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## The Canadian Mining Journal

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## UNITED STATES BREAK WITH GERMANY

As was to be expected, the United States has shown itself unwilling to continue friendly relations with the criminals who calmly announce their intention to murder those whom their submarines encounter in certain areas of the free seas. While word of Mr. Wilson's action was joyfully received in Canada; and throughout the civilized world, we doubt whether there is anywhere more satisfaction at the President's action than in the United States.

Many Americans since they learned of the horrors of the invasion of Belgium, the murder of innocents on the Lusitania, and other Hun barbarisms, have felt dissatisfied with their part in world affairs. They have tried their best to maintain neutrality, because of the President's appeal. They have found this role rather irksome, but have been very patient. Now at last their confidence, somewhat shaky at times, in the President has been justified.

Owing to the direct way in which the Germans this time strike at all neutrals and proclaim their criminal intentions there can be little doubt that Americans now realize more fully that regard for humanity is second in the German mind to military expediency. There can be little doubt therefore that if President Wilson finds it necessary to ask Congress to take the next step, he will have the full support of the American people.

We congratulate our neighbors on the new position which they have now taken in the eyes of the world. We hope they will not find it necessary to follow up their action by joining in the war; but we are glad to have from them this recognition of the fact that the Allies are fighting in the interests of humanity against a powerful and ruthless enemy.

Germany in risking war with the biggest neutral doubtless regards our neighbor as unable to assist the Allies to an extent that would counter the advantages to be gained by unrestricted submarine warfare. We have however a high regard for the abilities of American industrial leaders and for the average American's love of his country and his country's ideals. If President Wilson calls the citizens of the United States to arms in the defense of their rights and their principles there will be a response that will soon be felt in Berlin.

The preliminary program for the annual meeting of the Canadian Mining Institute indicates that some very interesting sessions will be held. There are to be addresses on such subjects as Industrial Preparedness, Industrial Relations and Industrial Research, as well

as several technical papers on subjects that are of unusual importance at the present time. A list of the papers appears elsewhere in this issue. The meeting will be held in Montreal, March 7th, 8th and 9th.

## FILL IN THE CARDS

There was recently organized in Toronto a committee, composed of representatives of the various technical organizations having branches in Toronto, whose object is to assist the government in the prosecution of the war. This committee has held several meetings during the past month and it seems likely that the committee will be able to make the services of technical men more readily available for war purposes.

As one result of the meetings held during January the committee is now endeavoring to obtain information concerning the qualifications and experience of all the technical men in Ontario. With this object cards are being distributed and it is hoped that they will be promptly filled out and returned by those who receive them. Owing to the very incomplete lists now available many technical men will not receive these cards. It is therefore particularly desirable that requests for cards be sent in by those who wish to assist the committee in making the files complete.

Those mining men in Ontario who are members of the Canadian Mining Institute will receive the cards. There are many others whom the committee will not be able to reach without some assistance.

We urge mining men in Ontario to fill out their cards promptly and return them. We further urge that the names of technical men who do not receive cards by Feb. 15, be sent to the secretary of the committee.

The taking of a technical census is of course only a small part of the work of the committee. It is however an important part and as it is the first in which all technical men in Ontario have been asked to cooperate it should be made a success. Do not be satisfied with sending in your card therefore; but do whatever you can to make the list of technical men engaged in the mining industry complete.

## LABOR AFTER THE WAR

Owing to the present great industrial activity in most parts of the world and owing to the large number of men being used in the great armies in Europe there is at present a great demand for men and wages are high. In some quarters there is therefore considerable uneasiness concerning what will happen when the war is over, if it is found impossible to continue paying high wages.

Writing on this subject in the February number of "Industrial Management," Mr. Lewis R. Freeman makes some statements which may help to dispel the fears that have been expressed and point out the way in which the difficulty may be overcome. Mr. Freeman emphasizes the fact that present conditions are the natural result of supply and demand; there is more work to be done and fewer men to do it because so many are on military duty. This condition he expects to continue for some time after the war because so many formerly productive men are being killed or incapacitated and because of the expected demand for reconstructive work. He believes however that cooperation between labor and employer may result in conditions being not worse after the war, but better. He says:

"At a time when the cloud of industrial dissension looms darker on the horizon than ever before, it may be well in point to call attention to the sane and earnest efforts the British employer and workman—both chastened in spirit by the great war in which each is playing so crucial a part—are making to "get together" in the matter of their differences. How far they have already progressed—in thought, if not in action—will be evident from the two following extracts from letters which I find in a recent issue of the London Times Trade Supplement. The first is from a labor correspondent:

"'To promote good understanding there should be, in all big works, what I may call workshop consultative committees. The men should be invited to elect representatives to form these committees, along with an equal number of foremen, managers, directors or shareholders. The committees should meet regularly, and freely and frankly discuss anything and everything of mutual interest. The employers should explain their difficulties; the men their grievances. Grievances could be remedied in their earliest stages, whereas at present they are seldom brought to the notice of employers until they develop into strikes, or threats of strikes, after causing much discontent. On the other hand, the employers or management could often explain difficulties to the men, and get their loyal support where at present the men are unaware of such difficulties.'

"The other letter is from a large firm of manufacturers:

"'One can only witness the antagonism between labor and capital with feelings of sorrow. Speaking as employers, and in the assurance that employers generally are with us, we feel that the time has come when some bold step should be taken. Leaving out of consideration the question of bias, it must be agreed that there are many excellent ideas on both sides which could be welded into one great and beneficient scheme. Should it not therefore be possible for a select committee, representing employers of various trades, to meet a corresponding committee composed of the trade union leaders? If these gentlemen could only get together, firmly determined to make an absolutely square deal, a result far exceeding our highest expectations might be attained.'

"It is this very widespread spirit of mutual consideration and conciliation that bids fair to bring Great Britain—on the heels of a political peace—nearer to the prospects of an industrial peace than she ever dared dream of in the decade preceding the great war. Is there no lesson in this for America, or must she, lacking the chastening influence of a great international war, fritter away her energies in continued and increasingly bitter and costly industrial war within her own borders?"

Mr. Freeman looks hopefully ahead and tactfully suggests that if serious disruption in industries follows the war it may be not wholly because of unreasonable demands of labor on industries that cannot continue to pay wartime wages; but because of failure of employer and employee to "talk it over."

## CORRESPONDENCE

### FOREIGN CONTROL OF CANADIAN MINES.

Editor, Canadian Mining Journal:

Sir,—Enclosed I send a clipping from a local newspaper purporting to give an account of an interview at Vancouver, B. C., with "Mr. F. H. Phippen, Chief Counsel for the Canadian Northern Railway," which account you may be inclined to reprint for the information of mining men in Ontario and other parts of Canada in which your journal is circulated.

May I venture the opinion that it might be well for the Canadian Northern Railway to instruct those prominently associated with its business affairs to refrain from meddling with matters connected with the mining industry of this province, to which it looks for considerable support, whatever they may do relative to that of Ontario. To those of us who have had many opportunities to observe the generally disastrous outcome of mining enterprises in British Columbia undertaken by British companies, whether Canadian or Old Country (with the outstanding exceptions of the Consolidated Mining and Smelting Company of Canada, Limited, and the Crow's Nest Pass Coal Co., and the far less conspicuous success of an occasional much smaller organization), the frequent "butting in" of politicians, or self-styled experts, or even of eminent lawyers, is a matter of deep regret. Further, the flagrant inconsistency of urging the development of the natural resources of the country, as is the commendable custom of numbers of public-spirited men, on the one hand, and of agitating for cutting off the main, if not the only source of capital available under existing conditions for new mining enterprises in Western Canada, as some others are doing, on the other hand, brings about a situation sometimes hampering and perplexing, and at others quite prohibitive of development and substantial progress.

Having in mind the fact that many British owners of mineral claims, as well as foreign owners (and it occurs to me that certain men at the head of the Canadian Northern Railway have been among the former) have held them inoperative for years, and that so far as British Columbia is concerned there is nothing to prevent a continuance of such a paralyzing policy, is it not better to offer even greater inducements to "foreign" capital, rather than to stir up agitation to frighten it away. Certainly the mining industry of this province would be in a very bad way were it not for the enterprising activity and abundant financial support of United States' capitalists. Why, then, should the mining industry in its need of money for development be debarred from accepting aid from men who know how to make a success of mining, and do so far more often in the West than do Britishers? Has any one ever heard of British companies operating in foreign lands in Siberia, in Spain, in South America, and in the United States? And why should they not if they have the requisite money?

If it be permissible for the Canadian Northern Railway or any other transportation or manufacturing or development enterprise to go to the United States for money for its legitimate purposes, why may not the mining and metallurgical enterprises of Canada do likewise? Whether Mr. Phippen's grandiloquent sentiment, "if we cannot develop our own resources and obtain the full benefit from them, then those resources should not be developed," is practical or is utopian may be a matter of opinion. Probably the great majority of those in British Columbia who are directly interested in productive mining and allied industries will be quite content for that gentleman to experiment in the province from which he comes, but few, if any of them are likely to welcome his efforts along such precarious lines in this part of the Dominion.

Yours, etc.,

Victoria, B.C., January 26, 1917. E. JACOBS.

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The clipping from the "Colonist," referred to by Mr. Jacobs follows:

In an interview at Vancouver, Mr. F. H. Phippen, chief counsel for the Canadian Northern Railway, expressed himself as believing that the Federal Government should take drastic steps to prevent the natural resources of the Dominion falling under the control of foreigners.

"What benefit to Canada are the mines we now have?" he asked. "They have been financed by outside capital and the dividends are sent away from Canada. The only good our country gets out of the resources which are now under development is the support of the workmen who are employed at the different mines.

"This is but a trifle. Canada should benefit entirely from her natural resources. All the money should be kept within the Dominion."

Asked if it would not possibly discourage development if foreign capital was forbidden investment in Canadian mines, Mr. Phippen declared that if this was the result it would be better to leave the properties undeveloped until Canadian capital could be obtained. With foreigners benefiting, Canadians were being robbed of their heritage.

"Canada should be for Canadians only," declared Mr. Phippen. "If we cannot develop our own resources and obtain the full benefit from them, then those resources should not be developed.

"As it is now our natural resources are being wasted to Canada. For all the good our great mines are doing us they might as well not be in Canada. Take for instance the valuable mines of Northern Ontario. The dividends from those mines are in large part being sent across the border. Americans are deriving the benefit."

The judge is convinced that there is a great future ahead of Canada as a mining country. It will be, he believes, the greatest mining country in the world.

On the question of making operative his restriction of investment scheme, the judge stated that it was too late to consider applying the rule to the mines now in existence. But the Government should pass an enactment which would restrict investment in mines to be opened up in the future to Canadians only. Then in the tremendous development to come, Canada would get the whole benefit.

## A SUGGESTION.

Editor, Canadian Mining Journal:

Sir,—In the editorial in your issue of the 15th you invite suggestions dealing with the removal by, as you term it, united effort, of obstacles encountered by those who have been trying to develop ore deposits and increase production of raw materials.

As you are aware, during the last six years, suggestions have been made, through the public press, through delegations, and through the associated Boards of Trade of Northern Ontario, asking for the removal of these very same obstacles. In 1911 we were told by Hon. Frank Cochrane, that the Government's policy was to protect its forest resources rather than to encourage further encroachment by prospectors, miners or railroads. The people asked for bread and were given a stone.

It is true that the Legislature made an appropriation of money for the purpose of giving the aid asked for. But as long as the Cabinet Ministers are able to ignore the wishes of the House and to use money so appropriated, for other purposes, Legislative action alone does not relieve the situation.

It is evident, from the statement by Hon. Frank Cochrane, that he was acting as Minister of Lands and Forests. There are no indications that he was acting as a Minister of Mines.

In view of past experience, it seems to me that in order to get any assistance that might be needed in order to facilitate increased production of raw material from the mines it will first be necessary that the industry be represented in the Cabinet and I, therefore, suggest that the mining men of Ontario ask for and insist on getting as Minister of Mines one who is not tied to the apron strings of any other industry.

West Shining Tree, January 29th, 1917.

L. O. Hedlund.

## GRANBY.

Estimated earnings of Granby Consolidated for the six months ended Dec. 31, 1916, were $2,533,079, less dividends of $600,000, leaving a surplus of $1,933,079.

The report shows that there were treated during the six months ending Dec. 31, 1916, at Grand Forks smelter 464,927 dry tons, and at Anyox smelter 446,857 dry tons, a total of 911,764 dry tons.

Production of metals was as follows:—

| | Pounds. Copper. | Ounces. Silver. | Ounces. Gold. |
|---|---|---|---|
| Anyox smelter . . . . . | 16,179,521 | 193,142 | 4,681 |
| Grand Forks Smelter . . | 6,351,710 | 78,362 | 13,228 |
| Total . . . . . | 22,531,231 | 271,504 | 17,909 |

According to the Revelstoke Review, Alberta and Seattle men have organized the Circle City Mines, Limited, and have bonded a group of mineral claims situated in the Lardeau country. It is stated that an adit, driven 80 ft., has cut a 6 ft. lode of ore containing silver and lead.

## HOW MOLYBDENUM CONCENTRATES ARE MARKETED.

The basis on which molybdenum ores and concentrates are bought and sold varies according to whether the contained molybdenum mineral is molybdenum or wulfenite. Molybdenum products are invariably purchased on the basis of their molybdenum content, reckoned as $MoS_2$, whereas wulfenite is always bought either on the basis of its molybdenum content expressed as metallic molybdenum or as $MoO_3$. It is unfortunate that custom should have established these three methods of calculation where one, based on the content of metallic molybdenum, would have sufficed and avoided needless complications and frequent misunderstandings between buyers and sellers. In connection with the use of these three standards it may be of interest to note that 1 part by weight of $MoS_2$ is equivalent to 0.9 part of $MoO_3$ and to 0.6 part of Mo, and, inversely, that 1 part by weight of Mo is equivalent to 1.5 parts of $MoO_3$ and to 1.67 parts of $MoS_2$.

In Canada and the United States the short ton of 2,000 pounds is the measure of weight used in buying and selling of molybdenum ore, and quotations are generally based on the number of units of 20 pounds each of pure Mo, $MoO_3$, or $MoS_2$, contained in a ton. In Europe, on the other hand, the long ton of 2,240 pounds is almost invariably used, and accordingly European purchasers settle on the basis of a unit containing 22.4 pounds. Quotations both in this country and abroad are generally made on a sliding scale to cover various grades of material. Specifications usually state the minimum percentage of Mo, $MoS_2$, or $MoO_3$ in the ore or concentrates that is acceptable to the purchaser, and also the maximum percentage of objectionable elements, such as copper, tungsten, bismuth, arsenic, and antimony that will be allowed. Just what are objectionable elements depends largely on the use to which the molybdenum product derived from the concentrates is destined and the methods employed in treating it. Copper and tungsten seem to be universally objectionable both to the iron and steel and to the chemical trades. Copper is particularly undesirable and its presence in excess of 1 per cent., even in high-grade molybdenite concentrates, is usually sufficient to render the material unmarketable. Some dealers will, however, accept concentrates containing more than 1 per cent. copper, but when 4 or 5 per cent. copper is present the penalties exacted are such as to be prohibitive. Likewise, some dealers have no objection to the presence of small quantities of arsenic and bismuth in molybenite concentrates, as they state that these elements are readily volatilized when the ore is roasted in the process of treatment. Up to 1914 it was difficult to sell molybdenite concentrates containing less than 80 per cent. $MoS_2$, or wulfenite concentrates with less than 25 per cent. $MoO_3$, but at present molybdenite and wulfenite concentrates containing as low as 20 per cent. $MoS_2$ and 18 per cent. $MoO_3$, respectively, can be marketed.—F. W. Horton, U. S. Bureau of Mines.

Development of the Oregon mineral claim, situated in Camp Hedley, Similkameen district, is to be resumed. Tenders have been invited for extending an adit, now in about 130 ft., for 75 to 100 ft. The claim is owned by Mr. F. H. French, of Hedley, and some associates resident on the Coast.

# COPPER MINING IN BRITISH COLUMBIA

By E. Jacobs.

Copper mining is making greater advances in British Columbia than is any other branch in that, the most westerly province of Canada. The estimated output for 1916 was approximately 70,000,000 lbs., which compares with 56,918,000 lbs. in 1915, and 51,456,000 lbs. in 1912, those being the only other years in which the production of this metal exceeded 50,000,000 lbs. The yearly average for the five-year period 1911-1915 was 47,354,520 lbs., the quantity produced in 1916 was nearly 50 per cent. greater than that average.

The first recorded production of copper in the province was that of 324,680 lb. in 1894; for the eight-year period, 1894-1901, the total output on official record was 63,016 lbs. For the three five-year periods since 1901 the figures are as follows: For 1902-6, 180,389,000 lbs.; for 1907-11, 208,876,000 lbs., for 1912-16, 269,845,000 lbs. The total production in 23 years, 1894-1916 (that for 1916 estimated) has been 722,126,000 lbs. While revised returns for 1916 will probably show a somewhat higher production in that year, it is not expected the difference will be as much as 1,000,000, so it will not materially alter the position as above outlined.

The chief copper-producing district of British Columbia until 1914 was that known as the Boundary, comprising Grand Forks and Greenwood mining divisions, in which the Granby Consolidated and British Columbia Copper companies (with preliminary development organizations) have been operating more than twenty years. In 1914, however, what is known as the Coast district, came into greater prominence, this including Vancouver mining division in the southern part, in which the Britannia Mining and Smelting Co's mines are situated, and Skeena mining division in the northern part, in which the Granby Consolidated Co. also commenced producing copper in 1914, these together being on a larger scale than Boundary. Approximate figures for 1916 indicate the position as regards sources of copper production in the province to-day, as follows: Northern Coast, 29,971,000 lbs.; Southern Coast, 18,765,000 lbs.; Boundary, 16,158,000 lbs.; Trail Creek (Rossland), 3,986,000 lbs.; other parts 1,120,000 lbs.; total 70,000,000 lbs.

The following table shows the quantities of copper from the several producing districts for all years to date.

| | |
|---|---|
| Boundary . . . ..... | 413,557,000 lbs. |
| Coast (Southern, 121,300,000 lbs., Northern, 67,571,000 lbs) ..... | 188,871,000 " |
| Trail Creek Division (Rossland)... | 101,698,000 " |
| Nelson Division (West Kootenay).. | 15,000,000 " |
| Other parts . . ..... | 3,000,000 " |
| Total for all years, 1894-1916..... | 722,126,000 " |

While the greater part of the copper produced in the Northern Coast district has come from the Granby Consolidated Co's Hidden Creek Mine, near Observatory inlet, about 5,000,000 lbs. was produced in 1915 and 1916 from the Rocher Deboule Copper Co's mine in Omineca mining division. There is promise of a steadily increasing output from the Skeena region and other parts of the northern country. In the southern part of the province, in Similkameen division, west of the Boundary district, the British Columbia Copper Co. has developed ore in considerable quantity in a group of mineral claims on Copper mountain, within a dozen miles of Princeton, the most important of the several small towns in the Similkameen district.

The companies producing considerable copper in the province are the Granby Consolidated, British Columbia Copper, Consolidated Mining and Smelting Company of Canada, and Britannia Mining and Smelting Co. Among the smaller producers are the Rocher Deboule Copper Co., already mentioned; the Kamloops Mining and Development Co., which has just started concentrating copper ore near its mines in Ashcroft division, Yale district and several others in Yale or Coast districts.

Information relative to reserves of copper ore and to metal contents or recoveries from ore mined and treated in several recent years has been obtained from various sources. From the following figures an idea will be obtainable as to (1) the estimated quantities of ore available for mining in some of the mines that have been largely productive in recent years, and (2) the metals contained in a part of the ores already disposed of.

The Granby Consolidated Company estimated, at the close of its last fiscal year, that the ore remaining in its mines at Phoenix, Boundary district, totaled 3,610,996 tons, from which a recovery of 17 lbs. of copper and 75 cents in gold and silver to the ton can be made; also that 400,000 tons of ore that will yield 9 lb. of copper and 60 cents in gold and silver may be estimated. The last annual report showed that the recoveries from 1,097,299 tons of ore from the company's Phoenix mines averaged 14.6 lb. of copper and $0.779 in gold and silver per ton, the quantities of the several metals recovered having been 15,992,476 lbs. of copper, 204,779 fine oz. of silver, and 36,801 fine oz. of gold. Estimates of ore reserves at the company's Hidden Creek mine, near Anyox, Observatory inlet, were: Of high-grade ore 2.37 per cent. 9,416,385 tons; of low grade ore 0.63 per cent., 8,601,635 tons; total 18,018,020 tons. Bonanza mine reserves are placed at 414,775 tons of 2.19 per cent. ore, and 489,580 tons of 0.70 per cent. ore; total 904,355 tons, averaging 1.60 per cent. copper. Metals recovered from 722,630 tons of Hidden Creek ore were: Copper, 24,012,838 lbs., or an average of 33.23 per cent.; silver, 186,041 oz., and gold, 4,928 oz., or an average of $0.297 a ton in gold and silver.

The Britannia Mining and Smelting Co's report to the end of 1915 gave information concerning the company's Fairview mine ore reserves as follows: Broken ore in stopes, 578,206 tons; ore developed in place, 2,855,947 tons; probable ore, 2,544,000 tons; possible ore, 4,275 250 tons; total, 10,253,403 tons of an average of two per cent. copper. A corresponding estimate of ore in the company's Bluff, Jane and Empress mines gave a total of 6,944,386 tons, average 1.53 per cent. copper. These figures together give a total in excess of 17,000,000 tons of ore. Available figures show that the actual production of the Britannia company in four years, 1913-1915, was approximately 1,087,000

tons of ore which was concentrated into 173,800 tons of shipping product with metal recoveries as follows: Copper, 52,000,000 lbs.; silver, 289,000 oz., gold, 1,536 oz. This company is the operating company in British Columbia of the Howe Sound Company, of New York.

The British Columbia Copper Co., which is controlled by the Canada Copper Corporation, Limited, New York, after about fifteen years of productive operation in Boundary district, does not report any considerable reserve of known ore in its mines there, though it owns mines just across the International Boundary line, in the State of Washington, from which it still obtains ore for smelting at its works at Greenwood, B.C. Its most important operations now are on Copper mountain, Similkameen district, where it is preparing to mine ore, estimated as at December 31, 1915, to be in quantities as follows: Reasonably assured ore, 9,075,000 tons; probable ore, 2,000,000 tons; total, 11,075,000 tons. The average grade of this ore is estimated at copper 1.75 per cent. and gold and silver 20c a ton (recoverable value). Underground development of these orebodies is in progress and the installation of concentrating plant is being prepared for.

The mines at Rossland of the Consolidated Mining and Smelting Company of Canada, Limited, contain ore the chief valuable metal content of which is gold. No figures as to estimated ore reserves have been made public, but it is well known that the condition of the company's Centre Star War Eagle, Le Roi, and other mines of the big group in Rossland camp is favorable to many years of further productive operation. A good idea of the grade of the ore may be obtained from the following figures showing the production of four years, 1911-1914: Ore mined and smelted, 915,597 tons; gold, 459,691 oz., silver, 317,832 oz.; copper, 11,684,515 lbs.

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From Seattle, Washington, has come the statement that more than a ton of gold, the biggest shipment of the new year, valued at about $500,000, constituted part of the cargo of the steamship Mariposa, of the Alaska Steamship Co., which docked at Seattle from the North on January 17. The gold, it is announced, was taken aboard the Mariposa at Seward, where it arrived on January 9. It was transported on four dog sleds from the Iditarod district to Forty-Mile Station on the U. S. Government railway and taken thence to Seward by special train. The trip of 500 miles from the Iditarod to Forty-Mile was made with the temperature from 20 to 30 degrees below zero. The treasure was in charge of Mr. Robert Griffith and Capt. A. E. Healey of the Wells Fargo Express Co., and two assistants.

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A press despatch from Wrangell, Alaska, states that John Finlayson, a famous explorer, after whom Finlayson River and Finlayson Lake, in Yukon Territory, were named, is dead, at the age of 105. His age was well authenticated. He was a native of Scotland. He prospected and mined gold in Oregon and thence to Yukon Territory. He explored large areas into which white men had never before penetrated. He always prospected for gold and was one of the first to enter the Stikine and Cassiar regions of British Columbia. Many years ago he retired to Wrangel with what he supposed was a sum ample to meet all his needs, but he had not expected to attain so great an age, and two years ago he was obliged to apply to the Pioneers' Home, at Sitka, Alaska, on a pension to which he was entitled by law.

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## HEDLEY GOLD MINING CO'S MILLING PRACTICE.

After describing, at considerable length, in Mining and Scientific Press, the Hedley Gold Mining Co.'s Nickel Plate group of mines and 40-stamp mill in Camp Hedley, Similkameen district, British Columbia, Mr. T. A. Rickard, says:

"At the present time the total extraction at Hedley is 88 per cent., of which 70 to 75 per cent. is by concentration, so that it is evident that cyanidation presents a minor part. The position is to be reversed. The idea now is to slime everything, treat with cyanide, return the tailing over vanners and either cyanide the re-ground concentrate or ship it to the smelter, in proportion to the lowering of the freight-rate by the railway company. Tests have been made, using ten stamps, or a quarter of the mill. These tests have yielded an 86 per cent. recovery by direct cyanidation and 9 per cent. more in a marketable concentrate. Formerly the concentrate assayed 4 to 6 ounces in gold per ton; now, after cyanidation, the assay has declined to about $25 per ton. The concentration used to be in the ratio of 10.1 on 600 tons of concentrate monthly; now the shipments will be 100 to 125 tons only.

"The plan of treatment now to be adopted may be sketched thus: Crushers, 40 stamps, spitzkasten, the coarse going to eight corrugated-belt vanners, the tailing from which is returned to two tube-mills. The fine from the stamps and the tube-mills is delivered to 12 Deister tables and 16 smooth-belt vanners, the tailing from which is re-classified by four cones, the spigot-discharge being further classified in cones with upward flow of water. The slime from both sets of cones goes to one set of cyanide vats and the sand to another set.

"The treatment of the residue for the further extraction of the gold and for the recovery of the arsenic depends upon the freight and smelter rates to be obtained. Like the tariff, metallurgy is a local question."

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## ALGOMA IRON ORE AND PYRITES.

The chief producing iron ore mines in Ontario are the Helen and Magpie mine owned by the Algoma Steel Corporation.

During 1916 the Helen produced 85,241 gross tons iron ore and 6,624 gross tons pyrites. There was shipped to the Soo furnaces 40,660 gross tons and to the Magpie roaster 57,343 tons high sulphur ore. This Helen high sulphur ore is mixed with Magpie raw ore and then roasted, producing a very desirable Bessemer ore, running 52 per cent. iron and 0.043 phosphorus.

Of the pyrites 3,120 tons was shipped to the Soo, and the balance stockpiled.

The total tonnage shipped from Helen Mine since 1900, the opening, is 2,409,971 gross tons iron ore and 40,690 gross tons pyrites.

During 1916 there was mined at the Magpie 208,163 gross tons iron ore. There was shipped 187,966 tons, of which 108,478 tons went to Lake Erie ports to fill contracts with U. S. furnace companies and the balance to the company's furnaces at Sault Ste Marie. Since opened in 1913 the Magpie has produced 424,816 gross tons of which 161,119 tons was exported and the balance used at the Soo furnaces.

# TRANSVAAL GOLD MINING IN 1916

By Rowland Gascoyne

Notwithstanding the war, and the difficulty experienced with regard to labor and supplies, the gold production in 1916 in the Transvaal is estimated to constitute another record. The Rand Goldfield practically produces the whole of the gold in the Transvaal, and for 1916, the production is estimated at 8,971,564 ozs., value £38,108,797, as compared with 8,771,919 ozs., value £37,260,746 for 1915, which for any one year was the highest output previously obtained. A feature of the year was the intersection of the Main Reef Series below the South Rand Dyke by a borehole apparently in a profitable condition, but otherwise no important discovery was made during the year.

During the year what will probably prove of immense importance was the result of Dr. Mellor's work of the Geological Survey in connection with the Far East Rand Goldfield. Dr. Mellor shows that the reef in that goldfield was deposited in elongated patches, whose long axis shows a definite roughly parallel direction, alongside areas completely barren of reef with the hanging and footwall in contact. Further where the reef is found well developed and of workable width profitable values may be expected. As the Far East Rand Goldfield is many square miles in extent, and the only part of the Rand to which future increases of gold production can be looked for, this discovery will prove of the highest importance, as it will materially assist prospecting operations, on account of indicating the position where payable and unpayable areas may be looked for.

Except in the Far East Rand little prospecting with the diamond drill was done during the year, and here the boring seems to have been done principally in unprofitable or barren areas. Owing to the falling values at the East Rand Proprietary Mines in depth, a somewhat ambitious prospecting scheme was decided upon. It was decided to drive two converging cross cuts 2,000 feet in length, and where the cross cuts intersect each other, to sink a shaft 2,000 ft. deep to prove the value of the reef. At this point the depth from the surface to the reef will be no less than 6,000 ft., and the work is expected to last about four years and to cost £200,000.

Several new shafts were started during the year to the immediate south of Johannesburg, where the depth to the reef will be about 4,500 feet. One of these shafts circular in shape, No. 14, of the Crown Mines, has eclipsed the world's previous record for speed having sunk 252 feet in one month. A deep shaft has also been started at Daggafontein near Springs, which is expected to reach the reef in five or six years.

During the year much trouble and expense has been caused to the deep mines, working at vertical depths of from 4,000 to 5,000 ft. by the pressure and movement of the superincumbent strata. Masonry and reinforced concrete have been tried without relief, and even larger pillars have failed to withstand the pressure. The only reliable preventative appears to be sand-filling, upon which considerable sums have been spent during the year. For several years in the town and neighborhood of Johannesburg, these subsidences have produced earth tremors similar to earthquake shocks, and a Government Commission was appointed to investigate and report upon the matter. After an exhaustive enquiry, the Commission confirmed the view as to their origin being due to mine subsidences, and recommend that larger pillars be left for the protection of the workings to be entirely removed later on. The depreciation of values in depth at the East Rand Proprietary Mines was one of the features of the year, as was also the failure of selective mining when tried at the Crown Mines.

It is now generally conceded that the future of the gold mining industry on the Rand depends on the Far East Rand, a deep lying goldfield some 400 sq. miles in extent north-east and east of Boksburg. During the year interest has been almost exclusively centred in this field, three-fourths of which area belongs to the Government. It is not expected that more than one-half of this goldfield will prove profitable, but even then the Government Mines Department estimated during the year, that the yield of this field might be placed at £450,000,000. Several attempts have been made by three Governments without success, to lease certain of these mining areas. During the year two mining areas were offered on more liberal terms and brought forth nine tenders. For the area adjoining the Brakpan mines, the tender of the Brakpan Mines was accepted at five per cent. of the profits for the first five years, over the whole of the Brakpan farm and Schapenrust, and 12½ per cent. minimum afterwards. The tender of the Central Mining and Investment Corporation was accepted at 10 per cent. of the combined profits of the leased area along with Rand Klipfontein and Cloverfield. In order to facilitate the leasing of the mining rights on the Far East Rand, the Government after instructing the Mines Department to report upon the matter, proposed new mining legislation, with the object of making the terms more attractive to investors. Owing, however to an outcry that the Government should work the mines themselves by means of State mines and thus secure the whole of the profits, the Government appointed a Commission to investigate and report upon the merits of State mining. This Commission was still pursuing its labors at the end of the year. As it will take about eight years for these deep mining areas on the Far East Rand to produce gold, and many important mines on the Central Rand are fast approaching exhaustion, it is anticipated that the gold output of the Rand may possibly decline before these new mining areas can contribute to the Rand gold output. Owing to the impossibility of raising capital in Europe for the purpose of opening new mines on the Far East Rand. Messrs. Lewis and Marks attempted to raise capital during the year in the United States. Several engineers visited the Far East Rand to report but owing to the uncertain mining legislation, the efforts were unsuccessful.

The condition of the South African coal trade materially improved during the year, owing to the Suez canal route being abandoned by many of the shipping lines in favor of the Cape. This gave quite an impetus to the bunkering trade at Durban and Capetown, with the result that both the output of coal and selling prices increased during the year. The diamond mining industry materially improved during the year. In 1915 the value of the output was under £400,000. By June it had reached two millions sterling, and in October seven millions, so that in 1917 the old output of eleven millions will be easily reached. In the base metal mines there was a good feeling during the year, asbestos, lead and mica showing the most improvement, copper and tin remaining steady.

## FLORENCE SILVER MINING CO.

For several years the Florence Silver Mining Co., of Spokane, Washington, has been developing a group of mineral claims situated a mile or two north of the town of Ainsworth, on the west side of Kootenay lake, British Columbia.

The published report of the gold commissioner for the district for the year 1911 included the statement that "the Florence Mining Co. is driving a tunnel to a depth of 500 ft. on the Hope property, and is confident that it will be well repaid for the labor." For 1912 the official report was that the company had "employed an average of ten men on development work; sunk a shaft to a depth of 80 ft.; did 200 ft. of drifting and shipped about 60 tons of ore; built a new shaft-house, cook-house, several dwelling houses, and two miles of road to connect with the Government road on the lake shore." For 1913 the commissioner reported that the company had employed on an average ten men during the year, mined about 100 tons of ore, and installed two air compressors. For 1914 the report was to the effect that the company had shown up large quantities of clean and milling ore, and that it was its intention to erect a concentrator near Princess Creek. The 1911 report stated that the company's property "had just entered the shipping list; arrangements were made to mill the ore at the Highland mill, near Ainsworth, late last fall, but through lack of water it shut down. A new camp for forty men was erected and a hydro-electric plant was installed on Woodbury creek. Ten men were employed."

### Progress in 1916.

The following summary shows that substantial progress was made in 1916:

Development.—No. 3 tunnel, which will give an additional depth of 350 ft., as compared with the present workings in ore, has been driven a distance of 1,500 ft., with 500 ft. yet to go to reach its objective point. In addition there has been approximately 1,500 ft. of development work done in raising and drifting.

Production.—The ore-production in 1916 was entirely incidental to development, and consisted of 660 tons of silver-lead concentrate and 134 tons of crude ore, all of which was shipped to the Consolidated Co's smeltery at Trail. Concentration of the ore was done at the Highland mill.

Equipment.—The equipment provided was as follows:

A power plant for air, consisting of a 250-horse power Ingersoll-Rand compressor (15-drill), direct connected to water wheel, with one mile of 6 in. pipe from the plant to the mine, was completed at a cost of about $15,000.

A hydro-electric plant of 350 horse-power, with two miles of transmission line from the generating station on Woodbury creek to the concentrating mill on the western shore of Kootenay lake, was completed at a cost of about $35,000.

A concentrating plant, with a capacity of 300 tons daily, was put in at a cost of about $80,000. This plant will be in operation early in 1917.

An aerial tramway from No. 3 tunnel to the concentrating mill, a distance of 1,800 ft.. equal to conveying 25 tons an hour, was constructed at a cost of about $8,500.

### Geology and Ore.

Mr. Stuart J. Schofield, in the Geological Survey Summary Report for 1914, gave the following information relative to the claims operated by the Florence Silver Minig Co. of which Mr. F. R. Wolfe, of Spokane, is president and manager, and Mr. Charles Simpkins mine superintendent:

"The country rocks on these claims are all sedimentary, consisting of interbanded siliceous limestones and mica schists striking north and south with a dip of 45 deg. to the west. The vein which cuts this sedimentary series strikes N. 65 deg. W. and dips 60 to 75 deg. S.; it varies in width from a few inches to 16 ft. This variation in width is due to the character of the country rocks crossed by the fissures. In the mica schists the vein is barren, but where it crosses the siliceous limestone a great enlargement takes place which is in the nature of a replacement deposit. Locally these enlargements are called cross veins. The ore consists mainly of coarse-grained galena with subsidiary amounts of zinc blende and iron pyrites. The gangue is mostly quartz and silicified limestone."

## CREDIT TO WHOM CREDIT IS DUE.

Writing to Mining and Scientific Press, Mr. E. H. Hamilton, of Trail, B.C., now metallurgical manager for the Consolidated Mining and Smelting Company of Canada, Limited, who is too just and big a man to take credit due to others, makes it quite clear who it was that did so much of the preliminary difficult work in connection with the establishment of an electrolytic zinc refining industry at Trail. His letter, published in Mining and Scientific Press of January 20, follows:

"Sir,—In your issue of December 30, the editorial on electrolytic zinc at Trail seems to infer that I had to do with designing the plant. The credit of this is entirely due to Mr. R. H. Stewart, Mr. S. G. Blaylock, and Mr. F. W. Guernsey, and the able staff.

"I can bear testimony to the enormous difficulties overcome in bringing the plant to the operating stage in 11 months, during a period when material, machinery, and men were so difficult to obtain, and while most of the building operations were carried on in the severest winter of many years. The top of the 200 ft. stack was housed and warmed to prevent the material from freezing. Men were hard to get, as one-twelfth of the whole population of the province had volunteered and gone to the front. This included practically all of the unmarried engineers, chemists, and better class of mechanics."

Trail, B.C., January 4. E. H. Hamilton.

## WEST SHINING TREE.

Sudbury, Feb. 2.—Mr. Thos. Foster, of West Shiningtree, gave a purchase option for three claims to Mr. Stull, of Sudbury. The property adjoins the Freer claims, controlled by the Canadian Development Syndicate. The south Foster claim shows a four-foot vein of quartz of the Gosselin character, which assayed seven dollars and forty cents.

Mr. De Morest of the firm of De Morest & Stull, engineers of Sudbury, left for Toronto and Ottawa, on Tuesday evening. He stated a very important mining deal was about to be closed for Shiningtree. Stull and De Morest have taken an option on the Moore property controlled by Jack Moore of Sudbury.

Mr. L. La Forest, Mr. John Mataris and five miners left Sudbury for the Mataris Copper property situated about eight miles west of West Shiningtree. A road is now being built into the property from the Shiningtree government road, a distance of six miles. The property will be prospected with diamond drills.—Sudbury Mining News.

## OMINECA MINING DIVISION, B. C.

The following notes give a brief review of mining in the Omineca division of British Columbia for the year 1916:

Although mining operations were active during the 1916 season throughout the whole district, so far as information received goes there were only two properties from which bulk shipments of ore were made. These are the Silver Standard, about eight miles from Hazelton on Glen mountain, and the Rocher Deboule Copper Co's mines on Rocher Deboule mountain, twelve miles from Skeena Crossing, a station on the Grand Trunk Pacific railway west of Hazelton.

The Silver Standard, which was one of the earliest shippers in the district, in 1913 sent to the smeltery at Trail 282 tons of ore which averaged $4.20 in gold and 138 oz. of silver to the ton, and 24 per cent. lead, and in 1914 736 tons of ore containing about 200 oz. gold, 122,000 oz. silver, and 282,000 lb. lead. Then came a suspension of production, following the outbreak of War in Europe. However, shipment of ore was resumed in 1916, and during that year there was received at Trail from this mine 738 tons. Reports are to the effect that the mine looks increasingly better as development is proceeded with, and although the owners state that they can hardly claim yet they have an important mine, they have great hopes it will yet prove to be one.

The Rocher Deboule Copper Co's production in 1915 consisted of about 17,000 tons of ore, shipped to the Granby Consolidated Co's smeltery at Anyox, Observatory inlet, which ore averaged about 8 per cent. copper and $1.65 gold and 50 cents silver to the ton. Shipments in 1916 totalled between 16,000 and 17,000 tons.

Among other properties on Rocher Deboule mountain that have been opened are the Indian, Comeau, Armagosa and Chicago groups, and the Daly West and Ohio mines.

In the Babine region, much development work has been done on the Babine Bonanza and the Debenture groups, both of which are expected to be on a shipping basis before the close of 1917.

On Telkwa river, a great deal of work has been done on the Jefferson-Dockrill group, to which a wagon road is being made. It is expected that ore will shortly be shipped from this property.

A syndicate, with headquarters at Portland, Oregon, has been at work continuously on the Copper Crown group on Blue Grouse mountain, and machinery is in place on this property.

The Fiddler group, on Fiddler creek, was systematically and continuously developed, and the owners constructed a good wagon road to it during the season.

Placer-gold mining was not active, generally speaking, in the district during the 1916 season; however, numerous placer leases, for claims in either the Omineca or the Peace River mining divisions were applied for.

On the whole, the prospects for mining in the district are bright, and it looks as though the 1917 season will prove to be a busy one.

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The Silver Gable Mining and Milling Co., has been organized in Spokane, Washington, to do development work on a group of mineral claims situated in the northern part of Ainsworth mining division, near Heal's landing, at the upper end of Howser lake. Mr. W. B. Smith has taken half a dozen men to the property to erect buildings and otherwise prepare camp for mining operations in the Spring.

## ANNUAL MEETING C.M.I.

The Nineteenth Annual Meeting of the Institute will be held in the City of Montreal on Wednesday, Thursday, and Friday, March 7th, 8th and 9th, 1917.

It is expected that the following papers will be presented for discussion:—

Presidential address on "Industrial Preparedness," by Mr. Arthur A. Cole.

"Organization for Industrial Preparedness," by Mr. E. P. Mathewson.

"A Plea for the Union of Capital and Labor," by Col. D. Carnegie.

"The Amelioration of Industrial Relations," by Dr. David H. Browne.

"The Work of the Advisory Council of Scientific and Industrial Research," by Dr. Frank D. Adams.

"The Organization of Industrial Research," by Mr. Arthur D. Little.

"Electro-Chemical and Metallurgical Possibilities in Canada," by Mr. H. E. Howe.

"Possibilities for the Manufacture of Cyanide in Canada," by Mr. Gordon Spencer.

"The Development of Canadian Magnesite," by Mr. Harold J. Roast.

"Canadian Magnesite and Its Uses," by Mr. H. J. Ross.

"Refractory Clays of Saskatchewan," by Mr. N. B. Davis.

"Potash, Its Production and Uses," by Mr. C. W. Drury.

"Utilization of Canadian Molybdenite," by Mr. J. W. Evans.

"The Concentration and Marketing of Molybdenite," by Mr. H. H. Claudet.

"Benefication of Canadian Iron Ores," by Mr. G. C. Mackenzie.

"Bituminous Sands of Northern Alberta," by Mr. S. C. Ells.

"Electro Deposition of Zinc from Aqueous Solutions," by Mr. E. P. Mathewson.

"Electrolytic Zinc in Eastern Canada," by Mr. E. E. Watts.

"Flotation at the Buffalo Mines, Cobalt," by Mr. T. R. Jones.

"Flotation by the Callow Process in the Cobalt District," by Messrs. John M. Callow and E. B. Thornhill.

"Mining and Milling Practice in the Porcupine District," by Mr. A. R. Globe.

"Metallurgical Practice at the McIntyre Mill," by Mr. A. Dorfman.

"The Kingdom Lead Mine, Ontario," by Mr. John E. Hardman.

"Mining Methods at the Magpie Iron Mine," by Mr. A. Hasselbring.

"Canada in Relation to the Coal Trade of the Empire," by Mr. Allan Greenwell.

"Further Notes on Yukon Mining Problems," by Dr. H. M. Payne.

The Annual Dinner will be held in the Ritz-Carlton Hotel on the evening of Thursday, March the 8th.

By the courtesy of the managements of respectively The Canadian Vickers, Limited, The Dominion Copper Products Company, and the Montreal Ammunition Company, members will be afforded the opportunity of visiting the munition plants of these companies.

# OCCURRENCE AND UTILIZATION OF COBALT ORES*

Although metallic cobalt was unknown till 1735, when Brandt first prepared it, cobalt ores have been used from very early times for the decoration of porcelain, the production of blue glass, and of smalt and other pigments. Blue cobalt glass has been found in the tombs of ancient Egyptians and in the ruins of Troy. The blue pigment known as smalt was rediscovered in the sixteenth century, when the smalt industry of Saxony was started.

Recent experiments show that metallic cobalt can be used for many purposes with marked success; and only its high price, about four times that of nickel, has prevented its extensive employment in the past.

The word "cobalt" is said to be derived from the "kobolds," the legendary mine goblins. By mediaeval writers it was used for substances which, although resembling metallic ores, yielded no metal on smelting. Later, it denoted a mineral used in the production of blue glass.

### Cobalt Minerals.

The minerals which are of chief importance as ores of cobalt are the arsenide, smaltite, and the sulpharsenide, cobaltite. Absolite, a mixture of hydrates, also forms valuable deposits, and erythrite, a hydrous arsenate formed by the decomposition of arsenical cobalt minerals, is of value as indicating the presence of such minerals. These four minerals are described below.

Among the less abundant cobaltiferous minerals may be mentioned the sulphides linnaeite, $Co\ S_4$; carrollite, $Co_2CuS_4$; sychnodymite $(Co, Cu)_4S_5$; and cobaltnickelpyrite $(Co, Ni, Fe)S_2$; the sulpharsenides glaucodote, (Co, Fe) AsS and alloclasite, a bismuth-bearing plaucodote; and the arsenides skutterudite, $Co\ As_3$, and aflorite, $CoAs_2$. Sphaero cobaltite and remingtonite are cobalt carbonates, the latter being hydrated; heterogenite is a hydrous oxide, bieberite a hydrous sulphate, while cobaltomenite and pateraite appear to be a selenite and a molybdate of cobalt respectively.

Cobalt is also an occasional constituent of many other minerals, especially of pyrrhotite (sulphide of iron) and arsenopyrite (sulpharsenide of iron), and is usually present in nickel ores. Cobaltiferous varieties of arsenopyrite, known as danaite, are probably due to isomorphous intergrowths of glaucodote. Metallic cobalt has been recorded as occurring in meteorites.

Smaltite, sometimes known as tin-white cobalt, crystalises in the pyritohedral class of the cubic system, Combinations of the cube and octahedron are common, but the mineral often occurs massive. It has an imperfect octahedral cleavage and uneven fracture. Its hardness is 5.5 or 6, and its specific gravity is about 6.3. It is opaque, with a metallic lustre, and a color varying from tin-white to steel-grey, tarnishing on exposure. The streak is greyish-black. Smaltite is essentially an arsenide of cobalt, $CoAs_2$. Nickel and iron are both present, and frequently a small amount of sulphur. With increase of nickel the mineral graduates into chloanthite.

Cobaltite, or cobalt glance, is also cubic and pyritohedral in its crystallisation, the pyritohedron being a common form. It often occurs massive. The cleavage is cubic, and the fracture uneven. It has a hardness of 5.5 and a specific gravity of 6.2. It is opaque, metallic in lustre, and pinkish-white to steel-grey in color, with a greyish-black streak. In composition it is a sulpharsenide of cobalt, CoAsS. A little iron is present, and a large amount in the variety ferrocobaltite.

Absolite, or earthy cobalt, is an amorphous, earthy or compact substance of dull black color. It is a variety of wad, or hydrous oxide of manganese, containing a variable percentage of cobalt.

Erythrite, often called cobalt bloom, crystallises in the monoclinic system. The crystals are prismatic and vertically striated; they often form radiating tufts or stellate groups. More often the mineral occurs as an earthy incrustation on smaltite. There is a perfect pinacoidal cleavage. The mineral is sectile, has a hardness of 1.5 to 2.5, and a specific gravity of 2.95. It is transparent to subtranslucent, and pearly to dull in lustre. The color is peach-red or crimson, occasionally greyish, and the streak a little paler. Erythrite is a hydrous cobalt arsenate, $Co_3As_2O_8H_2O$. Nickel, iron and calcium are sometimes present. This is the usual alteration product of arsenical cobalt minerals, and on account of its striking color forms a useful "cobalt indicator."

The cobalt minerals may be recognized by the deep blue color they impart to borax and microcosmic salt beads.

### Occurrence of Cobalt in America.

Canada: The Cobalt District.—Cobalt lake and town are situated 4 or 5 miles west of the northern end of Lake Temiskaming, which forms part of the eastern boundary of Ontario. The orebodies were discovered during the building of the Temiskaming and Northern Ontario Railway in 1903, and production began in the following year. The output steadily increased rapidly and the production of the Cobalt mines is now the chief source of the world's cobalt.

The ores mined at Cobalt, are exceptionally rich silver ores, and cobalt, nickel and arsenic are merely by-products. One shipment of ore contained 7 402 oz. of silver to the ton, and several exceeded 6,000 oz. to the ton. A typical high-grade ore is said to contain 10 per cent. silver, 9 per cent. cobalt, 6 per cent. nickel, and 39 per cent. arsenic. Although the cobalt is a by-product for which the mine-owners receive little return, these ores have displaced almost all others in supplying the world with cobalt. Indeed, sufficient ore was produced at Cobalt, prior to the outbreak of war, to provide 1,500 tons or more of cobalt oxide annually, while the world's consumption was estimated at only 300 tons per annum.

Cobalt is obtained from these ores in the form of cobalt oxide and cobaltic material containing nickel and a little silver, in smelteries at Deloro and Thorold, Ontario. Metallic cobalt also is now being produced at these localities. A considerable amount of ore is sent out of Canada. The extraction is a complicated wet process, and yields cobalt oxide, $Co_3O_4$, in the form of a black powder. A bounty of six cents per lb. of metallic cobalt is paid on cobalt and cobalt oxide produced in Ontario; this bounty was to expire on April 10, 1917, but has now been extended for a further period of five years.

Other Canadian Occurrences.—In addition to the numerous veins in the immediate vicinity of Cobalt, similar cobalt-silver veins occur, at considerable dis-

*Extracts From an Article Published by the Imperial Institute.

tances from the town. They are worked in Casey township, 15 miles to the north; and at South Lorrain, 15 miles to the south-east and near Gowganda and Elk Lake, on the Montreal River, 40 to 60 miles to the north-west of Cobalt. Small shipments have been made from Maple Mountain, 30 miles west of Cobalt. The Lake Superior silver deposits contain cobalt, nickel and arsenic in smaller amounts than those of Cobalt. Cobalt is present in the nickel and copper deposits of Sudbury.

United States.—A small amount of cobalt was formerly recoverd from the Sudbury nickel ores smelted in the United States, but in the present method of smelting the cobalt is slagged out of the matte. From the lead ores of Mine La Motte and Fredericktown, Missouri, cobalt was at one time recovered, the metal being present as linnaeite in association with galena and calcite. At Marion, Kentucky, cobalt and nickel minerals occur in the flourite deposits. Grant County, Oregon, is said to have produced small amounts of ore containing cobalt, gold and copper. Smaltite occurs in a calcite vein in granite at Gothic in Colorado. Near Blackbird, Lemhi County, Idaho, lenticular bodies of cobalt nickel ore occur in pre-Cambrian schists and quartzites cut by diabase and lamprophyre dykes. In Los Angeles county, California, cobalt-silver ores are found in barytic lodes.

Argentina.—A cobalt deposit, occurring in veins in a talcose schist near its contact with an acid igneous rock, has been worked at Valla Hermoso, Vinchina, Provincia de la Rioja.

Chile.—At the Blanca Mine, near San Juan, in the Department of Freirna, Province of Atacama, cobaltite is associated with tourmaline, apparently deposited at the same period, and accompanied by later quartz and erythrite. The country rock is schist. Smaltite occurs in small quantities in the silver mines of Tres Puntas and elsewhere.

Mexico.—Cobaltite, smaltite, and erythrite are found at Pihuamo Jalisco, in veinlets cutting a large vein of magnetite (oxide of iron), associated with pyrite and pyrrhotite. These ores were formerly mined. Cobalt minerals also occur at Iturbide in Chihuahua, Guanacevi in Durango, Cocala in Sinaloa, and at the Mirador mine in Jalisco. At Boleo, Lower California, the zinc in smithsonite (carbonate of zinc) is said to be partly replaced by cobalt.

Peru.—Nickel and cobalt minerals are reported in the Department of Cuzco.

### Occurrence of Cobalt Ores in Europe.

Austria-Hungary.—At Joachimisthal, in Bohemia, the veins cut a series of mica-schists, calc-schists and limestones, and are themselves cut by dykes of basalt. The veins are narrow and contain quartz, hornstone, calcite, and dolomite as gangue. The ore minerals may be divided into: (1) Silver ores (native silver, argentite, polybasite, stephanite, tetrahedrite, proustite, pyrargyrite, sternbergite, argentopyrite, rittingerite, acanthite and cerargyrite); (2) Nickel ores (niccolite, chloanthite and millerite); (3) Cobalt ores (smaltite, bismuth-cobalt-pyrite and asbolite); (4) Bismuth ores (native bismuth, bismuthinite, bismutite and bismite); (5) Arsenic ores (native arsenic and arsenopyrite); (6) Uranium ores (pitchblende). Galena, zinc blende, pyrite, marcasite, chalcopyrite and bornite (sulphide of copper and iron) are occasionally present in small amount. The general conditions are similar to those prevailing at Schneeberg and Annaberg on the Saxon side of the Erzgebirge. The silver ores were mined first, and as early as 1518 the first "Joachimsthaler" were minted. This silver coin is now known as the "thaler," from which the word "dollar" is derived. After 1545 mining declined, but acquired new vigor when the cobalt and bismuth ores became valuable. The industry again languished, but received a fresh impetus with the demand for uranium and radium.

At Dobschau, in Hungary, Palaeozoic slates are intruded by a sheet of diorite, which follows the contact with a stock of garnetiferous serpentine. The veins consist chiefly of siderite (carbonate of iron), calcite, ankerite (carbonate of calcium, magnesium and iron), and some quartz, with tourmaline in a few cases. The ore bodies are irregularly scattered through the veins, and consist largely of a compact mixture of smaltite and rammelsberbite (arsenide of nickel). Copper ores, arsenopyrite and niccolite are sometimes present. The veins broaden upwards into trumpet-shaped expansions of coarsely crystalline siderite as much as 100 ft. thick, containing scattered nests of the copper and nickel ores.

In Styria cobalt and nickel ores are found in lodes traversing pyritic "fahlbands" in hornblendic slates and gneiss.

France.—Narrow veins containing silver, cobalt and nickel ores occur in crystalline schist at Chalanches, in Dauphine, France. They were discovered in 1767, and for long were worked only for their silver contents. The richness of the ore and its ready fusibility led to systematic robbery of the mines. Later, the slags and speiss containing nickel and cobalt were recognised as being valuable, and the arsenide ores of these metals were exported to England and Germany. An attempt to manufacture cobalt pigment at Allemont was unsuccessful.

Quartzose veins containing ferriferous smaltite were prospected in 1784, at Juzet, near Montaban-de-Luchon, Haute-Garonne. The ores produced, together with those from Gistain on the Spanish side of the Pyrenees, were treated at Saint-Mamet.

Germany.—At Schneeberg in Saxony veins containing cobalt, nickel, bismuth and silver occur in contact-metamorphosed clay-slates, and tend to become impoverished in the underlying granite. The primary gangue minerals are calcite, ankerite, barite and fluorite; but these minerals are now largely replaced by fine-grained quartz. The ore minerals are smaltite, chloanthite, niccolite, bismutite and native bismuth, native silver and silver ores, and uraninite (pitchblende). As at Cobalt, the cobalt and nickel minerals were deposited first and the silver minerals later. The uranium ores are intermediate in age. The rich silver ores were first mined in the latter part of the fifteenth century, and the invention (or re-invention) of smalt blue soon afterwards led to the exploitation of the cobalt veins. The color industry rapidly developed in Saxony, and color works, using Schneeberg ore, were also erected in Holland and elsewhere. It is estimated that the total production of pigment by the end of the eighteenth century was from four to five thousand tons per annum, representing three or four hundred tons of cobalt, which is greater than the world's consumption in recent years.

At Annaberg in Saxony, veins of similar composition to those of Schneeberg occur in gneiss with dykes of granitic and lamprophyric character. They are younger than the veins in the same region carrying cassiterite (oxide of tin) and those yielding pyritic ores with galena, but are cut by basalts. Chloride of silver is remarkably abundant in the veins.

A similar association of ores is found in several other localities in the Erzgebirge, as well as at Wittichen and at Wolfach, in the Black Forest, where the veins occur in granite.

In Thuringia fault fissures in the Kupferschiefer and Zechstein are filled with barite, calcite and fragments of the country rock, together with smaltite, absolite and erythrite. They have been worked especially at Schweina, near Liebenstein.

The palaeopicrite of Dillenburg (Nassau) contains cobalt, together with nickel, copper and bismuth. At Querbach and Giehren, in the Riesengebirge, the mica-schist near the contact with gneiss is impregnated with cobaltite, chalcopyrite, pyrite, pyrrhotite, arsenopyrite blende, galena, magnetite and cassiterite.

In the Fichtelgebirge ores of cobalt and nickel are associated with siderite, bismuth and barite. Siderite and copper ores are their associates in the Siegen district, Prussia.

In Alsace veins of smaltite, chloanthite and native silver in a calcite gangue were formerly worked at Sainte-Marie-aux-Mines.

Italy.—Cobalt and nickel ores occur in Piedmont with quartz, calcite and ores of copper.

Norway.—At Skutterud and Snarum, near Modum, in Southern Norway, the rocks are highly metamorphosed slates, schists, gneisses, amphibolites and quartzites. They are traversed by "fahlbands" impregnated with pyrite; these at a few points contained cobaltite in workable quantity, and the ore was mined here as far back as 1772.

Russia.—The Dashkessan cobalt deposits are on the east side of the Katschkar-Tschai Valley, about six miles west of Elisabethpol, south of the main range of the Caucasus. The ore minerals, mainly cobaltite, accompanied by chalcopyrite and a little zinc blende, haematite and magnetite, occur very irregularly in a sheet of serpentinised rock lying between magnetic iron ore and a decomposed porphyry. The mines have been worked by a German firm and the product sent to Saxony.

Spain.—Several mines were worked in the eighteenth century, and reopened for a time in 1872, in the valley of Gistain, Huesca, near the French frontier. The chief mineral is a compact ferriferous smaltite, accompanied by niccolite, chloanthite, bismuth and bismuthinite. The gangue is calcite, and the veins occur at the contact of schists and Palaeozoic limestones.

At Guadalcanal, in Andalusia, veins containing ores of silver, cobalt, and sometimes copper, in a calcite gangue, were at one time of importance.

Sweden.—Cobaltiferous "fahlbands" similar to those in Norway were once worked at Vena, near Askersund, on Lake Wetter, but the cobalt content is lower than in the Norwegian occurrences. At Tunaberg, in Sodermannland, cobaltite and chalcopyrite occur as grains scattered through crystalline dolomitic limestone. At Gladhammar, south of Westerwik, cobaltite, pyrite and chalcopyrite occur in irregular deposits in leptynites.

Switzerland.—Cobalt and nickel ores occur in Valais, as at Ayer in the Val d'Anniviers and at Kaltenberg in Turtmanntal. They accompany ores of copper and lead.

United Kingdom.—Small quantities of asbolite containing both nickel and cobalt were raised at Model Hiraddug, near Rhyl, in Flintshire, between 1873 and 1890. The total output for the period was 1,264 tons, valued at £6,784. The asbolite occurs in masses up to the size of an egg in red clay, which fills "swallow holes" in the Carboniferous limestone.

Cobalt minerals occur in small amounts at Alderley Edge in Cheshire, in several of the Cornish mines, and elsewhere.

### Occurrence of Cobalt Ores in Asia.

India.—A Cobalt mineral, described as a simple cobalt sulphide under the name of jaipurite, has long been raised at the copper mines of Khetri and elsewhere, in Jaipur State, Rajputana. It appears, however, to be really cobaltite. It is used in making blue enamel and blue glass bangles, and is said to produce a rose color on gold.

Earthy cobalt, with manganese, is reported to have been found near Henzai in Tenasserim, Burma, and elsewhere.

Linnaeite has recently been identified among some copper ores from Sikkim.

### Cobalt Ores in Africa.

Belgian Congo.—The crude copper produced by the Union Miniere du Haut Katanga, of which 8,064 tons was produced and shipped to Germany in 1913, contained from 2.8 to 3.25 per cent. of cobalt. This formed a by-product easily saved in electrolytic refining, and is said to have been the chief source of German cobalt in recent years.

Transvaal.—At Balmoral, east of Pretoria, the schists of the Cape formation are traversed by veins composed of hornstone with actinolite (silicate of magnesium, calcium, and iron), smaltite and erythrite.

Smaltite sometimes occurs in the auriferous quartz veins, as in the Middleburg district. One vein in the Lydenburg shales is filled almost wholly with smaltite, and contains 7 or 8 per cent. of cobalt, or 0.5 to 1 per cent. of nickel, and 60 to 150 grains of gold per ton. Another vein has a gangue of auriferous quartz mixed with kaolin, with bunches of smaltite, copper ores and sometimes molybdenite (sulphide of molybdenum). The ore carries 100 to 250 grains of gold per ton, 90 per cent. of which is contained in the chalcopyrite.

### Cobalt Ores in Australasia.

New Caledonia.—This island was the chief producer of cobalt ores at the time the deposits at Cobalt were discovered, but the industry was practically killed by the fall in prices which followed the Canadian production. The ore is absolite, and usually occurs in the form of bluish-black nodules in ferruginous clay. Like the New Caledonian nickel ore, it is the result of the decomposition of peridotite. Cobalt oxide averages from 4 to 6 per cent. of the ore.

New South Wales.—The second largest producer of cobalt in the world, before the discovery of the Canadian deposits, was New South Wales. Here the chief deposits are situated near Port Macquarie, and are similar in character to those of New Caledonia. Asbolite was also worked near Bungonia, and glaucodote near Carcoar.

South Australia.—Cobalt ore, containing smaltite and other minerals, is found at Bimbowrie, near Olary, on the Broken Hill line, but little work has been done on the deposit.

### Cobalt Compounds and Their Uses.

The cobalt compounds, and especially the pigments, were for centuries the only form in which cobalt was employed.

Smalt (bleu d'azur, bleu de Saxe), the manufacture of which in Saxony dates from the sixteenth century, is a blue glass, essentially a silicate of potash and cobalt, and usually contains about 6 per cent. of cobalt. For its preparation the cobalt ore, consisting of smaltite with a little bismuth in the case of the Saxon industry,

was first gently heated to melt out the bismuth, and was then stamped and roasted in reverberatory furnaces. The resulting crude cobalt oxide, known as zaffre, safflor, or safflower, was mixed with potassium carbonate and white quartz and fused in a glass furnace. A little arsenic, obtained as a sublimate in roasting the ores, was added to the mixture; it combined with the deleterious metals present in the ore, such as iron, copper and nickel, and caused them to settle to the bottom of the melting pot. The fused cobalt glass was dipped out with iron spoons and poured into cold water, giving a friable glass which was afterwards ground to powder, levigated, dried and sifted. Modern methods of manufacture are essentially the same as that described above. The name eschel is sometimes given to a fine-grained and light colored grade of smalt.

Cobalt blue (Thenard's blue, cobalt ultramarine, king's blue) is essentially a compound of cobalt oxide and alumina; phosphoric acid and zinc oxide are often added, the latter changing the tint from a slightly reddish to a greenish blue. This pigment is usually obtained by calcining a mixture of alum and cobalt sulphate, either alone or with zinc sulphate.

Cerulian blue (bleu celeste), obtained by heating together cobalt sulphate, tin oxide and precipitated silica or chalk, is a light-blue artists' color.

Cobalt green (Rinmann's green, or zinc green) is a compound of zinc oxide and cobalt oxide analogous to cobalt blue. It is a bright green color with a slightly yellow tinge.

Turquoise green, a bluish-green color, used chiefly in porcelain painting, is usually made by heating to redness a mixture of aluminium hydroxide, chromium hydroxide and cobalt carbonate.

Indian yellow (aureolin, cobalt yellow) is an artists' color, prepared by treating an acetified solution of cobalt nitrate with a solution of potassium nitrite, the precipitate being washed, filtered, pressed and dried.

Cobalt brown is formed by calcining a mixture of ammonium sulphate, cobalt sulphate and ferrous sulphate.

Red and pink cobalt compounds are of scientific rather than technical interest. If cobalt arsenate is strongly heated and then ground it yields a pinkish-red powder. The precipitate obtained from a solution of a cobalt salt with sodium phosphate is pink, changing to violet when heated. Cobalt magnesia pink is obtained from precipitated magnesium carbonate, mixed to a thin paste with cobalt nitrate solution, then dried and heated in crucibles.

Cobalt bronze is a phosphate of cobalt and ammonia, of a violet color with a bronze-like metallic lustre.

Although most of the cobalt colors mentioned above have considerable permanence, their high price and generally poor covering power as compared with other pigments of similar tint prevent their extensive use, and most of them have only a limited application as artists' colors. In the glass and pottery industries, however, cobalt is the only blue coloring matter employed, with the exception of the turquoise blue given by oxide of copper, and these industries are the chief consumers of cobalt compounds. The oxide is generally used, but also the carbonate, silicate and phosphate; added alone to a glaze, they give a beautiful deep blue, which is slightly violet; with alumina a sky-blue color is produced, while the addition of oxide of zinc gives an ultramarine tint. A small percentage of cobalt oxide, or a cobalt solution, is sometimes added to the body in order to counteract the yellow color due to the presence of iron, and gives a pure white ware.

Organic compounds of cobalt, such as the resinate, oleate, linoleate and tungate have been used as driers of oils, especially of fish oil and other cheap oils used as substitutes for linseed oil in paint. It is stated that the linoleate or resinate of cobalt and lead acts better than the single cobalt salt.

Cobalt nitrate is employed in the blowpipe examination of minerals. When moistened with this reagent and strongly heated, alumina gives a blue color, magnesia a pink, zinc oxide green, and zinc silicate blue, owing to the formation of some of the cobalt pigments described above.

Sympathetic inks.—Many of the soluble salts of cobalt are pink and deliquescent. If a weak aqueous solution of one of them, such as the nitrate or chloride, is used as ink, the writing is practically invisible, but if the paper is held near the fire the combined water is driven off and the writing becomes blue and visible. It will afterwards absorb water from the atmosphere and again disappear.

### Uses of Metallic Cobalt and Its Alloys.

The great production of cobalt-silver ores in Ontario has led the Dominion Department of Mines to endeavor to find fresh applications for cobalt, with a view to increasing the consumption. Accordingly, a series of researches on cobalt and its alloys was undertaken for the Mines Branch of the Department of Mines by H. T. Kalmus at Queen's University, Kingston, Ontario. The investigations include: I. The preparation of metallic cobalt by reduction of the oxide; II. A study of the physical properties of the metal cobalt; III. Electroplating with cobalt and its alloys; IV. Cobalt alloys of extreme hardness; V. Cobalt alloys with non-corrosive properties: VI. The magnetic properties of cobalt and of the alloy Fe-Co. The results of the first three of these investigations were published by the Mines Branch.

The preparation of cobalt from the oxide $Co_3O_4$ was successfully performed by Dr. Kalmus in four ways, using carbon, hydrogen, carbon monoxide and aluminium respectively as reducing agents. The first of these is the usual commercial method. Using powdered anthracite intimately mixed with the cobalt oxide, he found that practically complete reduction can be obtained in one hour or less at a temperature of about 1200 degrees C. Powdered charcoal or lampblack gives better reduction, and the temperature may be as low as 900 degrees C. Briquetting the charges with an organic binder tends to increase the rate of reduction at all temperatures, and yields the metal in a form that can be easily handled without previous fusion. The final product need not contain more than 0.20 per cent. of carbon. Small amounts of very pure cobalt may be obtained by heating in a current of hydrogen or carbon monoxide. The reduction takes place very rapidly at all temperatures above 500 degrees C. in the first case and 600 degrees C. in the second. Complete reduction is obtained in a few minutes at temperatures of 1100 degrees C and 900 degrees C. respectively, and the cooling must be carried out in the reducing atmosphere to avoid re-oxidation. Producer gas may also be employed, and offers a cheap and efficient method of preparing large quantities of pure metallic cobalt. Reduction of cobalt oxide with aluminium powder in an ordinary thermit welding furnace takes place with extreme violence, and gives metallic cobalt containing 0.1 per cent. or less of aluminium and no carbon at all.

In his memoir on the physical properties of cobalt Dr. Kalmus describes the pure metal as resembling nickel in color, although it possesses a slightly bluish cast. Metallic cobalt that has been reduced from its oxide at a sufficiently low temperature is a grey powder. The specific gravity of cobalt is 8.7918 at 17 degrees C. when cast and unannealed, 8.9253 when swaged. The hardness of cobalt, cast from just above its melting point, is 124 on the Brinell scale, which is considerably higher than that of cast iron or cast nickel. The metal has a sharply defined melting point at 1467 degrees C. Previous determinations of the melting point gave 1530 degrees C (Copaux) and 1478 degrees C. (U. S. Bureau of Standards). The tensile strength of pure cast cobalt is about 34,400 lb. per square inch, and slightly higher after annealing. The tensile yield point is very near the tensile breaking load. When the metal is rolled its tensile strength increases rapidly, and may reach over 100,000 lb. per square inch in a swaged wire. The presence of 0.06 to 0.3 per cent. of carbon, as in "commercial cobalt," raises the tensile strength from 34,400 to 61,000 lb. or more per square inch. The compressive strength of pure cast cobalt is about 122,000 lb. per square inch, and very slightly less when annealed. The compressive yield-point is 56,100 lb. per square inch when annealed, and 42,200 when unannealed. "Commercial cobalt," with 0.06 to 0.3 per cent. of carbon, has a compressive breaking strength of over 175,000 lb. per square inch.

Pure metallic cobalt may be machined readily in the lathe, although it is somewhat brittle and yields a short chip. The addition of small amounts of carbon renders cobalt less brittle and yields a longer curling chip on turning. "Commercial cobalt," containing small percentages of carbon, may readily be swaged down from cast bars to wires of any desired diameter, but cobalt of extreme purity cannot be rolled or swaged unless first cooled down under pressure, and then rolled at 500 degrees or 600 degrees. The specific electrical resistance of cobalt wires of extreme purity is 89.64 x $10^{-7}$ ohms per centimetre cube at 18 degrees C., or about five times that of pure copper. The effect of annealing the wire in vacua is to reduce the specific resistance by about 5 per cent. As little as 0.5 per cent. of impurities may treble the specific resistance, and samples of "commercial cobalt" gave values between 231 x $10^{-7}$ and 103 x $10^{-7}$ ohms per centimetre cube. Cobalt is magnetic at all temperatures up to about 1100 degrees C. The mean specific heat of cobalt between 15 degrees and 100 degrees C. is 0.1053.

The third memoir by Dr. Kalmus, published by the Mines Branch, deals with electro-plating with cobalt. Of many solutions tried, the best were found to be (1) cobalt-ammonium-sulphate, 200 grams per litre of water; (2) cobalt sulphate, 312 grams. and sodium chloride 19.6 grams per litre, together with nearly sufficient boric acid to saturate the solution. From these solutions cobalt will readily deposit on articles of the various shapes, sizes, and compositions met with in ordinary nickel-plating practice.

The electrical conductivity of these two solutions is considerably higher than that of the standard commercial nickel solutions, so that they may be operated at a lower voltage for a given speed of plating. At higher voltages they are capable of plating at very high speeds, the first solution at four times, and the second at quite fifteen times the speed of the fastest satisfactory nickel solution, without any agitation of the solution. The cobalt plate is firm, adherent, hard and uniform, and may be buffed readily to a brilliant surface. It is deposited well in the indentations of the work, and withstands the bending, hammering and burnishing tests to which nickel plate is ordinarily submitted. It is harder than nickel plate, and consequently a lesser weight of cobalt deposit will afford the same protective coat as a greater weight of nickel. The second solution, for example, will deposit in one minute as satisfactory a plate as the best nickel baths will deposit in one hour, the actual weight of the cobalt deposit being one-fourth that of the nickel. This difference in the weight of metal used more than counteracts the higher price of cobalt compared with nickel, and the extreme rapidity of the process would further reduce the working cost. Not only would a smaller plating room be required for a given amount of work a day with cobalt than with nickel, but mechanical devices for passing the work through the bath become possible, thus reducing the labor cost.

As a steel-alloying element, cobalt has been employed with notable success in high-speed steels. Steels containing about 4 per cent. of cobalt, in addition to tungsten and chromium, make high-speed tools which retain their edge well at or near a red heat, and will cut or turn manganese and nickel-chromium steels successfully.

In the form of a cold saw the cobalt-steel was found to be less satisfactory, its most valuable property being its "red-hardness," which enables the steel to cut at a high speed. Nickel, on the other hand, gives a steel which softens at the edge when hot.

A German steel, somewhat misleadingly called "iridium steel," contains approximately 4.25 per cent. cobalt, 16.00 tungsten, 3.55 chromium, 0.67 vanadium, 0.80 molybdenum, and 0.60 per cent. carbon. It is said to be greatly superior to the best tungsten steels.

Ferrocobalt, containing about 70 per cent. of cobalt, is the usual form in which the cobalt is added to steel. It has recently been proposed, however, to introduce the cobalt in the form of cobalt fluoride, which can be prepared cheaply.

An alloy of cobalt and iron, approximating to $Fe_3Co$, has been found to possess a magnetic permeability in strong magnetic fields which is about 10 per cent. higher than that of the best Swedish soft iron. This was discovered independently by P. Weiss at Zurich and by H. T. Kalmus at Kingston, Ontario.

Small percentages of cobalt added to pure iron give alloys which resist corrosion and are suitable for roofing.

Alloys of cobalt and chromium, on account of their hardness and resistance to acids, are much used in "stainless" cutlery. The original stellite is one of these alloys, containing about 75 per cent. of cobalt and 25 per cent. of chromium; table knives made from it may be used in vinegar and acid fruit juices without tarnishing or appreciable loss of lustre or sharpness.

By the addition of molybdenum and tungsten the stellite alloys are made very hard. In some experiments by E. Haynes, with the chromium maintained at 15 per cent., it was found that the alloy gradually increased in hardness with the percentage of tungsten. When the quantity of tungsten is 5 per cent. the alloy is distinctly harder, particularly when forged under the hammer. When the tungsten reaches 10 per cent. the metal still forges readily, and a tool formed from it takes a fine cutting edge. This alloy is suitable both for cold chisels and for wood-working tools. When the tungsten rises to 15 per cent. the metal can still be forged, but great care is necessary to avoid checking. This alloy is considerably harder than that containing

10 per cent. tungsten, and is excellent for cold chisels. When the tungsten rises to 20 per cent. the alloy is still harder and can be forged to a small extent. With 25 per cent. of tungsten a very hard alloy is formed, which cannot be forged, but casts readily into bars which can be ground to a suitable form for lathe tools. These tools are highly efficient, particularly in the turning of steel, since they are very strong, and retain their hardness at high speeds. The tungsten may be increased to 40 per cent., giving an alloy that will readily scratch quartz.

When molybdenum is added to a cobalt-chromium alloy containing 15 per cent. of chromium, the hardness rapidly increases with the molybdenum content, until the latter reaches 40 per cent., when the alloy becomes extremely hard and brittle, scratching quartz with ease. With 45 per cent. of molybdenum the metal takes a strong, keen edge, has a beautiful lustre, and is very suitable for fine, hard cutlery. If carbon, boron or silicon is added to any of the above alloys a harder, but more brittle, metal is obtained.

Similar additions of tungsten or molybdenum, or both, to a cobalt-chromium alloy containing 25 per cent. of chromium gave equally satisfactory results.

Another cobalt-chromium alloy, cochrome, may be swaged into wires which are in some respects superior to nichrome wires in electric heating elements. They are less readily oxidised at high temperatures, and have a higher melting point.

A French patent (No. 460,093, July 7, 1913) covers the preparation of cobalt filaments for incandescent electric lamps. The filament is made from a solution of cellulose with zinc chloride, cobalt oxide and manganese sulphate; it is heated to incandescence for twenty hours and then coated with carbon.

An alloy containing 40 per cent. of cobalt and 60 per cent. of tin is extremely acid-proof, even to aqua regia, but is too brittle for practical use. If from 5 to 20 per cent. of this alloy is added to molten copper, a product is obtained which can be machined and still retains a high degree of non-corrodibility.

The addition of 0.25 and 0.5 per cent. of cobalt to a brass containing 80 per cent. of copper and 20 per cent. of zinc was found to increase the tensile strength by 15 and 20 per cent. respectively.

Light alloys of aluminium and cobalt usually contain from 9 to 12 per cent. of cobalt. The structure of these alloys is coarsely crystalline, and the tensile strength is little more than that of pure aluminium. The addition of 0.8 to 1.2 per cent. of tungsten, however, renders the structure fine, and increases the strength to two or three times that of aluminium. Such alloys have a specific gravity between 2.8 and 2.9; they work and polish well, and are very stable in air, Molybdenum has the same effect as tungsten.

An amalgam of cobalt with mercury is used in dentistry.

## THE CARBIC LIGHT.

Carbide is now largely used for underground lights and compared with most systems of lighting has many advantages. Among the disadvantages are (1) liability to overheating and (2) generation of undesirable gases. To overcome these defects the Carbic light has been devised and is now in use in many mines.

The carbide light is an excellent light for use by individual miners, but the system of generating the gas as used in these lamps is too dangerous for powerful lights. In the Carbic light the carbide is used in the form of cakes which have been chemically treated and compressed. They are said to be easily handled and perfectly safe and will not deteriorate if left in the open air for a length of time.

The Carbic cake gives a pure white, smokeless light, leaving the air pure to breathe. It can be used until every particle is consumed in the burning of the light, therefore there is absolutely no waste. The light is so constructed that over-generation is eliminated. The gas is generated as required, and when the burner is shut off the generation of gas ceases in the generating chamber.

The light is equipped with a patent burner, which is self-cleaning, adjustable to any candle power up to 2,000, made of solid hard brass and guaranteed to last indefinitely. In mechanical construction, complicated parts are avoided, thereby relieving the operator of any chance of costly blunders. It does not require a smooth surface for the light to stand on. The light is so constructed that it will stand on lumps of earth or rock and still be in an upright position.

## BUY A CERTIFICATE.

The new War Savings Certificates which have been created by the Government to encourage thrift and economy and to give everyone an opportunity to assist in financing our war expenditure, are now on sale at every bank and money order post office in Canada. The $25 certificate sells for $21.50, the $50 for $43, and the $100 for $86.

As an investment these certificates offer many attractive features—chief of which are the absolute security and the excellent interest return. For every $21.50 lent to the Government now, $25 will be returned at the end of three years.

There are two other features which are especially interesting to small investors. First, the certificates may be surrendered at any time, if the buyer should need his money; and second, each certificate is registered at Ottawa in the buyer's name and, if lost or stolen, is therefore valueless to anyone else.

But while they are excellent from an investment standpoint, the certificates should appeal strongly to Canadians because they offer to those who must serve at home a splendid opportunity for a most important patriotic service. The person who honestly saves to the extent of his ability and places his savings at the disposal of the Government by purchasing these certificates, may feel that he is having a direct share in feeding, equipping, and munitioning our Canadian soldiers, who are so nobly doing their part.

The Coast Copper Co., organized to acquire and operate a group of mineral claims situated in Quatsino mining division, Vancouver island, is reported from Trail, where the company has its head office, to be employing about 40 men in connection with the development of its copper property, which includes the Merry Widow and Old Sport groups, already partly developed by men connected with the Stewart Mining Co., of the Coeur d'Alene district of Idaho.

A report of progress at the Highland Mining and Development Co's mine and recently completed concentrator, in Ashcroft mining division, made several weeks ago by the president and manager of the company, Mr. Frederic Keffer, gives the information that five carloads of concentrate had been produced, and that a flotation concentration plant put in would soon be ready for operation. Three raises had been made from one of the adits to the surface and a fourth is being made.

# MINING OF ANTIMONY ORES IN CANADA*

By A. W. G. Wilson.

The principal source of the antimony obtained in Canada is the mineral stibnite, with which, in some localities, is associated native antimony. Pure stibnite contains 71.4 per cent. metallic antimony, and 28.6 per cent. sulphur. In past years metallic antimony has been recovered as a by-product from the lead refinery at Trail, being derived from antimonial lead ores of southern British Columbia.

Antimony ores, as mined in Canada, contain from 1 per cent. to 20 per cent. metallic antimony; but occasionally, small lots are secured in which the metallic content is greater. Native antimony has been reported from six Canadian localities, and stibnite from seventeen, of which eight are in British Columbia. It is probable that a revision of the list will include many additional localities, especially in British Columbia.

At the present time there are only five places, so far as I can ascertain at the date of writing, where mining has been carried on purposely to recover antimony ores. In two of these the product is auriferous or argentiferous, and is of value not only for the antimony, but also for the precious metal content. These localities are: West Gore, Hants County, Nova Scotia; Lake George, Prince William Parish, York County, New Brunswick; lot 56, range I, Township of South Ham, Wolfe County, Quebec; Bridge River District, British Columbia; and Wheaton River District, Yukon.

Antimonial lead ores have been produced from a number of mines in the Kootenay district of British Columbia. Similar ores are also reported from northern British Columbia, in the district of which Hazelton is the business centre. No antimony is being recovered from these ores at the present time.

### West Gore, Nova Scotia.

The mine at West Gore, Nova Scotia, now belongs to the West Gore Antimony Company, the principal stockholders of this company being closely associated with the ownership of the St. Helen's Smelting Company, of Manchester, England.

The first discovery of antimony ore in this locality was made during some road building operations many years ago. The first mining was done in 1884, the property being then known as the Rawdon mine. Operations were continued for a number of years, the production gradually diminishing until 1891 when it stopped altogether. The mine was re-opened in the autumn of 1898 and operated for a short time, closing again in the spring of 1900.

It was again re-opened in January, 1903, a new plant was installed, and mining operations and development was carried on vigorously for a number of years. In 1907 a concentrating mill with a capacity of 100 tons of ore per day was erected, but appears to have been operated only a short time. The mine was closed down early in 1908 owing to litigation.

The present owners of the West Gore property came into possession about six years ago, but operations were not resumed until October, 1914. Ore shipments were resumed in December, and since that date have been gradually increasing. The present rate of output is about 1,200 tons of ore per month, which is treated in the concentrating mill, the shipments being in the neighborhood of 110 tons per month of concentrates containing from 38 per cent. to 45 per cent. antimony. All concentrates are shipped to the St. Helen's smelter, Manchester, England.

These deposits occur within the Gold Bearing Series of Nova Scotia. The rock immediately associated with the ore bodies is a dark colored, soft, somewhat fissile slate. The ore bodies occur as fissure veins containing stibnite, native antimony, a little pyrite, and occasionally small coatings of the oxides of antimony, kermesite and valentinite with a little associated quartz and calcite. Three veins have been discovered in the locality. The most northern one—called the Messervey and McDougall property in the report of the Nova Scotia Department of Mines, 1899,—was worked only for a short time. The vein is stated to have averaged probably about 5 inches in width and to have shown considerable antimony associated with quartz and calcite. A shaft was sunk for a depth of 55 feet, following the vein which dips to the south at an angle of about 72 degrees.

The principal vein of the district, the one which has produced most of the ore, and on which work is now in progress, lies about 800 feet south of this. The general strike of the vein is about N. 46 deg. W. magnetic, and the dip towards the southeast is about 72 deg.

A third vein, apparently that referred to in the report for 1899 as the "Northup" lead, occurs about 1,200 feet farther southwest. In later reports this vein is known as the Brook vein. An exploratory shaft was started prior to 1899 and a small amount of ore was secured from a vein about 4 inches in width. This shaft was subsequently re-opened in 1907, and a little more work done, but there does not appear to have been any large recovery of ore from this vein.

The principal vein was first opened up by two shafts in 1884, and most of the ore recovered during the first period of operation of the mine appears to have been removed through these shafts. The depth of these shafts was about 175 feet. The ore body is reported to have varied between 4 in. and 18 in. in width.

When the mine was re-opened in 1903 a third shaft was started. In 1903, No. 1, the most eastern shaft, had a depth of 430 feet. No. 2, the middle shaft, was located about 160 feet west of No. 1, and had a depth of 240 feet. No. 3, located 112 feet west of No. 2, had a depth of 180 feet. The period of greatest development of the mine appears to have been between the years 1903 and 1908. The development at the end of September, 1907, is shown in the following table:

| | | Present length in feet. | |
|---|---|---|---|
| No of Level | Depth in feet | East | West |
| 1 | 113 | 122 | 160 |
| 2 | 228 | 44 | 160 |
| 3 | 318 | 182 | 432 |
| 4 | 410 | 342 | 763 |
| 5 | 492 | 290 | 179 |
| 6 | 586 | 18 | 269 |
| 7 | 662 | 57 | 447 |
| 8 | 769 | 124 | 200 |
| Shaft | 502 | | |
| Winze | 332 | | |

Levels Numbers 6, 7, and 8 are reached from the winze which lies 257 feet east of the shaft. The shaft

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now in use is vertical for the first 200 feet, and then slopes to the south at an angle of about 70 deg., following the inclination of the vein.

As previously noted the mine was closed down early in 1908 and little additional development work can have been done. Since it was re-opened in December, 1914, a certain amount of new development work has been under way, but the principal work has been the recovery of ore already developed. At the present time active mining is going on at a number of points on the four lower levels, and a small amount of ore is also being recovered from some of the old workings on the third level.

The main ore body varies in width from a minimum of almost nothing to a maximum width of about four feet. The greatest extent of any single ore vein along any one level appears to have been about 200 feet, though small veins of ore, presumably offshoots from the main vein, have been encountered on several levels. The depth to which the main ore shoot extends has not been determined. It has been found to pitch towards the east at an angle of approximately 50 degrees.

The ore, as mined, consists of stibnite and native antimony, associated with a little pyrite, quartz, calcite, and fragments of the country rock.

At the present time ore mined below the fifth level has to be raised in the winze east of the shaft and trammed up by hand to the main shaft. All the hoisting is done through this shaft in a skip of about one ton capacity.

The ore is delivered to a small bin near the top of the head frame, from which it is loaded into a car and trammed by hand across a trestle to the mill, which is located about 200 feet north of the main shaft-house.

The boiler room at the shaft house is equipped with three boilers, a 200 horse-power Barrow Combination, a 100 horse-power Babcock Wilcox, and a 50 horse-power Matheson. The first is used on the compressor, the third on the hoist, and the second is held in reserve. There are two compressors, a small 5 drill straight line Rand, and a Blaisdale duplex steam, compound air with a capacity of about 1,250 cubic feet per minute. The hoist is a Lidgerwood, 10 by 12 capable of hoisting from a depth of 1,100 feet.

The mill was designed and constructed by Mr. D. F. Haley, and was erected in 1907. A fairly complete description was published by the Nova Scotia Department of Mines in 1907, and a full description of the equipment and a flow sheet of the mill is given in that report. The present flow sheet is only slightly different from the original flow sheet as given in the publication quoted above. In general it may be stated that water concentration is used. The oversize ore is handpicked, and afterwards crushed. The crushed ore and the undersize from the first screening are successively crushed, sized, and concentrated in a series of jigs followed by Wilfley tables and Frue vanners. The mill is equipped with four jigs, five Wilfley tables, and three Frue vanners. Power is supplied by a 150 horse-power return tubular boiler, Truro Foundry Company, supplying steam to a 135 horse-power Wheelock engine, cylinder 15 in. by 34 in. The main water supply is obtained from an artificial pond formed by a dam thrown across the hollow of the creek bed in which the Brook shaft was located, some 1,200 feet west of the mill. It is pumped from this point to a 500,000 gallon water tank located about 400 feet south of the mill. Additional water is to be secured by another dam located north of the mill on another small creek. The principal machines employed in the mill are a Farrel rock-crusher, 10 in by 16 in., two Dodge crushers, 8 in. by 10 in. and 4 in. by 6 in. respectively, a Huntingdon mill, 5 ft. diam., a set of rolls, 20 in. by 15 in., and two elevators, one 60 ft. and one 40 ft. in length. The shipping products are hand-picked lump ore, Jig concentrates, Wilfley concentrates, and Frue slimes.

The ore is packed in barrels and shipped to the St. Helen's smelter, Manchester, England, belonging to the principal owners of the mine.

According to the returns published by the Nova Scotia Department of Mines the output of the mine is in the neighborhood of 1,200 tons of ore per month. This ore is concentrated in about the ratio of ten tons of ore for each ton of concentrates. The concentrates as shipped contain on the average, about 40 per cent. of metallic antimony, or perhaps a little more. It is stated that the ore also contains about one dollar's worth of gold for each per cent. of antimony in the original ore. The shipment of 1,403 tons of ore in 1907 is reported to have contained 1,319 ounces of gold. In 1906 the shipments of 782.5 tons of ore, hand-picked, yielded 1,031.6 ounces of gold. It is to be presumed that the present yield is at about the same rate. The yield per ton of concentrates shipped will presumably be somewhat higher, as mill concentrates were not included in the 1906 shipments, and appear to have formed only a very small part of the 1907 shipments.

At the present time the output of the mine is limited by two factors, the capacity of the shaft, and the water supply for the mill. At certain seasons of the year the water supply is limited, but it is expected that the new supply to be obtained from the new pond on the creek north of the mill will be sufficient for all requirements.

The country rock is fissile, and in the immediate shattered. On exposure to the wet mine air it exhibits a tendency to slough off. In development it is therefore necessary to timber the drifts.

In mining an overhead stoping system is employed. The ore chutes are located at about 25 ft. centres, and are timbered. The stopes are filled with waste rock obtained in following the vein, which is usually of a less width than the stope. The top of the filling is kept as close to the backs as possible, leaving only room to work. The ore is broken down upon the filling and partially sorted by hand from waste before being thrown down the ore chutes. From the ore chutes it is hand-trammed in ordinary steel mine cars of about one ton capacity to the shaft, where it is hoisted to the surface in a one ton skip.

(To be continued.)

## USES OF MOLYBDENUM.

The principal use of molybdenum is in the manufacture of alloy steels to which, particularly in conjunction with chromium, manganese, nickel, cobalt, tungsten, and vanadium, it imparts many desirable properties. These steels are used for a large variety of purposes such as for crank-shaft and propeller-shaft forgings, high-pressure boiler plate, guns of large bore, rifle barrels, armor plate, armor-piercing projectiles, permanent magnets, wire, and for self-hardening and high-speed machine tools.

## OBITUARY

W. T. McClurg, who died recently at Sandon, Slocan, B.C., was at one time cashier of the First National Bank, Spokane, Washington. In 1899 he went to Sandon, where he became accountant for the Minnesota Silver Co., which operated the Ivanhoe group of mines in the mountains above Sandon and a concentrating plant placed in the valley just below Sandon. Afterward he occupied a similar position in the office of the Slocan Star Mining Co. Later he was associated with Mr. R. T. Poff of Detroit, and Mr. W. T. Bennett, of Sandon, in operating the Mountain Con mine, also in the Slocan, from which were shipped several cars of silver ore of exceptionally high grade. His age was about 55 years.

A recent victim of pneumonia was Guy Stanley Davys, of Kaslo, B.C., an Associate of the Royal School of Mines, London, England. He had been engaged in assisting his father, Mr. M. S. Davys, formerly manager of the Silver King mine near Nelson, West Kootenay, in operating the magnetic separating and concentrating plant at Kaslo. Prior to Mr. Davys, Sen., undertaking the work of putting the Kaslo works into running order and adding concentrating plant, both father and son had been for several years engaged in concentrating ore from the Hewitt-Lorna Doone silver-zinc mine, near Silverton, Slocan lake, at the mill on Four-mile creek, in Silverton camp where much experimental work in flotation concentration was done. The deceased young man was born in Nelson, B.C., and was only 25 years of age when his untimely death occurred.

## COAL MINING AT NICOLA.

The three coal mines in the neighborhood of Merritt, Nicola Valley, now being operated are busy, and many more miners could be employed in the mines of the Middlesboro and Inland Coal and Coke companies if they could be secured, says the Merritt Herald. Shipment of coal is being increased steadily, and the amount of the monthly payroll is gradually approaching its 1914 total. In January the combined shipments of the three mines were about 15 cars of coal a day, about two-thirds of this quantity going to Boundary and Coast points and one-third to places along the Canadian Pacific Railway main line. The Diamond Vale mine has not yet become a heavy shipper, but good progress is being made with the work of preparing it for production, about 45 men being employed. The pumps are still unwatering the lower levels of the mine, and as soon as these shall be made ready for mining coal it will be possible to increase the output considerably. There are now more men on the mines' payrolls in the neighborhood of Merritt than at any previous time in the last two years. While the output of coal from the Middlesboro and Inland Coal and Coke companies' mines is larger than for many months past, it could easily be doubled if it were possible to obtain sufficient miners to meet present demands.

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The Multiplex company has made a small shipment of ore from its property in the neighborhood of Camborne, Lardeau mining division of West Kootenay, to the Consolidated Company's smelting works at Trail, for test purposes. It is stated that more than 100 tons of silver-lead-zinc ore has been hauled down from the Beatrice mine, also near Camborne, for shipment to Trail.

## THE EROSION OF GUNS.

New York. In an effort to increase the efficiency and life of guns constructed for the U. S. Government members of the Naval Consulting Board will, during the next two weeks, meet with the American Institute of Mining Engineers for discussion of an important phase of this subject. The meeting will be in connection with the 114th convention of the Institute to be held in New York during the week of February 19th, and officers of the Army and Navy, Government representatives and other experts will be in attendance.

The special subject to be discussed deals with the erosion of guns, or the hardening of the inner surface of the gun tube, a problem which is at present seriously engaging the attention of many of the country's leading scientists. The discussion will be opened with a paper by Dr. Henry Fay, of the Massachusetts Institute of Technology, which paper was prepared from a series of tests of metals made at the Watertown arsenal, and which is one of the technical papers at the forthcoming convention.

A committee of the Naval Consulting Board, headed by Dr. Hudson Maxim, will be present at the Mining Engineers' session and discuss the subject, after which the committee will hold a meeting with technical experts in the rooms of the American Institute of Mining Engineers.

The entire Naval Consulting Board has been invited to attend the meeting of the institute and in view of the great interest aroused in this subject, it is believed that the coming meeting will ran with any in the forty-six years of the Institute's history. About five hundred mining engineers from all parts of the country will attend.—Bradley Stoughton.

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Coal Age, New York, recently published the following item: Peace River, Alta.—Two coal mines in this neighborhood are being opened. One of these is situated on the Heart River, about two miles from the town of Peace River. The coal which is reported to be of good grade is expected to be immediately put on the market. The other mine is six miles down the Peace river and the coal is said to be of fine quality.

The Victoria, B.C. Daily Times said on January 17: When the Yukon company left Victoria yesterday, there was lost to the city a magnificent fighting unit, thoroughly trained, well officered, and in every respect a competent band of men. . . . The Yukoners are going to the Princess Patricias. Their commanding officer is Captain Black, chief official of the Dominion Government at Dawson, Yukon, under whose guidance the men have been recruited and trained. The homes of practically all the men are in the far northern country, and the majority of the men are hardened to the rigors of severe weather.

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## A LARGE MASS OF COPPER.

The Quincy Mining Co., has just completed the extraction of a mass of copper that will rival the largest ever secured in the Michigan district. The miners have been working on this mass for three months. It was over 78 feet long and varied in thickness from six inches to two and a half feet. Its width ran from three feet to 10. The mass was first struck at the 70th level of No. 2 shaft and not far from the lode. On the first of the year it was all taken out but ten tons which has since been extracted. The mass was cut into blocks and sent direct to the smelter.

# PERSONAL AND GENERAL

Mr. Frank Oliver is examining mineral deposits in North Carolina for New York interests.

Mr. Geo. R. Rogers is in the West Shiningtree district examining properties.

Mr. Geo. C. Mackenzie will address the Royal Canadian Institute in Toronto on Feb. 17, on mining and metallurgy of Canadian molybdenum ores.

Mr. W. A. Davidson, Mr. Walter F. McNeill and Mr. Norman C. Pitcher will represent Alberta on the Council of the Canadian Mining Institute for the coming year.

Mr. E. E. Campbell, Mr. Thomas Graham and Mr. Gomer P. Jones have been nominated to represent British Columbia on the Council of the Canadian Mining Institute.

Mr. O. T. Bibb is in charge of work on the Multiplex company's property in the neighborhood of Camborne, Lardeau district of British Columbia.

Mr. R. Randolph Bruce, of Wilmer, East Kootenay, left British Columbia for England early in January.

Mr. James Cronin, who has for several years been developing mineral claims situated in the Babine region, Omineca division of British Columbia, was in Victoria last month interviewing the Government relative to improving wagon road conditions so that ore may be hauled from the Babine-Bonanza Mining and Milling Co's mine to the Grand Trunk Pacific railway, for shipment thence to a smeltery.

Prof. J. C. Gwillim left Nelson, B.C., on his return to Ontario, after having been in British Columbia several months making investigations relative to occurrences of molybdenum and zinc, for the Dominion Government.

Mr. A. B. W. Hodges, of Los Angeles, California, for a number of years local manager in Boundary district of British Columbia, for the Granby Consolidated M. S. and P. Co., was in Victoria last month, on his way north to visit that company's Hidden Creek mine and smelting works at Anyox, Observatory inlet, B.C.

Mr. George Long, for years engaged in mining in Slocan City mining division, has been engaged by Mr. Clarence Cunningham, lessee of the Van-Roi silver lead mine, near Silverton, Slocan, B.C., to superintend mining work recently undertaken on that property.

Mr. Lucius W. Mayor, of New York, president and consulting engineer of the British Columbia Copper Co., and its holding company the Canada Copper Corporation was in the Boundary and Similkameen districts of British Columbia last month looking over the company's mining property and smelting works. He was accompanied from Greenwood, Boundary, to Copper mountain, Similkameen, by Mr. Oscar Lachmund, general manager in British Columbia for both companies.

Mr. J. W. D. Moodie, vice-president and general manager of the Britannia Mining and Smelting Co., returned to Britannia Beach, Vancouver mining division, B.C., late in January from a business trip to New York, the headquarters of the company.

Mr. Thomas Russell, for many years managing coal mines on Vancouver Island, B.C., and latterly superintendent of the Crow's Nest Pass Coal Co's colliery at Michel, Southeast Kootenay, has returned to his home in Vancouver, B.C., ill-health having necessitated his relinquishment of the arduous duties he had been performing at Michel.

Mr. E. L. Warburton, recently appointed to the charge of the Diamond Vale coal mine, in Nicola Valley, British Columbia, has accepted the position of superintendent for the Corbin Coal and Coke Co., operating in Southeast Kootenay, B.C., in succession to Mr. Chas. Graham, now superintendent of the Michel colliery, also in the Crow's Nest district.

Mr. Henry S. Fleming, of New York City, chairman of the executive committee of the Canadian Collieries (Dunsmuir) Limited, operating the Comox and Extension collieries on Vancouver island, B.C., arrived in Victoria from New York, on January 29.

Mr. W. H. Wayne recently examined the Mountain Chief mining property, near Renata, Arrow Lake, B.C., which has been bonded by Mr. G. S. McCarter, of Calgary, Alberta.

Mr. W. M. Brewer, of Victoria, B.C., was in the neighborhood of Agassiz last month investigating a mining property for the British Columbia Department of Mines.

Capt. C. A. Foster has resigned from the 228th Battalion and has been appointed to the aviation branch of the Imperial Munitions Board in charge of construction of flying schools in Canada. The first school is now under construction at Camp Borden and will be in operation April 1.

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### Industrial Research and Misinformation.

During the past few months there has been much progress made towards obtaining in Canada greater encouragement for scientific and industrial research. Unfortunately some of the enthusiastic supporters of the movement have not shown themselves to be well informed, and a lot of misinformation is being disseminated.

As we have previously pointed out the mining industry in Canada has taken a leading part in the application of science to industry. Those who are familiar with the work of such organizations as the Mines Branch at Ottawa and the Bureau of Mines at Toronto, and with the research work that is done by mining companies throughout the country will perhaps be surprised to learn that several organizations in Toronto, including the University, through its president, several bank managers, the board of trade and the Canadian Manufacturers' Association, have signed a petition in which it is clearly stated that up to the present there has been no industrial scientific research carried on in Canada with the exception of that done by a few manufacturers.

The reason for signing such a statement may be a good one; but it is an evidence of the fact that many interested men have been misinformed and do not yet realize it.

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### CORUNDUM MINING IN ONTARIO.

The Manufacturers Corundum Co., of Toronto, has resumed mining operations in Hastings County, Ontario. There has been little production in Ontario since the company's mill at Craighmont was burned in 1913. A new mill has been constructed at Jewellville and the deposits there are now being mined. Jewellville is the postoffice at Palmer's Rapids in Raglan Township.

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The Northwest Milling Association will hold a convention at Spokane, Washington, opening on February 19th and closing on 25th.

# SPECIAL CORRESPONDENCE

## BRITISH COLUMBIA.

Some of the newspapers published on Vancouver Island were at the end of January publishing divergent views concerning the position in Island coal mines in relation to the employment of alien enemies in the mines. A news despatch from Victoria stated "that acting upon information which he has received from several up-Island mining centres, to the effect that a number of Austrians and other alien enemies who had been interned in the Morrissey (Crownsnest district) camp and elsewhere, have lately been released and are now working in the mines of Vancouver Island, the Hon. Wm. Sloan, Minister of Mines, has instructed Mr. Thos. Graham, Chief Inspector of Mines, to make a thorough investigation into the matter. While realizing that both the interment and subsequent release of these men are in the hands primarily of the Dominion Government, the Minister of Mines is determined that as long, at least, as he controls the Provincial Department of Mines, this province shall not be made a dumping ground for alien enemies at the cost of depriving loyal subjects of the Empire of a means of livelihood. Under the Coal Mines Regulation Act, the Minister has full power to control the labor situation in the mines, and he is firmly resolved that any such practice as the sending of alien enemies from internment camps to work in mines must be abolished."

Of two newspapers published at Nanaimo, one, in the course of a long editorial says: "We hope that the action which the Hon. the Minister of Mines is taking in ordering his Chief Inspector to investigate the matter very thoroughly may have the desired effect of ridding Nanaimo of the alien incubus which at the present time is threatening to choke it. Such a riddance will, if it is accomplished, without doubt have the effect of temporarily reducing the output of the mines, but this, while no doubt it would be annoying to the American shareholders, who it must not be forgotten are also aliens, would be far more preferable in the long run and less inimicable to the true welfare of the city, than the present high rate of production, maintained by such thoroughly undesirable population." Dealing with another aspect of the question, this editorial concludes as follows: "A coal famine is pressing hardly upon the industries of many parts of Canada to-day, and yet the fuel that would make the continuance of those industries possible, is withheld from them and shipped by the thousands of tons to foreign parts. If the Dominion Government is really sincere in its campaign for national service and conservation, it should take steps to see that Canadian industries are adequately supplied with Canadian fuel before a ton of the latter is allowed to be exported."

The other Nanaimo newspaper, after remarking that it is unfortunate that with certain newspapers prejudice and not reason should be made the court of appeal says further: "There is one point on which there is general agreement. This is that there should be no employment in Canada for alien enemies. . . . We have tried to interest American capitalists in Canadian industries and vice versa. Whether we go to the other side or Americans come to this side, we are all under the law. It might suit some insular British prejudices to build a wall between Canada and the United States, but it certainly would not benefit Canada. For the rest there is nothing to be gained by misrepresenting the local situation. If there is such a thing as a coal famine pressing hardly upon Canadian industries it can hardly be located within striking distance of the Island mines. Such Canadian industries as came within the field of the Island mines got clear of coal famines for all time by putting in oil fuel burners. Then as to output—it is just as well to mix sense with your heroics. No true Canadian, with patriotic instincts, wants to see employment given to enemy aliens. At the same time he does not want any unreasonable interference with the operation of the mines. The better the mines work, and the bigger their output, the better it will be for this city and all in it. There may be something in the idea of conserving the local coal resources. If the town and those in it can stand for it, no doubt the operating company can. The Government would probably have little difficulty in making the deal, whatever happened to the rest of us. Meantime it may be said that during the regime of the Western Fuel Company, Nanaimo has been fairly prosperous. The company has paid better wages and given better conditions than its competitors even if they are British. And so far from exporting coal by the thousands of tons to foreign parts in the present crisis it has leased the ships it had chartered to help out the situation. For these reasons and perhaps because it has no German shareholders and has not thrown a few hundred Orientals into its mines, it is always first choice with a certain class of critics."

## WEST KOOTENAY.

Slocan.—The finding of new orebodies in several Slocan mines is reported. A new shoot of silver-lead ore has been found on the fifth level of the Rambler-Cariboo mine, and ore containing zinc has been opened on the thirteenth level. Another body of ore has been entered in the lowest level of the Galena Farm mine near Silverton. On the 100 ft. level in this mine there was ore in the drift for about 300 ft.; it ranged in width up to 22 ft., and averaged between 8 and 9 feet.

Nelson.—On the Celebration group, La France Creek which is on the eastern side of Kootenay lake, silver-lead ore 18 inches in width has been found at a depth of 50 ft. At the Granite-Poorman group of mines, the cross-cut being driven to open the Hardscrabble vein at 100 ft. greater depth is thought to be nearing the vein, which in the shaft sunk on that claim nearly two years ago well maintained its width, and the gold value in its ore down to a depth of more than 100 ft.

Rossland.—Shipment to Trail of ore from Rossland mines is being continued but the outlook is not promising at present owing to the stoppage of coke shipments to the smeltery from Crowsnest collieries. The report of the Le Roi No. 2, Limited, for November shows that its Josie mine shipped 1,505 tons of ore. Receipts were 19,863 and all expenditures totalled $8,350.

## OMINECA AND SKEENA.

The Omineca Herald states that at the Rocher Deboule copper mine, the adit at about 2,000 ft. from its portal entered a vein, known as the middle, or No. 3 vein, which had previously been uncovered at the surface. Where cut by the adit the vein is strong, but there is only a little ore there and that of a milling grade. Drifting on the vein will be undertaken in February. Good progress is being made in raising on No. 2 vein.

## COBALT AND PORCUPINE

### Beaver.

A development of more than ordinary significance to the Cobalt Camp as a whole has taken place during the past couple of weeks in the discovery of a series of veins on the Beaver property at a depth of 1,600 ft., the greatest depth at which mining operations have been carried on in the camp.

In driving a crosscut from the Beaver to the Temiskaming, who are also sinking a shaft to the same depth, an eight inch vein of high grade silver, containing approximately 2,000 ounces to the ton was encountered, and the wall rock for three or four feet on each side of the vein contains excellent values in high grade milling ore.

It is said that since the discovery of this vein two weeks ago three small stringers have also been encountered, which leads to the conclusion that there is a series of these veins.

When it is realized that after cutting through the thousand foot diabase sill on the Beaver the same zone as exists in the Cobalt camp on the surface near Cobalt Lake is encountered, the importance of the new development to the Beaver will be readily seen. The company is actively pushing development work on the new finds and much interest is evinced in the work, which is considered to be the commencement of a new era in mining in the southern portion of the camp, where the success of the Beaver will no doubt lead to the opening up of other properties.

### Customs Mill for Kirkland Lake.

It is unofficially stated here that the Dominion Reduction Company will enter the Kirkland Lake field in the near future and erect a customs mill for the treatment of gold ores. This move will be welcomed by a number of the properties in the district, as it would assist them to become producers quicker than would otherwise be possible.

Among the properties that are at present developing and will soon be in need of milling facilities might be mentioned the Kirkland Lake, Lake Shore, Wright-Hargraves, Sylvanite, Orr, and Hunton.

When it was announced that the Dominion Reduction would enter the Kirkland Lake camp, it was also rumored that the Lake Shore mine would cancel their order for a mill. The natural location for a mill would be in close proximity to this property, hence the opportunity of foregoing the installation of a mill was said to be welcomed by the company.

Mr. Eugene Steindler, president of the Dominion Reduction is in New York at the present time, where he is understood to be formulating plans for the early commencement of the work.

Two mines in this district have already installed mills; the Tough-Oakes, which has been in operation for a number of years and is the pioneer mine of the district, and the Teck-Hughes.

It is a good commendation of the future of the Kirkland Lake camp that the Northern Ontario Light & Power Company is expending the sum of $300,000 in constructing the power line to the camp, a distance of sixty-five miles. Owing to the prevailing war conditions this company has had to deal with many handicaps in the way of slow delivery of plant and equipment, however it will only be a short time now until everything is working smoothly, and Kirkland Lake should soon forge ahead as one of the great mining camps of the North.

### Crown Reserve.

The discovery of a four inch vein of high grade is reported at the Crown Reserve mine. This will come as a surprise to the shareholders, who were informed at the annual meeting of the company in Montreal recently that the outlook for this property was very poor and that unless new orebodies were discovered it was only a matter of a short time until they would have to discontinue operations. The new find is on the 700-foot level, and with the excellent results being obtained at depth on the Beaver it is expected that the Crown Reserve will push development as rapidly as possible. It would not be surprising if they opened up a large body of paying ore at this new working.

### Ophir.

So far nothing of great importance has been encountered in the work being done at the Ophir property which is being worked from the shaft on the People's Mining Company's property. Drifting is being continued on a strong calcite vein but up to the time of writing commercial values have not been encountered.

### National Mines.

The National Mines, Cobalt, (formerly the King Edward) is crosscutting to the contact at the 1,000 foot level of the mine, in the hope of encountering a strong silver vein which is running in the direction of their property from the O'Brien mine, at a slope which if it continues to the King Edward should be encountered at this depth on the National property. The company has recently installed a small oil flotation plant and will treat the ore and tailings from the dump. This can be accomplished with a very fair margin of profit.

### Flotation at Coniagas.

The Callow oil flotation process was put in operation at the Coniagas mine on Monday night of this week, and marks another step forward in the career of this famous mine.

The Coniagas is at present treating from 250 to 300 tons of ore daily in the 60-stamp mill and will be able to handle an additional one hundred and fifty tons of tailings from the huge sand pile which has accumulated on the property and is said to contain an average of five ounces of silver to the ton.

By the new oil process it will be possible to recover approximately three ounces of silver from these tailings. This, at the present price of the metal will net the company around $9,000 per month, and will lengthen the life of the mine considerably.

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### SILVER PRICES.

| | New York, cents. | London, pence. |
|---|---|---|
| January 20 | 76⅝ | 37¼ |
| " 22 | 76⅛ | 37 |
| " 23 | 76½ | 37 3/16 |
| " 24 | 76½ | 37 3/16 |
| " 25 | 76½ | 37 3/16 |
| " 26 | 77 | 37 7/16 |
| " 27 | 76⅝ | 37¼ |
| " 29 | 76⅝ | 37¼ |
| " 30 | 76¾ | 37 5/16 |
| " 31 | 76¾ | 37 5/16 |
| February 1 | 76¾ | 37 5/16 |
| " 2 | 76¾ | 37 5/16 |
| " 3 | 76¾ | 37 5/16 |
| " 5 | 76⅞ | 37⅜ |

# MARKETS

## TORONTO MARKETS.

Cobalt oxide, black, $1.05 per lb.
Cobalt oxide, grey, $1.15 per lb.
Cobalt metal, $1.25 to $1.50 per lb.
Cobalt anodes, $1.50 to $1.75 per lb.
Nickel metal, 45 to 50 cents per lb.
White arsenic, 5½ to 6 cents per lb.

Feb. 9, 1917—(Quotations from Canada Metal Co., Toronto)—
Spelter, 13½ cents per lb.
Lead, 11 cents per lb.
Tin, 60 cents per lb.
Antimony, 32 cents per lb.
Copper, casting, 35½ cents per lb.
Electrolytic, 36½ cents per lb.
Ingot brass, yellow, 23 cents; red, 24½ cents per lb.

Feb. 9—(Quotations from Elias Rogers Co., Toronto)—
Coal, anthracite, $9.50 per ton.
Coal, bituminous, nominal, $10 to $14 per ton.

## NEW YORK MARKETS.

Straits Tin, spot, nominal
Copper—
Prime Lake, nominal.
Electrolytic, nominal.
Casting, nominal.
Lead, Trust price, 8.00 cents.
Lead, outside, nominal.
Spelter, prompt western shipment, nominal, 9.92½ cents.
Antimony—Chinese and Japanese, nominal, 25.00 cents.
Aluminum—nominal—
No. 1 Virgin, 98-99 per cent., 57.00 to 59.00 cents.
Pure, 98-99 per cent. remelt., 51.00 to 53.00 cents.
No. 12 alloy remelt, 37.00 to 39.00 cents.
Powdered aluminum, 85.00 to 90.00 cents.
Metallic magnesium—99 per cent. plus, $3.00 to $3.50.
Nickel—shot and ingot, 45.00 cents.
Electrolytic, 50.00 cents.
Cadmium, nominal, $1.45 to $1.50.
Quicksilver, $90.00.
Platinum—
Pure, $100.00.
10 per cent. Iridium, $105.00.
Cobalt (metallic), $1.50.
Tungsten ore per unit, $17.00 to $17.50.
Silver (official), 76¾ cents.

Metal Products—Following quotations represent mill prices and are strictly nominal except in the case of lead sheets and sheet zinc:
Sheet Copper—
Hot rolled, 42.00 cents.
Cold rolled, 43.00 cents.
Copper bottoms, 50.00 cents.
Copper in rods (round), 41.00 cents.
Square and rectangular, 42.00 cents.
Copper wire, nominal, 38.75 to 39.75 cents.
Copper wire, May, June, 37.00 cents.
High brass—
Sheets, 39.00 to 40.00 cents.
Wire and light rods, 40.00 cents.
Heavy rods, 38.00 to 39.00 cents.
Low Brass—sheet wire and rods, 42.00 cents.
Tubing—
Brazed bronze, 51.00 to 52.00 cents.
Brazed brass, 48.00 to 49.00 cents.
Seamless copper, 45.00 to 46.00 cents.
Seamless brass, 43.00 to 45.00 cents.
Seamless bronze, 52.00 cents.
Full lead sheets, 9.25 cents.
Cut lead sheets, 9.50 cents.
Sheet zinc, f.o.b. smelter, 21.00 cents.

## STOCK QUOTATIONS.

(By courtesy of J. P. Bickell & Co., Toronto.)

As of close February 8th, 1917.

### New York Curb.

| | Bid. | Asked. |
|---|---|---|
| Boston and Montana | .62 | .65 |
| Canada Copper | 1.50 | 1.62 |
| Dome Extension | .30 | .31 |
| Hargraves | .19 | .20 |
| International Petroleum | 11.37 | 11.62 |
| Kerr Lake | 4.62 | 4.87 |
| La Rose Con. | .50 | .56 |
| McIntyre | 1.87 | 1.93 |
| North Amer. Pulp & Paper | 6.50 | 7.25 |
| Nipissing | 7.62 | 7.87 |
| Temiskaming | .57 | .59 |
| Thompson-Krist | .22 | .25 |
| Tommy Burns | .30 | .35 |
| Vipond | .52 | .56 |
| Victoria Oil | 1.31 | 1.37 |

(Standard Exchange, Toronto)

### Porcupine Stocks.

| | Bid. | Asked. |
|---|---|---|
| Apex | .11 | .11½ |
| Davidson | .77 | .78 |
| Dome Extension | .30½ | .31 |
| Dome Lake | .30 | .33 |
| Dome Mines | 20.75 | ... |
| Gold Reef | ... | .04 |
| Hollinger Con. | 6.50 | 6.55 |
| McIntyre | 1.85 | 1.87 |
| Moneta | .14 | .15 |
| Porcupine Crown | .67 | .69 |
| Porcupine Imperial | .03½ | .04 |
| Porcupine Tisdale | .03½ | .04 |
| Vipond | .51½ | .52 |
| Preston East Dome | .06¼ | .06½ |
| Schumacher | .69 | .70 |
| Teck Hughes | .70 | .73 |
| West Dome | .30 | .30½ |
| Boston Creek Mines | 1.14 | 1.15 |
| Vacuum Gas and Oil | .35½ | .42 |
| Thompson Krist | .20 | .23 |

### Cobalt Stocks.

| | Bid. | Asked. |
|---|---|---|
| Bailey | .06 | .06½ |
| Beaver Con. | .45 | .45½ |
| Chambers Ferland | .15 | .16 |
| Coniagas | 4.15 | ... |
| Crown Reserve | ... | .38 |
| Hudson Bay | ... | 55.00 |
| Kerr Lake | 4.85 | ... |
| La Rose | .50 | .52 |
| McKinley Dar. Sav. | .50 | .52 |
| Nipissing | 7.70 | 7.85 |
| Peterson Lake | .10½ | .11 |
| Right of Way | .04½ | .05 |
| Temiskaming | .57½ | .58½ |
| Trethewey | .15 | .17 |
| Wettlaufer | .07¼ | .08 |