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CANADIAN MINING JOURNAL

VOL. XXXVII TORONTO No. 2

In This Issue:

The Canadian Mining Journal, Purman Bldg., 263-5 Adelaide St West, Toronto, Ont.

The Canadian Mining Manual
1915

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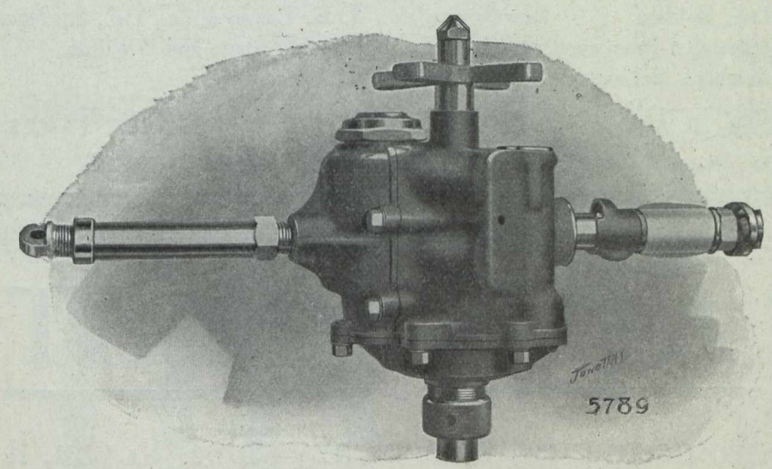

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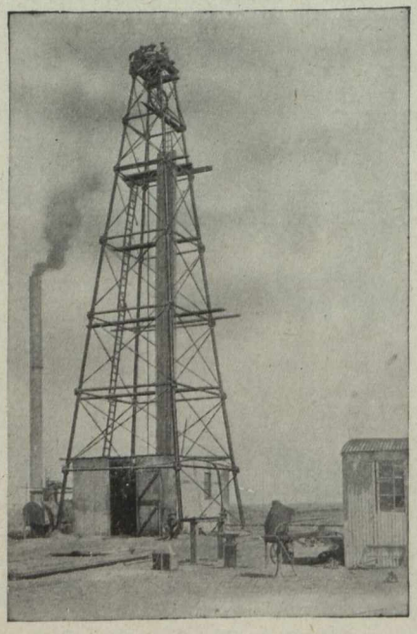

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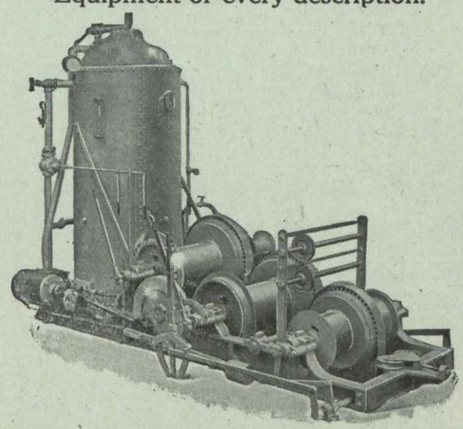

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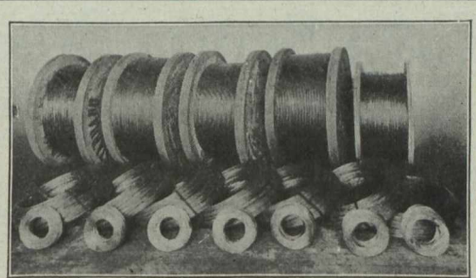

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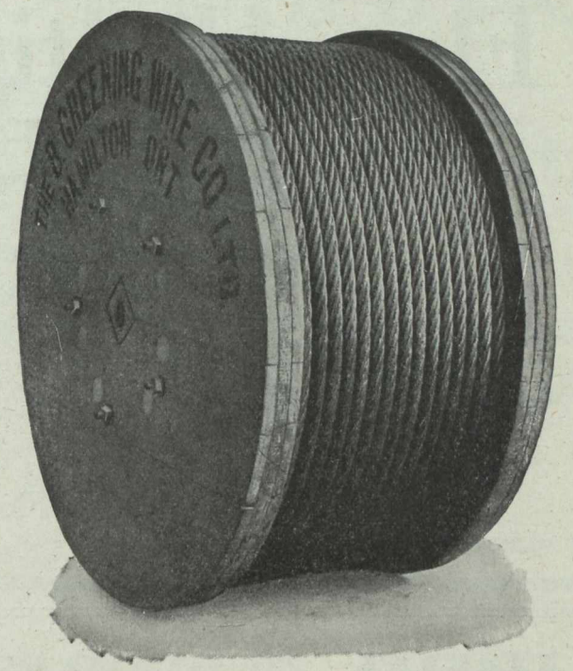

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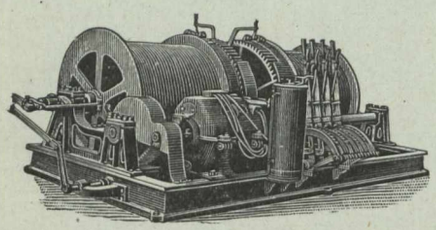

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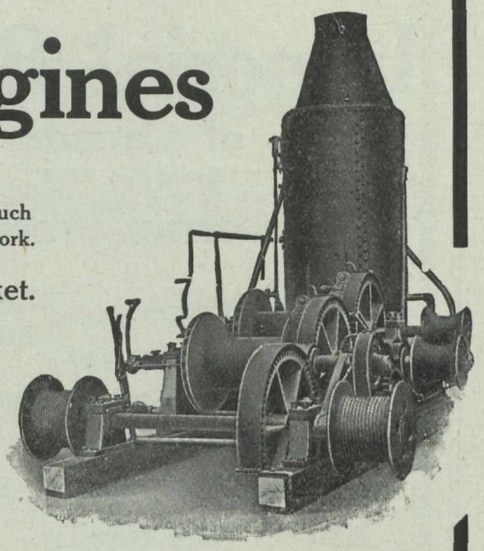

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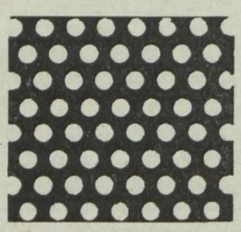

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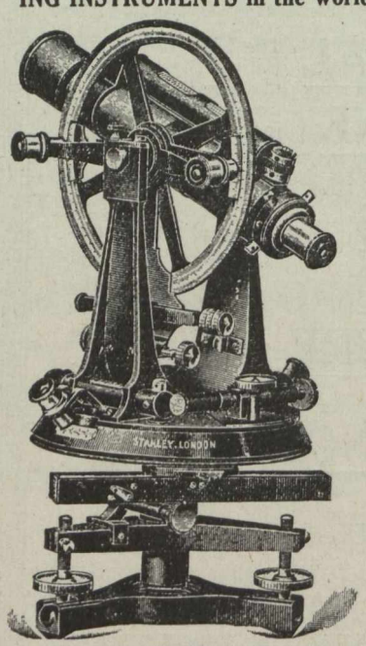

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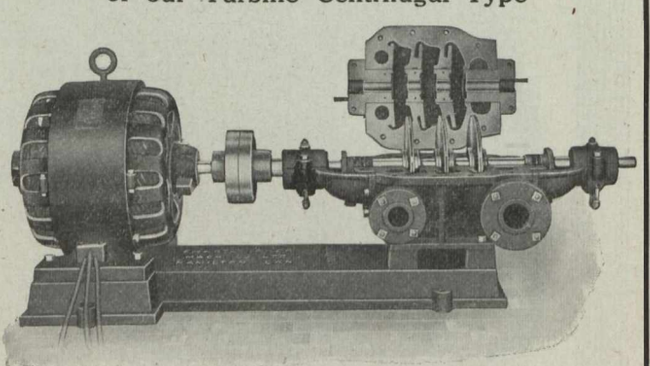

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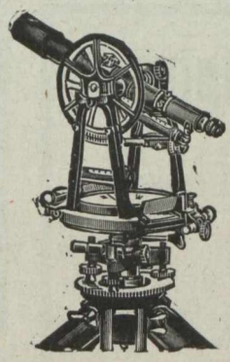

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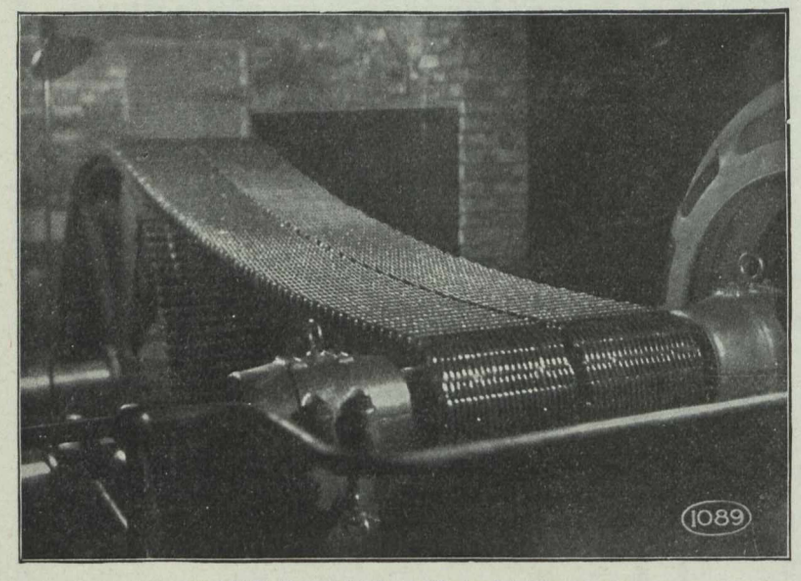

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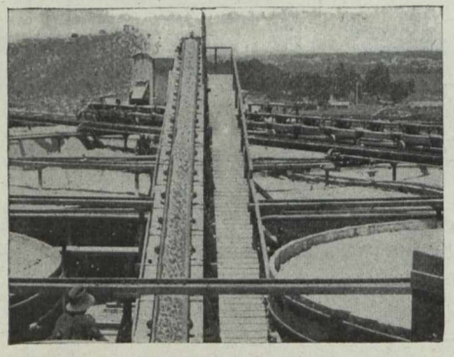

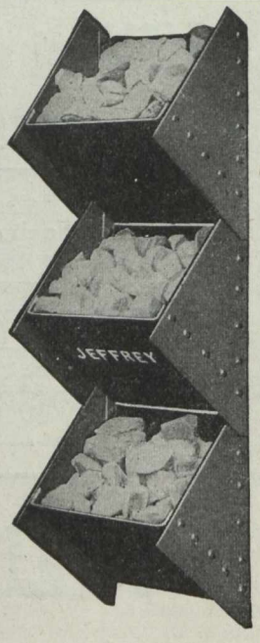

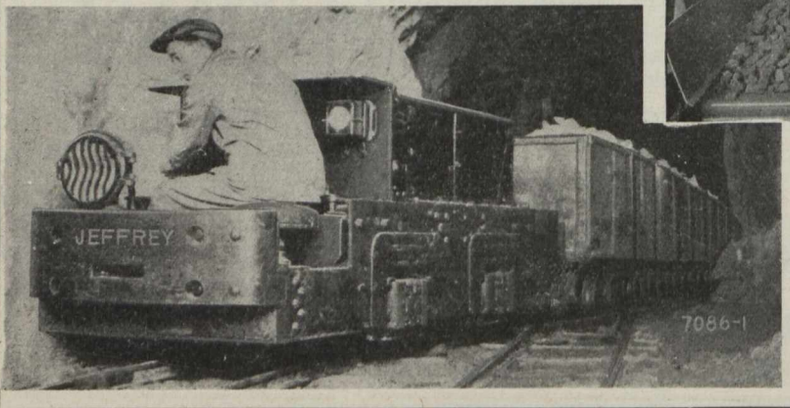

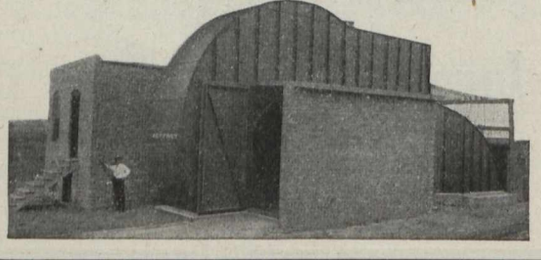

THE CANADIAN MINING JOURNAL

VOL. XXXVII. TORONTO, January 15, 1916. No. 2

The Canadian Mining Journal

With which is incorporated the

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Devoted to Mining, Metallurgy and Allied Industries in Canada.

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CIRCULATION

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MINING IN CANADA IN 1915

Canada is making new records in mineral production and the outlook for 1916 is very promising. This is a pleasing contrast with the conditions a year ago, when the disorganization of industry which followed the outbreak of war resulted in a severe though brief check to the ever-increasing mineral output of the Dominion.

In Canada, as in other countries the production in the early months of the war was small. Production of most metals might have been increased, but, owing to the general disorganization of business with consequent temporary falling off in demand for mine products, many mines were closed and many others operated at half capacity. The demand for war munitions during 1915 and the increase in general business in the latter part of 1915 created an unprecedented market for most metals.

The year 1915, in spite of the low output in the early months, shows an increase in production of metals in Canada. Non-metals are, as a rule, not in as great demand as before the war.

Ontario for 1915 shows a greatly increased output of gold, nickel and copper, and a substantial decrease in silver. The estimated value of the production for 1915 is: Gold, $8,000,000; silver, $10,750,000; nickel, $7,200,000, and copper, $2,700,000. The output of nickel-copper matte is being very greatly increased and it is expected that the December output will be over 7,000 tons matte. The iron ore production will be slightly greater than in 1914, but the Moose Mountain mine has been closed down. Petroleum output is less than in 1914, but natural gas production is larger. Structural materials are not in as good demand as in 1914. Pyrite shipments have increased. The operation of a graphite property in Eastern Ontario has been successfully begun during the year.

Alberta coal production in 1915 will show a decrease of about 500,000 tons, being estimated at 3,250,000 tons as compared with 3,743,672 tons for 1914. In the last quarter of 1915 conditions are much improved and output is being increased.

Quebec in 1915 shows an increase in production of metals and decrease in non-metals. The latter make up a very large part of Quebec's output and consequently the total production shows a considerable falling off as compared with 1914. After a period of dullness the asbestos market has improved greatly and the latter part of 1915 has seen a return to normal conditions in the asbestos district.

The great demand for chromite resulted in operations being resumed at several chromite properties in the Coleraine-Black Lake region. Copper and pyrite

production has been increased. A new mill is being erected to replace the Eustis mill which was burned in August. Lead-zinc deposits at Notre Dame des Anges are being successfully worked. Four companies are operating magnesite properties.

The production of British Columbia in 1915 will be about $30,375,000. This is an increase over 1914 though less than that of 1913, the record year. A great increase in production of copper has helped to swell the total. The value of the chief products is estimated as follows: Placer gold, $680,000; lode gold, $5,481,000; silver, $1,812,000; lead, $1,756,500; copper, $9,978,500; zinc, $1,395,000; coal, $5,782,000; coke, $1,490,500; miscellaneous, $2,000,000.

Nova Scotia's chief mineral product is coal. The production for 1915 is estimated at 6,600,000 tons, or practically the same as that of 1914. The output in the last quarter of 1915 was considerably larger than for the corresponding period of 1914. The coaling of ocean ships has become quite a feature of the Nova Scotia coal trade.

In the Yukon gold production during 1915 was about $4,750,000, a slight increase over that of 1914. The first machine for use on the Treadgold properties arrived during the year and will probably be in operation during 1916.

EDUCATION IN MINING

In a letter published in the January bulletin of the Canadian Mining Institute Mr. John A. Dresser makes some very interesting comments on education in mining. He says: "The highway to efficiency is education. The means of education vary widely in kind and degree, and man's time and ability to learn are inevitably limited. Consequently our methods of education in mining and metallurgy as well as in every other profession call for careful thought and closest scrutiny."

We should not be satisfied with our present methods of education. It is in the best interests of the mining industry to improve methods of preparing the young men who elect to make mining their profession. Every contribution to the discussion will help those who are responsible for the teaching of mining students.

It should be borne in mind that mining in Canada is increasing at a rate which is much greater than is generally appreciated. The public learns, for instance, that the Cobalt silver mining companies have passed their zenith as profit makers and jumps to the conclusion that mining is on the wane. As a matter of fact not only is production in other districts being increased, but in such districts as Cobalt there are many mining and metallurgical problems which will for years continue to make demands on the best technical talent available. The fact that lower grade ore must be treated in succeeding years means that profits will be smaller and that the necessity for efficiency will be more acute.

Mr. Dresser inclines to the belief that the number of students in mining will fluctuate with the demand for graduates. No doubt it will, but it fluctuates in a way that those who are connected with mining colleges find it difficult to understand. At present there is a demand for mining graduates that Canadian colleges will scarcely be able to meet. Young men should be encouraged to enter the profession. But those who are engaged in mining owe it to these young men to use their efforts to make the years of preparation as profitable as possible.

At the meeting of the Canadian Mining Institute in March there will be, according to the January bulletin, consideration of the subject of mining education. It is to be hoped that those in charge of mining operations as well as those engaged in teaching will voice their opinions.

The price of silver is holding well around 56 cents and the prospects for larger profits in 1916 than in 1915 are very good. During a year of low prices the Cobalt district suffered considerably. However, most of the mines continued to yield large profits. The margin of profit was considerably lower during 1915 than in any previous year, and it was found advisable in some cases to restrict production, not because it was not profitable, but because larger profits from higher prices were expected to be available later. In some cases production was necessarily restricted owing to decrease in ore reserves. It is not to be expected that all the mines will make large production in the future, for a large part of the high grade ore has been worked out. There is still a lot of silver in the Cobalt district, however, and with higher prices available it may be expected that renewed activity will result. Already several old properties are being reopened.

There is a great deal of interest being shown in oil flotation methods in mining districts throughout Canada and the United States. Many Canadian metallurgists are experimenting. It will not be surprising if methods are devised for profitably treating the sand and slime piles at Cobalt which contain four to eight ounces of silver per ton and which might conceivably be treated at a cost of 50 cents per ton. That is perhaps too much to hope for; but it is a figure that has been suggested by one who has done a great deal of experimenting on Cobalt ores.

The Mond Nickel Company has carried out a number of experiments on flotation of nickel-copper ores and it is not improbable that the Sudbury district ores will be further tested. The results obtained so far are, however, not available for publication.

Hollinger made a new record in the four weeks ending Dec. 2, making a gross profit of $210,588.52 on 29,448 tons ore treated. During 1915 the company distributed $1,560,000 in dividends and spent about $300,000 on additions to plant; but is nevertheless able to report an increase in surplus.

ELECTROLYTIC REFINING OF ZINC

Notable progress in the metallurgy of zinc was made in 1915, and a number of plants designed for the treatment of zinc ores by leaching and electrolysis have been installed. Canadian companies are taking a prominent part in the development of the processes and three of the plants now in operation are in Canada. The Weedon Mining Company, which is operating a lead-zinc mine at Notre Dame des Anges, Quebec, has put into operation at Welland, Ont., a plant in which the Watts process is used. At Trail, B.C., the Consolidated Mining and Smelting Company of Canada has carried on much experimental work on electrolytic refining of zinc, and has produced spelter from Sullivan mine ore at the rate of 1,000 pounds per day. The results obtained were considered promising enough to warrant the construction of a larger plant. There is now being erected at Trail a plant designed for an output of twenty-five to thirty-five tons per day. At Silverton, B.C., the Standard Silver Lead Mining Company is using the French process of electrolytic production of zinc.

In view of these developments an article published in the January 1st issue of Metallurgical and Chemical Engineering if of special interest. The authors, D. A. Lyon, O. C. Ralston and J. F. Cullen, of the Department of Metallurgical Research, University of Utah, say:

"When the European war started there were three electrolytic zinc plants in Europe supposed to be operating on a commercial scale. All of these were on a small scale, and were producing zinc from by-products. At Winnington, Northwich, Cheshire, England, was the plant of Brunner, Mond & Co., which is an alkali works and which has been disposing of calcium chloride solution wastes by leaching zinc ores with them (with simultaneous action of carbon dioxide). This gave a zinc chloride solution from which the zinc was recovered by electrolysis, giving a spelter containing 99.96 per cent Zn., and producing chlorine gas which was absorbed to make bleaching powder. This process is one of those originally designed by Hoepfner, and was experimented on during the 90's in Germany, resulting in the installation of a like plant at Duisburg, Germany. Both of these plants have kept secret the exact details of the process by which they have been able to get good zinc deposits as their pure spelter has been for years at a premium of at least 1 cent above the ordinary market price. In 1914, a plant was built for treatment of zinc carbonate ores at Kristiania, Norway, under the direction of Borchgrevink, and another at Balestrand, Sogn, Norway, under the direction of E. A. Ashcroft, to treat flotation concentrates from Broken Hill. So far as we know, nothing has been heard of these plants since the war began.

"In the United States and Canada, however, a great deal of experimental work has been done on the leaching of zinc from ores with its subsequent electrolysis. Nearly all of this work has been sulphuric acid leaching followed by the electrolysis of the zinc sulphate solution. While all the various plants have this much in common, the details of the work vary at most of them by almost as many methods as there are plants.

"The Anaconda Copper Co. perhaps has gotten farther along with this work than have most of the other companies. They now have a 25-ton plant nearing completion. By a 25-ton plant is meant one that will produce 25 tons of metallic zinc per day. The Anaconda metallurgists regard this as only an experimental plant. Some splendid work has been done at Anaconda in their research work in connection with the development of the process which they are using and the publication of the details of this work by Mr. Laist and his associates will be keenly awaited by those interested in this line of work.

"As to the general outline of the processes employed at the various plants at Trail, B.C., and at Anaconda, the electrolytic liquor containing sulphuric acid, regenerated by electrolysis with insoluble anodes, is used for leaching the ore. The ore is a roasted complex sulphide of lead and zinc carrying silver, some gold (and some copper in the case of Anaconda). By the use of barely sufficient acid to dissolve the zinc, it is possible to get a solution of zinc sulphate carrying low amounts of the other constituents of the ore. This solution must be cleaned by the use of zinc oxide, lime or other cleaning agents, and is then electrolyzed. At most of the plants, lead anodes are used in the electrolytic tanks in order to regenerate sulphuric acid. The process as thus outlined is old, but the refinement of detail has been the feature of nearly every plant attempting to use it.

"At Murray, Utah, and Omaha, Neb., are small plants recovering zinc electrolytically. The one at Murray is following the practice as developed at Anaconda, with variations made necessary by local conditions. It is only an experimental plant and it is expected to produce about 2 tons of zinc per day. The Omaha plant is working on zinc oxide material from the refining of argentiferous lead by the Divine process, and is also in the nature of an experiment.

"Perhaps the most extensive research work on the leaching and electrical precipitation of zinc has been carried out on the ores of the Bully Hill mine, Shasta county, California. The process for the Bully Hill ore was worked out on the assumption that a good deposit of zinc cannot be obtained from a solution containing much sulphuric acid and the effort has been to neutralize the acid as fast as it is formed at the lead anodes. In treating the Bully Hill ore, lime is used to precipitate zinc hydroxide and calcium sulphate from the solution of the zinc sulphate. This precipitate is suspended in the zinc sulphate liquor of the electrolytic cell and as fast as sulphuric acid forms it is neutralized by the zinc hydrate.

"The Reed Zinc Co., whose plant is at Palo Alto, Cal., has operated on the bag house dust from the Kennett smelter of the U. S. Smelting, Refining and Mining Co. This is also an experimental plant designed to produce about a ton of zinc per day. Instead of a solid lead anode they use a sponge lead anode resembling the electrode used in a storage cell. As fast as sulphuric acid is formed at this anode it combines with the lead, forming lead sulphate. This lead sulphate can later be used to give up the acid by reversing the current, after placing the electrode in a sulphuric acid solution. The solution for electrolysis is prepared by dissolving zinc sulphate crystallized from the leaching liquor.

"At Silverton, B.C., the Standard Silver Lead Mining Co. is also experimenting with the production of electrolytic zinc by the French process. French was probably the first man to use manganese in the electrolysis of zinc sulphate solutions, although its beneficial effect has been noticed by other investigators. He found that it deposits as dioxide on the anode and can

be redissolved in sulphuric acid and used over again. He operates his process with considerable of the manganese sulphate in his electrolyte, and instead of using sulphuric acid for leaching, uses a solution of by-product sodium bisulphate.

"At Welland, Ontario, the Weedon Mining Co. is also said to be meeting with success in operating the Watts process. This process proposes the use of a solution of zinc sulphate for an electrolyte in electrolysis, the depolarization of the anode and the prevention of the formation of sulphuric acid by the use of any solid compound of zinc which does not contain objectionable impurities, such as zinc oxide, or blue powder. The fundamental idea of this process is the same as has been worked out in the treatment of the Bully Hill ore. It is also brought out in the recent patents of O. Best, of Oakland, Cal.

"At Mt. Read on the west coast of Tasmania, it has been reported that the Tasmanian Metals Extraction Co. erected a plant for the treatment of zinc-bearing ores, producing a concentrate of zinc oxide. Nothing of the details of the process has been given out, but the zinc is doubtless precipitated from solution by a solution of some alkali, and the resulting hydrate calcined to oxide."

The rapid advancement now being made in the hydrometallurgy of zinc is in no small measure due to the war. There is at present an unusual demand for a high grade product and the price of all grades of spelter is high. There has seldom been a better opportunity to try out the electrolytic method. While it is not unlikely that experimental work would have been carried on by some of the companies under normal conditions, there would hardly have been the same progress in such a short time, but for the incentive given by war demands.

It seems likely that the electrolytic process will prove so successful that it will be well established and many difficulties overcome before the price of zinc returns to its pre-war level. It seems reasonable to expect the cost of treatment to be so much lowered that the problem of treating our troublesome zinc ores will have been very considerably minimized. It is a long time since any such advance has been made in the metallurgy of zinc. The owners of zinc deposits in Canada will do well to consider how the activities of metallurgists have increased the value of properties during 1915.

Calumet and Hecla Mining Company on New Year's Day announced a ten per cent. increase in wages to all employees. The big company is making a large output of copper and disposing of it at a good price. As usual under such circumstances the employees are given a share of the profit. The Calumet & Hecla management has a reputation for efficiency and consideration of employees that is second to none. The New Year's present is characteristic of the company.

According to our Cobalt correspondent the Nipissing stopes are now more nearly full of ore than at any time in the history of the company and discoveries of new orebodies at the Meyer shaft and under Cobalt Lake makes the future brighter than for a long time.

At the Dome numerous additions are being made to plant and the mill output is increasing. The December production was 30,120 tons, averaging $5.34 per ton.

Owing to the war the cost of explosives for mining purposes has been considerably increased. This is of course to be expected. The extraordinary demand has resulted in great advances in the price of raw materials.

There is considerable interest in prospects at Porcupine and it is not unlikely that several claims, now idle, will be developed this year.

The National Graphite Company of Toronto has successfully put into operation its mine and mill in Hastings County. A very good product, comparing favorably with any on the market, is being obtained.

The Sudbury mining district is experiencing the most prosperous period in its history. The insistent demand for nickel and copper has led the producing companies to push production to capacity. This, however, has proven insufficient and important additions to plant are being made and planned. It is evident that the present year will witness an enormous increase in production of nickel and copper matte. Already the output has been increased to an extent not thought possible a few months ago.

Of the leading gold mines at Porcupine, Hollinger produced $3,000,000, Dome $1,325,000, Acme $900,000, McIntyre $750,000, Porcupine Crown $600,000, Vipond $265,000, and Dome Lake $105,000 in the year 1915. As a gold producing district Porcupine is making an excellent record. The 1916 output is expected to be considerably larger.

The revival of chrome mining in Quebec, concerning which Mr. A. C. Allenson contributed an article in our issue of Sept. 15, has resulted in over 10,000 tons being shipped in the latter half of the year 1915. Twenty-two mines and prospects contributed to this total.

The demand for copper and pyrite has favorably affected the mining industry in Quebec. The Weedon and Eustis mines are making a large production of pyrite.

Good results are being obtained by the Weedon Mining Company in treating complex lead-zinc ores, at Notre Dame des Anges, by oil flotation methods. A commercial concentrate is being made. The concentrate will be roasted at the mine and then shipped to Welland for treatment by the Watts electrolytic process.

In Michigan the wages of copper miners have been gradually raised as the price of copper warranted it, until they are now the highest ever known in the district.

MINING IN ONTARIO IN 1915

Ontario made a good record in 1915, showing very large increase in production of gold, nickel and copper and some increase in lesser metallic products. Against these increases were considerable decrease in silver output and a falling off in demand for structural materials.

Porcupine shows an increase of over $2,500,000 in gold production. The Hollinger mill was treating 7,034 tons per week in November as against 5,706 tons in January, and making a gross profit of $46,192 per week as compared with $37,746. The average value of the ore varies but little from month to month. It began in January at $11.10 per ton and in November was $10.34. The total output for the year was about $3,000,000. The Hollinger, which is paying 4 per cent. dividend every four weeks, or 52 per cent. per annum on its capitalization of $3,000,000, has a claim to be ranked among the great gold mines of the world. Its veins are numerous and persistent in depth, and some of them are large. A number of new and valuable veins have recently been found in underground exploration. A six-compartment central shaft is being steadily pushed down, and it is intended to operate the adjoining Acme claims, controlled by the same interests, in conjunction with the Hollinger. The Acme ore is treated in the Hollinger mill, but the returns are kept separate. The yield from the Acme for the twelve months was over $900,000.

During 1915 $300,000 was spent on increasing plant at the Hollinger and $1,560,000 was paid in dividends; but, nevertheless, the balance sheet at the end of the year showed an increase in surplus.

Further increase in milling capacity is under consideration. The metallurgy at the Hollinger mill has not been changed; it is still making use of the modified system of counter-current decantation, together with filtration of part of the residue. Stamp crushing has always been considered satisfactory at the Hollinger, and no change has been made in it.

The Dome mine also shows an improved position as compared with the beginning of the year. Exploration at the fourth and fifth levels has revealed the existence of much better ore than the mixed material on which the mill operated in 1914, and in consequence the average contents have risen in value from $4.25 per ton to $5.50. At this rate the production of the Dome in 1916 should be nearly equal to that of the Hollinger. In 1915 the gross return was about $1,325,000. Opened on a mass of quartz that showed remarkable value in spots, the Dome speedily took on the character of a low-grade mine. The richer ore, resembling that of the original Dome, has materially improved the Dome's prospects. The mill is being enlarged and is expected to be in shape next March to treat about 55,000 tons of ore per month.

No change in the metallurgy is under consideration, the system continuing to be stamp crushing, regrinding in tube mills and separate treatment of sand and slime.

McIntyre-Porcupine Mines, Ltd., produced about $750.000 in 1915. This company has greatly enlarged its sphere of operations by securing control of adjoining property, formerly held by the Jupiter and Pearl Lake companies. This section of Porcupine will now be developed more energetically and the production will be much larger when the plans for working the three properties jointly have been carried out.

Porcupine-Crown's operations during 1915 yielded about $600,000. The Porcupine-Vipond took out about $265,000, and Dome Lake about $105,000. The Schumacher mill began to obtain bullion in November. The outlook at Porcupine for the incoming year is undoubtedly good.

Of the other gold mining areas, Kirkland Lake is perhaps the most advanced. Here the new mill at the Tough-Oakes mines began to run shortly after the beginning of the year and has done excellent work. The veins of this mine though narrow are rich, and the ore treated averaged about $19.00 per ton, some $450,000 having been obtained altogether.

The Tough-Oakes mill, completed in 1915, is a highly developed cyanide plant for handling rich gold ore. It is referred to by Mr. Herbert A. Megraw in the following terms: "This is probably the most important plant finished and operated during the year. It certainly embodies the results of the most advanced technical study. The Tough-Oakes is a 100-ton all-slime cyanide plant, in which a ball mill replaces stamps. In this case a ball mill of the Hardinge type is installed, the product of which goes to two Dorr classifiers, each operating in closed circuit with a 5 x 20 ft. tube mill. Provision is made for the introduction of copper amalgamating plates should that at any time be considered necessary. The slimes from the Dorr classifiers go to a thickener, the overflow of which is clarified and precipitated. The pulp is sent to Dorr agitators and a series of continuous counter-current thickeners. Transfers of thickened pulp are effected by diaphragm pumps. From the final tank the thickened pulp is discharged by a spigot into a launder, whence it runs through a mechanical-sampling device and then to waste. It will be noticed that in this plant the newest developments of cyanide metallurgy are incorporated. The elimination of stamps from the metallurgical lay-out is a feature that is becoming increasingly frequent during the last few years, and one that will probably become the rule in the future. Continuous pulp-flow and automatic transfer of pulp in solution is another feature of the mill. The elimination of the slime filter for the tailings is a feature of importance. The mill design was under charge of the Butters-Johnston Engineering Syndicate."

Of other properties at Kirkland Lake, the Teck-Hughes has been acquired by Buffalo Mines, Limited, and the latter is building a large mill for treating the ore. Beaver Consolidated is another Cobalt company which has interested itself at Kirkland Lake, having late in the year taken an option on the stock of the Kirkland Lake Gold Mines, one of which company's claims, known as the McKane, adjoins the Teck-Hughes, and is said to carry high values. The Lake Shore is another company engaged in developing promising showings in the same neighborhood.

Several other districts have contributed to Ontario's gold production in 1915. The Canadian Exploration Co., at Long lake, near Sudbury, won about $260,000. In Munro township, quartz of phenomenal value was found in the Dobie-Leyson claim, now known as the Croesus mine. From 800 pounds of rock $40.000 in gold was recovered by hand, and in a shaft 125 feet deep, with a little drifting and crosscutting, it is re-

ported that a million dollars' worth of gold has been put into sight.

The year was more than ordinarily prolific in promising discoveries. In Boston township, J. K. Papassimakes is developing a claim which shows in places a free distribution of fine gold in dark greenish quartz, and in Pacaud, the next township to the south, Miller and Connell have acquired the McDonough claim, one of the best looking finds of the year. This is a quartz vein a foot wide and about 2,000 feet long, showing free gold wherever uncovered. At Kowkash, 300 miles west of Cochrane, on the National Transcontinental Railway, a spectacular find of gold in quartz was made in August by E. King Dodds, but on sinking, the values disappeared. South of Dryden, on the Canadian Pacific, near Lake Wabigoon, a narrow and irregular vein showing abundance of free gold was located by E. G. Rognon. These veins no doubt will all be opened up in the near future. Meantime the year closed with a decidedly optimistic feeling so far as gold mining is concerned.

Silver production in Ontario in 1915 was smaller than in 1914. The decrease amounted to approximately $2,000,000, the product having a value of about $10,750,000 as against $12,795,214 in 1914. In other words for every six dollars won in 1914, the mines last year won five. Part of the decrease is due to the low prices which prevailed for silver from January until November, when a sudden and decided increase took place, amounting to 8 or 9 cents per ounce. This had the effect of stimulating production and development, and the year ends at Cobalt with a much improved outlook as compared with a year ago. The leading mine at Cobalt is still the Nipissing, the Mining Corporation of Canada coming next, and Coniagas, Kerr Lake, Seneca-Superior, Temiskaming, Beaver, McKinley-Darragh-Savage, O'Brien and LaRose following. The finding of new veins continues to reward exploration, both above and below ground. At the Townsite mine a system of high grade veins has yielded much rich ore. Deep drilling is in progress at the Beaver mine in the hope of eventually encountering good ore at the lower contact of the diabase sill and the Keewatin. Most of the silver produced from the mines is now refined in the Province; much of it at the mines themselves and the remainder by the refineries at Deloro and Thorold. The sale of cobalt and nickel oxides has almost ceased since the war began, but the refineries are beginning to produce both metallic cobalt and metallic nickel.

Taken together, the value of the gold and silver obtained in Ontario in 1915 exceeded that obtained in 1914, but while the production of gold is going up, that of silver is going down. The famous mines of Cobalt have passed their zenith, and their yield is decreasing. Production was stimulated by the sudden and decided rise in the price of silver in November. By-products of the Cobalt ores, particularly cobalt oxide and nickel oxide, had a poor year, the continental markets in Europe being cut off by the war. In consequence, stocks of these substances are accumulating at the refineries.

At Cobalt during 1915 a new slimes plant was built by the Cobalt Reduction Co. This plant was designed to handle the slime from the concentrating mills. It is being successfully operated.

The output of nickel in Ontario in 1915 was the greatest in the history of the Province, and further, the rate of production to-day is much higher than in the early part of 1915. The year's output was about 32,000 tons of nickel. Practically all of this came from the Sudbury district, the Alexo mine near Porcupine and the Cobalt ores contributing a small proportion. The Canadian Copper Co. and the Mond Nickel Co. have been pushing production to the utmost limit of their capacity in the effort to supply the demand for war purposes. Most of the former company's output was from the great Creighton mine, the ore of which carries a high percentage of nickel as compared with the average of the mines in the district. The Mond company draw their ore from a number of openings, including the Garson and Levack, the latter having reached the stage of steady production. The Alexo ore is purchased by the Mond company and smelted at Coniston, and this company has also bought the old Bruce mines for the sake of its siliceous ores which are desirable for smelting mixtures, and which besides carry an appreciable percentage of copper. The final product of the Sudbury plants is the Bessemer matte, containing 75 or 80 per cent. of nickel and copper combined. This is sent to New Jersey by the Copper company and to Wales by the Mond company for final separation of the metals. Values in gold, silver, platinum and palladium are also recovered from these mattes.

The copper production of Ontario increases with the nickel production, the copper occurring with the nickel in the ores of the Sudbury district. The output in 1915 was about 18,750 tons. In addition to the nickel-copper ores there was mined during the year some siliceous copper ore from the old Bruce mines. This is used as a flux at the Coniston smelter. The Mond company purchased the Bruce mines recently.

Although Moose Mountain mine is now closed down, shipments of iron ore during 1915 were somewhat larger than in 1914. Production during the first nine months of 1915 from Helen, Magpie and Moose Mountain mines was valued at $601,444.

On the other hand, the quantity of pig iron turned out by the blast furnaces of the province fell off materially. Most of the iron ore charged in these furnaces is imported from the United States.

The demand for building materials and clay goods, owing to the stoppage of building operations consequent upon the war, was not good in 1915, and production of these non-metallic substances consequently fell off. Petroleum continues to be pumped in the Lambton field, but in diminishing quantities, the yield in 1915 being not over 7,000,000 gallons. Natural gas, on the other hand, has been obtained in much larger volume during recent years than formerly, and valued at a low figure at the wells, the production in 1915 was worth about $2,300,000.

Pyrite production was considerably increased during 1915 and the National Graphite Co. put into successful operation its mine and plant in Hastings county. Salt production was about as usual. There was a small production of molybdenite and a concentrating plant has been put in operation by the Orillia Molybdenum Co.

While the record of Ontario's mines in 1915 is a very good one, considering the ill effects of the war, the year's record is hardly indicative of present activity. Production during the latter part of the year was much greater than in the early months and was never so great as it is to-day.

The year 1916 will be a busy one at the mines. Increase in production is being planned and numerous additions to plants will be necessary. Several new properties and some old ones are being opened up.

COAL MINING IN BRITISH COLUMBIA IN 1915

By E. Jacobs.

The gross production of coal in British Columbia in 1915, that is including the coal made into coke, was approximately 2,308,000 short tons. It being the official custom of the province, however, to record production in tons of 2,240 lb., it will be more convenient to make comparisons in that measure. The quantity given above is subject to revision when the final returns shall come in, an estimate having been made of the December production in arriving at the total here used as representing the production of 1915. The following table affords opportunity for making comparisons between the totals of output of six successive years:

Gross output in	Tons of 2,240 lb.
1915	2,060,804
1914	2,166,428
1913	2,570,760
1912	3,025,709
1911	2,297,718
1910	3,139,235

The year 1910 was the "record year" of the coal production of British Columbia; since then conditions have been in one way or another unfavorable to a correspondingly large yearly output—large for the province—being made. For eight months of 1911 the Crowsnest District collieries were closed, owing to non-agreement between the operators and the mine-workers relative to wages, etc.; the result, so far as production was concerned, was a decrease of 941,000 tons as compared with the 1910 output of that district. For several months of 1912 there was labor trouble at the mines of the Canadian Collieries (Dunsmuir) Limited, with a resultant decrease in output of coal. In the spring of 1913 the United Mine Workers of America determined to force an issue and so called a strike at all the coal mines on Vancouver Island, so there was a decrease of 616,000 tons in that year's production in the Coast district as compared with that of 1911 when there was not any similar obstacle in the way of production. The reasons for a further decrease in the total output in 1914, as stated in the official "Annual Report of the Minister of Mines" included the following: "The decreased coal output is undoubtedly entirely attributable to the war, not acting directly, but through the allied industries which serve as customers for the colliery products, an illustration of the interlocking of the modern commercial business. In the interior of the province the effect of the war was first felt in the complete demoralization of the metal markets, which are essentially world markets. This led to the immediate shutting down of all the larger copper mines and smelteries, thus removing an important factor in the market for coal and coke. In turn, this reacted upon the volume of freight to be handled by the railways, causing thereby a very great reduction in the consumption of fuel in the locomotives. . . . In the Coast district the war made itself felt through different channels, as there were not any smelteries in operation there, but the activity of German cruisers so affected trans-Pacific shipping as to greatly reduce the quantity of coal used for this purpose. . . . It is claimed that much more coal could have been produced by Vancouver Island collieries had there been a demand for it."

As to 1915, the chief loss in production was in the Crowsnest district, caused in large measure by the Hosmer mines having been closed and by a lessened output from the Corbin colliery, these together showing a decrease of 123,825 tons, against which there was an increase of 18,607 tons from the Crow's Nest Pass Coal Company's mines, leaving a net decrease of 105,218 tons. This company now has some of its mines in such good condition that it could have produced, without difficulty, had there been a market for it, fully twice as much coal as it did. There was a generally reduced output from the relatively small mines of Nicola and Similkameen districts, their total production having been only 101,060 tons as compared with 138,931 tons in 1914. These mines are at a disadvantage in being situated at a comparatively long distance from populous or manufacturing centres. The production of several of the Vancouver Island mines was smaller than in 1914, the Vancouver-Nanaimo Co.'s output having been 61,000 tons less; that of the Canadian Collieries Company's Comox mines 34,000 tons less, and that of the Pacific Coast Coal Mines, Ltd.,'s South Wellington mine (which was flooded for several months) nearly 26,000 tons. Against these decreases there was an increase of nearly 101,000 tons from the Western Fuel Co.'s mines, of which 28,000 tons was from its new Reserve Shaft mine; 35,000 tons from the Extension Colliery mines of the Canadian Collieries, Ltd., and 22,500 from the new Morden mine of the Pacific Coast Coal Mines, Ltd. The net result was an increase of about 37,500 tons as compared with the output of 1914, the totals for the two years having been approximately 1,109,800 long tons in 1915 against 1,072,300 tons in 1914.

Production of Coal in British Columbia in 1915.

		Tons of 2,240 lb.
Vancouver Island:		
Canadian Collieries (Dunsmuir) Limited		
Comox Mines (Cumberland)	360,410	
Extension Mines	164,365	524,775
Western Fuel Co—		
Nanaimo Mines	382,604	
Reserve Shaft Mine	28,866	411,470
Pacific Coast Mines, Ltd.—		
South Wellington	105,000	
Morden Shaft Mine	22,500	127,500
Vancouver-Nanaimo Coal Mining Co.		46,034
		1,109,779
Nicola:		
Middlesboro Collieries	54,500	
Inland Coal and Coke Co.	32,820	
Pacific Coast Colliery Co. of B. C	1,065	88,385
Similkameen:		
Princeton Coal and Land Co.		12,675
Southeast Kootenay:		
Crow's Nest Pass Coal Co.	707,010	
Corbin Coal and Coke Co.	52,955	849,965
Gross production of coal		2,060,804

Of this coal, about 409,000 tons was made into coke—nearly 360,000 tons at the Crow's Nest Pass Coal Co.'s ovens at Fernie and Michel, Southeast Kootenay, and

the remainder at the Canadian Collieries Company's ovens at Union Bay, Vancouver Island. The quantity of coke made was about 248,000 long tons, of which 239,000 tons was made in the Crow's Nest district and 9,000 tons on Vancouver Island. The ovens at Union Bay had been inoperative for several years until, in 1915, they were again used, this time to supply coke for the Granby Consolidated Company's new smelting works at Anyox, Observatory Inlet.

After deduction of the amount of coal made into coke, the net quantity to be taken into account as part of the mineral production of British Columbia in 1915 is approximately 1,652,000 tons. While there will be some changes made after the final returns for the year shall have been received, it will not be sufficient to considerably affect the total, as here given. The net production of coal in 1914 was 1,810,967 long tons, so that there will be a net decrease for 1915 of about 159,000 long tons. On the other hand, there will be a gain in coke, for against a production of 234,577 long tons in 1914 the estimated quantity for 1915 is 248,424 tons. Shown in money, the difference in value between the production of coal and coke combined in 1914 and 1915 will be $473,303, the respective totals being $7,745,847 for 1914 and an estimated total of $7,272,544 for 1915.

VANCOUVER ISLAND COLLIERIES.

Western Fuel Co.—Of the Vancouver Island coal mines, those of the Western Fuel Co. made a substantial increase in output in 1915 as compared with 1914, their total for 1915 having been 411,470 tons against 310,564 in 1914, a gain of 100,906 tons—72,514 tons from the Nanaimo mines and 28,392 tons from the new mine known as the Reserve Shaft mine. The increase would, doubtless, have been considerably larger but for a disastrous explosion which for some time seriously interfered with production from the Reserve mine. The company's Nanaimo operating mines include the No. 1 or Esplanade Shaft and the Protection Island mine. A brief official description of these mines, which are connected underground, is as follows. "No. 1 mine is situated at the south end of the Esplanade, in the city of Nanaimo, and has been in operation for many years, with good prospects for many years to come. The present operations are at a depth of 600 to 1,200 ft. below the surface, with a large submarine area. This mine has three openings, namely, the main hoisting (No. 1) shaft, Protection and Newcastle Island shafts. These shafts are connected and are part of the Douglas and Newcastle seams, and all are equipped with hoisting apparatus in case of emergency.

"The Newcastle seam is from 3 ft. to 3 ft. 6 in. in thickness, and is of a very hard nature; it is worked on the longwall system, to which it is well adapted. It is 60 to 70 ft. deeper than the thicker Douglas seam which, it is of interest to note, was first opened when, in 1884, No. 1 shaft 17 ft. and No. 2 14 ft. in diameter were sunk to it after a bore-hole, which was put down in 1881, had shown the seam to be at a depth of 650 ft. and to there be 8 ft. 6 in. in thickness. In 1887 No. 2 shaft was deepened and at 71 ft. below the Douglas seam it entered the Newcastle seam, there about 6 ft. thick. It will thus be seen that these Nanaimo mines have been producers of coal for more than 30 years. The Reserve mine is distant from Nanaimo about five miles. The shaft is in the centre of a 2,500-acre virgin coalfield. Sinking was commenced in 1910, and coal was reached, at a depth of 1,043 ft., in April, 1913. Main and auxiliary shafts 350 ft. apart were afterward connected. The coal, where cut by a rock tunnel from the shaft, showed 14 ft. in thickness of the Douglas seam, the coal being clean, firm, and of good quality. Ventilation of the two shafts was provided for by a pair of 90-in. Sirocco fans connected to a 24 by 30 engine by a rope-drive and standing on substantial concrete foundations 80 ft. distant from the shaft with two concrete tunnels having a total area of about 110 sq. ft. The surface equipment is modern, with tipple and screening plant at the main shaft. The tipple building is a commodious structure, and the handling capacity of the plant is 2,000 tons of coal in nine hours.

Canadian Collieries.—The Canadian Collieries (Dunsmuir) Limited, operates two collieries, namely, Comox and Extension. These collieries were previously owned and operated by the Dunsmuir interests but were acquired in 1911 by the organizers of the Canadian Collieries.

The mines of the Comox colliery are situated in the neighborhood of Cumberland, about 70 miles north of Nanaimo. A standard-gauge railway connects the mines with the seaboard at Union Bay, where there are a coal-washer and a battery of coke-ovens. The mines that have been worked in recent years are Nos. 4 and 7 slopes and Nos. 5, 6 and 8 shafts. There has not been much change since 1913, when electric power was substituted for steam, much new machinery and mine and railway equipment put in, and considerable underground development work done. Before all this preparation for increased production of coal was completed labor troubles were experienced, commencing in the autumn of 1912 and continuing throughout 1913, and these adversely affected the supply of fuel to markets then open. Since these difficulties have been overcome there has not been a sufficiently large demand for coal to admit of the mines being worked anything like full time. The changed conditions are shown by the production figures over a series of five years. For 1911, 1912, and 1913, respectively, the gross output of coal from these mines was 437,335, 475,803, and 508,095 long tons; for 1914 it was 394,731 tons, and the estimate for 1915 places the quantity at 360,410 tons. As compared with 1914, last year's production shows a decrease of 34,321 tons. The successful conclusion of negotiations with the Granby Consolidated Co. for the supply of coke for its smelting works at Anyox, on the Pacific coast, provided means for profitable use of between 45,000 and 50,000 tons of slack. Speaking generally, the plain fact is evident, that there was not a market for anything like the quantity of coal that could have been produced at Cumberland had there been a considerably larger demand for it.

At the company's Extension mines, of which four have been in operation in late years, there was an improvement over the conditions that obtained in 1914, for the increase in output in 1915 was 35,149 tons, which a little more than compensated for the decrease at Cumberland, leaving the net increase from the whole of the company's mines at 828 tons.

Pacific Coast Coal Mines, Ltd.—The flooding of this company's South Wellington mine early in the year, water from a nearby old mine having broken through into it, caused a suspension of output of coal from workings previously productive, the result having been a decrease from South Wellington of 25,645 tons. However, the company's new Morden Shaft mine produced 22,500 tons, so the net loss was only 3,145 tons. The South Wellington mine production figures for the two years were 130,645 long tons in 1914 and 105,000 (estimated) in 1915. In 1911, however, an output of

205,048 tons was made, so this company, like others, has suffered from the unfavorable conditions of quite recent years.

Much progress has been made in developing and equipping the company's Suquash colliery, in the northern part of Vancouver Island.

Vancouver-Nanaimo Coal Mining Co.—This company operates the Jingle Pot mine, New East Wellington colliery, situated about two miles from the city of Nanaimo, working on the coal seam known as the Old Wellington seam. Its production in 1915 was the smallest for five years or more—only 46,034 long tons, against 107,158 tons in 1914. In the official report for 1914 the district inspector of mines reported "no development work is in progress. All places have reached the boundary, and we are coming back extracting pillars." Probably similar conditions are accountable for the decrease in output in 1915.

NICOLA AND SIMILKAMEEN.

Three collieries produced coal in Nicola district in 1915, but there was a decided falling off in the total output, which was only 88,385 tons against 114,546 in 1914. The Middlesboro Colliery produced 54,500 tons, the Inland Coal and Coke Co. 32,820 tons, and the Pacific Coast Colliery Co. 1,065 tons. The corresponding figures for 1914 were 60,705, 53,281, and 560 tons. The net decrease, therefore, was 26,161 tons. Slackness of coal trade and high railway freight charges are held accountable for the non-progressive conditions obtaining here.

In Similkameen district, only the Princeton Coal and Land Co. made any production, and the output from its mine at Princeton was but 12,675 long tons as compared with 19,535 tons in 1914 and 29,206 tons in 1913. There is, however, a decided improvement in the fact that recently another railway was completed and commenced operating, and this gives Princeton coal access to several markets previously practically inaccessible to it, since only long and roundabout railway connections were available, with a correspondingly high freight charge that was really prohibitory. The prospects, therefore, are now believed to be more promising than at any previous time since the company commenced to mine coal.

The Coalmont colliery was closed throughout the year, awaiting money for continuing development and providing machinery and other equipment and transportation facilities between mine and railway. Here again confidence is felt that the outlook is better now that there is a competing railway and more provincial markets accessible.

SOUTHEAST KOOTENAY COLLIERIES.

The closing of the Hosmer colliery in 1914 left but two coal-mining companies operating in this district, namely the Corbin Coal and Coke Co. and the Crow's Nest Pass Coal Co. The loss of production from the Hosmer mines has made a considerable difference in the total output of the district, since the Canadian Pacific Railway Co. does not take from other mines in the British Columbia part of the Crow's Nest district coal to compensate for that it formerly took from the Hosmer colliery. In 1914 the Hosmer mines made an output of 102,468 tons against nil in 1915. A reduced output from the Corbin mines made the decrease larger, and this was only in small degree offset by an increase of 18,607 tons from the Crow's Nest Pass Coal Co.'s mines, so that the net decrease was 105,218 long tons, the district total having been 849,965 tons in 1915 as compared with 955,183 tons in 1914.

Corbin Coal and Coke Co.—This company operated two mines, namely No. 4 mine, situated near the tipple, and No. 3 mine, also known as the "Big Showing," worked both on the surface and underground. At the latter, surface operations are carried on when there is not any snow to impede the work by the open-cut or quarrying system, the coal being loaded by hand into one-ton bottom dump cars which are emptied into railway cars nearby. Output from No. 3 was 24,210 tons, and from No. 4 underground workings 28,745 tons, total 52,955 tons, against 74,312 tons in 1914.

Crow's Nest Pass Coal Co.—This company in 1915 worked eight mines at its Coal Creek colliery and four at its Michel colliery. Coke ovens were operated at both Fernie and Michel. Its gross output of coal was 797,010 tons, against 778,403 tons in 1914, an increase of 18,607 tons. The quantity of coke made was 239,178 tons, as compared with 199,866 tons in 1914, an increase of 39,312 tons, which more than compensated for the loss of production at the Hosmer ovens that in 1914 made 34,711 tons.

Of the eight mines operated at Coal Creek in 1915, that known as No. 1 East, one of four on the south side of the valley, was the largest producer. It is at an elevation of 90 ft. above the central tipple and 800 ft. east of it. It was opened by means of a rock tunnel which cut the coal at 215 ft. from the entry. Both main and counter tunnels were driven 3,500 ft. toward the south. The cost of upkeep of the return airway having been considerable owing to pressure of the upper part of the large seam (the airway had been driven in the lower part of the seam), the timbers were drawn and the top coal to the main roof was dropped. The roof is of hard sandstone, so no timber is required to keep it up; the permanent air-course now provided will cost little to keep it in good order. Late in the year there was installed an endless-rope haulage system, operated by an engine placed outside the mine, to deliver the coal from the inside of the mine to the central tipple.

Much good work has also been done in the company's mines at Michel colliery, which like Coal Creek, now is in shape for production on a much larger scale than in past years, large new coal-areas having been opened. Of the four mines in operation, that known as New No. 8 is most noteworthy. No. 8 seam has been redeveloped above old No. 8 workings sealed off on account of fire. Two tunnels have been driven and from these a four-way system of levels is projected, the two lower now well on the way, and Nos. 3 and 4 being developed by the advancement of backway incline raises that are being driven. A three-track tram line connects with a Phillips crossover tipple at the head of a gravity incline down to the endless-haulage system, thence to the main tipple. A pair of counterbalanced 7-ton skips operated from two 8-ft. drums controlled directly from the top loading-station and automatically loading and discharging are capable of handling under active working conditions 300 tons of coal an hour. The extension of coal-producing operations into the large field here entered constitutes one of the most important recent developments at the Michel colliery.

GOLD MINING IN YUKON IN 1915

According to the Dawson Daily News the Yukon Territory has contributed to the outside world approximately $185,000,000 in virgin gold. This magnificent sum has come chiefly from the placers within fifty miles of Dawson. Other rich creeks within 100 miles of Dawson have furnished the bulk of the remainder, while the remaining portion has come from more distant locations.

The record shows a fluctuating output during the ten years previous to the famous discovery on Bonanza Creek in 1896, a tremendous yearly increase until the banner year of 1900, and a gradual decrease until the lowest ebb was reached in 1907, and then began a continued upward leap due to the installation of hydraulics and giant dredges. Since 1910 the fluctuation has been but slight, and the shipments from Dawson have approximated $5,000,000 annually. In 1914 the slight shrinkage was accounted for to considerable degree by the breaking down of one of the largest dredges just as it got into the best of pay. The same dredge has been out of commission all of this season, undergoing repairs, and it is not certain when it will resume work, so that it is not aiding in this year's totals. Another dredge which worked most of last year on Bonanza is idle this year. But, notwithstanding the idleness of the two dredges, a splendid showing is being made.

The 1915 production is estimated at $4,750,000, a slight increase over that of 1914.

"**The Yukon Gold Company's dredges** have been in some of the richest ground this year that they ever worked, and, as a consequence, the total yield for this season of the Klondike camp is ahead of last year. The Yukon Gold Company worked one virgin claim, No. 21, on Eldorado, this season, from which an enormous sum was taken. The claim was bought in the early days of the camp by John J. Healy, the veteran frontiersman, for the N. A. T. & T. Co., and never was worked, so that when the dredge got to work there this year it found the pay as rich as custard. Representatives of the two companies say nothing of the total clean-up, but rumor has it that the dredge got fully half a million dollars in virgin gold out of the ground.

"Some Eldorado claims yielded much better than that by old methods. Tom Lippy, of Seattle, is said to have cleaned up more than a million and a half from No. 16 Eldorado, and No. 17, which was owned by Jim Hall, was a marvellous producer. Both of these claims, like nearly all the best Eldorado properties, were worked by steam thawing and hoisting methods. The old system required five or six years to work out a claim, whereas the dredges now work out several of the claims in a single season, and take up several feet of bed-rock and get therefrom much gold which the miners by the old methods could not get.

"The yield now is slightly lower than a year or two ago. Bonanza and Eldorado are now worked by new methods, to a large extent, and other creeks which have been under preparation for the new methods are expected to begin yielding in another season.

"**The Treadgold properties,** totaling many miles, on Dominion and Quartz creeks, have been in preparation for several seasons, and the first excavator or machine for working there on the large scale has just arrived. It is now being hauled to the creek, and is to be set up this fall. Mr. Treadgold is expected to arrive here this fall to see it work. The machine was worked in England as a test before being sent here. Similar excavators are used for other classes of mining on an extensive scale in other parts of the world.

Producing Creeks.—"The gold is extracted from the Klondike river, between Bear and Bonanza creeks, and from Bonanza, Eldorado, Hunker and Gold Run creeks. The largest hydraulics are along Bonanza benches. Milvain is working a dredge on Miller creek. Individual production also comes from Sulphur, which now leads in activity on old time creeks near the city and elsewhere in the territory.

"It has been estimated by some that the placers in the old Klondike district, that is, within fifty miles of Dawson, still contain $130,000,000 to $150,000,000. The Treadgold property of Indian river, Dominion creek, Quartz creek, Sulphur and tributaries alone aggregating 75 miles or more, have been estimated in the company's prospectus to contain fully 300,000,000 cubic yards carrying 30 cents to the yard, or $90,000,000. It was stated some time ago that eight miles of gravel between Bear and Bonanza creeks, on the Klondike, remaining to be worked and carrying gravels worth 22 cents a yard, contain fully $20,000,000. The Yukon Gold Company's properties remaining in the camp are believed to contain fully that much, if not far more. They include, besides properties on Hunker, Eldorado and Bonanza yet unworked, a large portion of Gold Run. Upper Gold Run, comprising 70 claims, also is practically unworked. Many other creeks in the territory being worked by individuals may yet yield millions.

Possible Dredge Propositions.—"Creeks which have been looked on as possible dredge propositions, but which are yet in the hands of individuals, include Gold Bottom, Allgold, Eureka, Clear, Barlow, Scroggie, Mariposa, Henderson, Barker, Thistle, Britannia, Canadian, Nansen, Livingstone, Big Salmon, some of the Kluane creeks, Highet and several others of the Mayo district and a long mileage on McQuesten, many miles of Fortymile and tributaries, while below the Yukon boundary are numerous creeks in the gold belt in the Circle district, including Independence, Mammoth, Mastodon, Woodchopper and Coal creeks; the several creeks about Eagle and others out of which individuals have taken much gold.

"If the Treadgold excavator works as estimated it will bring many of the lower grade creeks into the producing zone, which years ago never were dreamed of as being workable at a profit, but which are indicated to contain such pay that were they in a thawed zone would produce multiplied millions even by the old dredge methods. Some predict that ground sluicing and scraping or excavating methods, if not dredging, will yet win their golden treasure and good profits to the operators."

"Scotty" Allan, a well-known driver of racing dogs in Alaska, has returned to America from France, whence he went with about 400 malamutes from Alaska and Labrador, for which the price was $100 each. Some of the dogs had been winners of long distance races over frozen trails in the Nome region, Alaska. Mr. Allan was in Montreal at the end of December and went thence to Berkley, California, to visit his family before returning to Alaska.

ALLOY STEELS*

By George L. Norris.

Steel can broadly be defined as an alloy of iron and carbon that can be forged and rolled. From expediency and necessities of manufacture, certain impurities beneficial or otherwise are present, but not in sufficient amounts to materially alter the characteristics of the pure alloy of iron and carbon.

Under this definition, steel, or as it is now often referred to, carbon steel, is usually within the following maximum composition: Carbon, 1.50 per cent.; manganese, 1.00 per cent.; silicon, 0.35 per cent.; phosphorus, 0.05 per cent.; sulphur, 0.05 per cent.

An "alloy" steel is steel alloyed with one or more metals, in sufficient amounts to influence or change the characteristics of steel, and still possible of forging or rolling.

The usual steel alloying metals are manganese, silicon, nickel, chromium, tungsten and vanadium. As these metals will all alloy with each other, it is evident that it is possible to obtain a great variety of alloy steels.

Steel containing upwards of 1.50 per cent. manganese is not commonly considered an alloy steel, although this percentage of manganese undoubtedly has some effect on the characteristics of steel. This is due no doubt to the fact that manganese is always present in steel.

The alloy steels are usually divided into two groups: "ternary" steels, with one metal alloyed, and "quarternary" steels, with two metals alloyed. The more complex alloy steels are practically limited to high-speed tool steels.

The general characteristics of alloy steels are high elastic limit and great strength, combined with a high degree of toughness as compared with the carbon steel with which they are alloyed. The strength and hardness can be enormously increased by heat-treatment (quenching and tempering) and still have the steel retain great toughness.

Alloy steels are not as a rule placed in service in the condition as forged or rolled. The forging and rolling temperatures are usually so high that the steel requires heat-treatment to refine the grain and develop the exact combination of strength, hardness and toughness desired. It is frequently necessary to anneal after forging in order to facilitate machining operations. This, of course, necessitates subsequent heat- treatment.

Most of the alloy steels are of medium or low carbon content. The corresponding simple or carbon steels are only slightly or moderately improved in strength by heat-treatment.

The use of alloy steels in cutting tools dates back nearly a hundred years, although it was not until after 1850 or 1860 that alloy steels for this purpose became firmly established.

With the advent of iron clad warships began the struggle for supremacy between projectile and armor plate that has been so fruitful in the development of alloy steels. Chromium, nickel and nickel-chromium steels are largely the result of this struggle.

The publication in 1888 by Hadfield of the results of an extensive research of the alloys of manganese and steel, which resulted in the discovery of a remarkable new alloy steel, marks a period of active investigation into the effect of other metals on steel. The most important of these were the investigations on nickel steels by James Riley in 1889, which demonstrated that a mild open-hearth steel, such as used for structural, general forging and machinery purposes, when alloyed with 3 to 4 per cent. nickel had considerably higher elastic limit and tensile strength, with practically the same or greater ductility. One of the earliest and most extensive applications of nickel steel was for armor plate. For many years nickel steel was the principal alloy steel in use.

During this same period referred to, Hadfield made investigation of the effects of silicon on steel, and also a very complete study of chromium steels, which for some time had been used in a small way for springs and special forgings, but principally for tools and armor piercing projectiles.

The development of high-speed steel about 1900, making it possible to readily machine heat-treated alloy steels, and the advent of the automobile with its demand for superior steel, have brought about the present extensive use and development of alloy steels.

The automobile industry, with its demand for steel of high strength and durability, has been undoubtedly the most important factor in the development of commercial alloy steels, and the largest consumer. Alloy steels are used extensively for transmission gears and shafting, axles, steering levers and spindles, spring chassis frames, crank shaft, cam shaft, connecting rods, valves, and many other parts of automobiles.

They are also extensively employed in forgings for high-speed engines, marine engines, locomotives, electrical machinery, mining machinery and other mechanical engineering structures.

The use of alloy steels in bridge construction has been limited, but there is undoubtedly a field in long-span bridges for an alloy steel of high strength that can be used in the condition as rolled, preferably, or at most with a simple annealing.

Coincident and having a marked influence on the development of alloy steels, was the discovery of large deposits of vanadium ore in Peru, thus assuring a source of supply at a reasonable cost of this rare metal, which is the most powerful yet discovered for alloying with steel, that is, in small amounts.

The most important of the engineering or constructural alloy steels are those containing nickel, chromium and vanadium, singly or in combination. With all these steels it is possible, through heat-treatment, to obtain a tremendous range in strength, in round numbers varying from 100,000 to 250,000 pounds per square inch, depending also, of course, upon the size of the section.

It is not possible nor within the province of this paper to go deeply into the technology of alloy steels, but only to briefly describe the principal alloy steels and their characteristics.

Manganese Steel.—This steel usually contains 10 to 13 per cent. of manganese and approximately 1 per cent. of carbon. It is practically non-magnetic and has a peculiar hardness to which it owes a remarkable resistance to abrasion. It is extremely difficult to machine. It has high strength and toughness, but rela-

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tively low elastic limit. With care it can be forged and rolled. It has found its principal application in castings for crushing and grinding machinery and railroad crossings. Manganese steel has the peculiar property of being toughened and softened by quenching in water, resembling copper in this respect. All manganese steel castings are subjected to this treatment to remove brittleness.

Silicon Steel.—There are two types of silicon steel, one of which has found some application as an engineering steel. This steel, frequently called silico-manganese steel, is generally covered by the following limits of composition: Carbon, 0.45 to 0.65 per cent.; silicon, 1.50 to 2.00 per cent.; manganese, 0.50 to 0.80 per cent.; the manganese is normal, contrary to what is indicated by the name. The principal application of this steel is for automobile springs, and to some extent for gears. It fibres readily through heat-treatment, and is very brittle in the direction at right angles to rolling. It is very sensitive to heat-treatment, and a relatively small variation in annealing temperature after quenching has a strong effect on the results obtained.

The other type of silicon steel contains 3 to 5 per cent. silicon, is low in carbon and manganese and is extensively used for electrical transformer sheets on account of its high permeability and electrical resistance. It is weak and has no constructural value.

Nickel Steel.—Nickel alloys with steel in all proportions, but by far the most important nickel steel, from an engineering standpoint, is the law and medium-carbon steel with 3 to 4 per cent. of nickel, commonly known as 3½ per cent. nickel steel. The presence of manganese in nickel steel is very essential, as it has a marked effect on the mechanical properties. The amount of manganese should range from 0.50 to 0.80 per cent. This steel has been extensively used since its introduction in 1889, and is a good all-round engineering and structural steel with considerably higher elastic limit and tensile strength than the corresponding carbon steel, and with practically the same degree of ductility. The low-carbon steel, 0.10 to 0.20 per cent. carbon, is used extensively for case-hardening parts. It case-hardens more readily than carbon steel and gives a harder casing with a strong, tough, fibrous core. A great deal of nickel steel with carbon from 0.20 to 0.35 per cent. has been used in shapes and plates as rolled, and in annealed eye-bars for bridge construction. In this condition, which is not to be recommended for forgings, the following are typical physical properties: Elastic limit, 45,000 to 60,000 lbs. per sq. in.; tensile strength, 80,000 to 100,000 lbs. per sq. in.; elongation in 2 inches, 20 to 15 per cent.; reduction of area, 40 to 25 per cent. Annealed nickel steel forgings have only slight advantage in strength over carbon steel, and consequently are not advantageous either from an engineering standpoint or commercially unless heat-treated. With heat-treatment it gives considerably higher strength than carbon steel, combined with greater ductility or toughness. It does not give as high values as the nickel-chromium and chromium-vanadium steels. Nickel steel rolls and forges readily and machines easily. It develops a very thick, hard scale which is apt to give considerable trouble in drop-forging and is hard on the dies. Nickel steel is also very liable to develop seaminess, especially when made in large heats and cast into large ingots, as is now customary. It requires a larger discard to ensure soundness. The use of nickel steel in forgings, and particularly drop-forgings, is falling off in favor of other alloy steels with greater values.

Chromium Steel.—The use of this steel is confined principally to a few specialties and it is not in general use as an all-round engineering steel. One of the principal uses is for balls and ball races. The great mineralogical hardness obtained by quenching is very desirable for this purpose. The steel for this application contains approximately 1 per cent. each of carbon and chromium.

Chromium steel is also used for stamp-mill shoes, and in combination with soft steel in laminated plates for construction of burglar-proof safes, and in the same combination in bars for jails.

The low- and medium-carbon types, containing 0.80 per cent. or less of chromium, have somewhat higher mechanical properties than the corresponding carbon steel. It is not used to any great extent, other alloy steels being superior, both in static and dynamic strength. Chromium steel is also very liable to crack and check in heat-treatment.

Nickel-Chromium Steel.—The addition of chromium to nickel steel has a marked effect, greatly increasing the strength and resistance to shock and particularly the mineralogical hardness. It is more difficult to forge and heat-treat and harder to machine, and is also liable to the seaminess frequently present in nickel steel. There are three types of this steel, differing both in the percentage of nickel and chromium, and all with low or medium carbon:

	Nickel	Chromium	Carbon
1st.	3.5 p.c.	1.50 p.c.	0.25 to 0.45 p.c.
2nd	2.0 p.c.	1.00 p.c.	0.10 to 0.45 p.c.
3rd	1.5 p.c.	0.50 p.c.	0.10 to 0.45 p.c.

The first type is used principally for armor plate and armor-piercing projectiles and came into use about 1895, superseding the nickel plates and chromium projectiles. The other two types were developed by the automobile industry. The second type is largely for automobile forgings. It gives high strength with heat-treatment, has great hardness and good shock and fatigue resisting qualities. The third type is a largely used all-round engineering steel. It is used for automobile forgings and for a variety of miscellaneous drop-forgings and machine parts. It is an excellent case-hardening steel, carbonizing readily. This type is more tractable in working, heat-treating and machining than the other two. It is also somewhat lower in tensile strength.

Vanadium Steel.—The addition of small amounts of vanadium, generally under 0.25 per cent., to simple carbon steel or any of the alloy steels increases very considerably—about 30 per cent. or more—the elastic limit and breaking strength, without materially affecting the ductility. To an even greater extent it increases the resistance to shock and fatigue.

The vanadium steel which has been up to now most generally used is a chromium-vanadium steel of the following typical composition: Carbon, 0.10 to 0.55 per cent.; manganese, 0.50 to 0.80 per cent.; chromium, 0.80 to 1.00 per cent.; vanadium, over 0.15 per cent.

The lower carbon type, 0.10 to 0.20 per cent., is used mainly for case-hardening and is the best steel for this purpose. It carbonizes readily, gives the highest maximum carbon and finest grain. The casing is very strongly coherent to the core, very hard, tough and strong and practically free from any tendency to flake or powder. The core is remarkably strong and tough.

The higher limits of carbon, 0.45 to 0.55 per cent., are extensively used for automobile and locomotive

springs, giving remarkable resiliency and endurance. It is also extensively used for oil-tempered gears.

The range in carbon from 0.35 to 0.45 per cent. is largely employed for crank shafts, locomotive axles, crank pins, connecting rods, hammer piston rods, automobile transmissions and rear axle shafts.

The range from 0.25 to 0.35 per cent. carbon is used for automobile forgings of all kinds and a great variety of miscellaneous work requiring the best combination of static and dynamic strength.

As illustrating the wonderful shock and fatigue enduring qualities of chrome-vanadium steel, drop-hammer piston rods of this material are giving many times the length of service of carbon, nickel and chromium-nickel steel rods.

Vanadium steels have a much wider heat-treatment range than other steels. The desired physical properties can be obtained with a higher draw-back or annealing temperature, which is very advantageous as more completely removing quenching strains, and also as a manufacturing proposition.

Chromium-vanadium steel forges and machines better than nickel-chromium steel, is not as liable to injury in heating for forging, is not so liable to crack or check in heat-treatment and is free from the seamy tendency of steel containing nickel.

Carbon steel with a small percentage of vanadium, from 0.15 to 0.20 per cent., has been used extensively for locomotive frame castings with great success. The failures of these frames from all causes over a period of nearly ten years has been only a fraction of one per cent.

In tool-steel grades, this steel has better cutting qualities, hardens deeper and more uniformly, and has remarkable toughness. In what are termed battering tools, chisels, cutters, dies, etc., it gives several times the length of service of ordinary carbon tool steel.

The handicap of high cost of vanadium has almost disappeared, and simple carbon-vanadium steel in the ordinary forging grades will undoubtedly soon become very widely used as an all-round engineering steel, when a better steel than carbon is required. It is remarkably clean and is as easily worked as carbon steel. It is free from the seaminess and ugly scale of nickel steels and the tendency to check and crack of the chromium steels, particularly nickel-chromium.

Tests of carbon-vanadium steel rails in curves are showing about 20 per cent. less wear than rails with 0.15 to 0.20 per cent. higher carbon, and are also considerably stronger. This difference in wear will doubtless be much greater when the carbon percentage in the vanadium rails is increased to that of the standard rails.

In simple annealed forgings, plain vanadium steel has physical properties well above those specified for heat-treated (quenched and tempered) carbon steel.

This type of vanadium steel has a wider range of quenching temperature than nickel or nickel-chromium steels; and for mechanical properties after heat-treatment is practically on an equality with 3½ per cent. nickel or the low nickel-chromium steels in general use, and apparently has higher fatigue resisting qualities.

While nickel and chromium interfere seriously with the welding quality of steel, vanadium does not, but on the contrary improves this quality. Vanadium steel wire is in common use for autogenous welding.

Tungsten Steel.—This is principally used for magnets for magnetos and to some extent in hack saws and special tool steels. Tungsten is seldom used in engineering constructional steels, and then usually in combination with chromium.

Complex Alloy Steel.—Practically none of the constructional steels contain three or more alloy metals. The only steel in this class to be considered is what is commonly known as high-speed steel. Robert Mushet developed and patented about 1860 an air-hardening steel that was very much superior to carbon tool steel for machining hard material. Mushet steel, as it was known, had about the following composition: Carbon, 2.00 per cent.; manganese, 1.75 per cent.; silicon, 0.75 per cent.; chromium, 0.40 per cent.; tungsten, 5.50 per cent.

At the Paris Exposition in 1900, the Bethlehem Steel Co. exhibited a new tool steel that took wonderfully heavy cuts at high speeds, the point of the tool heating up to a strong blue color without losing its edge. This steel, which immediately became known as high-speed steel, was the culmination of the research work carried on for many years by Mr. F. W. Taylor and later published in his monograph "The Art of Cutting Metals." The difference between this steel and Mushet steel is apparent from the following typical composition: Carbon, 0.60 per cent.; manganese, 0.20 per cent.; silicon, 0.10 per cent.; chromium, 4.00 per cent.; tungsten, 18.00 per cent. With this steel, cutting speeds of over 90 feet per minute were obtained.

Within three or four years it was found that the addition of vanadium to high-speed steel made it possible to still greatly increase the speed and size of cut. At first only about 0.30 per cent. vanadium was added, but this has been increased until now 1.00 per cent. is practically the standard amount in most high-speed steels, and speeds of 140 feet and upward per minute have been attained.

Lately the addition of cobalt to high-speed steel has been meeting with favor as still further improving the endurance of the steel. The amount of cobalt generally used is 3 to 4 per cent., with no change in the percentage of the other metals—tungsten, chromium and vanadium.

DIVIDENDS PAID IN 1915.

Excluding the Mond and International nickel companies operating in Ontario, Canadian mining companies paying dividends in 1915 included: Beaver, $120,000; Caribou Cobalt, $115,000; Coniagas, $600,000; Crown Reserve, $141,505; Consolidated Mining and Smelting Co. of Canada, $464,352; Dome, $400,000; Granby, $449,955; Hedley, $300,000; Hollinger, $1,560,000; Kerr Lake, $450,000; La Rose, $412,122; Le Roi No. 2, $58,320; McKinley-Darragh-Savage, $269,723; Mining Corporation of Canada, $518,750; Nipissing, $1,200,000; Nova Scotia, $127,200; Peterson Lake, $189,000; Porcupine Crown, $240,000; Rambler, $35,000; Seneca-Superior, $335,218; Standard, $250,000; Temiskaming, $75,000; Rea Mines, $12,000, and Tough-Oakes, $65,187. Considering that 1915 was a poor year for the silver mining companies, these figures indicate that mining is being very profitably carried on in Canada. They fail to show, however, more than one-half the profits. The two companies operating nickel-copper mines in the Sudbury district made alone profits nearly equal to the total dividends paid by the above mentioned mining companies.

MINING CUPRIFEROUS PYRITES IN QUEBEC*

By J. Austen Bancroft.

In the history of copper mining in the Eastern Townships, the year, 1909, should always be prominent because of the discovery of the McDonald or Weedon mine in Weedon township, Wolfe County. The rusty appearance of quite extensive outcrops of sericite schist had attracted the attention of prospectors for several years, but no work had been done, because of the prevalent belief that only disseminated particles of pyrite were present in the schists. In the autumn of 1908, Mr. John McDonald of Sherbrooke, purchased the property, and during the following winter and spring, sank several pits in the rusty schists. It was not until the latter part of August, 1909, when, abandoning the rock outcrops, he began to excavate in the bottom of a grass-covered depression, elongated in a direction identical with the strike of the schists, that a body of cupriferous pyrite was discovered. Here, a shaft, 8′ by 8′, penetrated solid ore to a depth of about 25 feet. The property was leased under option to Dr. Pierre de Pierre Ricketts of New York, who later transferred it to the East Canada Smelting Company. According to the agreement of option, this Company paid Mr. McDonald $100,000 for the property.

The first shipment was made from the Weedon mine on August 2nd, 1910, and during the balance of the year 6,112 tons of ore were sent to market. Since that time the shipments (in tons of 2000 lbs.) from this mine, as compared with the total shipments of cupriferous pyrite from this district have been as follows:—

Year	Total shipments from Eastern Townships	Shipments from Weedon mine
1910	24,040	6,112
1911	38,554	23,700
1912	62,107	33,130
1913	87,550	52,000
1914	117,778	59,058
	330,029	174,000

Thus during the past five years, the Weedon mine has produced 174,000 tons of the total of 330,029 tons of cupriferous pyrite that have been shipped from the Eastern Townships.

At intervals, from 1911 to 1914, about 1800 tons of copper ore have been shipped from the Ives mine, near Eastman. In 1914, 1600 tons of pyrite, carrying only a trace of copper, were shipped from the deposit near Stratford, six to seven miles from St. Gerard station on the Quebec Central railway. The Eustis mine was the only other property from which ore was exported during this period, so that the amount shipped from the Eustis for the years 1910 to 1914, inclusive, has been about 154,249 tons.

The main ore-body of the Weedon mine is a lenticular mass of cupriferous pyrite with which very small amounts of galena and zinc blende are associated; it has proved to be 570 feet in length with a maximum thickness of 40 to 45 feet, and striking N 37° E, dips 40° to 45° to the southeast. On the average the north-eastern portion of the lens has been found to carry somewhat higher values in copper than the south-western. Three shafts have been succesively sunk on the vein to depths of 96, 350, and 470 feet. At first, the ore was taken by teams from the mine to the railway, a distance of 5 miles, at a cost of about 80 cents per ton. In 1912, a Bleichert aerial tramway, 19,500 feet in length, was constructed from the mine to the railway, at a cost of $1.75 per foot, and the cost of transporting the ore to the railroad thus has been reduced to 6.7 cents per ton. From January 1st to September 1st, 1914, 50,000 tons of ore was shipped, the maximum monthly shipments being those of June and July of 7050 and 7220 tons, respectively. Up to date, the ore has averaged 3.62 per cent. of copper. 40.74 per cent of sulphur, 0.77 per cent. of zinc, a trace of lead, and 0.46 oz. of silver and .01 oz. of gold per ton. The ore shipped has been sold for about $9.00 a ton, payment being made on the sulphur and copper contents.

At present, the Eustis mine is working at a depth of about 3,900 feet on an average incline of 38°. In 1912, at a depth of 3,450 feet the ore bodies comprised four parallel lenticular veins known as the footwall, the main, the shaft and No. 1 veins. The footwall and shaft veins then carried somewhat better values in copper than the others; but in 1913, the average product of the mine contained slightly less than 2 per cent. of copper. At present, work is progressing at the bottom of the mine, upon two lenticular bodies of ore that average 2 per cent. in copper. The Maximum capacity of the mine equipment is about 200 tons per shift. The concentrating mill, which had a capacity of from about ten to twelve tons of mill feed per hour, and in which an Elmore oil concentrator was installed in 1913, was burned in August 1915. A new mill is in course of construction.

During 1909 to 1914, development work on a small scale, but more or less continuously, progressed at the Suffield mine on lot 3, range XI, Ascot, one of the properties of Mr. A. O. Norton. No ore was shipped during this period and upon the outbreak of war, work was suspended, although they were continuing to keep the water out of the mine. In 1910 and 1911, Mr. Norton also removed the water from the old workings of the Marrington mine on lot 6, range IX, of Ascot, but during this time only three tons of ore were sent to market.

In 1910, the Ascot mine had the water removed from it and some sampling was done for the East Canada Smelting Company, but no ore was shipped. In 1913, this mine was again reopened but soon was again permitted to fill with water.

In 1910, as a result of the interest aroused by the discovery of the Weedon mine, a lenticular deposit of pyrite was discovered on lot 8, range VI, S.W. of Stratford township, where in the years 1910 and 1911, an inclined shaft was sunk to a depth of 45 feet in the north-eastern end of the ore body. Four diamond drill holes were also put down and although several feet in thickness of pyrite were penetrated, the copper content of the ore was disappointing to those holding the property in lease at the time. In the summer and autumn of 1914, this property was leased by P. E. Beaudoin of Thetford Mines. The shaft was extended to a depth of 75 feet and in September, at a depth of about 50 feet, they were commencing to drift towards the southwest. About 1600 tons of pyrite carrying on the average from 45 to 48 per cent of sulphur and a mere trace of copper were shipped to the Grasselli Chemical Company's works at Hamilton, Ontario.

The Galt shaft of the old Ives mine, near Eastman, that had been closed since 1876, was reopened in May, 1911, by Messrs. Cromwell and Parker of Eastman. Since then prospecting work has been carried on more or less continuously. The shaft has been sunk from 100 to 180 feet and at this depth a drift extended for 72 feet to the southwest, along a zone of chlorite schists that for a width of four to five feet are traversed, parallel to their schistosity by veins of chalcopyrite and quartz. Operations ceased a

*From report on Copper Deposits of Eastern Townships, Mines Branch, Quebec, 1915.

few months prior to the outbreak of the war. Six carloads, of about thirty tons each, have been shipped from the mine; five of these yielded an average copper content of nine and a half per cent., while one carload selected from a portion of one of the old dumps carried five per cent in copper.

In the summer of 1912, Mr. Pierre Tetrault, of Montreal, started to erect a concentrating mill at the Huntingdon mine (lot 8, range VIII, Bolton) with the aim of working over some of the old dumps on that property. The building was completed but the machinery has not been installed. In the spring and early summer of 1914, the water was pumped out of the old Nichols shaft down to about 275 feet. At a depth of 180 feet, some prospecting work was done where they found the schist impregnated with small amounts of chalcopyrite and pyrite, and traversed, parallel to the schistosity by narrow stringers of quartz carrying chalcopyrite. Work was suspended on the property a month or more before the outbreak of the war. Mr. Tetrault has purchased the property from the Nichols' Copper Company.

In 1909, water was removed from the old shaft of the Lake Memphremagog mine (lot 28, range IX, Potton) and about 125 feet north of the open cut a new shaft was sunk to a depth of 80 or 90 feet.

In the fall of 1909, an Allis-Chalmers water jacketed furnace with a capacity of 80 tons per day, was erected at the old Acton mine, lot 32, range III, Acton by Mr. P. Tetrault of Montreal. The plan was to smelt portions of the old dumps at these mines, and carry on some custom work. About six hundred tons of cupriferous pyrrhotite were brought from the Lake Memphremagog mine; this pyrrhotite was roasted and then mixed with the copper bearing magnesian limestone of Acton. Fifteen hundred tons of ore, selected by hand-picking the old dumps at the Acton mine, are said to have carried about one and a half per cent. of copper. After a short run, operations were suspended and have not been renewed. It is certain that none of the dumps at the Acton mine will average a half a per cent in copper. At the Acton mine, black shales lie beneath an upper limestone and rest upon a series of massive limestone beds. The copper ore that was taken from this property in the early days came from the upper limestone and the uppermost portions of the shale in the vicinity of their contact with irregular dyke-like instrusions of a now highly altered diabase or closely allied rock. In 1913, in order to determine the possibility of mineralization of the lower limestone, a diamond drill hole was put down at what was considered to be the most favorable locality on the property; but no evidences of mineralization were found. This work was done under the direction of Prof. J. W. Bell of McGill University.

In addition to the above operations, some prospecting for copper has been done on other properties, but without discovering any deposits of economic value. During portions of the summer of 1914 prospecting work was being performed on lot 6, range VI, of Brompton, on lot 22, range V, of Stoke, on some lots in the vicinity of the deposit of pyrite at Stratford, and some diamond drilling was being done on lot 23, range III, Weedon, but no encouraging results were obtained.

Labor.—During the early days of prospecting and mining in the Eastern Townships, labor was cheap. Especially was this true of the period during and immediately after the Civil War (1861-65). At that time a considerable number of men, chiefly deserters from the army, and locally known as "skidaddlers," crossed the border into Canada. It was a good miner that during that period received $1.00 a day; $1.25 was a very exceptional wage, and many men considered themselves fortunate if they earned 75 to 80 cents a day.

At present wages are higher. At the Eustis, a miner eceives $1.75 a day. A large proportion of the men are on contract and some of them earn $3.00 or more a day. At Weedon, the average daily wage is $2.60. Much of the development work is done under contract at the following rates:—Drifts, 7 x 4, at $6.00 per foot; Raises, 6 x 10, at $4.50 per foot; Winzes, 10 x 5, at $12.50 per foot, and Shafts, 16 x 6, at $25.00 per foot. These prices cover all labor and supplies, except drill repairs, compressed air and drill steel. In raising and drifting, the company does the shovelling.

MINE-RESCUE AND FIRST AID TRAINING IN BRITISH COLUMBIA.

The larger coal mines of British Columbia are those situated on Vancouver Island and in the Crow's Nest district of Southeast Kootenay, respectively. Smaller fields are those of Nicola and Similkameen, which are about midway between the two larger fields. In all these coalfields instruction is given to miners and other mine-employees in both mine-rescue and first-aid methods. During 1915 it was manifest that first-aid work had taken a firm hold in the larger fields, for in both there were held first-aid demonstrations and competitions. Further, there was a gratifying increase in the total number of members of classes for instruction held under the auspices of the Canadian Branch of the St. John Ambulance Association, which association is the Ambulance Department of the Grand Priory of the Order of the Hospital of St. John of Jerusalem in England, and is engaged in doing work similar in many respects to that of the Red Cross Society in the United States.

On Vancouver Island first-aid instruction classes have been held at Cumberland (Comox colliery), Nanaimo, South Wellington, and Ladysmith (Extension colliery). There have also been several first-aid public demonstrations, in Comox district, at Nanaimo, and at Ladysmith. At the last-mentioned place there was held in November the first annual competition for the Frost-Cunningham Cup, donated by the mines surgeon, Dr. A. C. Frost, and J. H. Cunningham, superintendent of the Extension colliery. Four teams, each of five men, competed, and the winners were the members of team B, from No. 1 mine, Extension. Similarly, there have been demonstrations of the use of oxygen-breathing mine-rescue apparatus and the pulmotor.

The approximate number of men who attended the first lecture of the St. John Ambulance course of instruction in first-aid in 1915 was 700. While less than one-half of these presented themselves at the final examination at the conclusion of the course, it is satisfactory to note that fully 300 passed and obtained the St. John Ambulance Association's certificate of competency to render first-aid to the injured. These numbers include men connected with metalliferous mines as well. Classes were conducted at 20 different mines in 1915. The total number of mine-rescue proficiency certificates issued to date by the British Columbia Department of Mines is 244. Mine-rescue and first-aid railway cars are maintained by the Canadian Collieries (Dunsmuir) Limited, and the Western Fuel Co., on Vancouver Island. There are Government mine-rescue training stations at Nanaimo, Merritt (Nicola), and Fernie (Crow's Nest). Both Thos. Graham, chief inspector of mines, and Dudley Michel, instructor, are zealous in fostering first-aid and mine-rescue training work in the province.

THE METALLURGY OF CANADIAN COBALT ORES

I. METHOD OF TREATMENT AT THE COBALT PLANT OF THE CANADIAN COPPER CO.

By Ralph W. Bridges

The Cobalt plant of the Canadian Copper Company was situated at Copper Cliff, Ontario, about one half mile south of the large copper nickel smelter. The works were remodelled and designed to smelt and treat ores and concentrates from the Cobalt silver district. The plant was in operation from December, 1905, to February, 1913, during which time more than 40,000,000 ounces of silver, 2,200,000 pounds of cobalt, 1,500 000 pounds of nickel, and 4,500,000 pounds of pure arsenic were produced. Some idea of the richness of the ores treated can be obtained from Table 1. The low grade Crown Reserve ore included in this table was used as a flux.

Treatment:—If the ore was in large lumps it was crushed and then ground in a Krupp ball mill to pass 30 mesh. For sampling about 6% was cut out by a Snider sampler. Sampling was completed by coning and quartering. The first quartering divided the sample into four parts, which were worked down as two independent samples known as No. 1 and No. 2. These samples were reduced by quartering until the final quarters separated by a Jones sampler gave two samples of about 18 pounds, one of which was ground and the other held for reserve. The samples were ground to pass 100 mesh, or until nothing but silver scales remained which were weighed and assayed separately. The sampling work and moisture determination for the 8 cars of ore received in May, 1910, is shown in Table No. 2.

The ore was charged with suitable fluxes into 32″ x 72″ blast furnaces, having a capacity of 25 to 30 tons per 24 hours. Limestone from Michigan was used as a basic flux and low grade Crown Reserve ore was used as the acid flux.

The products of the blast furnaces were:—1. Flue dust and crude arsenic; 2. Slag; 3. Silver Bullion: and 4. Speiss.

The crude arsenic and flue dust from the blast furnaces and roasting furnaces were collected in suitable condensing chambers. The flue dust was recharged to the blast furnaces and the crude arsenic was sublimed from an arsenic refining furnace which made it ready for packing. Pure white arsenic assayed 99.98% arsenic oxide with about 0.03 ounces of silver per ton.

The slag from the blast furnaces during ore runs was rejected except when it was found to carry more than 10 ounces of silver per ton in which case it was used as revert to the blast furnaces. The slag produced while smelting speiss to remove the iron was all used as revert on ore runs because of its high silver and high cobalt content. Complete assays of the two slags were as follows:—

	Ore Slag	Speiss Slag
Silver	8.8 oz.	32.8 oz.
Arsenic	.13	.47
Cobalt	.44	13.97
Nickel	.29	1.28
Iron-oxide	11.63	28.54
Aluminum-oxide	14.15	9.75
Calcium-oxide	22.78	6.50
Magnesium-oxide	8.67	4.68
Silica	41.13	34.03
	99.35	99.22

The silver: About 75% of the Silver in the ore charged was obtained as buttons which were easily separated from the speiss and charged into an oil-fired cupelling furnace with a capacity of 30,000 ounces. The assay of this crude silver was as follows:—

Lot	Weight oz.	Assay	Fine Silver
668	16128.80	85.88	13851.41
669	14524.67	84.91	12332.90
670	15982.97	86.71	13858.83
673	15939.22	85.99	13706.14
674	14758.00	86.11	12708.11

After about 24 hours in the cupelling furnace the silver was ladelled out and cast into bars and shipped to the Balbach Smelting and Refining Company of Newark N.J. A few lots of this silver assayed as follows:—

Lot	Weight oz.	Assay	Fine Silver
637	46320.40	99.44	46065.17
645	37893.25	99.54	37721.97
649	34339.70	99.43	34147.05
652	50230.10	99.34	49900.59
659	52646.70	99.21	51238.68

The speiss was quite brittle as a rule and easily broken with a hammer. After being run through a crusher it was ground in the ball mill to pass 30 mesh, 20% of salt being added as the speiss was charged to the mill. This speiss, known in the smelter process as high iron speiss, was roasted in 8 Edwards reverberatory furnaces fitted with mechanical rabbles and having a capacity of 2400 pounds per 24 hours. The composition of high iron speiss is shown in Table No. 3.

The product of the roasting was a chloridized speiss which was transferred from the smelter to the hypo-leaching building. Here it was treated in a large agitation cylinder, first with cold water which dissolved out the undecomposed salt and the soluble salts of cobalt, nickel and copper. This water solution was decanted onto scrap iron to precipitate the copper and was then pumped to another tank where the cobalt and nickel were precipitated as hydrates by caustic soda. This precipitate was dried, calcined to oxides, ground and barrelled for shipment. The average assay of this material was:—Silver, 15.0 oz; Arsenic 0.3%; Cobalt 40.00 %; Nickel 3.00%. Nickel is lower than the usual proportion of nickel to cobalt for the reason that it is less easily converted to a soluble salt in the chloridizing roast.

After the wash with water the treatment of speiss is continued with four covers of sodium hyposulphite solution which takes all the silver chloride into solution and gives the "First Hypo Residue" which contains 20 to 30 oz. of silver. The silver was precipitated from the hypo-solution as silver sulphide which was collected in a filter-press, dried and mixed with sodium nitrate and carbonate. This mixture was roasted in an oil-fired furnace and then leached in hot water. The residue was a sponge-like mass of metallic silver which was charged to the silver refining furnace.

The "First Hypo Residue" resulting from the leaching process was returned to the smelter where it was mixed with quartz and run through the blast furnaces for the purpose of removing the iron. This was made necessary because of the contract under which the "Crude Cobalt Material" was sold, which required that the iron content be below 5%. This smelting operation resulted in a new green speiss called "Low Iron Speiss" of a composition shown in Table No. 4.

This speiss was milled with salt and roasted just the same as the "High Iron Speiss", and then washed with water and treated with hypo. The residue in this case was called "Second Hypo Residue". It was dried and

mixed with 20% sodium nitrate and 10% sodium carbonate and roasted in a reverberatory furnace. This converted the arsenic to sodium arsenic which was leached out with hot water. The dried residue was sold to refineries in Germany as "Crude Cobalt Material". the sampling and weighing being done by Ledoux and Co. of New York City.

The composition of a few lots shipped in 1912 is shown in Table No. 5.

Power for operating the smelter was supplied from the company's power plant at High Falls, Ontario, 14 miles distant from Copper Cliff. 200-300 horse power was required and 60 to 100 men were employed, working in 12 hour shifts.

A complete statement of the ore treated and the products of the cobalt plant while in operation is given in Table No. 6.

TABLE I.

Lot	Dry Weight	Assay Co. %	Assay Ni. %	As. %	Ag. oz.	Metallic Content lbs. Cobalt	lbs. Nickel	lbs. Arsenic	Ounces Silver
				Buffalo Ore.					
399	48275	7.47	3.65	32.24	2135.38	3606	1762	15564	51542.73
403	45602	8.52	3.87	33.24	2169.77	3885	1765	15158	49472.93
408	45789	7 57	3.02	31.31	1823.34	3466	1383	14337	41744.46
416	44305	7.11	2.61	29.33	1680.11	3150	1156	13004	37218.64
				Nipissing Ore.					
407	63795	9.22	5.49	38.02	3535.99	5882	3502	24255	112789.24
422	64652	9.01	6.40	38.72	3022.60	5825	4138	25033	97708.37
426	62304	8.03	5.18	32.90	3852.70	5003	3227	20498	120193.31
437	64703	8.85	5.49	40.82	2209.53	5726	3552	26412	71481.61
				La Rose Ore.					
394	61839	8.79	7.94	37.33	1934.32	5436	4910	23084	59808.21
409	73040	9.04	6.69	39.65	1017.91	6603	4886	28960	37174.07
410	64967	9.16	8.16	40.30	1167.36	5951	5301	26182	37919.94
411	64680	9.30	6.69	39.12	1177.12	6015	4327	25303	38068.06
				Kerr Lake Ore.					
400	61379	10.74	3.85	44.56	3639.12	6592	2363	27350	111682.77
406	61487	6.87	3.08	24.51	4565.81	4224	1894	15070	140368.98
420	61560	10.65	3.56	40.00	4121.77	6556	2191	24624	126868.08
427	60876	7.33	2.30	29.77	3794.77	4440	1393	18033	114935.99
				Trethewey Ore.					
431	60878	10.00	1.77	48.58	1296.79	6088	1078	29575	39422.99
476	56387	10.26	2.30	41.54	3348.35	5785	1297	23423	94431.71
494	59843	9.67	2.31	49.75	1904.84	5787	1382	29772	56995.67
522	47520	9.86	1.91	46.60	1375.05	4685	908	22144	32671.19
				Temiskaming Ore.					
567	59262	5.89	1.34	21.80	3659.93	3491	794	12919	108358.49
576	59030	4.41	1.07	22.30	2742.82	2603	632	13164	80954.33
595	57987	3.70	2.41	15.00	3838.55	2146	1397	8698	111293.00
608	52384	3.47	2.43	14.30	3371.76	1818	1273	7491	88313.14
				Crown Reserve Ore—High Grade					
395	48624	6.42	4.04	21.16	5255.28	3122	1964	10287	127766.37
421	59776	8.40	5.45	28.73	4761.74	5021	3258	17174	142318.89
435	59666	8.75	5.61	32.42	4136.13	5221	3347	19344	123397.30
452	59047	5.84	4.86	19.29	4225.71	3448	2870	11390	124757.75
				Crown Reserve Ore—Low Grade.					
396	55347	0.36	0.46	1.15	250.10	199	255	636	6921.14
401	58621	0.32	0.32	1.15	144.15	188	188	674	4225.11
405	59769	0.39	0.50	1.05	141.75	233	299	628	4236.13
415	58754	0.30	0.33	0.75	121.00	176	194	441	3554.62

TABLE 2.

Date	Mine	Lot	Milled Weight	Sample Weight	Per ct. Sam.	Per ct. Water	Total wt.gr	Sample No. 1 Scales	Sample No. 1 Fines	Sample No. 2 Total wt. gr.	Sample No. 2 Scales	Sample No. 2 Fines
May 2	Buffalo.....	568	59713.5	3655.5	6.12	0.22	7003	27.67	6975.33	6442	42.71	6399.29
" 9	Temiskaming.....	569	6359.7	2129.5	3.35	3.83	6969	1.50	6967.50	6713	1.45	6711.55
" 10	Temiskaming.....	570	56915.5	2446.5	4.27	2.08	7719	17.23	7701.77	7441	25.83	7415.17
" 11	Buffalo.....	571	4787.5	3379.5	6.22	0.15	8226	36.11	8189.99	7984	44.20	7940.80
" 22	Crown Reserve....	572	6426.9	3114.	4.84	0.10	7695	200.65	7494.35	9569	192.26	9376.74
" 22	Buffalo.....	573	61180.5	3827.5	6.26	0.20	7438	60.47	7357.53	7509	46.25	7462 75
" 24	Millerette.....	574	56430.5	3351.5	5.95	0.87	5004	....	.....	5894	....	.....
" 30	Crown Reserve.. .	575	63311.	3330.	5.26	0.12	8174	428.50	7745.50	8015	271.80	7733.20

Average Sample.....5.28%.

TABLE NO. 3

High Iron Speiss

Lot	Dry Weight	Co. %	Ni. %	Assay As.%	Ag. oz.	Fe. %	Lb Cobalt	Lb. Nickel	Lb. Arsenic	Ounces Silver
112	56656	25.13	15.61	34.10	1181.90	14.65	14238	8844	19320	33480.86
116	40144	24.24	8.53	30.25	1617.70	23.10	9731	3424	12144	32407.47
122	70008	25.38	16.23	32.70	1299.50	14.55	17768	11362	22893	45487.70
125	34654	23.28	10.92	31.50	1888.90	19.80	8067	3784	10916	32728.97
138	62783	22.78	12.26	30.40	1703.79	21 55	14302	87697	19086	53484.52
158	31077	24.48	19.60	31.45	1650.34	15.70	6677	6091	9774	25643.81
174	42014	29.86	14.48	28.85	1557.60	12.10	12545	6084	12121	32700.50
176	84284	22.25	21.57	30.25	1280.45	13.80	18753	18180	25496	53961.36
182	68885	25.59	20.70	33.65	1290.64	11.10	17628	14259	23180	44452.87
193	58854	29.57	13.44	30.20	1357.50	15.00	17403	7910	17774	39447.15

TABLE NO. 4.

Low Iron Speiss

Lot	Dry Weight	Co. %	Ni. %	Assay As. %	Ag. oz.	Fe. %	Lb. Cobalt	Lb. Nickel	Lb. Arsenic	Ounces Silver
118	12620	28.16	25.60	31.10	1617.90	3.90	3554	3238	3925	10208.95
128	18461	28.49	28.53	30.50	1451.65	3.60	5260	3267	5631	13399.46
157	58161	24.11	29.36	31.95	1552.50	4.75	14023	17076	18582	45147.48
163	9987	25.29	34.01	29.75	1184.75	2.00	2526	3397	2971	5916.05
165	9834	33.24	22.86	29.70	1210.00	4.30	3260	2248	2921	5949.57
167	18334	32.85	26.13	26.30	979.71	5.05	6033	4791	4822	8981.00
171	19992	31.21	25.51	29.20	1420.29	2.80	6240	5100	5838	14197.12
172	86705	29.31	30.73	28.10	1268.53	2.40	25413	26644	24364	54993.95
181	21095	28.60	31.01	27.65	1111.90	2.90	6033	6542	5833	11727.77
196	17573	28.10	25.35	30.55	1720.40	3.40	4933	4455	5369	15116.26

TABLE NO. 5

Crude Cobalt Material

Lot	Dry Weight	Co. %	Ni. %	Assay As. %	Ag. oz.	Fe. %	Lb. Cobalt	Lb. Nickel	Lb. Arsenic	Ounces Silver
19B	23714	31.00	31.66	1.10	36.60	.....	7350	7508	261	433.97
20B	32783	30.92	31.63	1.10	29.70	.....	10137	10369	361	486.83
21B	43086	31.38	30.40	1.08	28.00	.....	13520	13098	465	603.20
22B	23691	31.92	28.68	1.10	25.90	.....	7562	6795	261	306.80
23B	17182	31.72	28.60	1.15	24.00	.....	5450	4914	198	206.18
24B	16759	31.47	29.18	1.10	34.80	.....	5274	4890	184	291.61
25B	26292	31.91	28.97	0.98	31.80	.....	8390	7617	258	418.04
26B	17382	28.64	25.11	1.21	48.70	.....	4978	4365	210	423.25
27B	17629	28.45	24.43	1.13	50.40	.....	5040	5015	199	444.25
28B	52363	29.84	29.10	1.30	36.40	.....	15625	15238	681	953.01

TABLE NO. 6

Statement of Ore treated and product produced during operation of Cobalt plant.

Year	Pounds of Ore Treated	Ounces of Fine Silver Produced	Pounds of Cobalt	Pounds of Nickel	Pounds of White Arsenic
1906	1767692.5	1282692.78	9021	3987	.....
1907	4560627.5	3829542.82	331151	138427	510622
1908	9857072.5	8551582.07	464171	268140	942827
1909	10651189.5	8779014.55	690737	463588	1248722
1910	9792571.0	8696624.87	346483	260756	843609
1911	6744108.0	6584102.46	238684	234323	680074
*1912	3266267.0	2798954.80	161412	169966	280486
	46642528.0	40522514.35	2241659	1539187	4500350

*9 Months

RELATION OF GOVERNMENTS TO MINING*

By Horace V. Winchell

(Continued from last issue)

Since the United States, although occupying less than six per cent. of the continental land area of the globe, and containing a little over six per cent. of its people, produces, roughly, over one-third of the world's minerals, we should expect to find among its citizens full appreciation of the importance of the mining industry, and on its statute books the best and wisest and most up-to-date provisions for the encouragement and perpetuation of this great industry.

The following statement is reproduced with slight changes from the report (No. 694) by the House Committee on Mines and Mining, Sixty-third Congress, second session, submitted May 20, 1914:

"That the mining industries of the country, and especially the metal-mining industries in our public-land States, are not keeping pace with the normal development of the country is clearly shown by the following data:

"In the population of the public-land States west of the Mississippi and Missouri Rivers there was an increase from 14,800,000 in 1900 to 19,600,000 in 1910, or 32 per cent.

"The agricultural crops of the public-land States had a valuation in 1900, of $921,000,000, and a valuation in 1910 of $1,950,000,000, an increase of 112 per cent.

"During similar periods the average annual valuation of all the mineral products in the public-land States increased from $287,000,000 during the period of 1901-1905 to an average annual valuation of $358,000,000 during the period from 1906-1910, an increase of less than 25 per cent.; whereas the production of the precious metals in the public-land States decreased from an annual average valuation of $136,000,000 during the earlier period (1901-1905) to an average valuation of $127,000,000 during the latter period (1906-1910), a decrease of nearly 7 per cent.

"No better illustration could be given of the contrast in the treatment of these two great national industries than the fact that in spite of this lagging behind in the mining industry during this 10 year period the National Government expended for the reclamation of agricultural lands in these public-land States not only all the money received from the sale of public lands for agricultural purposes, but also nearly $7,000,000 received from the sale of mineral lands in these States.

"The reduction in the nuumber of men employed in the different metal-mining industries in the public-land States tells even more clearly than do the figures of production the falling behind of the mining industry. The figures from one of these States may be taken as an example. The average number of men employed in the metal-mining and metallurgical industries in the State of Colorado for the 4-year period, 1900-1903, was 36,189; during the period from 1904-1907 the annual number of men employed was reduced to 34,364; and during the 4-year period from 1908-1911 the number of employees was further reduced to 22,560.

"Among the causes of this lagging of the mine development are the following:

"(a) The approaching exhaustion of many of the more easily discovered and richer ore deposits, and the fact that not enough other rich deposits are being discovered to supply ore to replace that now being extracted; (b) the absence of known methods of profitably working many low-grade ore deposits; (c) the wasteful methods now followed in some mining and metallurgical operations, which, although they may bring temporary profits to mine or furnace operators, are reducing the national wealth in a manner that can be remedied only by the discovery and use of more efficient methods.

"Of a number of our important mineral resources, we have for both the present and future needs of the Nation only an adequate supply. The utilization of certain of these resources, such as coal, oil, and natural gas, destroys them. Common prudence demands, therefore, that through the necessary researches the Nation should learn how to use this one supply of its mineral resources more wisely and more efficiently.

"The loss of life in the different branches of mining industry is a discredit to the Nation. It calls for more extended inquiries and researches on the part of the Federal Government, and a proper dissemination of the results obtained; it calls for more stringent police supervision or inspection by the State, and for more determined cooperative effort on the part of both the miners and the mine owners in the way of mining and enforcing safety regulations.

"The National Government should do its full duty in this matter without further delay. It should lead in a great movement for the practical conservation of life and resources.

"Congress is now appropriating as an aid to agricultural advancement about $28,000,000 per annum. These funds are being expended and the work authorized is being carried forward through a well-organized department with a Cabinet head and with nearly 14,000 employees.

"That these large expenditures have resulted in still larger benefits to the country there can be no doubt, and one of the evidences of the benefits is to be seen in the large increases in the aggregate value of the farm products of the country, which had an estimated value of less than $5,000,000,000 in 1898 and nearly $9,000,000,000 in 1912.

"The conditions underlying agricultural progress differ as to many details from those associated with mining, but the broad general principles of progress are the same, and the favorable response to the national aid for agriculture is itself an evidence of the favorable result that can be depended upon if similar aid is extended to mining. Furthermore, the less extended actual experience growing out of the more limited expenditures through the United States Geological Survey and the Bureau of Mines on behalf of the mining industry furnishes specific evidence of the larger benefits that may be expected to result from larger expenditures for mining investigations. Thus, under the Bureau of Mines, through a small expenditure, the saving in national wealth through stopping the waste of natural gas in one and one-half years has aggregated more than $15,000,000, which is several times the total cost of the maintenance of the Bureau of Mines from its beginning.

"The benefits that may be expected from more liberal aid to the mining industry will come (1) through a better safeguard of the health and lives of those engaged in mining and metallurgical operations; (2) through the lessening of the unnecessary waste in the mining and treatment of the various mineral products; (3) through increased efficiency in mining operations by the improvement of health and safety conditions; (4) through the development of more efficient and cheaper methods in the treatment of low-grade ore deposits, which are either not now worked at all or worked only in their richer parts or pockets.

*A paper presented at a meeting of the International Engineering Congress, 1915, in San Francisco. Cal., Sept. 20-25. 1915.

These benefits may come either through the discovery of new methods in connection with the researches of the Bureau itself or through its activity in stimulating researches by private parties.

"A brief statement of facts will indicate in a general way what the National Government is doing to aid the development of each of its two great basic industries and what in turn these two industries are contributing yearly to our national wealth and progress. Although the figures are not fully comparable in all respects, they will be found to be essentially correct.

"What these two basic industries do for the Nation:

Item.	Agriculture including forestry.	Mining and mineral industries.
Number of employees	13,000,000	2,300,000
Yearly value of products	$10,500,000,000	$4,600,000,000
What each worker in these industries contributes to the national wealth yearly	$800	$1,800
What each industry contributes to the freight tonnage of the country yearly, per cent.	22	60

"What the National Government is doing for each of these industries:

Yearly Appropriation.	Agriculture.	Mining.
For education—		
From direct appropriation	$2,500,000	.....
From land grants	1,030,000	.....
From Smith-Lever Act for demonstration educational work	480,000	.....
For 52 experimental stations, one in each State and Territory	2,550,000	.....
For general researches and other work to aid agriculture and mining	22,410,000	$1,967,000
Total	$27,970,000	$1,967,000
Per capita contribution from the people of the U. S. for advancement of these industries	$0.28	$0.02
Of this contribution the per capita expenditure for safeguarding the lives of 2,300,000 employees in the mining industry is about one-half of 1 per cent. per annum		.005

"Nothing can show the relative national neglect of the mining industry more clearly than does the above tabular statement; and this neglect is all the more difficult to understand in view of the hazards of that industry and the other conditions that should appeal to the humanitarian as well as to the commercial instincts of the American people. But another fact that tells the story with equal emphasis is that during the past 10 years, in addition to the large sums paid out of the National Treasury for the benefit of agriculture, as indicated above, and the payment towards the reclamation of agricultural lands in the Western States of all funds arising from the sale of public lands in those States, even the proceeds of the sale of the Nation's mineral resources in like manner have gone not to aid mining but to the reclamation of additional agricultural lands.

"Agriculture is much the larger of the two industries; it embraces a large number of persons, more widely distributed, and each acting as an independent agent. Its products, supplying the country with food, and clothing, bring this industry even closer to the lives of the people than does the mining industry, though the latter supplies them with the fuel that cooks their food, heats and lights their houses (which are built largely of mineral products), operates and supplies a large share of the materials and all the machinery of their factories, conducts and operates largely their facilities for transportation and communication, and supplies more than 60 per cent. of the total freight tonnage of the country. Indeed, the mining industry is in large measure the real basis of our modern civilization and national life.

"But, more than the above, there must be some special reasons why the mining industry has received relatively so little aid from the National Government, and these are to be found, no doubt, in certain misapprehensions concerning the industry. Mining is usually regarded as an industry comprising the operation of a few large, highly profitable properties, such as the old Comstock mines in Nevada, the Treadwell mine in Alaska, or the Homestake mine in South Dakota. It is usually considered to be an industry controlled by a few parties, the owners of the large properties mentioned, who would gladly avail themselves of an opportunity to unload on the National Government the cost of conducting those researches in which they are particularly interested. Therefore, it is usually considered as an industry that should be allowed, and even required, to take care of itself. These assumptions are far from correct.

"The facts of the situation are:

"(1) These large, highly profitable properties are few in number, and, so far as known, their owners have never joined in a request for Government appropriation to aid in the mining industry, nor have they been given any special consideration either in the establishment or in the plans of the U. S. Bureau of Mines. These mine owners have neither asked for assistance nor have they endeavored to unload upon the Government any investigations of their own. On the contrary, at the request of the Bureau of Mines, a number of them have expended considerable sums from their own funds for investigations that promise to be useful not only to them, but to other less important mining developments in which they are, and were in no way interested.

"(2) Although the number of large mines is small, there is a large number of small mines. The records show that in the country as a whole there are about 40,000 coal mines, metal mines, and quarries and about 170,000 oil wells that are operating on a smaller or larger scale. In addition there are many plants for treating ore by mechanical concentration, smelting, or other processes and various mineral-industry plants in different parts of the country. Few seem to appreciate the importance of helping those who hold these small properties to find methods of operation by which the properties can be worked at a profit instead of being helplessly transferred to a few large corporations which alone may have the funds for developing the processes that will make profitable operation possible.

"(3) The most urgent appeal for larger national aid to the mining industry comes from and on behalf of the 2,300,000 employees of the different branches of the industry, who are asking the aid of the Government in the development of safer and more healthful working conditions. The humanitarian appeal should be given precedence over calls for appropriations to advance commercial gains. It comes from employees working under hazardous conditions, a majority of whom are unfamiliar with our language, our laws, or our institutions. These men have been led to believe that the Government of the United States is interested in their welfare and has been planning to aid in bringing about safer and healthier conditions for them; but owing to long delays and slow progress in the Governments's work, they are now becoming discouraged in their belief that such plans would be realized.

"(4) Another important end to be sought through these larger contributions to the aid of the mining industry is helping the consumers or users of mineral products, who are distributed throughout every part of the country. Mineral products are becoming more and more indispensable to the domestic life of the people and to our manufacturers, as well as being the basis of transportation facilities and of the products to be transferred. Under normal conditions, as our mines become deeper and our mineral resources are depleted, not only the hazards of production but also the per capita cost of mineral products is increasing and one important purpose of the larger investigations proposed in behalf of the mining industry is to find how the cost to each consumer may be kept down to a minimum.

"Some special reasons why mining should receive larger national aid are enumerated below:

"(1) Agricultural products, if ordinary care is given to our soils, will be supplied continuously by annual crops. But as regards mineral resources the case is different. Our mines can produce only the one available supply; this one supply must meet the future as well as the present needs of the Nation; and a century's experience has clearly shown that our use of the more important of these resources, such as mineral fuels, precious and other metals, and potash and phosphate deposits, will increase much more rapidly than will our population.

"(2) Although certain of our mineral resources, such as the metals, are destroyed rather slowly in use, other essential resources, such as coal, oil, and natural gas, are consumed or destroyed beyond recovery.

"(3) In the utilization of certain of our mineral resources such as natural gas, petroleum, coal, zinc, and some of our other metals, there are large losses or wastes that are believed to be unnecessary, and it is a wise duty of the National Government to aid in the prevention of such wastes. These wastes now exceed $1,000,000 per day.

"(4) And more important than all the above in their appeals for the larger aid of the Federal Government are the hazards of the mining industry—the accidents that yearly result in such large losses of life and the unfavorable health conditions in many mines and metallurgical plants which affect adversely the vitality of employees. None of these conditions is encountered in agriculture, but they are in a peculiar way characteristic of the mining industry; and these conditions alone more than justify additional expenditures from the Federal Treasury."

Still another reason why federal aid should be extended to the mining industry is found in the fact that few countries are independent and self sufficing in their production of minerals and ores. This fact is brought prominently to the front at the present time, by the interruption to the world's commerce occasioned by war. In speaking of this situation, the Director of the United States Geological Survey uses the following language:

"I believe the mineral wealth of the United States is in largest measure the foundation of the marvelous growth of the last few decades. Industrial America! Think to what a degree the industries of America are based upon our ores and mineral fuels, or figure if you will the percentage of railroad tonnage that originates at the mine.

"Not only is our country a world-leader in the output of such essential minerals as coal, petroleum, copper, zinc, iron, lead, phosphate—and in three of these it exceeds all other countries put together—but as far as such things can be measured or estimated we are blest in the possession of the largest reserves of many of the more important of these minerals. No other country can in any sense compare with the United States in the degree of industrial independence afforded by the possession of these mineral resources. The raw material is at hand to enable us to win and maintain supremacy as a manufacturing nation.

"Yet, under this most-favored nation clause, the catalogue of our mineral resources is not the complete list of minerals essential to modern civilization; a few items are missing, others are present apparently only in insufficient quantities, and the quality or locality of the deposits of still other minerals may be unfavorable to present day utilization. Thus it happens that the nation is not wholly independent in its mineral industry. The list of what we lack is short. We are wholly dependent on other countries for only four principal items—tin and nickel, potash and nitrate. Among the minerals of which the United States has a deficient supply are manganese, platinum, gems and asbestos. Still other minerals it has been more profitable to buy abroad than at home, such as chrome ore, barytes, flint pebbles, magnesite, mica and graphite. * * *

If it is then important for the people and government of the United States to aid and encourage the development of its own mineral resources, how much more important should such efforts be for those nations which have not the generous provisions of nature in the shape of easily won mineral deposits. Nor is it alone the federal government which should evince an interest in the working of mines. Every state and province should do its share, and instead of looking upon mines as something to be taxed to the very limit or beyond, should feel that **it is of intimate and vital importance to every citizen of the state or province that its mines and quarries be worked to the highest stage of productivity of which they are capable.** Far greater than the value of the taxes paid into the state treasury is the benefit derived indirectly from great institutions for the production and working of minerals; and the operation of steady mines and metallurgical plants in a community is of incalculably greater importance than the derivation of direct revenues to enrich and often debauch the public treasury. For concrete examples of the truth of this statement look at Chile with its nitrate deposits paying millions yearly to the government and then turn to Sweden and observe its wise policy of encouragement of the development of its iron mines. The former country has not only not aided in the nitrate industry, but has done its best to turn it into cash for the government treasury, much to the disadvantage of public morals; the latter country has given its lands freely, has appropriated large sums for railroads and for other necessities to those who would develop an industry which would afford permanent employment to large numbers of laborers.

Full discussion of this subject would involve consideration of the bearing of mineral production on all lines of industry; it would necessitate a study of modern civilization and industrial development in all lands. For those who are already students of the subject, such elaboration is superfluous; to those who are not, it would be tiresome and unread. Enough has been said to indicate its importance. In conclusion, the following propositions may be taken as established beyond question:

1. From the dawn of civilization to the present time national standing has been dependent on and conditioned by mineral wealth and consumption.

2. Next to agriculture no industry so deserves the sympathy and aid of governments.

3. The attention of legislators, should not only be invited but compelled to the necessity for wise and sympathetic legislation in connection with the mining industry.

4. It is incumbent on every engineer and mining man, and indeed upon every citizen to insist that our mining laws shall be most carefully framed so as best to promote the interests of the mining industry, and hence of every industry throughout the entire length and breadth of the land.

According to General Manager James MacNaughton of the Calumet and Hecla Mining Co., the use of the Carr bit has resulted in an increased output per miner equivalent to his total output of a few years ago, thus not only decreasing costs but making available tremendous tonnages of low-grade ore that would not otherwise be commercial.

The decision of the British Admiralty to give Nova Scotia coal a thorough test will probably result in the removal of the prejudice in favor of Welsh coal and give a new outlet for the coal of Cape Breton.

CANADIAN SUPPLIES OF IRON AND STEEL IN RELATION TO MUNITIONS OF WAR*

By Thos. Cantley

The steel Industry in Canada is represented by plants in three of the Eastern Provinces: Nova Scotia, Quebec and Ontario. Those of the first and last mentioned Provinces are the most important, supplying over 99% of the total production.

Probably the first effort in iron smelting in Canada was made in the Province of Quebec. During the early decades of the last century we find that various small enterprises were started in all three Provinces, charcoal being used as fuel and local ores smelted. The amount of metal produced, however, was very small.

The Londonderry district in Nova Scotia was the first to assume commercial importance, and quite modern furnaces and plant were laid down about the middle of the last century. Iron was made here about the same date and a rolling mill was installed in 1860. It is of interest to note that the pig iron made at Londonderry had quite a good reputation, and was in demand. It is said that owing to its superior quality, the British War Office, upon the recommendation of Sir William Fairburn and others, used it for the manufacture of ordnance in these days, and imported it into England for the purpose. About 1875, there was further development in this district with important additions to plant; coke pig iron being then made for the first time in Canada in a commercial way. In a paper written on the iron and steel industry in 1885, Londonderry is referred to as the "site of the most important Iron Works in the Dominion." Up to 1887 it had produced over 200,000 tons of pig iron smelted from local ore; 42,000 tons of bar iron and forgings, and 40,000 tons of nail plate, wheels and castings. Operations at Londonderry have since been carried on intermittently, pig iron having last been made in 1908, and steel in 1912. Farther east at New Glasgow, the first steel was made on a commercial basis in 1883, when two 20-ton acid lined open hearth furnaces were put in operation. Imported pig was used. Four years later the basic open hearth process was adopted, thus making it possible to use local pig iron. Since this date all steel made in Nova Scotia has been exclusively basic open hearth. In the Pictou district the first iron was made in 1826, by the General Mining Association, then operating collieries at Albion Mines, when they smelted local ores using native flux with beehive coke made from Pictou coal. Owing to the refractory nature of the ore, the venture was not a success and operations were discontinued. In Cape Breton the first pig iron and steel was made in 1899, and from this date Cape Breton has been the most important steel district in the Province.

In 1737 the right of mining and smelting iron ore in the District of St. Maurice, near Three Rivers, was granted to a company by Louis XIV. From that date until a year or so ago mining, dredging, and smelting of bog ore has been carried on almost continuously in the district, on a small scale. Attempts to smelt iron on a commercial scale were made at Moise in 1867; at St. Urban in 1873, and at Hull in 1872 and 1887; but without commercial success. At Radnor and Drummondville, furnaces have been operated continuously from 1887 to 1912, using local ore, with locally made charcoal as fuel; producing on an average about 8000 tons per annum. At present there are no blast furnaces in operation and steel is only produced in small open hearth and electric furnaces, for making castings, or by the crucible method for special qualities; the tonnage involved being small.

One iron furnace was erected in Leeds County about 1800 and another at Normandale a few years later. These initial efforts proved failures, but in 1832 operations were resumed and continued until 1847. The Marmora furnace established in 1810 was operated unprofitably at intervals until 1875. A furnace was erected at Madoc, and operated for eight or nine years. Furnaces were also built at Houghton, in 1854, and at Burnt River, in Haliburton County. All these enterprises proved to be commercial failures, and in 1892 the Province of Ontario had not a single furnace in blast. Two years later in 1894, furnaces were put in operation at Hamilton by a company which is now incorporated with the Steel Company of Canada. These furnaces have been operated continuously since that time and the growth of the industry during the following decade was rapid.

Present Conditions

The industry as it exists to-day may be conveniently divided into two groups, the one in Nova Scotia, and the other in Ontario.

Nova Scotia.—In the province, the Nova Scotia Steel and Coal Company and the Dominion Steel Corporation operate under almost identical conditions. They use ore and coal from the same beds and generally are confronted with the same metallurgical problems. All the steel is made from Wabana (Newfoundland) ore, smelted with retort oven coke made locally from Cape Breton coal, while local flux is used. The blast furnaces are seven in number having a daily capacity of 1930 tons. There are eighteen open hearth furnaces including mixers, and two 15 ton Bessemer Converters.

Ontario. The industry here may be sub-divided into the Niagara Peninsula and the Lake Superior groups. All the important companies operate, however, under very similar metallurgical conditions.

In the Niagara peninsula, the following important companies are operating:

The Steel Company of Canada, with furnaces at Hamilton.

The Canada Iron Corporation, with furnaces at Midland.

The Canada Furnace Company, with furnaces at Port Colborne.

The Standard Iron Company, with furnaces at Deseronto.

In the district there are seven blast furnaces with daily capacity of 900 tons. The greater part of the ore and all of the fuel for these furnaces, is imported, although a couple of the smaller companies use a certain tonnage of local ores. Seven open hearth furnaces provide a steel making capacity of about 350,000 tons per year.

In the Lake Superior district, the following companies are located:—

The Algoma Steel Corporation, with furnaces at Sault Ste. Marie.

The Atikokan Iron Co., with furnaces at Port Arthur.

In this district there are four blast furnaces with a capacity of 1,050 tons per day, 5 steel furnaces and 2 Bessemer converters.

The Atikokan Iron Company has a furnace in the district with a capacity of 100 tons per day, which has been idle since 1911.

The ores smelted are partly native, from the Helen field and Magpie mines, but the greater part is imported from

*Read at a meeting held on November 10th, 1915, of the Montreal Metallurgical Association. This paper will also be presented and discussed at the Annual Meeting of the Canadian Mining Institute, March 1st, 1916.

the American Lake Superior ore field. The fuel used is, in part, locally made charcoal, but the greater part is coke, imported from Illinois or Pennsylvania. In 1910 a battery of 110 Koppers coke ovens was built at the Sault for the purpose of coking imported coal at the furnace, thus saving the breakage inevitably produced in the transportation of coke. In 1913 some 600,000 tons of coal was imported for this purpose and 419,000 tons of coke was made.

The consumption of materials used in smelting iron ores in Canada in 1914 was: ore etc, 1,358,184 tons, limestone 419,864 tons, coke 910,887 tons, charcoal 883,625 bushels.

The Nova Scotia industry is in the centre of Cape Breton coalfield. It supplies itself with coke and is thus self-supporting. The Ontario industry obtains all its fuel supply fron the United States, either in the form of coal or coke.

The following is a list of manufacturers of oven coke in Canada:

Company	No. and Type of Ovens	Location of Ovens
Intercol. Coal Mfg. Co., Montreal	36 Bee Hive.	Westville, N.S.
Londonderry I. and Mg. Co., Limited, Montreal	97 Bee Hive.	Londonderry, N.S.
Nova Scotia S. & C. Co., New Glasgow, N S	120 Bernard, 30 Bauer	Sydney Mines, N S
Dominion I & St Co, Sydney, N S	620 Otto Hoffman,	Sydney, N S
Atikokan Iron Co Limited, Port Arthur, Ont	100 Bee Hive	Port Arthur, Ont
The Algoma Steel Corp., Sault Ste Marie, Ont	110 Koppers,	Sault Ste Marie

There are in Canada, twenty-two blast furnaces, having a total theoretical capacity of 1,500,000 tons per year. These are in twelve separate plants and are owned by nine companies.

It is improbable that a greater tonnage than 1,350,000 can be obtained in 1915.

There are four steel plants in Canada containing thirty open-hearth furnaces and four Bessemer converters, and having a total capacity of 1,250,000 tons of steel a year: It is improbable that this amount can be exceeded during the coming year by more than 100,000 tons, and it should be borne in mind that 300,000 tons of this capacity is Bessemer steel which is not accepted in the manufacture of munitions. In addition there are eight or nine steel-casting plants, operating either small open-hearth furnaces or converters.

The production of steel ingots and castings in 1914 was: open hearth 549,716 tons, Bessemer 144,447 tons, other kinds 284 tons.

Electric Smelting.—In the above estimates we have not made any allowance for such additional tonnage as might be obtained by electric smelting. The tonnage of steel derived from this source in 1913 was under 5000 tons, not including the tonnage of ferro-alloys, which amounted to 8000 tons. The problem of electrically made steel is a large one. Melting scrap in a relatively inexpensive steel-furnace, where electric power is cheap, is very attractive. This no one doubts. The difficulties that may be encountered in securing any great tonnage in this way, while problematical, are bound to be enormous, and it is unlikely that our figures will have to be changed materially because of the tonnage derived in this way.

The following is a list of the companies making ferro-products or steel in the electric furnaces.

Name of company, address, location of plant, and products:—

The Electric Reduction Co., Buckingham, P.Q., Buckingham, ferro-phosphorous.

Electro Metals, Limited, Welland, Ont., Welland, Ont., ferro-silicon.

Electric Steel & Metals Co., Welland, Ont., Welland, Ont., steel castings.

Algoma Steel Corporation, Sault Ste. Marie, Sault Ste. Marie, ferro-silicon.

The Moffat Irving Steel Works, Limited, Toronto, Toronto, steel castings.

Tivani Electric Steel Co., Belleville, Ont., Belleville, steel castings.

Development of the Industry

The production of war munitions will doubtless be limited as much by the capacity of the blowing mills in this country as by the capacity for producing steel ingots.

In reviewing the statistics of the industry in reference to the present crisis it will be observed that its development has been slow. The first great impetus was given by the Iron and Steel Tariff of 1887 introduced by Sir Charles Tupper. It is due to his statesmanship that the conditions were established on which our present achievements rest. With the subsequent changes in import duties there was little advance in the industry until the second stage of development commenced at the close of the last century. This was brought about by the action of the Government in introducing a graduated system of bounties. This system resulted in large iron and steel enterprises in Nova Scotia and Ontario, culminating in 1913 in the production of 1,128,967 tons of pig iron and 1,168,993 tons of steel. It is a melancholy reflection that even in such a "banner" year. the iron and steel production of Canada was less than half our total requirements. During 1914 owing to the World-wide depression, the output declined considerably.

After the outbreak of hostilities the British War Office first looked to the United States for supplies of heavy ammunition. Thanks however to the initiative and energy displayed by the Canadian Minister of Militia, General Sir Sam Hughes, an invitation was shortly thereafter extended to Canada to help meet the requirements of the army in this respect. That it was possible to accept this invitation may be ascribed to the satisfactory condition of the iron and steel industries in Nova Scotia. Steel makers in that province were thus in a position to supply the steel and to make the forgings for shells. The Shell Committee co-ordinated this work and that of other manufacturers to produce the finished ammunition and in this way completed the first order for 200,000 shrapnel shells.

Between October, 1914 and June 10th, 1915, munition orders alone to the amount of over $160,000,000 were placed in Canada providing employment for thousands of workmen engaged not only in the iron and steel and allied industries but in other trades as well as to a large army of mechanics who would otherwise presumably have been without employment. As an example of the effect of the munition business in stimulating other than the metal industries it may be cited that over a million ammunition boxes for the making of which over ten million feet of lumber was used were supplied while a further twenty-five million feet of lumber has been made into cases to hold other munition exports.

During the first nine months of 1915 there was shipped to Great Britain from Canadian ports more than 4,229,000 shells about twenty-five per cent of which was fixed ammunition. Incidentally it may be of interest to mention that Nova Scotia Steel Co., the first of the Canadian steel companies undertaking to supply shell steel and shrapnel forgings, made at the company's New Glasgow plant during the twelve months ended October 31st last, a total

of 2,145,525 shell forgings, over twenty per cent of which were of the largest size for high explosive shells yet produced in Canada.

During the past spring and summer Canadian exports increased in volume at a rate never before experienced in the history of the country. This condition of affairs is largely attributable to the establishment of the business in munitions. Canada had built up a steel industry. In addition to what has been already accomplished the Dominion will probably during the next fifteen months, export to Great Britain munitions aggregating in value not less than two hundred millions of dollars—possibly three hundred millions of dollars—fully eighty per cent of which will be wholly the product of Canadian labor.

Whether the value of these exports will reach the higher figure mentioned depends merely on whether a sufficient supply of steel either from Canadian furnaces or elsewhere is obtainable. If the steel can be secured the engineering shops of the country can without doubt undertake the assembling and finishing of shells to the value of more than $300,000,000.

The largest production of steel ingots in Canada in any year was in 1913, when a total output of 1,048,538 tons was recorded. In 1914 this declined to 775,000 tons. Since the close of 1913, the steel producing capacity of the Canadian plants has been only slightly increased, and consequently, it is doubtful if the production this year will exceed at the utmost 1,250,000 tons.

Meanwhile in the United States, an extraordinary situation at present obtains. Never in the history of the steel industry of that country has the demand for steel been so great; and buyers for steel of every description are experiencing increasing difficulty in securing supplies. During the month of October last, the United States production o pig iron exceeded 3,000,000 tons, a monthly output never previously attained. It was greater in fact than the September record by over 95,000 tons, and was almost double the production made during October,1914. The amazing consideration is that while the United States to-day is producing pig iron at the unprecedented rate of 37,500,000 tons a year, prices are advancing daily. The advance in price during the first week in November was 50 cents a ton on coke iron and $1.00 a ton on charcoal iron; while during the year basic iron has advanced from $12.50 to $15.80 a ton. The demand for and the increase in price of steel is even greater than in the case of pig iron. Indeed the situation is unique as regards the price of finished steel, and at present it is difficult to find a seller who can make deliveries. Eastern and Western mills are alike congested with business, and very few indeed have any open capacity.

Plate mills are fully occupied with car, locomotive and ship-building work. The railways, which were almost entirely absent from the market for many months past, have recently given orders for large quantities of rails; while about 300,000 tons it is understood, have been booked for export within the coming two months to Russia. During October, the American railways bought more than 27,000 cars, and probably more than 10,000 have been booked for export to the Russian Government. As regards steel plates, the increase in price is even greater, while it has failed to discourage demand in the least; in fact in many cases, price is no longer a consideration, but rather to find a mill that will guarantee deliveries. While the situation as regards structural steel is grave, it is in forging billets that the situation is most acute. Steel bars in November 1914 sold at Pittsburg at $1.10. In November 1915,the price was $1.50 or a 36 per cent advance. In forging billets the difference was much greater, the figures being $25 and $42 respectively; or an advance of sixty-eight per cent. Indeed high carbon steel sold in large quantities at previously unheard of prices. Even during the closing days of October orders aggregating more than 60,000 tons of high carbon forgings billets were reported as having sold as high as $56.00 per ton, Pittsburg. Further it is stated that the Entente requirements, now becoming insistent for high carbon shell steel, alone represent the enormous aggregate of 20,000,000 tons.

It is therefore clearly evident that Canada and the United States will, during the coming year, face a steel famine unprecedented in the history of this continent. The outcome will be as interesting as it will be far-reaching. It will probably reduce very largely some of the profits so easily shown on paper as capable of being earned by munition plants yet unbuilt, and which must necessarily be dependent for a supply of raw material on producers of iron and steel.

It will be seen from the above statements that a strong and evenly balanced iron and steel industry constitutes an important national asset.

COBALT SHIPMENTS.

Cobalt, Jan. 8.—Ore shipments for the week were considerably over double that of the preceding week. Ten shippers sent out fourteen cars, five of which went to American smelters. Included in the list was a copper shipment sent out by the Rand Syndicate to Chrome, New Jersey. Temiskaming had two cars and was second on the list, Nipissing taking the lead. There were no bullion shipments for the week ending last night.

Silver ore shipments for the week ending yesterday were as follows:

Mine.	Pounds.
Coniagas	121,525
Penn. Canadian	100,089
Buffalo	62,255
Nipissing	131,168
Peterson Lake	66,000
Dominion Reduction	88,000
Mining Corporation—	
Townsite City	71,234
Cobalt Lake	65,713
Beaver Mine	64,763
Temiskaming	127,212
Total Silver	897,959
Copper—	
Rand Syndicate	49,912

A press despatch from Seward, Alaska, gave the information that on December 29th the steamer Northwestern sailed from that port for Seattle, Washington, having on board $550,000 worth of gold bullion brought to Seward by dog-teams from Iditarod, and $50.000 worth of copper ore. It was stated, further, that the Northwestern was to take from places on Prince William sound about $100,000 worth of copper ore, also for Puget sound, where it would most likely be smelted at the Tacoma smeltery.

At Vancouver, B.C., on December 28th two writs were issued at the instance of Zera Strong against A. N. C. Treadgold, of London, in connection with the sale and purchase of placer gold claims in Yukon Territory. One of the writs is for a balance of $21,300, balance of principal and interest alleged to be due the plaintiff on purchase price of his claims, and the other is for 10,000 shares in the Granville Mining Co., stated to have been given to the defendant for sale on plaintiff's account.

THE MARKET FOR MOLYBDENITE

The Director of the Imperial Institute of the United Kingdom, the Colonies and India, South Kensington, London, S.W., under date of 17th December, 1915, says in a letter to Mr. T. W. Gibson, Deputy Minister of Mines of Ontario:

With reference to the disposal of the molybdenite which is becoming available in Canada, I may say that the British Government has recently taken action with a view to securing supplies of molybdenum ores for munition purposes, and the market for the ores in this country is now under Government control. An official arrangement has been made with regard to Australian supplies and I therefore consulted the Ministry of Munitions as to the procedure which should be adopted with regard to Canada.

I am informed by the Ministry that it has been decided to leave the question of Canadian supplies of molybdenite in the hands of the Dominion Shell Committee at Ottawa (now I believe merged in the new Imperial Munitions Board), who have been notified that the British Government will purchase up to 50 tons of molybdenite ore. The arrangements have been left entirely in the hands of this committee and it is therefore desired that all communications on the subject of Canadian supplies should be addressed to the committee or to the new Munitions Board.

I suggest that this information should be made public in Canada, if this has not been done already, as the Imperial Institute is receiving a considerable number of enquiries from that country with reference to the disposal of molybdenite ores or properties, and is of course still ready to be of any service on this side that may be required.

With reference to the disposal of molybdenite properties, the following persons and firms have applied to the Imperial Institute for information regarding such properties with a view to purchase: Mr. R. Woodburn Kirby, 26 College Street, London, EC.; The Osram Lamp Works, Ltd., Brook Green, Hammersmith, London, W.; L. LePersonne and Co. (Metal Department), 99 Cannon Street, London, E.C.; Mr. J. C. Stead, 57 Chancery Lane, London, W.C.

Enquirers in Canada might be given these names, but it must be understood that the Imperial Institute cannot assume any responsibility regarding firms and persons mentioned.

The samples of molybdenite concentrates prepared at Orillia by the Orillia Molybdenum Co., which you forwarded, are too small for complete investigation, but the following results of their mineralogical examination may be given. No. 1 consists of coarse flakes and is apparently clean molybdenite. Nos. 2 and 3 consist of smaller flakes (No. 3 being the finest) and contain mica, but the molybdenite largely preponderates in both samples. No. 2 was found to contain about 6½ per cent. of biotite mica (including a little quartz) and a little pyrite. No. 3 contains about 12½ per cent. biotite mica (including a little quartz) and, like No. 2, also included a little pyrite. It would therefore appear that the percentages of molybdenite present in these concentrates are not below the figures which you quoted.

The Ministry of Munitions has asked for information as to the quality of the samples and I am accordingly transmitting these particulars to them.

PERSONAL AND GENERAL

Mr. Wm. Alderson, superintendent of the Hollinger gold mine, has resigned.

Mr. Chas. Fergie, of Montreal, has been nominated as vice-president of the Canadian Mining Institute.

Mr. J. A. Dresser, of Montreal, has been nominated as a councillor of the Canadian Mining Institute.

Mr. Duncan Chisholm, of Toronto, has taken an option on the Jamieson claims in Rodd township.

Mr. M. W. Summerhayes has been nominated as a councillor for the Canadian Mining Institute.

Mr. O. E. Le Roy, chief geologist of the Canadian Geological Survey, has obtained a commission in the Seaforth Highlanders.

Mr. E. F. Cartwright, of Alden, N.Y., and Mr. R. W. Cartwright, of Ridgeway, Pa., are at Porcupine.

Mr. H. C. Anchor is in charge of the Dome Extension property at Porcupine, where exploration has been resumed.

Dr. W. G. Miller and Mr. Cyril W. Knight, of Toronto, attended the meeting of the Geological Society of America at Washington, D.C.

Dr. W. G. Miller and Mr. T. W. Gibson, of the Ontario Nickel Commission, are en route to Cuba.

Mr. Geo. T. Holloway, chairman of the Ontario Nickel Commission, is in England.

Mr. J. B. Tyrrell expects to leave shortly for England.

Mr. Geo. B. Church has returned to New York from Juneau, Alaska.

Mr. G. G. S. Lindsey expects to return to Canada in February.

Drs. McCracken, of Worthington, Couts, of Garson Mine, and Freeman, of Levack, of the Mond Nickel Co.'s medical staff, have enlisted for service overseas in the Army Medical Corps.

Brigadier-General John Carson, honored by his King in being created a Civil Commander of the Bath, is a striking example of the "self-made" man. It is only a few years ago that he was an insurance agent—but a thoroughly aggressive one. His energy and capabilities have placed him where he is to-day. The Brigadier-General is best known as the president of Crown Reserve Mining Co. It was Crown Reserve that gave him his present wealth.

M. Beatty & Sons, Ltd., Welland, have received an order from the Confederation Construction Co., contractors on section 3, Welland Ship Canal, for six electric hoists—for a concrete handling plant.

According to our Newfoundland correspondent this winter promises to be the best mining season that Newfoundland has ever enjoyed. The great iron deposits are to be worked all through the winter on an unprecedented scale. For the first time the five iron mines of the Dominion Iron and Steel Company are all being worked.

In its excellent annual review number issued on January 8, our esteemed contemporary, the Engineering and Mining Journal, of New York, estimates Canada's gold production in 1915 at $15,875,000 as compared with $15,925,044 in 1914. As a matter of fact Canada's gold production in 1915, instead of being smaller than in 1914 was nearly $3,000,000 greater.

SPECIAL CORRESPONDENCE

PORCUPINE AND KIRKLAND LAKE

Dome.—The December returns for the Dome Mining Company, now officially made, complete the record for the year. The total for the twelve months of 1915 show that the Dome produced $1,468,272. The average grade for the year was $4.56 per ton. The recent grade during the last six months has considerably exceeded this, since ore has been mined from the new and higher grade orebody. It is a fact, however, of importance, that 70 to 71 per cent. of the total ore is still coming from the original Dome or Glory Hole. The mill and mine will not be in good shape to handle this new ore for a month or six weeks yet. After that it is probable that the grade will be slightly increased, though there is not any intention to use the higher grade of the ore to force production. Tonnage treated during the year was 317,873. The last month's crushing of 30,120 tons was considerably more than 21,000 tons higher than of any previous monthly period. Bullion produced had not a corresponding increase, it being less than $1,000 higher than in November. The production for the month of December was 30,120 tons milled, value $160,950.70, with an average per ton of $5.34.

The production this month will show a considerable increase as the new Hardinge mill has been installed. The manufacturers fully expect that the ball mill will treat over 300 tons a day, but it is not to be anticipated that it will reach this maximum until some months of trial. The ball mill is of the eight foot, thirty-inch type and has been installed alongside the stamps and will do almost the same work. Two more pachuca tanks have also been installed. These are nine feet in diameter instead of eight feet. The two extra sand tanks and Dorr Thickeners will be of the same size. It is the intention of the management to install more ball mills as the opportunity occurs and it is desired to still further raise tonnage. At the Dome and in the Porcupine Camp generally it is believed that the ball mills will handle Porcupine ore under certain conditions better than the stamps, therefore, not only will ball mills be introduced to take care of further tonnage, but as stamps are worn out they will be replaced by ball mills.

Excellent progress is being made with the new central shaft at the Dome. Raises have now been holed through from the 600 foot to the surface and it is confidently expected that the new shaft will be completed and ready for use before the date it was determined, namely, the first of March. Cross cuts from the present working shaft to the new central shaft have been opened up and a considerable body of ore indicated by diamond drilling, but not before actually put in sight. This orebody is 40 feet wide and 200 feet long as at present determined.

Hollinger.—The Hollinger production for the 12th period of the big mine in 1915 easily broke all records. The production of $210,558 gross profits was not less than $25,790 more than at any previous period of the Hollinger history. This very considerable increase was due to the fact that over 1,000 tons more ore was crushed and also that the grade was better by 65 cents a ton. Both mining and milling costs were higher, but general costs were lower, so that the total costs for the period ending December 2nd were $3,522, in which we include 0.882 milling costs per ton and 1.982 mining costs per ton. It is to be remarked that the total costs for the past seven periods average $3,574 a ton, whereas the average grade was $9,645 a ton, leaving a profit per ton of $6,701.

In the long cross-cut which is being run to connect the new central shaft with the shaft which is being sunk on the Gillies claim near the Vipond boundary, two promising veins have already been cut. As these veins were not previously on any Hollinger charts they give promise of yielding an increase in ore reserves above any estimate. The completion of the cross-cut will take much time as it is a distance of 2,500 feet between points and only one drill is operating in the face.

The McIntyre-Extension shaft has now reached the thousand-foot level, a depth only attained by one other company in the Porcupine. From it, it is proposed to carry on all development on the McIntyre group which now includes the McIntyre, McIntyre-Extension, and McIntyre-Jupiter. The next development will be to commence the cross-cut to the No. 5 shaft where work on the lower levels is already congested. It is a distance of about 800 feet, so that it will be some time before it is completed. To the north of No. 5 shaft drifting on the 500 and 600 ft. levels is confirming the diamond drill work done here early in the year. The orebody where first encountered was 20 ft. wide from the foot wall. It ran about thirty dollars to the ton for about ten feet, but the quartz in the remainder of the orebody ran quite low. Intrusions of schist are now beginning to appear in this quartz and as they do so, the values grow. The vein is also opened up on the 600 ft. level. The building to house the additional machinery to be installed at the McIntyre mill has been completed some time, also the Dorr machinery for the cyanide mill has arrived, but delivery of the tube mills and ball mills is not satisfactory and it may be some time before the addition to the mill is running, in consequence of this delay.

Jupiter.—Progress in making ready the Jupiter to be a producing mine once more is marked. In B shaft a raise has been holed through from the 300 to 200 ft. level. The mine is also being re-surveyed and there is no doubt that mining should be well under way by the first of February.

Dome Lake.—There is some interest among mill men in the new process of cyanidation to be used at the Dome Lake mill. Without going into details it might be stated that a Detroit company proposes to treat the tails from the present mill in a large rotary drum. They claim for this process that it will make good extraction in four hours instead of 17 to 18 hours, and that the costs will be low. The Dome Lake mill is not making any payment on machinery or under any obligation in any way until it has been shown to be successful. The company guarantees to obtain a 95 per cent. extraction, otherwise they will not claim anything for their installation.

Burns Claims.—The little two-stamp mill which has been erected on the Tommie Burns claims in Shaw is now running. The same syndicate of working miners which made a success of their lease on the Gold Reef formed a company known as the Excelsior Mining Company. After the expiry of their lease on the Gold Reef they took up the lease on the Burns claims in Shaw and have now been working them for some time. They are sinking two shafts, one on a vein of quartz in which there is remarkable values in gold. This vein

is from one to two inches wide and as there is no sulphide ore in it, a good extraction should be made from the plate. The other shaft is being sunk on a big sulphide vein. There is a good deal of free gold in this vein, so that the operators hope to save quite a little from running this ore through the mill.

Jamieson.—Mr. Duncan Chisholm for his New York connections has taken over the Jamieson claims in Robb Township. These claims have been sampled more than once, but interest previously was not as keen in Porcupine prospects as to-day. The gold is found in quartz stringers over a quartz porphyry dyke about 200 feet wide. Mr. Chisholm has sent down a gang of eight or ten men and camps are being erected and surface work commenced, at once. The properties are about twenty miles from Timmins, near Kamiskotia Lake.

The Dome Extension Mining Company has overhauled its plant and commenced de-watering the mine. It is probable that one of the first operations undertaken will be diamond drilling near the Dome boundary. Recent development on the Dome has led to the belief that one of the Dome orebodies dips into the Dome-Extension at a depth of between 1,000 and 1,200 feet. Diamond drilling will be undertaken to ascertain if this is true, and to see if the orebody holds its value on the Extension side of the line.

New Companies at Porcupine.—There are prospects of several other companies starting up work in the Porcupine district in a very short time. Mr. A. M. Bilsky has recently been looking over the Apex for a Montreal company, with a view to seeing if it is desirable to open up the old property. It is understood that the American Goldfields will soon resume work on the claims in Tisdale. There are also reports that the Moneta Mining Company contemplate doing something on their properties adjoining the Miller Middleton. The Tisdale Mining Company is sinking a shaft near the Dome Lake line. It is certain that the West Dome contemplate opening up the old workings, but there is nothing definite as to when the actual de-watering will commence.

Demand for Prospects.—There is very great demand for Porcupine prospects and there is every indication that not only the producing properties in the centre of the camp will be busy this spring, but that many good prospects that have lain idle for years will be worked again.

COBALT, GOWGANDA AND SOUTH LORRAIN

The Nipissing had another unusually favorable month in regard to the discovery of new ore in December. The important discovery was on vein 490, on which a winze is being sunk on the fourth level. Until a depth of 75 ft. had been reached the vein was from three to eight inches in width and generally assayed low in silver values, running from 5 to 144 oz. At a depth of 75 ft. the vein was eight inches wide, very heavy in niccolite and a few feet assayed as high as seven or eight thousand oz. The next few feet found the vein faulted and low grade again, but geological conditions lead to the belief that it will hold more high grade ore.

At 80 shaft good ore was met with in the faulted extension of one of the branch veins at the 200 ft. level. about 50 ft. of an incline was driven on a vein averaging 2 in. in width and assayed 2,000 oz. Favorable results also continue in drifting on vein 102 at 96 tunnel. Ninety ft. of drifting has been done to date, in which distance the vein assays better than 4,000 oz. over an average width of one and a half inches. Further development has been started with a veiw to finding the top of the ore shoot.

To make a base for operations to cut the Cobalt Lake fault vein surface buildings have been completed at 81 shaft. Sinking is now being prosecuted and will be carried on to a depth of 480 ft.

Actual production from the Nipissing for the month constituted a low record for the company for some years. The estimated value of the production during December was only $112,907, whereas no previous production has fallen below $164,846. On the other hand bullion shipped from the mine was higher, reaching $379,642. But this was mostly customs ore, the Nipissing now being a very large purchaser of silver ore from other mining companies in the camp. The Nipissing stopes are now fuller than they have ever been in the history of the company and the discoveries of new orebodies at the Meyer shaft and under Cobalt Lake makes the future prospects brighter than for a long time.

McKinley.—While it is impossible to estimate ore reserves for more than six months at either the McKinley-Darragh or the Savage mines there is no doubt in the minds of those well acquainted with the old property that it will again be capable of surprises in 1916. The last annual report showed ore reserves of 55,176 tons and 12,835 tons for the Savage or a total of 68,011 tons. There has been milled during the year just past approximately 60,000 tons, so that there should be in sight less than 10,000 tons. As a matter of fact the tonnage is as great as at the beginning of 1915, though the silver content per ton is probably lower. No new orebodies have been found, but old orebodies have been discovered on lower levels and what was supposed to be the wall of the orebody has been discovered to be nothing more than a small barren block of ground on the other side of which there was good milling ore.

The blind vein at the 250 ft. level has been conducive of the most surprises. Estimates at the beginning of the year only gave ten feet below the 200 ft. level as likely to yield ore, but there is to-day a stope 35 ft. wide at the 250 ft. level on this vein. The Lake vein has also proved to be much less near exhaustion than was imagined and No. 20 on the 200 ft. level has yielded remarkably.

It was believed last year that the Savage would be worked out in 1915. Here again there have been no definitely new discoveries, but the old orebodies are being found to be much more extensive than any estimates gave them credit for. Some rich ore is now being taken out of a wide calcite vein in the old original shaft on the property. It was barren in the face as left for years, but a few shots discovered some rich high grade.

Chambers-Ferland still continues to make marked progress in the work at their shaft to the north of the town. All recent development has been from a winze sunk from the 300 ft. level. It was sunk on a strong vein of niccolite and smaltite carrying low silver values. This vein dipped out of the winze and it was necessary to cross-cut some 15 ft. before picking it up at a depth of 426 ft. It is here two to three and a half inches wide of ore that will run up to 3,000 oz. in silver. At the bottom of the winze there is an inch to an inch and a half of argentite ore. Eleven feet from the bottom of the winze there is an inch of smaltite ore running low in silver and 40 ft. away another inch vein

of high grade. A drift has now been pushed northeast on the main vein for about 40 ft. The experience in the Nipissing ground adjoining makes it most probable that there will be a big tonnage of mill ore between these various veins. An ore house is being built in which a sorting plant will be installed. Ore is already being sacked.

The Ophir Cobalt has been pumped out by the company and actual mining will soon commence under the direction of Mr. B. Neilly. The Silver Cliff has also been pumped out and sampled by the United States Smelting and Refining Co. and there are quite a number of other silver prospects being examined with a view to re-opening. The Genesee Mining Company operating the United States Cobalt prospect just north of the Hudson Bay, will start work again next week, Mr. Steenman, who is in charge of operations, returning from Rochester. The Coniagas Mining Company has purchased the Agaunico prospect on the shore of Lake Timiskaming near Haileybury and is now pumping it out before sampling.

The Flotation Process for the treatment of tailings in Cobalt has obtained a foothold in the camp. Experiments with the Callow process have been in progress for some time at the Buffalo mill and a small plant has been running on tailings for two months. The results are reported to be so satisfactory that several other companies in the camp are experimenting. In an annex to their low grade mill the Nipissing is installing a four unit plant for experimental purposes. It should be running very shortly. The McKinley-Darragh also has under consideration the installation of the process in connection with their water concentration mill and a contract has been drawn up for that purpose. Other companies have either tried or are now trying the process and it seems likely to meet with a fair measure of success.

NEWFOUNDLAND

Iron.—This winter promises to be the best mining season that Newfoundland ever enjoyed. The iron mines of the Dominion Iron and Steel Co., and of the Nova Scotia Steel Co., are to be worked all through the winter on an unprecedented scale. Till the beginning of the New Year, the activities that prevailed at the mines on Bell Island have during the winter been in a large measure preparatory to the great opening up that is now taking place.

With the Dominion Iron and Steel Co. mines Nos. 1, 2, 3, 4 and 5 are now being worked. This is the first time in the history of this company that these five mines have been worked together. Dominion No. 4 is practically a new mine, and little or no mineral has as yet been mined from it. The ore, however, has been thoroughly tested on this territory, and the quantity in which it is present as well as the quality has sufficiently warranted the grand scale on which this mine is now being opened.

Dominon No. 3, which has not been worked for eight years, and which was entirely filled with water, had to be pumped dry. This mine has a depth of roughly three thousand five hundred feet. It took one month to pump this mine, which meant an expenditure of perhaps $15,000. In addition to this the several surface mines of the company are being all worked, so that the daily output surpasses anything ever attained before.

With the Nova Scotia Steel Co. work is also being resumed on something approaching the old scale of operations. 1915 has been no doubt the "off" year in the history of the Nova Scotia Co. in Newfoundland. For the year the company shipped 188,260 tons of ore, and employed 450 workmen. Of the amount shipped 64,000 tons had been mined the year previous.

Since the opening of the New Year, however, there is every indication, judging from the increased activity displayed, that during 1916 the output from the mines of this company will approach 500,000 tons of iron ore.

Copper.—The Cape Copper mine at Tilt Cove, Notre Dame Bay is now working at a fairly good clip. More than one hundred men are employed at this mine at the present time. The last shipment of ore from this mine for this season has just left the coast. The shipment was taken by the S. S. Newfoundland, and is consigned to New York.

At the Baie Verte copper mine work is now progressing favorably; operations are to be continued through the winter. The stock pile that has already grown to a considerable size will be shipped away to English and American markets as soon as navigation opens in the spring.

The limestone quarries owned and operated by the Dominion Iron and Steel Co. for the past number of years in connection with the smelting of its iron ore has been completely closed down. All the employees have therefore left the limestone district, and found employment elsewhere.

The quarries, we understand, are to remain inoperative till the opening of the spring.

Electric Smelter.—Work is about to begin on a new electric smelter, to be established at St. John's, near the plant of the Reid Newfoundland Co. Mr. W. A. Mackay who is promoting the scheme has received from the municipal authorities at St. John's the necessary permit to the construction of such a plant. The electric power for the smelter will be secured from the Reid Company's power station at Petty Harbor.

Building Slate.—As there is likely to be a good demand for building slate after the war, for some time past much negotiation has been made for the purchase of some of the slate quarries of this country. The slate quarries of Newfoundland are large and of a very fine quality, and at intervals have been worked for years.

The Government Geological Survey of Newfoundland made by James P. Howley, F.G.S., in 1909, has this to say of the slate quarries of the country: "The slate of this country is of a superior quality, and has been pronounced equal to that of Wales by those competent to judge. It fetches in the English markets the highest price of any imported slate. It is an abundant material and is found in large deposits on the eastern and western sides of the island. Most of this slate is of a dark purple color, but some of it is reddish, and also some of an unfading pea-green color. It is said to be the best slate in America."

During the short intervals that these quarries have been worked to date 153,702 squares of roofing slate have been manufactured at the quarries.

Thomas L. Wilson, the promoter of the Newfoundland Products Co., died in New York Dec. 23rd. Mr. Wilson, who has been best known as "Carbide" Wilson, came to Newfoundland last year and was instrumental in putting through the House of Assembly one of the most gigantic schemes for the development of some of Newfoundland's mineral resources ever attempted.

This scheme was for the manufacture of the fertilizer ammonium sulphate. The construction of this plant was to involve an expenditure of twenty-one million

dollars. At the time of his death Mr. Wilson was in New York in connection with the financing of this corporation, and had met with excellent success.

A sketch of this scheme and what it entails was published in the number of the Canadian Mining Journal dated Dec. 1st, 1915.

As the work of construction of the plant of the corporation has been begun and great expenditures of money have been made already, in connection with the surveying of the territories which the corporation owns, the Reid Newfoundland Co., who are very largely interested in the scheme, does not anticipate that the work will be discontinued, although activities will no doubt be postponed somewhat by the sudden demise of Mr. Wilson.

At the present time a coal famine prevails at St. John's. Coal is selling for $8.00 per ton, and in a few days it is expected that the price will go much higher.

A Mr. Snow of the district of Trinity Bay made last month what promises to become a most valuable gold find. Mr. Snow is a fisherman of that district, and the find was purely by accident. Several samples were recently subjected to an assay, the yield of gold was large, and in the spring a commencement of operations on the find is authoritatively spoken of.

The steatite for the lining of the furnaces of the smelter now being erected by Mr. W. A. Mackay is now landing from steamer at St. John's. This material has been imported from America.

THE WORLD'S DEEPEST MINE.

Where is the deepest mine in the world? That is a question very few people in this country can answer correctly. Even most mining experts would probably make a wrong guess—unless they had made rather exhaustive inquiries anent the subject—for it is located in a section of the world where you would least expect to find it. In the forests which cover the hills that cluster about the mouth of the mine wild monkeys are chattering and jumping about from limb to limb of the graceful palms which afford them food as well as shelter, while among the bright-hued flowers exquisite orchids waft their perfume and display their beauty for the benefit of these impish progenitors of man. Birds of rare plumage flit in and out among the shadows and the gorgeous red-blue-yellow macaws add their raucous voices to the medley of sounds, while splendid butterflies wave their large wings of iridescent blue and green and gold to enhance the riot of color in these tropic realms.

Tropic realms? Verily, for the deepest mine—gold or of any other metal—is located in Brazil. It is near a place bearing the euphonious name of Villa Nova de Lima, in the State of Minas Geraes, about 330 miles north of Rio de Janeiro. It has been worked, more or less systematically, for something over 80 years, and yet few of us have ever heard of the place, much less of the mine, which is known as the Morro Velho and is owned and operated by an English company.

Last year two young professors of geology, Benjamin Le Roy Miller, of Lehigh University, and Joseph T. Singewald, Jr., of Johns Hopkins, struck out for foreign parts and wended their way even into the hidden recesses of South America with the view of finding out something in regard to the mineral resources of the western hemisphere. They investigated almost all of the known mining districts of the southern continent and brought back with them a vast store of information relative to the mineral wealth of the various countries visited. In Brazil they visited this unusual and in some respects unrivalled gold mine. They tell about it in an article in the December number of the Bulletin of the Pan-American Union (Washington, D.C.), from which the following facts are taken.

The Morro Velho mine is located in the gold belt of Brazil, where the Portuguese were first induced to settle by the discovery of the yellow metal. The first gold was discovered in 1699 near the present city of Ouro Preto. The gold was coated with a black substance and hence was called "ouro preto"—black gold. The city which they founded was long called Villa Rica de Ouro Petro—the Rich City of Black Gold—a name which was somewhat cumbersome even for the Portuguese, so they finally shortened it to just Ouro Preto, the name by which it is known to-day.

Just when the Morro Velho mine was first opened is not known, but it was being operated toward the close of the 18th century, and considerable work had been done when the present company obtained control of it in 1834. The orebody consists of a great vein of unusual persistence and regularity that dips at an angle of about 45 degrees. It may be likened to a gigantic knife blade, held vertically and thrust into the earth at this angle with the point still lower than the present deepest workings. The combined depths of the connected shafts give a total of 5,824 feet. In other words, here is a gold mine that is being worked at a depth of more than a mile below the surface of the earth. Now be it remembered that the rock temperatures increase as the earth's crust is penetrated, in some regions the increase being as much as I degree F. for each 50 to 60 feet increase in depth. At this rate the temperature at the bottom of this mine would be over 100 degrees higher than at the surface, and fried ham and eggs might be prepared for the miners without any other heating apparatus than the loose rocks lying about. Incidentally the miners would be going through the frying process, too. Fortunately, however, in this mine the rate of increase of temperature is only 1 degree for every 100 to 120 feet, giving the rocks a temperature of only 112 degrees. By forcing cool air down into the mine by means of fans the temperature is lowered to a little less than 100 degrees. Even at that it is rather snug, and the miners usually wear only shoes, donning trousers when company is expected. Still, the mine has produced a total of about $55,000,000 worth of gold, and is being worked now at a profit of something over $700,000 annually.

SILVER PRICES.

	New York cents.	London pence.
December, 1915—		
23	54	25 1/16
24	53 7/8	25 3/4
27	53 7/8	Holiday
28	54 1/8	25 7/8
29	54 3/8	26
30	54 7/8	26 3/16
31	55	26 1/4
January, 1916—		
3	55 7/8	26 11/16
4	56 1/8	26 3/4
5	56 1/2	26 7/8
6	56 5/8	26 7/8
7	56 5/8	26 1/16

MARKETS

STOCK QUOTATIONS.

(Courtesy of J. P. Bickell & Co., Toronto.)

January 10th, 1916.

New York Curb.

	Bid.	Ask.
Am. Brit. Mfg.	18.00	25.00
Atlanta.	.22	.23
Canada Copper	1.93¾	2.00
Chevrolet Motors (U. S.)	125.00	128.00
Am. Marconi	3.50	3.75
Belmont.	4.50	4.75
Goldfields Cons.	1.06¼	....
Jim Butler	1.09⅜	1.15⅝
Jumbo Extension	1.31¼	1.37½
Standard Oil & Lead (B.C.)	1.81¼	1.93¾
Stewart Mining	.50	.56¼
Tonopah Extension	4.00	4.06¼
Tonopah Merger	.55	.60
Tonopah Mining	6.87½	7.12½
Victoria Oil	2.25	2.50
West End Cons.	.78	.80
Anglo-Amer. Oil	17.50	18.00
Standard Motors	9.25	9.75
Submarine Corp.	41.00	41.50
Maxim Munitions	11.75	12.25
Standard Oil of N. Y.	217.00	220.00
Standard Oil of N. J.	515.00	520.00
Standard Oil (old)	1660.00	.....
Standard Oil (subs)	1150.00	.....

Porcupine Stocks.

	Bid.	Ask.
Apex.	.08⅝	.08¾
Dome Consolidated	.24½	.25
Dome Extension	.37½	.38
Dome Lake	.28	.28½
Dome Mines	28.25	29.00
Eldorado.	.00⅝	.00½
Foley O'Brien	.60	1.00
Gold Reef	.02¼	.03
Hollinger	29.00	29.50
Homestakes.	.37	..
Jupiter	.22½	.22½
McIntyre	1.01	1.02
McIntyre Extension	.29¼	.30
Moneta	.14	.14½
Porcupine Crown	.84½	.86
Porcupine Imperial	.05	.05¼
Porcupine Tisdale	.02⅞	.03
Porcupine Vipond	.73	.75
Preston East Dome	.06½	.06¾
Teck Hughes	.21½	.22½
West Dome	.16½	.16¾

Cobalt Stocks.

	Bid.	Ask.
Bailey.	.04⅞	.05⅛
Beaver	.44	.44½
Buffalo	..	.95
Chambers Ferland	.30¼	.30¾
Coniagas	4.85	..
Crown Reserve	.52½	.54
Foster	.05	.07
Gifford	.08	.08¼
Gould	.00⅞	.01
Great Northern	.04	.04½
Hargraves	.05⅜	.05¾
Hudson Bay	25.00	..
Kerr Lake	4.35	4.65
La Rose	.63	.68
McKinley	.43	.46
Nipissing	7.50	7.75
Ophir.	.09¾	.10
Peterson Lake	.37¼	.37½
Right of Way	.07	.07½
Seneca Superior	.65	.75
Shamrock Cons.	.18¼	.19¼
Silver Leaf	.02⅞	.03⅛
Temiskaming	.70	.70½
Trethewey	.18	.19
York Ontario	.01⅞	.02
Wettlaufer	.08	.09

NEW YORK MARKETS.

Jan. 7.—Connellsville Coke—
Furnace, prompt, $3.00 per ton.
1st half, $2.35 to $2.50; year 1916, $2.25 to $2.35. per ton.
Foundry, prompt, $3.50 to $4.00 per ton.
Foundry, contract, $3.00 to $3.25 per ton.

Jan. 7, 1916.—Straits Tin, f.o.b., nominal, 41.75 cents.
Copper—
Prime Lake, nominal, 23.25 to 23.75 cents.
Electrolytic, nominal, 23.25 to 23.75 cents.
Casting, nominal, 22.25 to 22.75 cents.
Lead, Trust price, 5.90 cents.
Lead, outside, 5.90 cents.
Spelter, prompt western shipment, 17.42½ cents.
Antimony—
English brands, nominal.
American, 42.50 cents.
Chinese and Japanese, 42.50 cents.
Aluminum—
No. 1 Virgin, 98-99 per cent., 54.00 to 56.00 cents.
Pure, 98-99 per cent. remelt, 53.00 to 55.00 cents.
No. 12 alloy remelt, 44.00 to 46.00 cents.
Nickel, 45.00 to 50.00 cents.
Cadmium, nominal, $1.25 to $1.50.
Quicksilver, $175.00.
Platinum—Nominal, $88.00 to $100.00.
Cobalt (metallic), $1.25.
Silver (official), 56⅝ cents.

METAL PRODUCTS.

Owing to the withdrawal of all price lists by the leading manufacturers of brass and copper products, quotations appearing below are based on the outside market and are likely to change at any moment. All prices are nominal as follows:

Sheet copper, base, 30.00 cents.
Copper wire, base, 24.75 to 25.25 cents.
High sheet brass, base, 33.00 to 35.00 cents.
Seamless brass tubing, 36.00 to 38.00 cents.
Seamless copper tubing, 36.00 to 38.00 cents.
Brazed tubing, 37.00 to 39.00 cents.
Brass wire, 33.00 to 35.00 cents.
Brass rods, 33.00 to 35.00.
Sheet zinc, f.o.b. smelter, 23.00 cents.

TORONTO MARKETS.

Jan. 11, 1916—(Quotations from Canada Metal Co., Toronto)
Spelter, 21 cents per lb.
Lead, 7¼ cents per lb.
Tin, 42 cents per lb.
Antimony, 48 cents per lb.
Copper casting, 22¼ cents per lb.
Electrolytic, 22¾ cents per lb.
Ingot brass, yellow, 13c.; red, 15c. per lb,

Jan. 11, 1916—(Quotations from Elias Rogers Co., Toronto)
Coal, anthracite, $8.00 per ton.
Coal, bituminous, $5.25 per ton.

PROFESSIONAL DIRECTORY.

The very best advice that the publishers of the Canadian Mining Journal can give to intending purchasers of mining stock is to consult a responsible Mining Engineer BEFORE accepting the prospectus of the mining company that is offered them. We would also strongly advise those who possess properties that show signs of minerals not to hesitate to send samples and to consult a chemist or assayer Those who have claims and who require the services of a lawyer, with a thorough knowledge of Mining Law, should be very careful with whom they place their business.

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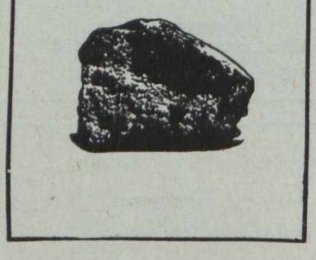

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