines Co. All four of these discoveries were narrow veins, filling vertical fissures in Huronian conglomerate, quartzite and shaley greywacke. Three of them showed native silver with smaltite and niccolite, while the fourth was largely smaltite.

Specimens of the niccolite from LaRose's discovery were shown by A. Ferland to Thos. W. Gibson, director of the Ontario Bureau of Mines, and as a result the discoveries were examined by Dr. W. G. Miller in November. After this examination, official announcements of the nature of the deposits were made in the daily press and in technical journals in December, 1903. These announcements aroused considerable interest, but, nothing being known of the extent of any of the deposits, few mining men investigated further. One of the few was E. P. Earle, of New York, whose attention was attracted by the descriptions of cobalt ore given by Prof. Miller. Mr. Earle later visited the camp and secured the property now known as the Nipissing.

During the winter and spring a number of claims, including properties which subsequently became important producers, were staked; but no important veins were discovered for seven months. W. G. Trethewey, an experienced prospector, had his interest aroused by Dr. Milton Hersey, who had received specimens of silver ore from McKinley and Darragh for assay. Trethewey saw more of the ore at the Bureau of Mines office in Toronto, and gathered information regarding the country and its mining laws. Leaving Toronto on May 15, 1904, he reached Haileybury two days later and Cobalt Lake on the day following. After examining the early discoveries he began to prospect himself, and on May 23 he found two veins on the hill north-west of the lake. Two claims of 40 acres each were applied for. These are the properties now known as the Coniagas and Trethewey.

Following the success of Trethewey, a number of claims, including the Buffalo, were staked on less valuable finds; but not until July was another notable discovery of silver made. Up to this date all the known deposits were veins in Huronian conglomerate. Now silver was found in the diabase at Cross Lake. Then in quick succession followed discoveries at Kerr and Giroux Lakes, including one in the Keewatin greenstones. By the end of the season of 1904 all the exposed rocks in the producing area at Cobalt had been more or less carefully examined.

In October, 1904, steel on the T. and N. O. Railway reached Cobalt Lake, and several rich shipments were made during the winter. Some of the car lots of hand-sorted ore netted about $2,000 per ton, and much outside interest was at once aroused. In the spring of 1905 a large number of prospectors began work in the district, and in addition to the work being done at Cobalt, rocks in more remote parts were subject to close scrutiny. Fortunately the surrounding country had been described and geologically mapped 10 years earlier by Dr. A. E. Barlow, of the Canadian Geological Survey. The prospectors were thus early aware that rocks similar to those in which they saw silver ores at Cobalt had been found over a large area to the westward.

In the spring of 1904, Dr. Miller, for the Ontario Bureau of Mines, and Dr. Parks, for the Canadian Survey, went to Cobalt to make official reports on the camp. Dr. Miller made a map of the immediate vicinity. Dr. Parks spent a few weeks examining the discoveries, and then went northwards to the height of land and across to the Montreal River to determine the areal extent of the silver-bearing rocks. With these and Barlow's reports, the crowd of prospectors had during the following years much useful information regarding the country they were working in.

Discoveries in 1905.

The prospectors now in the district had two chances before them. Some believing that the field would prove an extensive one made hurried examinations of the outcrops over a large territory. Others stayed close to the proven area and began a system of prospecting which proved to be very profitable, namely, digging of narrow trenches to bed rock through the glacial debris. In this way many very important finds have been made.

Most of the valuable discoveries were, like the first ones, in Huronian sediments. Some rich veins were found, however, in the diabase and in the Keewatin series. All of them were deposits of very similar form and composition—narrow, vertical veins carrying silver and arsenides of cobalt and nickel.

Those who went far from Cobalt found cobaltiferous deposits in widely separated areas in rocks similar to those of Coleman township.

The prospectors at first gave their attention almost entirely to outcrops of conglomerate such as they had seen at Cobalt Lake. For some time little was found outside of Coleman and Bucke townships.

Silver Found in Casey Township.

The first important location of a similar nature at a distance from Cobalt was made in Casey township, 15 miles north of the camp, by David Bucknell. Mr. Bucknell had been attracted to Cobalt from his father's home on the Blanche River, and was for some time engaged in clerical work. He observed that the deposits were in rocks which resembled those at home. On returning home one day, he immediately set out to examine an outcrop on a neighbour's farm. After a short search he found a vein and located the property now known as Casey Cobalt. Later other small veins were found on adjoining properties, but the only ore shipped has been mined on the claims first staked.

It was three years after Bucknell's discovery of this field, before important discoveries were made in Huronian sediments in another part of Nipissing, on the Blackburn property at Miller Lake—now Millerette mine.

While the first discoveries were all found in Huronian sediments, the prospectors in Coleman township soon found that similar, though generally less productive veins, occurred in the other rocks.

In the western part of Coleman cobalt ore was found in diabase in the vicinity of Portage Bay on the Montreal River, and during the same summer, 1905, small veins carrying smaltite in a quartzose gangue were discovered in Ingram township, 30 miles north of Cobalt.

The prospectors now began to regard the diabase with more favour, and their preference became more marked as the field seasons went by without any notable find being made in the sedimentary rocks.

Several occurrences of cobalt bloom in diabase were found during this year in the vicinity of Wendigo Lake; but the prospectors here did not find any silver, and their attention was soon diverted by the discovery of gold at Larder Lake, some 20 miles further north.

Native Silver Found in Temagami Forest Reserve.

A number of prospectors worked westward from Portage Bay and examined the country to and beyond Lady Evelyn Lake. During the fall of 1906, Messrs. White and Darby found several veins of cobalt and silver ore in a diabase ridge between Anvil Lake and Maple Mountain. Many prospectors had at this time gone up the Montreal River and were working for a few miles westward. Silver was found in James township and vicinity during the fall of 1906.

During the following winter hundreds of claims were staked in the vicinity of Maple Mountain and Elk Lake. The number of prospectors now in Nipissing was much greater than in any previous winter; but many of them were busily staking out gold claims at Larder Lake. The spring of 1907 saw a great rush into the Maple Mountain and Elk Lake territory. The diabase outcrops were subjected to close scrutiny by an army of fortune hunters, with the result that a large number of discoveries were made. Westward from Elk Lake, cobalt minerals were found in many places, notably near Bloom Lake, but no rich deposits were uncovered for some time.

Silver Found in South Lorrain.

While most of the prospectors were working in the Forest Reserve, a few were examining less well-exposed areas south-west of Cobalt. Late in the year 1907 discoveries of silver were made in South Lorrain, 16 miles from Cobalt station. During the winter 1907-1908 several claims were staked and other discoveries made. Most of these were in the Keewatin greenstones, some in the Keweenawan diabase, and all near the contact.

Silver Found at Miller and Gowganda Lakes.

The prospectors working westward from Bloom Lake in 1907 made several discoveries of cobalt minerals in diabase, and during the following winter and spring silver was discovered in the vicinity of Leroy and Miller Lakes. Then in August several silver-bearing veins were found west of Gowganda Lake.

No new silver field of importance has been discovered during the past few seasons, and most of the prospectors have been seeking gold.

Ten years ago there were in Nipissing only a few individuals who were at all interested in minerals, and very few of these were trained prospectors. There are to-day in the district hundreds of men experienced in mining and prospecting and well versed in woodcraft. It will probably be long before a twelve-month shall have passed in which none of these energetic pioneers has made an important discovery.

While the prospectors were hunting new fields, the working mines at Cobalt were steadily developed. Some veins rich near the surface were found disappointingly low grade at depth, and others pinched out. Some workings in low grade ran into rich ore and several new veins were found. These are the every day occurrences in the camp, new finds being made which counterbalance the working out of others.

Cobalt silver mines had another very profitable year in 1912, netting the owners over $10,000,000 on a production of about 30,000,000 ounces, having a gross value of about $17,000,000. During the year $8,179,468 was distributed in dividends. The output was somewhat lower than in 1911, but the average selling price was considerably higher and costs remained about the same. The output for previous years is shown by the accompanying table from the report of the Deputy Minister of Mines, Thomas W. Gibson. The mines have now produced a total of about 170,000,000 oz. silver, valued at more than $90,000,000. After the year's operations most of the mines have as much ore in sight as in 1911 and should be large producers in 1913. Two or three of the producers, however, have very little in reserve and will probably show serious falling off unless new discoveries of high-grade ore are made.

Two properties, Cobalt Townsite and Cobalt Lake, have shown great improvement during the last two years. They paid dividends of $220,000 and $310,000 in 1912, and are expected to increase production in 1913. Nipissing, the largest producer, had a highly successful year and was able to build a costly low-grade mill out of profits without decreasing the dividends; $1,800,000 was distributed to stockholders during the year. Coniagas met with like success in mining and developing, and paid to stockholders $1,440,000 without decreasing the known reserves. Crown Reserve held its own and was able to pay $1,080,000 to shareholders. McKinley-Darragh-Savage found some unusually rich ore and distributed $898,000 from profits. La Rose did not develop

as much new ore as was hoped, and the market value of shares fell to new low levels, but the company was able to pay 12 per cent. on its capitalization of $7,500,000 without decreasing the large surplus.

of 200 tons daily capacity for the treatment of low-grade ore by cyanide. The Nipissing has in operation a remarkable process for treating the high-grade ore. The crushed ore is ground with mercury and cyanide

Total Production, Cobalt Mines, 1904 to 1911.

Year.	Shipments of Ore and Concentrates, Tons.	—Cobalt— Tons.	Value	—Arsenic— Tons.	Value.	—Silver— Ounces.	Value.	Total Value.
1904	158	16	$19,960	72	$903	206,875	$111,887	$136,217
1905	2,144	118	100,000	549	2,693	2,451,356	1,360,503	1,473,196
1906	5,335	321	80,704	1,440	15,858	5,401,766	3,667,551	3,764,113
1907	14,788	739	104,426	2,958	40,104	10,023,311	6,155,391	6,301,095
1908	25,624	1,224	111,118	3,672	40,373	19,437,875	9,133,378	9,284,869
1909	30,677	1,533	94,965	4,294	61,039	25,897,825	12,461,576	12,617,580
1910	34,282	1,098	54,699	4,897	70,709	30,645,181	15,478,047	15,603,455
1911	26,653	852	170,890	3,806	74,609	31,507,791	15,953,847	16,199,346
Total	139,661	5,901	$736,762	21,697	$306,288	125,971,971	$64,322,180	$65,379,871

Table of Dividends Paid by Cobalt Silver Mining Companies.

Name of Company	Authorized Capital	Capital Stock Issued	Par Value	Dividends 1911	Dividends 1912	Total dividends to end of 1912
Beaver	2,000,000	2,000,000	1	$170,000	$180,000	$350,000
Buffalo Mines	1,000,000	1,000,000	1	440,000	270,000	1,617,000
City of Cobalt	1,500,000	1,500,000	1	.....	.....	138,375
Cobalt Central	5,000,000	5,000,000	1	.....	.....	192,845
Cobalt Lake	4,374,885	3,304,051	1	.....	310,000	310,000
Cobalt Silver Queen	1,500,000	1,500,000	1	.....	.....	315,000
Cobalt Townsite	1,000,000	1,000,000	1	.....	220,000	220,000
Coniagas	800,000	800,000	5	1,440,000	1,440,000	4,280,000
Crown Reserve	2,000,000	1,768,814	1	1,238,186	1,061,288	4,687,373
Foster Cobalt	1,000,000	915,588	1	.....	.....	45,000
Kerr Lake	600,000	600,000	5	990,000	600,000	4,320,000
La Rose	1,500,000	1,498,407	5	599,451	711,847	4,434,042*
McKinley-Darragh-Savage	2,500,000	2,247,692	1	1,123,666	899,769	2,831,757
Nipissing	1,200,000	1,200,000	5	1,800,000	1,800,000	9,090,000
Right of Way	2,000,000	1,685,500	1	33,710	.....	526,904
Temiskaming and Hudson Bay	25,000	7,761	1	116,451	209,847	1,706,520
Temiskaming	2,500,000	2,500,000	1	225,000	300,000	1,309,156
Trethewey	1,000,000	1,000,000	1	200,000	200,000	971,999

*Includes profits shared privately before incorporation.

Buffalo paid $320,000 and built a new amalgamation-cyanidation plant. Kerr Lake paid $600,000 and still has much rich ore in reserve. Temiskaming had a profitable year, paying $300,000 to stockholders, but as compared with some former years, has little high-grade in reserve. The same is true of the O'Brien mine. Beaver has been prosperous recently and is meeting with some success at greater depth than other Cobalt mines. The Temiskaming and Hudson Bay mine increased production and profits and paid dividends amounting to $209,000. Trethewey paid 10 per cent., but has little high-grade in reserve. Casey-Cobalt increased production, profits and reserves and should be a larger producer in 1913.

The most noteworthy discovery during 1912, aside from ore discovered on property of the large producers, was made by the Seneca-Superior. This company, operating on a lease from Peterson Lake Mining Co., opened a vein of high-grade ore under Cart Lake. A few shipments have been made and the property promises to be profitable.

While paying out handsome dividends during the last few years, the mines at Cobalt have also paid for construction of a large number of well equipped mills and cyanide plants. There are at Cobalt 17 mills with a total capacity of about 1,800 tons per day. Remarkable progress in treating the unique ore has been made. Straight concentration methods have been so adopted that a good recovery is now being made from low-grade ore. Cyanide methods have also proven suitable and the Nipissing company has just put in operation a plant

solution in a tube mill and most of the silver amalgamates with the mercury. The silver is recovered and refined on the property and the bullion shipped is of high purity. A plant to treat ore in a similar way has been constructed during the year by the Buffalo Mines, Limited.

Porcupine Gold Mining Industry.—Gold was first found in the Porcupine district in important quantity in 1909. Rapid progress was made in developing the deposits; but disastrous forest fires in July, 1911, gave the industry a serious setback. Nothing daunted, the mine owners immediately began reconstruction of mining plants and mills, and in 1912 Ontario became for the first time in history an important gold producer. The Porcupine mines yielded gold valued at about $1,800,000 and there are assurances that a very much larger production will be made in 1913.

The leading mines are the Hollinger and Dome. The Hollinger ore is comparatively rich and the profit per ton is large. The Dome has a large deposit of much lower grade ore. Other properties in the vicinity of the Hollinger, including the McEnaney, Miller-Middleton and Dixon, McIntyre, Pearl Lake, and Jupiter have also made a good showing, although overshadowed by the Hollinger and Dome.

At the Hollinger, Manager P. A. Robbins reported the estimated ore reserves at the beginning of the year to be 644,540 tons, valued at $11,271,400. The profit made during the last half of the year was $600,664.42.

At the Dome the new mill built to replace that lost in the fire of 1911, treated in the period from March 23,

1912, to March 31, 1913, 101,812 tons ore, which yielded $1,043,995. The tonnage developed above the 45-foot level is estimated at 315,528 tons with a sampling value of $7.53 per ton.

From these brief statements it will be evident that Ontario has now two very important gold mines. The smaller mines in the district will also contribute much to the country's wealth. During the past year also, promising gold discoveries have been made at Kirkland Lake, about 50 miles north of Cobalt, and there can be little doubt that the country traversed by the Temiskaming and Northern Ontario Railway will long be a very important mining district.

THE MINING ENGINEER AND THE PUBLIC*

By Bedford McNeill.

In these days of specialized professions the tendency is more and more for the mining engineer and metallurgist to limit himself within the narrow boundaries of the mining, or the treatment of the ore of that particular metal, with which his life's work may be associated. There are manifest advantages, however, in extending our enquiries and knowledge with regard to the metals with which we are associated, and, as it were, taking a more extended view of their influences and uses in our complex civilization.

It is no use ignoring or pretending to ignore, the fundamental fact that mining is and must always continue to be essentially speculative, and so far as its initial operations are concerned it will, in my opinion, become more speculative in the not very distant future. Attention has already been drawn in our Transactions to the extent to which deposits at or near the surface are being more and more worked out, although as we all know, there are still large areas of the world's surface yet to be properly prospected. We may ultimately be driven to working that class of mineral occurrence which presents no visible evidence whatever at surface, and the location and working of which will inevitably demand higher technical skill and involve greater risk of loss of capital than those deposits with which we have at present mainly to deal.

Each successive advance of the science of mining ought to tend to equalize its increasing hazards. We are limited by our present knowledge, and although the difficulties met with stimulate our exertions to overcome them, we have still to work with insufficient enlightenment in regard to certain natural laws. At practically all points (commencing at a minimum when prospecting) the mining engineer is in close contact with finance. It is in connection with the finding and the losing of capital that so many difficulties and perils occur to the members of our profession.

If we consider the life-history of a mine, we are faced at once with a very practical point—the provision of the necessary working capital—and we must consider the relations between the mining engineer and capitalist. I know there are some mining engineers (belonging rather to the opulent section of our community) who argue, that if a mining enterprise cannot have the capital they estimate to be necessary therefor, the property should not be worked, until the whole of the money is available. But this is not always possible, and I hold that one is justified in taking some risk in this direction. Again, it is necessary to consider the capitalist. The mining engineer cannot always obtain the working capital, save on terms that largely diminish the value of the property to the public, and from the dividend-paying standpoint.

The true prospector is a man who "dreams dreams" (he would not be any good if he did not), and who endures untold privations and hardships, anticipating that one day he will realize wealth beyond his wildest hopes. The prospector may be excused taking a too sanguine view when he has discovered something; but if a man styling himself "a mining engineer" wilfully misleads himself and others into believing that a mere "prospect" is a mine, it should not be possible for that man to retain the title which he has so improperly assumed.

Being of too sanguine a nature or too inexperienced in the chances of mining, may lead to large and useless expenditure and loss. The difficulty of spending money, so that the data developed by that expenditure, are going to prove that the money itself has been judiciously spent, and has led to the justification of raising further capital or otherwise, demands from the advising mining engineer, the exercise of his greatest skill. On the one hand, he has to get the information for the least expenditure; and, on the other, to so arrange that, in the event of the property proving all he hopes or more, his previous expenditure can still be further utilized. At one time he may have to restrain or at another time encourage, those with whom he is associated, and who may not be equipped with his technical knowledge and experience.

To curb one's own hopes, to proceed with deliberate caution, and not to lose valuable time, often requires that the mind shall have been educated, by experiencing the bitterness of disappointment. From the prospecting up to the final stage, that of actually working the property so as to get the largest amount of profit in the shortest possible time, we have the dependence of mining upon capital, and it is considerations such as these that demand the gravest thought from those who propose to legislate for members of our profession.

We all know instances where a man with little professional training, and with the merest superficial experience, has posed as a mining engineer; I ask, can we wonder that our profession is, in many instances, regarded by a large section of the public as being of little or no repute? That this view is no new thing, is evidenced by the fact that the mining engineer was long ago called upon to verify his report by affidavit.

We want to consider the qualifications of the mining engineer and metallurgist, and how best the status of the members of our profession can be advanced. We want when it is said of a man "he is a mining engineer," that all may know, he is a man, who, in connection with mining enterprises, can be trusted with the expenditure of other people's money, or who may equally be trusted to save it, and who for undergoing the necessary training and acquiring that special knowledge and experience which enables him to overcome the difficulties which beset mining enterprises, is entitled to be equitably remunerated. It must always be remembered that metal mines are, generally speaking, short-lived. Either the deposit itself be-

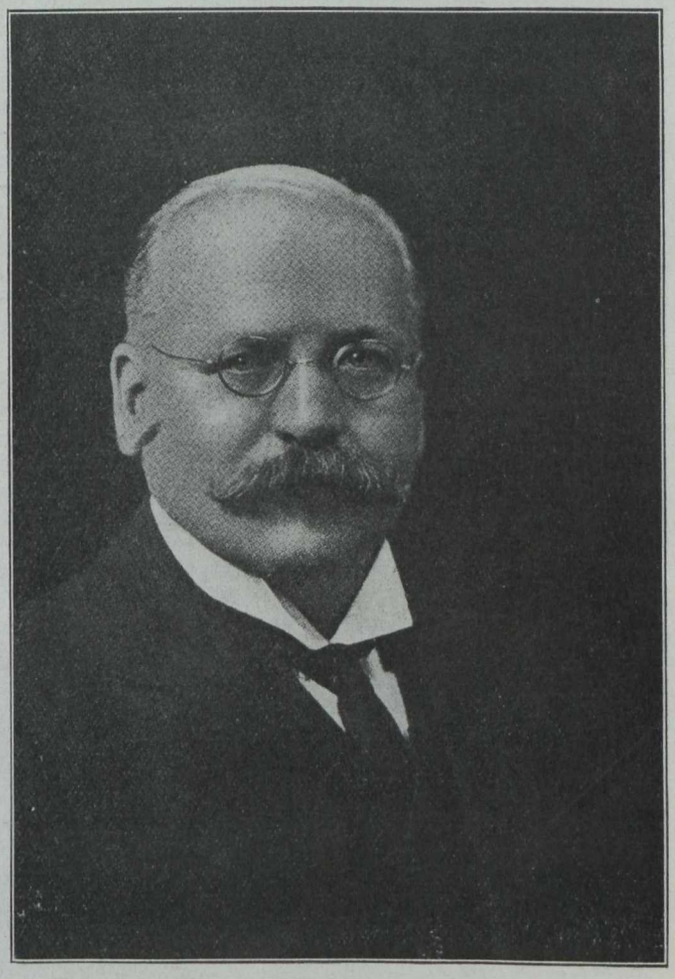
*Excerpts from the Presidential address, Institution of Mining and Metallurgy, March 13, 1913.

comes worked out, or the economic conditions which at one time permitted profits no longer continue. The market price of all metals (if we except gold) is liable to such fluctuations that the substantial profits at one period become certain losses at another, and we have also our own particular risks, some preventable, and others non-preventable. I mean disasters due to underground fires, floods at surface or underground, falls of ground, air blasts, etc.

It is our present misfortune, and it will be our fault, if such conditions with regard to the lack of control which we as an institution have over those who call themselves "mining engineers" be allowed to continue. I hold no one should be permitted to style himself a mining engineer, or to practise as such, unless he is qualified to do so; and of his qualifications for mining, other than coal, this institution ought to be the tribunal.

From this point of view our position as an institution is not satisfactory. According to the law—important though we know ourselves to be, and as a fact are—we are not recognized as existing. No other institution fills, or has attempted to fill, the place that we occupy. We cannot, in the quaint wording of the Physicians' Charter, "Plead or be impleaded." We have no authority, jurisdiction or corporate being whatsoever. Anyone can call himself "a mining engineer," can re-date and use a report years after it was originally made, can write a report on a property that he never visits, or if he does so, it may be when the underground workings are inaccessible, can knavishly mislead the public with impunity; and all we can do, if he uses our initials, is to ask him to cease doing so.

In this connection, I very much like the phrase employed by the Royal Institute of British Architects, with regard to members of that profession, and I trust the mining engineer (when the use of that title is legally restricted) will always be regarded not only as the agent of a client, but also that such implicit confidence will exist, as to enable him to become a "friend and adviser." What we wish to do is, to protect the public on the one hand, and, on the other, secure an honourable career for ourselves.



BEDFORD McNEILL
President, Institution of Mining and Metallurgy

MAGMATIC ORIGIN OF SUDBURY NICKEL-COPPER DEPOSITS

Numerous descriptions of the Sudbury nickel-copper deposits have been published and many geologists have discussed the origin of the ore bodies. Most of those who are familiar with the district believe that the ores originated in the same magma as the norite with which they are associated. Some believe that the metallic sulphides were concentrated from the molten magma by differentiation during or preceding crystallization. Others believe the sulphides to be essentially secondary deposits made by aqueous solutions which may or may not have been derived from the magma.

The writer's purpose here is not to sum up the evidence in favour of each of these views, but rather to call attention to some of the processes involved in the solidification of the nickel-bearing eruptive; to state certain peculiar relationships which Mr. David H. Browne has found to exist between the ore deposits and the furnace products; to give Mr. Browne's interpretation of these relationships and to show how these facts and the interpretation of them are in accord with the theory or origin.

That the formation of the ore bodies was primarily by differentiation is here assumed. It is not denied that there is abundant evidence of secondary deposition, for in some of the deposits there are relationships which can only be thus interpreted. After examining a few of the deposits and studying the literature, especially the work of Prof. Coleman, it seems clear to the writer that the localization of the ore bodies has resulted from a directly igneous process of concentra-

(1) Dr. A. E. Barlow and Dr. A. P. Coleman have reported on the district for the Geological Survey and the Ontario Bureau of Mines, respectively. They both believe that the ore bodies were formed by a process of magmatic segregation. Dr. C. W. Dickson has presented the evidence in favor of secondary origin in Transactions of A. I. M. E. Vol. XXXIV. 1904, pp. 3-67. Prof. T. L. Walker discussed differentiation in the nickel-bearing eruptive in Quart. Jour. Geol. Soc. Vol. LIII., No. 209, 1897, pp. 40-65. References to writings of several others are to be found in these reports and papers. An extensive bibliography accompanies Dr. Dickson's paper.

A paper presented by R. E. Hore at Annual Meeting Canadian Mining Institute, Ottawa, March, 1913.

tion, and that this is therefore the theory of origin most useful in directing exploration. Individual ore deposits often show sulphides in the form of fillings in the norite and sometimes secondary silicates occur with the sulphides. Such ore may very well have been derived without great migration of the constituents, from primary ore bodies. It would be remarkable if secondary changes had not taken place in these old deposits, especially in places where crushing and faulting (2) has occurred. Without further reference to such changes, however, let us consider the primary separation of the sulphides from the molten magma.

From Prof. Coleman's descriptions of the fused character of the conglomerate immediately overlying the eruptive sheet, with which the ores are associated, it is evident that when the magma had pushed its way out along the unconformable contact, it was still at a temperature much above that of its freezing point. It doubtless absorbed a very large amount of the conglomerate, and it is likely that the light coloured siliceous upper part of the eruptive is due largely to such absorption. The extension of the norite far out from the main mass into comparatively narrow crevices in the surrounding rocks points also to very considerable superheating. It seems likely that enormous quantities of heat were given off before any appreciable portion of the magma had cooled to a temperature at which solidification began. There was then this very thick molten bed with its thin solid crust surrounded by rocks that were already highly heated. Further loss of heat must have been at a very slow rate, and the time for differentiation in situ was undoubtedly enormously long.

So far as known molten silicates are miscible in all proportions. Molten sulphides, however, will not mix in all proportions with molten silicates. One cannot state off hand, therefore, whether the cooling magma would behave as one or as two or more solutions. From a consideration of the end products—the norite and ore bodies—it seems to the writer (3) that before solidification took place the magma with decrease in temperature had separated very imperfectly into two solutions. One of these was composed chiefly of the constituents of silicates and the other chiefly of the constituents of sulphides. Each solution contained a comparatively small portion of the constituents of the other. The sulphide solution being heavier sank to the bottom. The process would be much like the separation of matte from slag, with the very essential difference that none of the furnace man's precautions to effect a clean separation were taken. The proportions of the constituents not being the most favourable and no fluxes being added, the resulting solid does not show two distinctly separated portions. Not only was the boundary irregularly defined, but one solution in solidifying may have enclosed numerous detached portions of the other.

In each solution, moreover, there would be further differentiation as the necessary result of the fact that some minerals crystallize before the others. The first minerals formed would be found at the margins. On these more crystals of the same composition would form, and the composition of the remaining solution be thereby changed. Moreover, crystals forming early in any part of the solution, if of high specific gravity, would sink slowly. Since, however, at the temperature at which such crystals separate out the melt would be very viscous, the sinking of crystals would be extremely slow. Some differentiation from these causes alone would, however, without doubt take place.

If the proportions of sulphides and silicates were such that their molten constituents were perfectly miscible under the conditions and no separation in the liquid state took place, there would certainly be some accumulation of sulphides in the lower part as the result of the crystallization phenomena just mentioned. One may well doubt, however, whether the ore deposits were thus produced. It is true that all gradations from solid ore to norite containing only a few scattered grains of sulphides occur; but compared with the thickness of the sheet the transition takes places in a remarkably short distance. Incomplete miscibility of the constituents of the magma and consequent formation of two solutions would be much more likely to result in the formation of such deposits. Imperfect separation of the two solutions with resulting entanglement of large and small bodies of the other during the solidification would explain the absence of a sharp line of division comparable with that obtained in furnace practice. Moreover, each solution contained some of the constituents of the other. Thus the silicate solution was saturated with sulphides, and on cooling below the temperature beginning the freezing interval, it is probable that the sulphides would be among the first formed minerals. If in the silicate solution there were any included bodies of the sulphide solution, there would be doubtless a change in the composition of the solutions in contact. After the main mass of the silicate solution became solid there would on further cooling be a second deposition of sulphides from the included solution. We would expect as a result of such processes to find, and we do find, large masses of norite specked with grains of early formed sulphides and with occasional patches of later formed massive sulphides, and from the sulphide solution massive ore with early formed silicates enclosed in it.

David H. Browne's Comparison of the Ore Bodies With Furnace Products Obtained in Treating the Ores.

In the light of the theory that the ore bodies have been formed by a process of magmatic segregation as above outlined, it is interesting to compare the ore bodies with the furnace products. That the comparison is an apt one has been shown by Mr. David H. Browne in a paper entitled, "Segregation in ores and mattes," published in School of Mines Quarterly, July, 1895. Mr. Browne shows in his paper that the distribution of copper and nickel in the matte is closely analagous to the distribution of the two metals in the ore bodies, and he has kindly supplied the writer with data which clearly substantiate his argument. In his paper, Mr. Browne gives the results obtained by careful analysis of copper-nickel matte made in water-jacketed blast furnaces from roasted copper-nickel ore. This matte, having an average composition Cu. 24, Ni 20, Fe 28 and S 28%, was tapped into hemispherical or conical cast-iron pots, allowed to set and turned out on the dump to cool. The moulds or matte pots used were about 24 in. in diameter by 14 in. deep. The matte was tested to determine variations in composition at different parts.

"Numerous analyses showed that in one and the same matte casting a sample broken from the top will be, as a rule, higher in copper and lower in nickel than a sample from the bottom. Eleven pots thus examined gave an average as follows:

(2) The existence of a great fault at the Crean Hill Mine is pointed out by Dr. Coleman in his recent report to the Department of Mines. Summary report 1911, pp. 87-89.

(3) For previous views and further references on this subject see "On the Igneous Origin of Certain Ore Deposits" by F. D. Adams, Journ. Gen. Min. Ass. of P. Q., Vol. II., p. 35, 1894.

	Cu.	Ni
11 top samples	23.26	20.15
11 bottom samples.....	21.14	20.32
	2.12	0.17

"Further analyses showed that nickel was higher at the centre than at the bottom of the casting. Copper tends towards the top and outside of the casting, while nickel and iron tend to concentrate toward the centre."

Mr. Browne gives the following figures obtained from analyses of samples taken along central horizontal plane of a pot.

	Outside.			Centre.
Cu	25.12	24.30	21.06	19.02
Ni	22.82	23.80	25.04	29.24
Fe	26.5	26.6	26.8	27.00

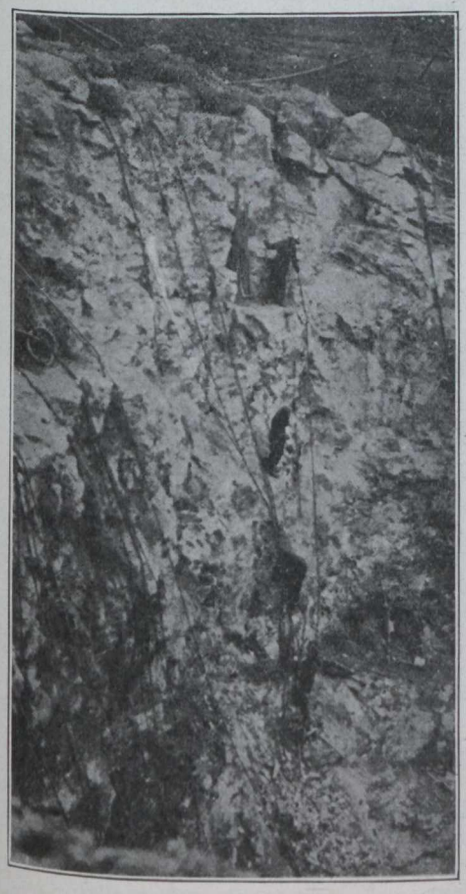
and the following figures for section along vertical central lines of a pot of furnace matte:

	Cu.	Ni.	Fe.
Top	27.36	22.46	24.0
	26.14	22.94	25.0
	19.02	24.24	27.0
Centre.....			
	19.6	27.0	28.1
	21.8	24.94	28.3
Bottom	24.12	22.46	28.0

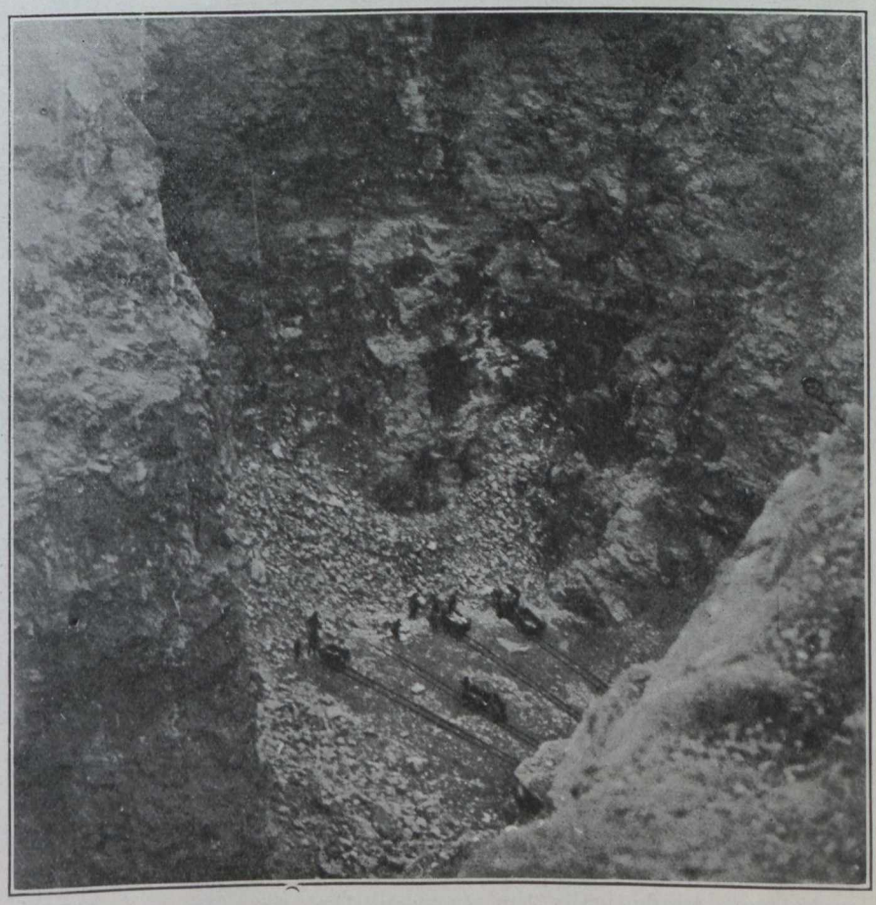
The analyses showed that the segregation of the nickel to the centre and the dispersion of copper to the outside is very pronounced. From other observations and experiments the same conclusion was drawn.

Mr. Browne also calls attention to the fact that sodium sulphide forms with the matte an exceedingly fluid magma from which on cooling nickel sulphide separates as a bottom. He concludes that "if copper-nickel-iron sulphides can be held in a molten condition the copper and nickel will separate as individual minerals, the sharpness of the separation being dependent on the fluidity of the mass and the time occupied in cooling."

Considering then the ore deposits, Mr. Browne states, "The tendency of copper pyrites to separate from the nickeliferous pyrrhotite is very noticeable. However closely the two minerals may be intermingled, each is entirely free from traces of the other. The chalcopyrite is free from nickel, while the pyrrhotite beside it is free from copper. Beside this chemical separation there is an equally noticeable physical separation. It may be stated, as a rule, that copper tends toward the rock, whether forming the wall or forming included masses. The miners often remark the way in which copper follows the rock, and look on the presence of massive copper ore as indicating an approach to the rock. In driving a drift from the shaft in clean norite to and through the ore, the first symptoms of the presence of the ore are small shots or pockets of copper pyrites impregnating the rock. Coming nearer to the ore-body the amount of copper increases, large masses being met with before any nickel is found. On reaching the ore proper, the copper pyrites is found mixed with pyrrhotite and rock, while



West end, open pit



East end, open pit, Creighton nickel-copper mine

"In order to get a correct sample and to map out, if possible, the variations of copper and nickel, a quarter pot was placed under a drill and sampled by drilling with an inch drill holes one-half inch deep at the points marked. These samples were analyzed and the entire quarter pot was now crushed, quartered, sampled and analyzed. It contained Cu 24.64, Ni 22.86, Fe 26.70 and S 25.82."

in the heart of a deposit a large quantity of nearly pure pyrrhotite (and pentlandite) almost free from copper is found. The cross-section of the ore-body then shows as follows: rock, copper-ore and rock, copper-nickel ore, nickel ore, copper-nickel ore, copper ore and rock, and finally rock again."

"The ore as mined does not show these variations for there is much ore intermixed with the rock walls and many included fragments of rock in the ore-body itself, and each mass of rock tends to attract copper ore."

"A general tendency of copper to disperse to the rock and to the walls and of nickel to concentrate towards the centre of the deposit, is thus shown to exist in the ore-body."

Mr. Browne further showed by analyses of ores from different depths at the Copper Cliff mine that the nickel sulphide is more perfectly separated as depth increases. This is true also of mattes.

In mining the ore there is necessarily broken a considerable percentage of rock. In the rock houses the ore is crushed and then hand-picked on travelling belts. Both ore and rock are regularly sampled and analyzed. There is kept, therefore, a complete record of the contents of all ore and rock that is mined. A consideration of the following figures, calculated by Mr. Browne from the average analysis for each year's output, will show clearly that the ratio of copper to nickel is much higher in the rock than in the ore. With Mr. Browne's figures I will quote the interpretation of them as he has presented it to me.

Ratio of Copper to Nickel in Ore and in Rock.

Creighton Mine.	Parts Nickel	Parts Copper	
		in ore.	in rock.
1909	100	35	87
1910	100	36	75
1911	100	38	88
Average	100	36.3	83.3
No. 2 Mine			
1910	100	61	141
1911	100	54	147
Average	100	57.5	144

"Averaging these results we find that for each 100 pounds nickel in ore there was at Creighton 36.3 and at No. 2 mine 57.5 pounds copper, and that for each 100 pounds nickel in the rock there was at Creighton 83.3 and at No. 2 mine 144 pounds copper.

"The ratio of relation of the nickel and copper in ore to the nickel and copper in rock is as follows:

"This means that the copper relation in Creighton rock is 2.3 times the copper relation in the Creighton ore.

"This ratio represents the average of a very large tonnage—in the case of Creighton mine several hundred thousand tons. Ore and rock from other mines show similar ratio of copper to nickel, and we can now make more emphatically the statement that the ratio of copper to nickel in the rock is very considerably greater than the ratio of copper to nickel in the ore. In matte similar relations were seen in comparing the margins with the centre.

"An analogy between ore body and matte along a horizontal line being thus established, we have now to consider the variations along a vertical line. If there is an analogy here we would expect to find the ratio of nickel to copper increase with depth until a point well down towards the bottom is reached. As the various workings in the mines are not separately sampled, we have no assay plan showing the required figures. We have, however, the analyses of regularly taken samples of ore mined and as, in general, each year sees ore taken from lower levels than the previous year, we have figures showing changes in ratios with increase in depth. In some mines, such as at Creighton, where ore is being still taken from various depths from surface to the fourth level, the yearly averages do not give much clue to changes with depth. At other and smaller ore bodies, where sinking was fairly regular, we find a very significant series of figures. These show clearly that with increase in depth in the ore there was an increase in the ratio of nickel to copper.

Increase in Ratio of Nickel to Copper With Increase in Depth as Shown by Average Analyses of each Year's Production.

Year.	Parts copper to 100 parts nickel.	Remarks.
No. 2 Mine.		
1898	74	Gophering on surface.
1899	121	
1900	77	
1901	79	
1902	90	Going down
1903	62	
1904	49	fairly
1905	53	
1906	44	uniformly.
1907	49	
1908		Not worked.
1909		Not worked.
1910	61	Taking out floors and pillars.
1911	54	
Evans Mine.		
1890	85	
1891	57	
1892	56	Widening on pit.
1893	92	
1894	117	
1895-96	94	
1897-98	98	Going down.
1899	87	
Stobie Mine.		
1890	113	
1891	93	Widening on pit.
1892	94	
1894	73	
1895	104	
1896	89	
1897	87	
1898	86	Going down.
1899	64	
1900	44	
Copper Cliff Mine.		
1888	200	
1889	147	
1890	156	
1891	87	
1892	125	
1893	118	
1894	108	
1895	80	
1896	135	
1897	157	A second ore shoot.
1898	93	
1899	137	Robbing pillars.
1900	150	

"These figures, while showing many irregularities, prove the statement that the ratio of nickel to copper increases with depth. Many of the apparent irregularities are in reality not evidence of exceptions to this statement. The first few years output in several cases does not represent increase in depth alone, being offset by horizontal extensions of the pits. The last two years at No. 2 mine and Copper Cliff show reversal to higher copper ratio corresponding to robbing of pillars. Regular decrease in copper ratio is very noticeable in the figures for No. 2 mine for years 1899 to 1907, and the production for these years was from fairly regular increase in depth on a clean uniform chimney of ore. The figures for the Copper Cliff mine show a fairly regular decrease in copper ratio down to 1895, and then a much higher copper ratio in the succeeding years, were found on inquiry to correspond with the working out of one ore shoot and the development of a second deeper shoot."

"Another analogy between ore deposits and the furnace products is found in comparing the ratio of nickel to copper in slags with the ratio between these metals in the mattes. Small drops of sulphide are carried off by the slag, and analyses show the ratio of copper to nickel in slag to be always greater than the ratio of copper to nickel in the corresponding matte.

"Ratios of copper to nickel in matte and in slag:

Year.	Parts copper to 100 parts nickel. In matte.	In slag.
1910	44.3	47.5
1911	43.9	53.0

"An objection to comparison of these furnace products with the ore deposits lies in the fact that the iron has been oxidized and all put into this slag, while in the ore body it remains with the other sulphides. A better comparison would be obtained from products obtained on melting together rock and ore without oxidation. This is not a common practice, but has been done, and the resulting slag showed a copper ratio of 41.5 compared with a ratio of 32.8 in the matte.

"Interesting also are comparisons between the ratio of nickel to copper in marginal and in offset deposits. If the analogy between furnace products and ore bodies still holds we would expect to find in the offset deposits, where the molten magma penetrated far out into the surrounding rocks, that the ratio of copper and nickel is less than the marginal deposits. This is in fact the case. For the marginal deposits the only available figures showing the average for the whole output of the mine are for the Creighton. The figures given for the other properties are less truly representative. For the off shoot deposits the figures given are in each case the average for total output.

Ratios of copper to nickel in marginal and offset deposits:

Marginal.	Parts copper for every 100 parts nickel.
Victoria mine	87
Gertrude mine	50
Creighton mine	33
Murray mine	50
Blezard mine	50

Average for 5 marginal deposits, 54 parts copper to 100 nickel:

Offsets.	
Evans	88
Cliff	147
No. 1	96
No. 2	71
Stobie	74

Average for 5 offset deposits, 95 parts copper to 100 nickel.

Summary.

1. It has been shown by Drs. A. P. Coleman, T. L. Walker, A. E. Barlow and others, that (a) the nickel-copper deposits of the Sudbury district all occur in the same type of rock—a quartz-hypershene-gabbro or norite.

(b) The norite forms the lower part of a great spoon shaped laccolitic sheet and the ore bodies occur along the lower outer margin of the sheet and in narrow masses of norite, which occur far out in the surrounding rocks.

(c) The ore bodies, sulphides of nickel, copper and iron have been formed by a process of magmatic segregation.

2. The author calls attention to the processes involved in the solidification of the magma and suggests that it is probable (a) that limited miscibility of the molten constituents of sulphides in the molten constituents of silicates resulted in the formation of two solutions—a silicate solution and a sulphide solution—each containing some of the constituents of the other.

(b) The sulphide solution sank to the bottom, but the separation was not a clean one, and on solidification a zone of intermediate composition was formed owing to inclusion of large and small bodies of one solution in the other. (In the furnace a cleaner separation is obtained by adding fluxes.)

(c) In each solution also differentiation took place by early formed minerals accumulating at the margins and especially at the bottom. Such differentiation was very incomplete owing to high viscosity at the freezing temperature.

3. Mr. D. H. Browne gives a statement of relationships between ore deposits and furnace products. He states that (a) "Analyses of a pot of matte show marked tendency of the nickel to accumulate in the central part, well towards the bottom. In the ore deposits a horizontal section shows increase in the ratio of nickel to copper towards the middle of the ore body. The output of mines shows an increase in the ratio with depth. The 'marginal' deposits show a greater ratio of nickel than do the 'offset' deposits."

(b) "Analyses of slag and matte show the ratio of nickel to copper to be greater in the matte than in the slag, and the same relation holds true for ore and the rock that is mined with the ore." One reason, doubtless, lies in the fact that molten nickel sulphide is more mobile than the copper sulphide, and that therefore a greater proportion of the former would settle out from the mixture. The relative solubility of the molten sulphides in the molten silicate solution is an unknown, but probably less important factor."

4. The analogies which Mr. Browne has shown to exist between the ore deposits and the furnace products strengthen the view that the deposits were formed directly from a molten magma.

5. Since the first solidification all the deposits have been altered—some slightly and others almost completely. The localization of the ore-bodies, however, was determined by the primary deposition, and this is, therefore, the factor of chief importance. The extent of secondary alteration has been peculiarly dependent on very local conditions, and the discussion of the nature of the secondary changes calls for more detailed description of individual ore bodies than is at present available.

STOPING DRILLS AT SUDBURY, ONTARIO*

By Albert E. Hall.

In late years the stoping drill of the hammer type has been steadily improved, until now no mine manager can afford to overlook the possibility of using it as a means of reducing his working costs.

A stoper is cheaper to operate, since it can be handled by one man instead of two, as required on a large machine. In some cases a helper is assigned to two or three stopers, but, as a rule, this is not advisable. In addition, the use of stopers permits a larger proportion of the total time to be spent in actual drilling. With a big drill much time is consumed in setting up after a blast or after moving to a new working place; with a stoper, on the other hand, the preparations for drilling are simple. As a rule, a stoper can be rigged up and set to work 30 to 40 minutes earlier than a big drill. One disadvantage of the stoper, when used for shrinkage stoping, is its tendency to create a large amount of shattered and partly loosened rock on the roof and walls of the working place. The men must first scale of this loose ground, which takes from 30 minutes to an hour. With a sufficient number of working places, however, this scaling can be done by a special gang of scalers, while the machine men are drilling in a previously scaled place.

As a result of the extra time applicable to drilling, and also of the more rapid drilling, stopers make an average of 30 to 40 linear feet of hole per shift, while a large drill will make 20 to 30 feet. As a rule stopers work on a bench in the back. When necessary a bench is created by taking out a diamond cut, and is then followed across the stope. The holes are made about 6 feet deep. The amount of powder used (40 per cent. dynamite) as computed from several groups of holes, average 0.63 lbs. per cubic yard of ore. The amount of air consumed by a stoper is estimated to be about two-thirds of that used by the largest drills.

Some workmen object to the stopers on the ground that stoppages for small repairs are too frequent. It is true that the dust, which is a disadvantage in itself, from the runner's standpoint, sometimes clogs the valve and prevents the extension leg or standard from working properly, but only a few minutes are needed to clean out the valve, and if a screen or a bit of waste be put into the hose, this trouble is almost eliminated. Water sprays can also be used. On the basis of total repair bills, the stopers do not compare unfavourably with the larger machines.

In many places it is impracticable to use a stoper, and a big drill becomes necessary; for example, in hard rock, where the light drill makes little or no headway; but in shrinkage stoping the smaller machine does excellent work. The stoper has one advantage, which is probably realized fully only by the men working underground; this relates to the matter of block-holing. Where the muck is being drawn off through chutes, the size must be fairly small, so as not to block the chute and so hinder tramming and hoisting. With small stoping drills, the ground is generally broken small enough to pass readily through chutes, and very little block-holing is required. With large machines, on the other hand, considerable block-holing is necessary.

*A paper presented at Houghton meeting Lake Superior Mining Institute, August, 1912.

SOME APPLICATIONS OF CONCRETE UNDERGROUND*

By H. T. Mercer, Painesdale, Mich.

The rapid growth in favor of concrete for certain classes of construction has been one of the most noteworthy engineering developments of late years; and in this the applications made to the mining field have played an important part. This is owing to the decreasing supply of suitable timber and to the limited life of even the best timber when exposed to underground conditions.

Concrete has been used for many years in building underground dams, bulkheads, etc., some notable examples of which can be seen at the Chapin Iron mine at Iron Mountain, Mich. The principal uses of concrete in mines, however, is in connection with shaft support, and it is the purpose of this paper to describe some of the work that has been done along these lines in the Michigan Copper Country. Good examples of concrete shaft collars can be seen at many of the mines, and although the details vary somewhat, a description of one or two will perhaps suffice to illustrate this form of construction.

At the Trimountain mine it was decided to replace the old timber collars with concrete, and work was begun at No. 2 shaft, where the overburden was 80 feet deep, consisting for the most part of sand, with more or less clay and some boulders. To guard against any possible "running" of the sand, and to make the operation of the shaft during construction easier, as well as to reinforce the concrete, it was decided to replace the timber with steel I beam sets, and then concrete between and around the steel sets. The sets would provide a support in case it became necessary to put in lagging to hold back the sand before the concrete was placed. A foundation was first prepared at the ledge by placing heavy steeel beam box girders across the shaft from foot to hanging under the dividers and under the south e—nd plate (Fig. 1A). At the north end there was a natural rock ledge or shelf. Starting from the foundation thus formed the steel sets were built up, two or three at a time, and concreted in. The work proceeded as follows:

First, the old timber on the ends and footwall was taken out for as great a height as was deemed safe; then two or three of the steel sets were placed and bolted up, after which the forms were erected, and the concrete poured. Then another space would be opened up and the operation repeated, and so on until the surface was reached. Fortunately the old hanging wall plates did not have to be removed, as there was sufficient clearance to permit the new concrete lining being carried inside of them. Care was taken to leave no timber or blocking under the foot wall side of the concrete lining which might by rotting permit settling.

*From School of Mines Quarterly, July, 1913.

The sand was carefully tamped along the foot wall as the concrete was finished. One skip road and the ladder way were built first, hoisting going on meanwhile in the other compartment. The skip was then changed over to the completed road, and the other road was built up. The steel sets were 2 feet 4 inches apart in the lower half of the collar, and 3 feet 0 inches apart in the upper half, centre to centre. The concrete between the sets was reinforced with ¾ inch rods, as shown by Fig 1, which also shows the construction of the steel sets and the position of the concrete.

The materials used for the concrete were: Portland cement, coarse amygdaloid stamp sand and crushed trap rock. They were mixed by hand in the proportion 1:3:5, in the shaft house just back of the shaft and lowered by means of a bucket and trolley, the trolley rope being concreted in on the hanging side as the work progressed. As no difficulty was experienced at No. 2 shaft with the sand running in, or otherwise, it was decided to build the Nos. 3 and 4 collars of reinforced concrete only, leaving out the steel sets. Fig. 3 shows the construction of the No. 3 collar, which was started in June, 1910, and finished in August, 1910. The materials for the concrete were the same and the work was carried on in the same manner as at No. 2, except that there were no steel sets. The collar at No. 4 shaft was similar to the one at No. 3, except that the dividers were made 12x48 inches instead of 12x12 inches. The overburden at No. 4 shaft was 128 feet deep on the pitch of the shaft, (71 deg.), that at Nos. 3 and 2 being 60 and 80 feet, respectively; but in order to secure a suitable foundation, the No. 3 and No. 4 collars were started some distance below the ledge in the solid rock. The length of No. 3 collar was 93 feet, and No. 4 was 158 feet.

Comparative Statement of Cost of Concrete Shaft Collars

	No. 2 Shaft.	No. 3 Shaft.	No. 4 Shaft.
Labor—			
Length to foundation..	80 ft.	93 ft.	158 ft.
Shaftmen	$2,019.10	$1,028.85	$1,994.70
Masons	528.51		
Surface labor	301.80	295.50	192.45
Blacksmith labor	360.41	67.55	40.50
Machinist labor	311.76	41.82	27.85
Carpenter labor	144.97	42.73	54.69
Electrician labor	10.84	8.82	8.96
Teaming labor	120.56	74.46	56.64
	$3,797.95	$1.559.73	$2,375.79
Supplies—			
Structural steel	$2,180.56		$ 136.00
Cement—1252 sks. No. 2	588.83		
Cement—1238 sks. No. 3		$ 470.80	
Cement—2169 sks. No. 4		810.09	
Stamp sand—11 cars No. 2	159.50		
Stamp sand—3¼ cars No. 3		45.70	
Stamp sand—8½ cars No. 4			123.25
Fine rock, 6 cars	90.00		
Sundry supplies	261.75	102.55	75.91
Freight	215.33		
	$3,495.97	$ 619.05	$1,145.25
Total cost of shaft collars	$7,293.92	$2,178.78	$3,521.04

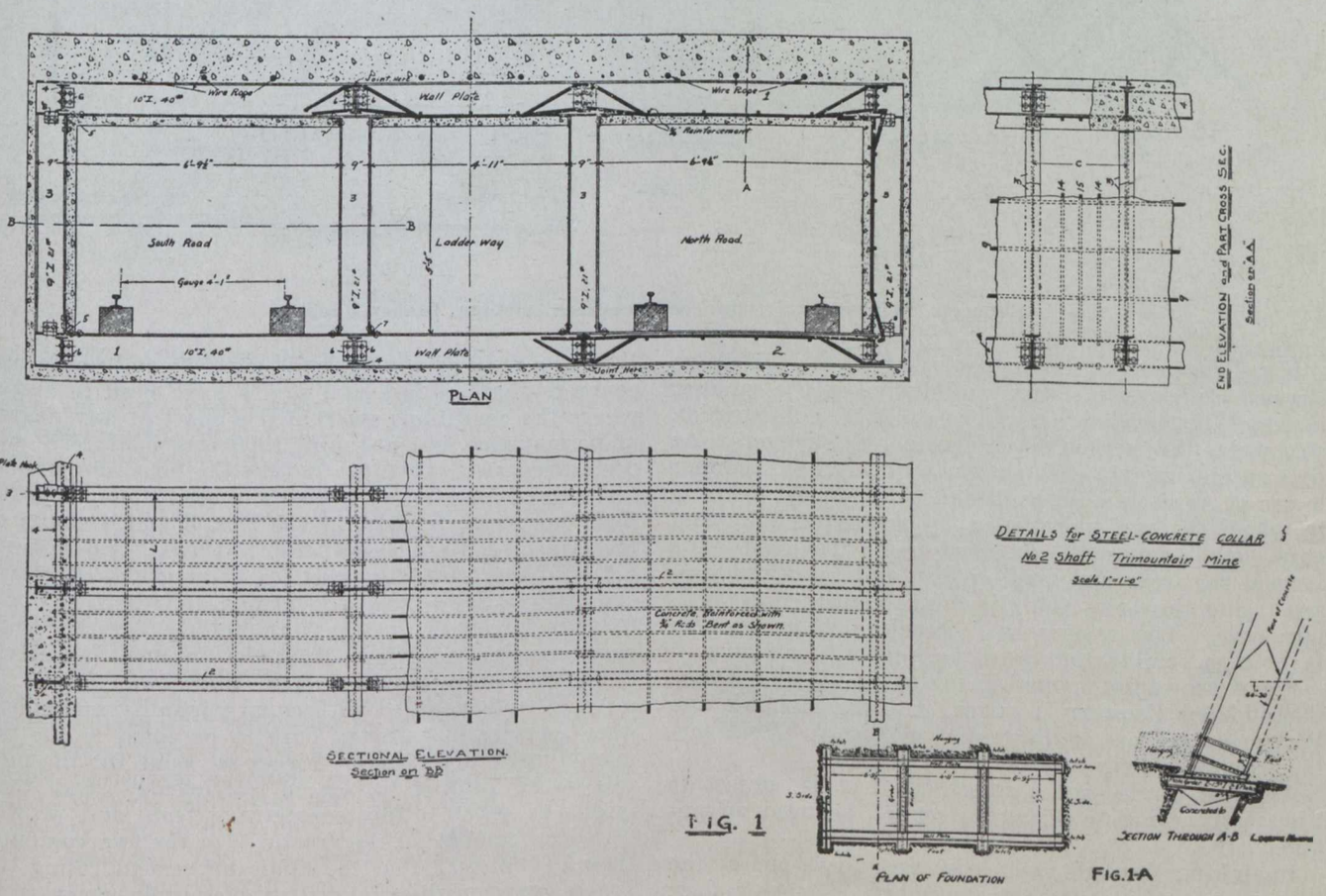


FIG. 1 FIG. 1A

Details for steel-concrete collar, No. 2 shaft, Trimountain mine

No. 2 Shaft Collar commenced February, 1907, completed August 1907.

No. 3 Shaft Collar commenced June, 1910, completed August, 1910.

No. 4 Shaft Collar commenced March, 1911, completed August, 1911.

Cost per Foot—	Labor.	Supplies	Total.
No. 2 shaft	$47.47	$43.70	$91.17
No. 3 shaft	16.77	16.66	33.43
No. 4 shaft	15.04	7.25	22.29

Fig. 2 illustrates a reinforced concrete collar designed by Mr. W. F. Hartman for No. 6 shaft, Mohawk mine, where the dip is very flat (about 38 deg.). The reinforcement was rods and wire rope. The collar was built in 17 days and the total cost was $3,931.00. The length of the collar was 100 feet. The pit was first excavated at the shaft site. Then the forms were started at the bottom and built up as the work progressed. The concrete was mixed on surface and run down to the working platform in an iron trough. The use of concrete for plat floors, levelers, stringers and dividers is becoming quite common.

put in, reinforced with old rails and wire rope. The concrete extended across the hanging and down on both ends, and sometimes across the foot, and there were also heavy concrete dividers 4 feet high by 10 in. thick, placed 10 or 12 feet apart. At several levels the whole plat was arched over with reinforced concrete. This lining has been in place about two years and has proven satisfactory.

Drift sets built of concrete have been tried to some extent at the Wolverine and Mohawk mines in some of their cross-cuts, where loose ground was encountered. These sets consisted of legs 6x6 inches in section, and a cap 6x8 inches, reinforced with ½ inch rods and wire rope. Concrete planks, reinforced with Kahn expanded metal, or woven wire, were used for lagging. Above the caps they were 4x14 inches in section and behind the legs 2½x14 inches.

The use of reinforced concrete in the form of shaft sets and lagging is well described in a paper read before the Michigan College of Mines Club, at Houghton, Mich., by Mr. E. R. Jones, who has kindly given his permission for the use of the following excerpt:

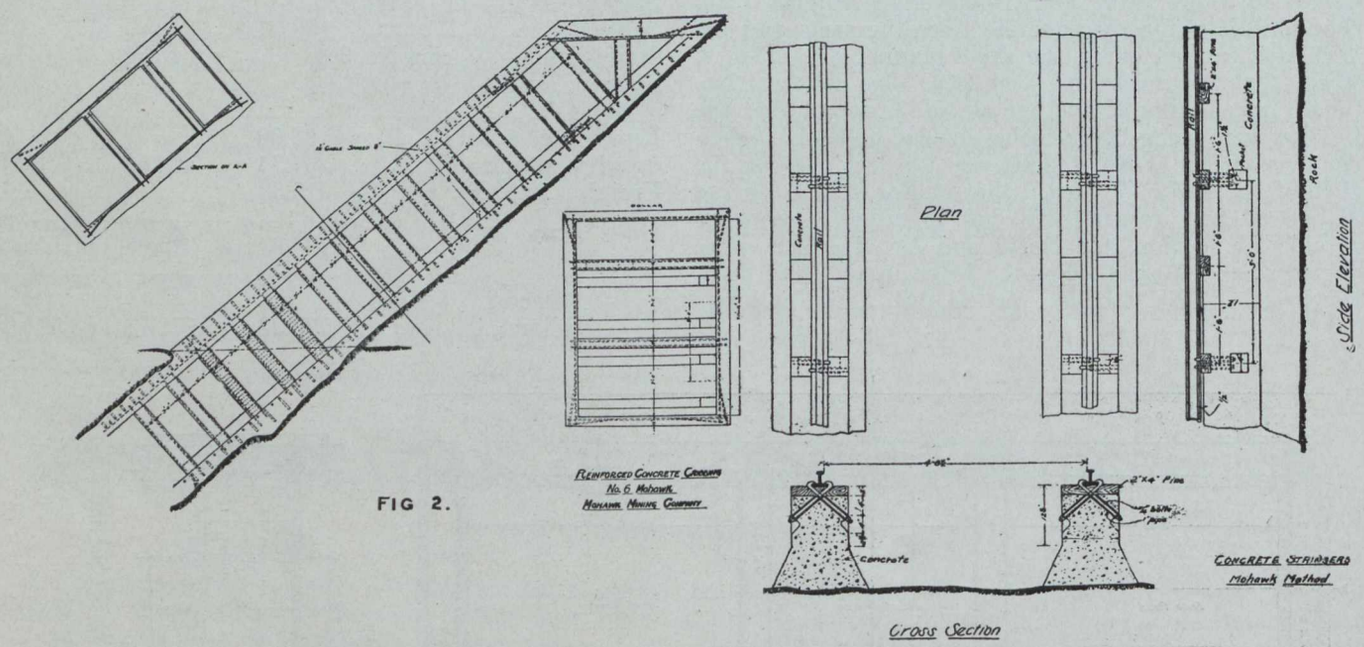


FIG 2.

Concrete Stringers and reinforced concrete cribbing, Mohawk mine

Fig. 4 shows a station or plat in one of the Champion Copper Company's shafts, and indicates the manner in which the levelers are reinforced. This illustration also shows the method used for concrete stringers. At first an all concrete stringer was built after the manner in use at Ahmeek mine, as designed by Mr. W. J. Uren, to which the rail was bolted by means of bolts and clips, but because of the hard rigid roadbed thus formed the wear and tear on skip and rails was very great, and the bolts and clips were continually working loose. The scheme was therefore abandoned in favor of a combination wood and concrete stringer.

Fig. 4 shows the method in use at the Copper Range Consolidated Company's mines, and the Mohawk and Wolverine scheme is illustrated in Fig. 6. Both methods made a very satisfactory roadbed.

At some of the mines where the foot is subject to "heaving" concrete stringers cannot be used advantageously.

In sinking through some loose ground at one of the Champion shafts it became necessary to close-timber, or line the shaft. Concrete 12 to 18 inches thick was

"For a number of years solid concrete and reinforced concrete shaft collars and shafts have been in vogue where the conditions warranted a shaft of any degree of permanence, but not until 1909 was reinforced concrete tried as a substitute to take the form and similar methods of installation as the long-used timber sets for shaft purposes; namely, at the Nos. 3 and 4 shafts of the Ahmeek Mining Company. At first, two distinct kinds of material were used; a good grade of gravel and natural sand from a local pit; and the trap rock, through which the shafts were sinking, together with clean conglomerate sand from the Calumet and Hecla mill. Sets were moulded from these two classes of material and installed with equal partiality and subsequent service has proven both to be equal to the demands made upon them. Pieces set aside for the purpose were allowed to season sufficiently that they might be given a fair competitive test, and it was found on comparing the fractures in the two combinations of material, that the sand and cement filling the spaces between the rounded pebbles broke away from them, while the fracture in the trap-conglomerate same

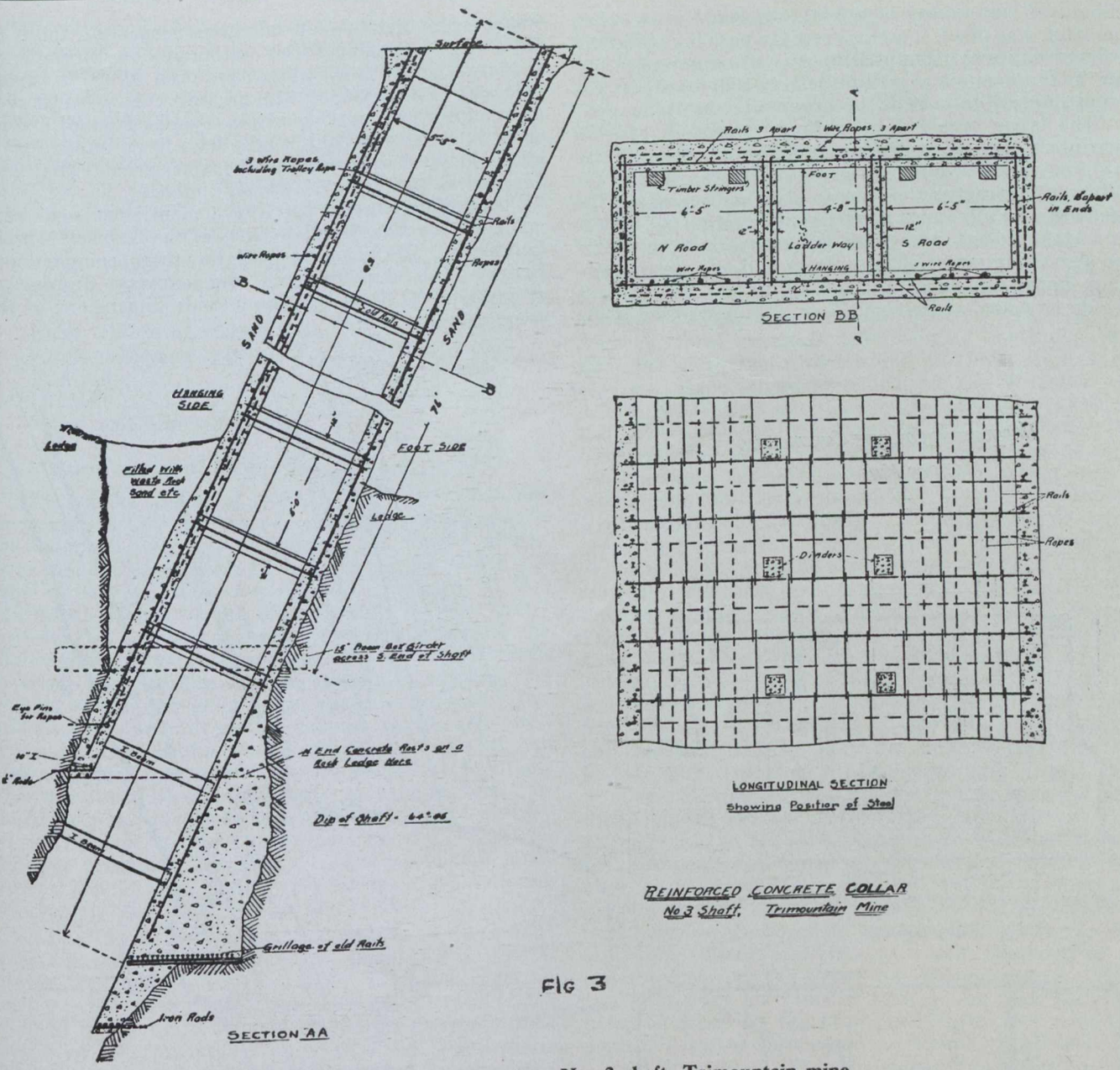


FIG 3

Reinforced concrete collar, No. 3 shaft, Trimountain mine

combination continued through the larger elements of the mixture. The gravel mixture could doubtless have been improved considerably by careful washing, but the cost of preparation, compared with the trap rock and conglomerate sand, prohibited its use in this particular case.

"The materials finally used were as follows:

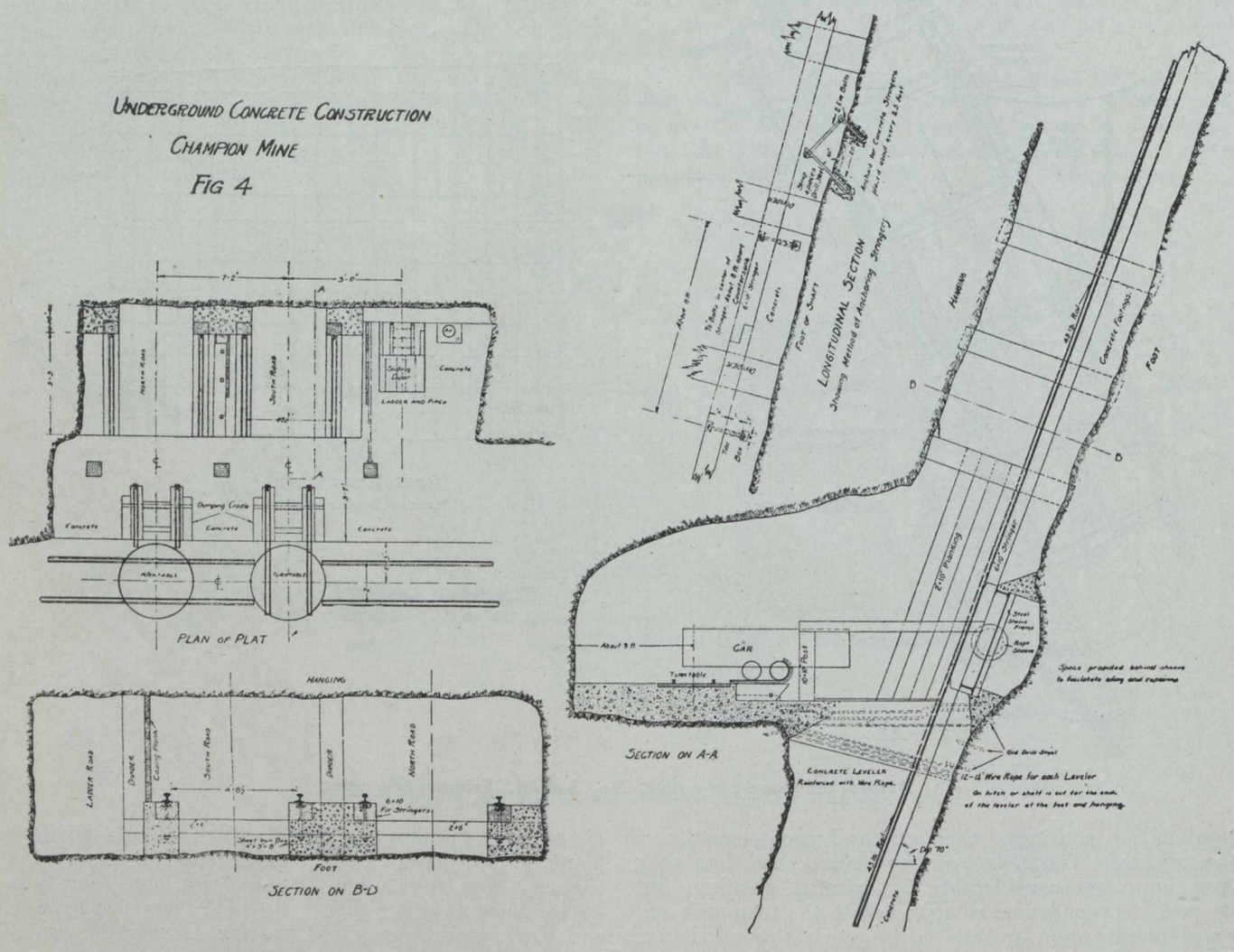
"No. 1 Portland cement. Conglomerate sand. Trap rock trommeled over ¾ inch through screens. The proportions used were 1:3:5 in wall plates, end plates, and dividings, and 1:2:4 in studdles. The reinforcement in wall and end plates consisted of three ¾ inch monolith steel bars with ¼ inch webs, crimped onto them, together with two straight ¾ inch monolith bars. The dividings were reinforced by four ½ inch monolith steel bars wound spirally with ¼ inch steel wire, the whole presenting a column with square cross-section. Studdles were reinforced with two pieces of old wire rope 1¼ inch in diameter. Reinforced concrete slabs were moulded for the shaft lining, the material used being fines of trap rock under ¾ inch, conglomerate sand and Kahn expanded metal as reinforcement. The mixture used for slabs was 1:2:4. By way of experiment, the writer selected a piece of No. 1 hemlock plank of the same length, width and thickness of a concrete slab, which had seasoned for one year, supported them at either end, and placed them side by side, and then applied an equal pressure across the centre of each. Three failure cracks appeared in the concrete slab just previous to the breaking of the hemlock plank, although total collapse of the concrete slab did not occur until the pressure was considerably increased. While the method of the test employed was crude, it proved to the satisfaction of the writer that the concrete slab was much superior in strength. Considering the rapid decay of timber used as shaft lining no further comparison of the two is necessary.

"In the moulding of the concrete sets, 2 inch No. 1 white pine was used in the construction of the forms. These were soaked in Delaney's wood preservative, and repainted with preservative on the interior each time before setting up, thus insuring them against warping and prolonging their lives indefinitely, as well as securing a smooth and easy parting from the concrete when removed. A Smith barrel type mixer was employed in preparing the charge for the forms. The

amount of water used in the mix was such that, when the batch was piled, it settled rapidly without agitation. A dryer mix was attempted by way of experiment, but due to the amount of reinforcement employed, it was found impossible to ram the dryer mix into place.

"The labor involved in making consisted of two carpenters, setting up forms and keeping them in repair; one man wheeling forms onto skidways ready for filling, returning used forms to shop and cleaning the same; one man feeding mixer from stock piles of rock, sand and cement; one man delivering mix to forms and shovelling material into place; and one mason ramming charge into final position. With this combination of men as many as four complete sets, consisting of 64 separate pieces, have been moulded in one day of nine hours. In ordinary weather, the sides of the forms were allowed to remain in position over night, and then removed, while the bottoms were left in place another 24 hours. The bottoms were removed by turning the pieces on their sides, where they were left to harden one day longer before removal to the stock pile. All through the process of removal the sets were handled with the greatest care in order to preserve the appearance of the set and prevent cracking, which might not develop to the eye until weathered. All skidways used in making and storing were brought to a level to prevent warping and bending while the sets were green, to insure a perfect fit underground, for, unlike timber, the concrete set cannot be brought to place unless perfectly true. Sets should not have been used under 60 days after removing forms, although we, through the reduction of the stock piles, have been forced to install pieces of 14 days set, but the greatest care was observed in handling and putting in place underground. Concrete sets one year old, which have been subjected to all manner of weather, can be abused somewhat and handled almost as carelessly as timber.

"As before stated, the above mentioned sets were made for the Nos. 3 and 4 shafts of the Ahmeek Mining Company. The shafts are of the three compartment variety—two skipways and one manway, dipping at an angle of 80 degrees. The outside dimensions of the compartments are:



Sections and plan showing underground concrete construction, Champion mine

"Skipways—7 feet 6 inches high, 6 feet 10 inches high.

"Manway—7 feet 6 inches high, 3 feet 0 inches wide, with the end plates and dividings, making the greatest span of 7 feet 6 inches. Offsets were moulded in all plates 5 inches from the inside face to accommodate lining slabs. Also, holes were cored for the use of hanging bolts and bracket bolts. The wall plates, end plates and studdles have a cross-section of 80 square inches, dividings 81 square inches. The percentages of reinforcement are approximately as follows:

Wall and end plates .....5 per cent.
Dividings .....5 per cent.
Studdles .....3 per cent.

"It was found advisable from the beginning, because of the great weight of the wall plates, to mould them in two sections, one section spanning the ladder way and one skipway, and the other section spanning the remaining skip compartment. These two sections were connected when in place by two bolts passing through holes, cored for the purpose, and two straps of iron spanning the splice. Studdles were made for 4 feet 0 inches, 5 feet 0 inches, and 6 feet 0 inches sets to accommodate the ground passed through.

"The weights of the different pieces comprising the set are as follows:

	Pounds.
Long section of wall plate	1,035
Short section of wall plate	700
End plate	600
Divider	645
Three feet 3 inch studdles	268
Complete set of 16 pieces	8,104

"Taking the weight of No. 1 Western fir, which has been exposed to the weather in stock piles, as 33 pounds per cubic feet, the above concrete set weighs almost three times that of a 12x12 inch timber set, which the concrete set is intended to replace. Because of this additional weight of the concrete set, it was found necessary to increase the usual five or six men on the timber gang to seven in number. In a vertical shaft, to which the concrete sets are especially adapted, the number of men per gang might again be reduced. The sets are hung or built as the ordinary timber sets, only requiring an additional rope and block to swing the pieces in place. After the sets are wedged to line, bottoms are put in between the plates and the surrounding shaft wall, and the set is then tied to the shaft wall by means of concrete, in the proportion of 1:3:5. The concrete slabs are then put in place, and loose rock thrown behind them, filling up what space still remains between the set and the wall of the shaft.

"After the set is in place, it is extremely important that it is well protected from the blast, for, unlike the timber set, concrete will not stand the blast. For the purpose, the writer used flat timber and steel plates chained to the under side of the plates and dividings, and even this precaution was at times inadequate. Where the ground was breaking easily, the sets have been as near as 12 feet to the miners, and again when the ground was especially refractory, sets 40 feet from the blast have been cut out. It is obvious that it is well to keep as far behind the mining as the ground will permit. In dangerous ground, which required timbering close up to the sinking, timber sets were used, but, had not time played an important part in the sinking, no ground was met in which concrete sets could not have been installed. With a gang of seven men, one complete set can be installed in a nine hour shift. This permits a sinking rate of better than one hundred feet per month, which was accomplished at the Nos. 3 and 4 shafts.

"The comparative cost of the concrete set and timber set, delivered at the shaft collar, is striking. The concrete set was delivered for $22.50, the timber set for $37.60. These figures are based on:

"Western fir at $28.00 per M., f.o.b. car.

"Crushed rock at 35c per yard, f.o.b. shaft

"Conglomerate sand at 60 per yard, f.o.b. shaft.

"No. 1 Portland cement at $1.15 per bbl., f.o.b. works.

"Reinforcement at $12.00 per set, f.o.b. factory.

"The Ahmeek Mining Company, I believe, was the first to adopt the concrete stringers, and the Mohawk Mining Company soon followed with their use. At the Ahmeek, these stringers have been in continuous use since the beginning of operations, and have required no repairs. Superintendent Smith of the Mohawk has informed me that soon after the stringers were installed, skip repairs increased about 100 per cent. The stringer being entirely rigid and the skip also of rigid construction, the axles of skips were found to be crystallized and the rivets working loose. This feature was overcome by moulding inch pine strips, after preserving them in Delaney's wood preservative to prevent decay, into the stringers at intervals of three feet, allowing them them to propect one-half inch above the face of the stringer, and resting the rail thereon. The pine strips have been in place four years, and none have been replaced to date, and skip repairs have been reduced to normal. Possibly because of a differently constructed skip, Ahmeek repairs were not abnormally high, but the same racking of the skip body occurred and the Ahmeek Company has adopted the Mohawk feature and expects to profit accordingly.

"Concrete plats, or stations, have been in use at both the Ahmeek and the Mohawk for some time. They differ from the timber plat in outward design only in the cross-section of the members, which are 9x12 inches, and are reinforced with old rail and wire rope, and replace the 12x12 inch and 12x14 inch timber formerly used. Holes are bored to accommodate gates for skip and dump doors, and tram rails are imbedded in the concrete, making the use of spikes unnecessary. When turn-tables are used on the back of the plat, the rigidness furnished by the concrete insures the trammers against derailed cars, resulting from a tilted table.

"At the present time our company is installing reinforced concrete dividings to replace the practice of putting in 10 inch flat timber. In cross-section they are 9x12 inches, and are reinforced by old rail. On the ladder road, they are placed six feet from centre to centre and between the skip compartments are put in as often as the hanging requires. Since the casing along the ladder road performs no other office than the protection of the men while on the ladder, or in case of a fall, plank is used for the purpose, and a 3-inch hemlock strip is moulded into the dividings to facilitate the fastening of this casing."

SPECIAL CORRESPONDENCE

PORCUPINE, SWASTIKA AND DANE

The Bush Fires which have caused so much uneasiness and loss of property, have subsided without much damage to the mining industry. The Cobalt camp is, of course, safe, and has been for several years past, owing to the very large area absolutely clear of all vegetation. In Porcupine there was some trepidation; but, thanks to the wholesale and very efficacious precautions taken after the lamentable fire of two years ago, there was no damage of any account done. At Kirkland Lake the bush is fairly green, and the wind shifted at a favourable moment. To sum up, the only loss was of several plants, isolated and long abandoned.

A Copper Mine at Dane.—There appears every possibility of the Temiskaming districts possessing a copper mine. In the first annual report just issued, Mr. G. O. McMurty, manager for the Dane Mining Company, estimates that in milling ore alone, they now have reserves which should yield a profit of over half a million dollars. The principal claims of the Dane Mining Company are about six miles from Dane, which is a station on the T. and N. O. Railway, fifty miles north of Cobalt. Before Cobalt was discovered, the Temiskaming and Hudson Bay Mining Company of New Liskeard sent prospectors north before they heard of the staking in Cobalt. These men stopped at Boston township, going up there by way of the Blanche River, before the steel was laid past New Liskeard. They staked what they described as iron deposits, but the claims were allowed to lapse when the tremendous excitement broke out at Cobalt. Some of these claims undoubtedly are the same as are now proving to be of value to the Dane Mining Company. After detailing the development to date, Mr. McMurty states: "We can therefore conservatively estimate by figuring on the vein or veins to a depth of 200 feet, and for the distance between the two shafts, together with a reasonable distance to the east of No. 4, altogether a distance of, say 1,000 feet, and by averaging the width to 7 feet it is 10 feet wide to the east of No. 1 on the surface, that we have 116,600 tons of ore. Figuring on three and a half per cent. copper content, we can reasonably conclude a net profit of $571,000."

Mr. McMurty points out: "This estimate, it must be remembered, does not include further high grade ore we are expecting in No. 4, nor the 4 per cent. blue quartz lead at the south of No. 4, nor the ore on the dumps, of which there is a considerable quantity, nor does it include the ore which we have in the bottom of the winze."

"The high grade ore is a direct smelting proposition. The lower grade material should probably be treated in a smelter on the ground reducing to a copper matte."

The company has made estimates, which show that it would be possible to set up and have running a 100 ton per 24 hours' smelting plant, for between $25,000 and $35,000.

Jupiter Again Active.—Resuming work after shut down caused by the strike, the Jupiter mine is now very busy in blocking out ore for the proposed new mill, plans for which have already been drafted. Ten to twelve drills are working underground, the company having rented the plant of the Plenaurum Mining Company. Recently a raise was put through from the 300 to 200 foot level, and here some of the best grade ore in the mine was found. At the 300 foot level there has now been developed an ore shoot 300 feet in length.

It is proposed that the Jupiter mill shall be financed out of the sale of the 157,214 shares as yet unissued.

The Rea Mine at Porcupine is being worked by the Mines Leasing Company on a 25 per cent. royalty basis. The little mill, which was purchased from the defunct Little Pet Mining Company, is now dropping stamps, and will treat between 17 and 18 tons per day. Before the old company abandoned the mine, there had been blocked out between the surface and the 200 foot level 10,000 tons of good milling ore, the shoot being from 180 to 200 feet long. No ore of milling grade was found at the 300 foot level, and the Mines Leasing Company will at once endeavour to pick up the vein.

Petzite at Harricanaw.—In a specimen from the Maloney claim at Harricanaw, the Northern Quebec gold camp east of Cochrane, there has been discovered the telluride ore, petzite. It was taken from the lead which yielded some remarkable specimens of free gold. Very little work so far has been done on claims in this particular district, although there have been prospectors in there for a year and a half at least. The Harricanaw district is reached from Cochrane and the Transcontinental. The claims can be reached by water from the Transcontinental Railway at a point about 130 miles east of Cochrane.

Hughes Porcupine.—At the 300 foot level of the Hughes Porcupine mine good results are being obtained. The development at this level has so encouraged the directorate that they have had plans drawn for a much larger mill. The present little mill has a capacity of only about ten tons a day.

Nickel Shipments from Alexo Mine.—During the month of June the Alexo Mining Company shipped 12 cars of about 30 tons each from the nickel property near Iroquois Falls. All this ore is going to the Mond Nickel Company's smelter at Coniston. The ore is still being taken out from the open cut. This has now attained a depth of 40 feet. The ore is being mined for a width of about eight feet.

COBALT, GOWGANDA AND SOUTH LORRAIN.

Cobalt Townsite and Casey Cobalt.—The production of the two principal English companies for the month of June by weeks was: Cobalt Townsite, June 7, 41,100 ounces; June 14, 41,500; June 21, 41,100; June 28, 40,100; total, 123,800 ounces. Casey Cobalt, June 7, 19,900 ounces; June 14, 20,000; June 21, 20,200; June 28, 20,000; total, 80,100 ounces.

Beaver Consolidated.—In the last quarterly report of the Beaver Consolidated Mining Company, the Beaver Auxiliary prospect at Elk Lake plays a prominent part. Mr. Frank L. Culver, in his report to shareholders, states that the Beaver Consolidated had already paid $40,000 for a three-quarters interest, leaving $30,000 still to pay. $34,800 has already been spent on development, and three-quarters of the amount, $26,100, had been paid by the Beaver Consolidated Mining Company. The shaft on the property is down to a depth of 194 feet, and the first cross-cutting will take place at the 280 foot level.

The company's cash balance on May 31 was	$ 7,226.71
Ore at smelters and in transit	40,994.17
Ore bagged ready for shipment	50,932.27
	$102,153.15
Less accounts payable	16,969.98
Available balance	$ 85,183.17

The Gowganda-Elk Lake Branch T. and N. O. Ry.—There seems very little possibility that the T. and N. O. Railway will undertake the extension of the Elk Lake branch into Gowganda. In an interview, Mr. J. L. Englehart, the chairman of the T. and N. O. Commission, states that of the half dozen surveys taken in an effort to locate an extension to Gowganda, there had not been one route which would warrant the construction. However, survey parties are still in the field.

Keeley Mine Has Good Ore.—There appears every probability that Erhlich and Hamilton, the English syndicate which is working the old Keeley mine of South Lorrain, will exercise their option. Two excellent veins of high grade ore have been discovered at the 50 foot level, and one of these has also been found at the 100 foot level.

Penn Canadian.—Although the Penn Canadian developed an old mine to a good producer during the

year, the first annual report shows a deficit. According to the president, Mr. Wm. J. Haines, the first 12 months' operations resulted in a loss of $24,211. He explains it as being "due to the exhaustion of ore, depreciation of plant and equipment, and annual proportion of deferred charges included among the assets."

A New Vein at the Savage Mine.—The most important discovery of the present year in the Cobalt camp was the cutting of an entirely new vein on the Savage property of the McKinley-Darragh-Savage Company. It is between two and a half to three inches wide of $5,000 ounce ore. In addition, the wall rock on both sides of the vein promises to make good milling grade.

The discovery was made in virgin territory. A crosscut, driven south from the No. 10 vein at the 140 foot level, cut the new ore body at a distance of 40 feet. The vein has a strike of east and west paralleling No. 10 vein.

BRITISH COLUMBIA.

Ore Receipts at the Consolidated Mining and Smelting Co.'s Smeltery at Trail during the six months to July 1 have been about 170,000 tons. Exact figures are not yet available, but it is known that the aggregate for the half year will be approximately that quantity. A rough apportionment shows the sources from which ore was received to have been as follows: From mines in East Kootenay, 18,000 tons; Ainsworth, 5,000 tons; Slocan, 12,000 tons; Nelson, 5,000 tons; Rossland, 113,000 tons; Boundary, 4,000 tons; Lardeau and other small shipping districts, 1,000 tons; United States, 12,000 tons. These figures do not include ores milled, but only the concentrates from such ores. An estimate of the quantity of ore received at Boundary district smelting works during the same period places it at 950,000 tons, 620,000 tons at the Granby Co.'s smeltery at Grand Forks, and 330,000 tons at the British Columbia Copper Co.'s reduction works at Greenwood. Included in the latter amount is about 20,000 tons from United States mines; otherwise practically all the ore was from the several mines of the respective companies. Then, the production of the Britannia and other mines in the Coast district was probably about 100,000 tons for the half year. Allowing 100,000 tons for other ores, not sent to smelting works, but treated in stamp mills or concentrators, it is evident that the aggregate output of the lode mines of the province during the expired half of the year has been about 1,320,000 tons. As the aggregate for 1912 was 2,688,000 tons, it would seem that this year's output of ore has thus far been approximately similar to the rate recorded for last year.

A Brief Review.

Briefly reviewing the position, mention may be made of the leading metal mines in the various districts, as under:

In East Kootenay, the Sullivan Group mines are the only important present producers of ore. Their output for the half year has been nearly 18,000 tons.

In West Kootenay, the several mining divisions worthy of mention are: Ainsworth, Slocan, Nelson and Trail Creek (Rossland). The Bluebell, near Kootenay Lake, made a comparatively large output of lead-ore—somewhere about 30,000 tons. Other mines in Ainsworth division that sent out ore, though in comparatively small quantities, were the No. 1, Silver Hoard, Florence Co.'s, and Utica. Development was continued on Retallack and Co.'s Whitewater group and on several other properties.

In Slocan district, the Lucky Jim and Noble Five mines shipped zinc ore, while the Rambler-Cariboo, Richmond-Eureka, Standard and Van-Roi sent out silver-lead products—ore and concentrate. The two last-mentioned also shipped zinc concentrate. Others that had more or less work done on them, and in some cases shipped ore, are the Payne, Ruth-Hope group, Slocan Star, Surprise, Silverite, Cinderella, Idaho-Alamo, Hewitt-Lorna Doone, L. H., Eastmont, Lily B. and a number on which operations were less important.

In Nelson division, the Queen Victoria (which shipped 13,000 tons of ore to the smeltery at Greenwood), Eureka, Granite-Poorman, Molly Gibson and Silver King group, in the northern part of the division; the Dundee, Yankee Girl and Wilcox, in Ymir camp; the Emerald and H. B.—both lead mines—near Salmo; the Queen and Motherlode, in Sheep Creek camp, and the Arlington and Second Relief, in Erie camp, constituted the chief working mines in this division.

Rossland mines, in Trail Creek division, made a production of about 123,000 tons, this including the ore concentrated at the mill of the Le Roi No. 2. Of this total about 102,000 tons was from the Consolidated Mining and Smelting Co.'s Centre Star and Le Roi groups, and practically all the remainder from the mines of Le Roi No. 2, Ltd. The destruction by fire a few weeks ago of the big head-frame, shaft-house, ore-bins, etc., of the War Eagle mine, while not seriously interfering with ore-production, occasioned the Consolidated Co. some inconvenience and loss. The Inland Empire gold mine and stamp mill, in this division, was operated when weather conditions permitted.

Turning to Boundary district, which produced between 900,000 and 1,000,000 tons of ore, it may be noted that both the Granby and British Columbia Copper companies continue to regularly maintain a comparatively large output of ore—the former from its big copper mines in Phoenix camp, and the latter from its Mother Lode mine and the New Dominion Copper Co.'s Rawhide mine. The Consolidated M. and S. Co.'s No. 7 mine shipped about 3,700 tons of ore to the company's smeltery at Trail. Additional plant and machinery was put in at the stamp mill of the Jewel-Denero Mines, Ltd., and preparations were made for mining and milling ore. Several other properties were worked in a small way, but they did not add much to the total of ore-production.

In Similkameen district, the only producer was the Hedley Gold Mining Co.'s Nickel Plate group, with an output of about 35,000 tons and a recovery of gold valued at approximately $450,000. The British Columbia Copper Co. continued doing exploratory work on a number of mineral claims on Copper Mountain, a few miles from Princeton, with results that are stated to promise favourably for the establishment there of a productive copper camp. Some work was done on placer-gold claims on Granite Creek, and the development of several mineral claims in Summit camp, at the head of the Tulameen River, was continued.

In the Coast district, the Britannia, near Howe Sound; the Marble Bay, on Texada Island; the Surf Inlet Gold mine, on Princess Royal Island; a considerable total of work in Omineca division of the Skeena country the important development work continued at the Granby Company's Hidden Creek mines, and the preparations for the establishment of a 2,000 ton smelting works; the operations of the Portland Canal Tunnels, Ltd., the Indian Mines, Ltd., and others in Portland Canal district, and the work done on Queen Charlotte Islands—all these contributed to a total of work and progress that augurs well for substantial improvement in the metal-mining industry of this district.

No detail can now be given relative to placer-gold mining in Cariboo and Atlin districts, nor of coal mining in various parts of the province. As to the former,

it may be said that the gravel-washing season opened auspiciously, with much snow on the mountains and cool weather to ensure its melting only gradually. It is hoped that there will be plenty of water late into the summer, and that autumn rains will assist in prolonging the operating season. Concerning coal mining —it is thought that production is being well maintained in all the coal mining centres of the province, save only in Nanaimo district, where there are labour troubles.

General Notes.

The low-level tunnel being driven by the Portland Canal Tunnels Co., about three and one-half miles from the town of Stewart, at the head of the Portland Canal, was in 1,400 ft. by about the middle of June. It is estimated that a further distance of 900 ft, will have to be driven to reach the fissure zone at that depth.

A drilling contest is to take place at Rossland on July 16, open to all union men in good standing. Fifteen minutes will be the time to be allowed for each team to drill. The first prize will be $100 and the second $50.

Development of the Milly Mac mine, near Burton, Arrow Lake, will be continued this summer.

The 10-stamp mill of the Coronation Gold Mines, Ltd., operating on Cadwallader Creek, Lillooet mining division, has been started crushing ore from the company's mine nearby. It is stated that a mill will shortly be placed on the Pioneer claim, in the same locality.

Requiring siliceous ore for metallurgical purposes, the Consolidated Mining and Smelting Co. lately resumed work at its No. 7 mine, situated several miles from Boundary Falls, Boundary district. After having shipped nearly 4,000 tons of ore to Trail, operations were suspended.

A report published in Spokane, Washington, is to the effect that during four months, to May 1, ore shipments from the Rambler-Cariboo mine, Slocan, totaled 1,403 tons, as compared with 1,153 tons during the whole of 1912. The quantity of crude ore and concentrate received at Trail from that mine during six months, to July 1 inst., was approximately 1,600 tons.

Negotiations have been in progress for some time with the object of securing the use of the electrothermic smelting plant at Nelson for the purpose of completing the investigation, by the Mines Branch of the Canadian Department of Mines, of the application of electric melting to the zinc ores of British Columbia. It is probable that the plant will be in operation during the ensuing autumn.

NOVA SCOTIA.

Dominion Coal Outputs.—During the first half of June the outputs were much reduced by absenteeism and general shortage of unskilled labour. Towards the end of the month, howeer, these conditions became much improved, and in the closing week of the month particularly, a high rate of production was obtained. During the week ending the 28th, the production of the Glace Bay mines was as under:

	Tons.
June 23	15,506
" 24	17,600
" 25	17,307
" 26	17,633
" 27	18,130
" 28	16,997
Total	103,203

This is the best sequence of outputs as yet obtained from the Coal Company's mines. The output for the month was 394,000 tons compared with 391,498 tons in June, 1912. The aggregate outputs to the end of the half year totalled 2,292,000 compared with 2,124,158 tons over the corresponding period of last year, a gain of 168,000 tons. The output of 18,130 tons for the 27th marks another record, which it is hoped will be again exceeded on several occasions during the coming summer. Following is the output of the individual collieries for this record day, and also for the month of June:

No. 1	2,082	44,000
2	3,147	68,000
3	526	9,200
4	1,437	33,000
5	762	18,800
6	1,198	22,200
7	813	17,900
8	297	6,400
9	1,285	30,500
10	694	16,000
11	222	3,900
12	1,257	29,600
14	1,671	36,000
15	844	18,100
16	1,079	22,400
21	600	12,600
22	216	4,600
	18,130	394,000 (Approximate)

QUEBEC.

The Asbestos Industry in the Thetford district has come to its own, and the prosperous times predicted for the past several years are now everywhere in evidence. Practically all the mines are working double shift and shipments are made as fast as the material can be produced. The fibre mines at Broughton are still idle, while of the three at Robertson but one is operating. The reason for the delay in these mines starting up is unquestionably the fact that the advance in prices has been principally in crudes and long fibre and that the advance in the price for short grades will be slow until the surplus in these grades has been used up. Recent reports moreover, indicate that there is a steady cleaning up of the various surplus stocks so that in a few months we may expect the average price equal to those of 1908.

Wages have advanced from 17½ to 20 cents per hour for pit labourers, and several of the mines have contracted for the mining and delivery of the ore. A good deal of labour has come into the camp and the present supply is considerably in excess of what it was at this time a year ago.

Mr. Theo Denis was a busy visitor to our city this past week when he was making elaborate preparations for the visit of the Congress Geologique.

Mr. P. Hammerich, who has for the past two years been mill superintendent for the Bell Asbestos Co., has accepted a similar position with the Jacobs Asbestos Co.

PERSONAL AND GENERAL

J. B. Tyrrell is making a short visit to the Harricanaw district in Northern Quebec to investigate some recent gold discoveries.

Mr. T. F. Sutherland, assistant inspector of mines, has been appointed chief inspector of mines of Ontario, to succeed Mr. E. T. Corkill.

The Lake Superior Mining Institute will hold its next annual meeting, August 26th to 30th, on the Mesabi Range, at places to be selected by the local committees as most convenient during the trip.

W. J. Woolsey, Thetford Mines, has returned from a nine months' business trip to Europe.

Chas. Spearman is superintending development work on the Burnside claims at Kirkland Lake.

A. E. Blair, Julio Madero and Raoul Madero, mining engineers, who took a prominent part in the Mexican revolution, are in New York City.

P. B. McDonald is at Gouverneur, N.Y.

Robt. Bryce is in charge of development work on properties south of Kirkland Lake.

H. K. Boysen has joined the staff of the Foster mine, Kirkland Lake.

Chas. H. Rogers, representing Ontario Porcupine Goldfields Company during the past year at Porcupine, leaves this month on a business trip to London, England.

Mr. Arthur S. Herbert has resigned his position as general manager of the Siemens Company of Canada, and has been appointed general manager of the branch offices of the Siemens Company in Australia.

W. Henderson Clark, managing director of the Anglo-French Exploration Company of London, England, and J. A. Denison, engineer in London for the same company, sailed from Quebec for Liverpool on June 26th on the Empress of Ireland, after having spent a month in the mining camps of Northern Ontario. They were accompanied on their trip by J. B. Tyrrell, who is their consulting engineer and representative in Canada.

The Roberts and Schaefer Company, engineers and contractors, Chicago, have just closed a contract with Mr. W. W. Keefer, president of the Pittsburg Term. Railway and Coal Company, and also the Millburn Coal and Coke Company, for the building of a large steel tipple at Keeferton, W. Va. The cost of this tipple will be about $30,000, and it will be equipped with the new Marcus combination screen and picking conveyor.

Mr. W. L. Anderson, formerly of Porcupine, has been appointed local manager for the Motherlode Sheep Creek Mining Co., with gold mine and stamp-mill in Sheep Creek Camp, Nelson mining division, British Columbia. Mr. Geo. E. Farish, of New York, resigned as general manager for the company several weeks ago. He left Nelson on a visit to New York, going via Montreal, at the end of June. Mr. John McMartin and associates are large shareholders in the Motherlode Co.

Mr. J. Berglund is in charge of diamond drilling operations for the British Columbia Copper Co., on a group of mineral claims that company is exploring under option of purchase, on Copper Mountain Similkameen, British Columbia. Four drills are being worked, and much development work is being done as well, under the superintendence of Mr. Ed. Berryman.

Mr. J. F. Fredin, formerly of Toronto, has for some time been engaged in doing mining engineering work for the British Columbia Copper Co. on Copper Mountain, near Princeton, B.C.

Mr. Jay P. Graves, vice-president and general manager of the Granby Consolidated Mining, Smelting and Power Co., accompanied by Mr. George W. Wooster, treasurer of the company, left Spokane late in June for Granby Bay, Observatory Inlet, B.C., on a visit of inspection of the company's Hidden Creek mine and the new smelting works being erected and equipped in its vicinity. On the coast the party was to be joined by Mr. A. C. Flumerfelt, of Victoria, who is also one of the directors, and Mr. F. M. Sylvester, assistant to Mr. Graves.

Mr. James J. Johns was given a valedictory smoker and made the recipient of a valuable present of silver plate and glass on the occasion of his leaving the Motherlode mine, near Greenwood, B.C., to proceed to Sudbury, Ontario, to begin his new duties of mine superintendent for the Dominion Nickel Co.

Mr. Frederick Keffer, geologist and mining engineer for the British Columbia Copper Co., recently examined a mine in Montana for that company. He was accompanied on his trip by Capt. Harry Johns, superintendent of the company's Kootenay mines.

Mr. I. L. Merrill, president of the Hedley Gold Mining Co., has returned to Camden, Maine, from a visit to Europe.

Mr. W. C. Thomas, of Vancouver, B.C., has been in Lilllooet district, British Columbia. He was formerly manager of the smelting works at Boundary Falls, in the same province.

Mr. J. Trainor, who was at one time superintendent at the Sunset copper mine, in Boundary district, B.C., is now engaged in a similar capacity on the property of the Dividend-Lakeview Consolidated Gold Mining Co., on Kruger Mountain, Osoyoos mining division.

STATISTICS AND RETURNS

OUTPUT OF ONTARIO MINES FOR FIRST THREE MONTHS OF 1913

Returns made to the Bureau of Mines show that the output of the metalliferous mines and works of Ontario for the first three months of 1913 was as follows:

Products.	Quantity.	Value.
Gold, oz.	50,637	1,030,920
Silver, oz.	7,264,559	4,040,450
Copper, tons	3,075	436,328
Nickel, tons	6,311	1,309,870
Iron ore, tons	15,389	25,695
Pig iron, tons	181,042	2,506,175
Cobalt, cobalt and nickel oxides, lbs.	280,096	120,500

COBALT ORE SHIPMENTS.

The ore shipments for the week ending July 5, 1913, were:

Mine.	High.	Low.	Pounds.
Casey Cobalt	1	..	73,800
Cobalt Townsite	1	..	56,500
Cobalt Lake	1	..	60,900
Dom. Reduction	1	..	86,900
Coniagas	2	..	156,460
Peterson Lake	1	..	59,650
Cobalt Comet	1	..	63,700
Trethewey	..	1	40,000
	8	1	597,900

The bullion shipments for the week were:

Mine.	Bars.	Ounces.	Value.
Nipissing	123	147,854.70	$85,706.21
O'Brien	29	26,983.00	14,889.93
Miller Lake O'Brien	2	1,976.00	1,082.86
	154	176,813.70	$101,679.00

STOCK MARKETS.

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

July 8th, 1913.

New York Curb.

	Bid.	Ask.
British Copper	2.12½	2.37½
Braden Copper	6.37½	6.75
Chino Copper	33.00	33.37½
Giroux Copper	1.37½	1.62½
Goldfield Cons	1.68¾	1.75
Greene Can.	5.87½	6.00
Inspiration Copper	14.00	15.00
Ray Cons Copper	16.50	16.75
Standard Oil of N. J.	353.00	356.00
Standard Oil of N. Y.	430.00	450.00
Standard Oil, pfd stock	1025.00	.....
Standard Oil Subs	700.00	.....
Tonopah Mining	4.50	4.75
Tonopah Belmont	6.25	6.50
Nevada Cons Copper	14.12½	14.37½
Yukon Gold	2.25	2.50

Cobalt Stocks.

	Bid	Ask.
Bailey.	.07½	.08
Beaver.	.28	.30
Canadian.	.20	.22
Chambers-Ferland.	.19	.21
City of Cobalt	.49	.51
Cobalt Lake	.66	.69
Coniagas.	6.75	7.50
Crown Reserve	3.35	3.50
Foster.	.07	.09
Gifford.	.04½	.06¼
Gould.	.03½	.03¾
Great Northern	.16	.16½
Hargraves.	.04	.06
Hudson Bay	65.00	70.00
Kerr Lake	3.15	3.30
La Rose	2.20	2.40
McKinley.	1.62	1.68
Nipissing.	8.40	8.75
Peterson Lake	.22½	.22¾
Right of Way	.04	.06
Rochester	.02½	.04
Leaf.	.03	.03¼
Cochrane.	1.00	1.30
Silver Queen	.04	.05½
Temiskaming.	.33½	.34½
Trethewey.	.33	.36
Wettlaufer.	.11	.13

Porcupine Stocks.

	Bid.	Ask.
Apex.	.01	.02
Crown Chartered	.00½	.01
Dome Extension	.09	.09½
Dome Lake	.75	.90
Dome Mines	14.50	15.50
Eldorado.	.01	.02
Foley O'Brien	.25	.27
Hollinger.	15.75	16.25
Jupiter.	.37	.38
McIntyre.	2.00	2.25
Moneta.	.03½	.05
North Dome	.35	.50
Northern Exploration	.50	1.50
Pearl Lake	.32¼	.33
Plenaurum.	.75	1.00
Porcupine Gold	.10	.10½
Imperial.	.02	.02½
Porcupine Reserve	...	.14
Preston East Dome	.02	.02¼
Rea.	.15	.30
Standard.	.00½	.01
Swastika.	.04½	.05
United.	.01	.02
West Dome	.15	.30

Sundry.

American Marconi	...	...
Canadian Marconi	...	...

TORONTO MARKETS.

July 9—(Quotations from Canada Metal Co., Toronto).
Spelter, 5½ cents per pound.
Lead, 5.60 cents per pound
Tin, 45 cents per pound.
Antimony, 10 cents per pound.
Copper, casting, 15¼ cents per pound.
Electrolytic, 15½ cents per pound.
Ingot brass, 11 to 15 cents per pound.

July 9—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).
Midland No. 1, $20.00 to $20.50 (f.o.b. Toronto).
Midland No. 2, $20.00 to $20.50 (f.o.b. Toronto).

July 9—(Quotations from Elias Rogers Co., Ltd., Toronto).
Coal, anthracite, $7.00 per ton.
Coal, bituminous, $5.00 per ton for 1¼-inch lump.

GENERAL MARKETS.

Coke.

July 7—Connellsville Coke, (f.o.b. ovens).
Furnace coke, prompt, $2.50 per ton.
Foundry coke, prompt, $2.75 to $3.00 per ton.

July 7—Tin, straits, 40.50 cents.
Copper, Prime Lake, 14.80 to 14.90 cents.
Electrolytic Copper, 14.50 to 14.62½ cents.
Copper wire, 15.75 cents.
Lead, 4.35 to 4.40 cents.
Spelter, 5.35 to 5.45 cents.
Sheet zinc (f.o.b. smelter), 7.00 cents.
Antimony, Cookson's, 8.45 to 8.55 cents.
Aluminium, 23.00 to 24.00 cents.
Nickel, 40.00 to 45.00 cents.
Platinum, ordinary, $46.00 per ounce.
Platinum, hard, $51.00 per ounce.
Bismuth, $1.95 to $2.15 per pound.
Quicksilver, $39.00 per 75-lb. flask.

SILVER PRICES.

	New York cents.	London pence.
June 21	58	26¾
" 23	58	26¾
" 24	57¾	26⅝
" 25	58¼	26 3/16
" 26	58⅛	26 3/16
" 27	58⅛	26 3/16
" 28	58⅛	26 3/16
" 30	58⅜	26 3/16
July 1	58⅛	26 3/16
" 2	58⅛	26 3/16
" 3	58¼	26⅞
" 4	..	27
" 5	58⅜	26 15/16
" 7	58½	26 15/16