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TWENTY-FOURTH YEAR OF PUBLICATION

The Canadian Mining Review

Established 1882

Vol. XXVII—No. 6. MONTREAL, DECEMBER, 1906. Published monthly. Two volumes a year.

DOMINION OF CANADA

SYNOPSIS OF CANADIAN NORTH-WEST MINING REGULATIONS.

COAL—Coal lands may be purchased at $10 per acre for soft coal and $20 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at the rate of 10 cents per ton of 2,000 pounds shall be collected on the gross output.

A person 18 years of age or over having discovered mineral in place, may locate a claim 1,500 feet x 1,500 feet.

The fee for recording a claim is $5.

At least $100 must be expended on the claim each year, or paid to the mining recorder in lieu thereof. When $500 has been expended or paid, the locator may, upon having a survey, made, and upon complying with other requirements, purchase the land at $1 an acre.

The patent provides for the payment of a royalty of 2½ per cent. on the sales.

Placer mining claims generally are 100 feet square ; entry fee $5, renewable yearly.

A free miner may obtain two leases to dredge for gold of five miles each for a term of twenty years, renewable at the discretion of the Minister of the Interior.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles. Rental $10 per annum for each mile of river leased. Royalty at the rate of 2½ per cent. collected on the output after it exceeds $10,000.

W. W. CORY,

Deputy of the Minister of the Interior.

Directory of Mining Engineers, Chemists, Assayers, Etc.

24th YEAR OF PUBLICATION

The CANADIAN MINING REVIEW

Established 1882

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CONTENTS.

Copper stocks decreased 236 tons during the first fortnight of November, but the visible supply increased 489 tons. The visible supply, according to Jas. Lewis & Sons' mid-monthly report, was 13,468 tons. This is larger than it has been at any time since the first of January, 1905. The price in that time has risen for Standard from £68 12s. 6d. to £100 15s., and the best selected ingots from £72 15s. to £106, the price per unit has, therefore, increased from £0 12s. 7½d. to £0 19s.

A company with the title The Mines Publishing Company, Limited, through its general manager, J. H. Harpell, has, we understand, represented that the said Mines Publishing Company, had purchased or was about to purchase, the stock of the Review Publishing Company, Limited. Such a statement, if made, was false. The Review Publishing Company has not sold its stock, nor has it entered into any arrangement with the Mines Publishing Company, and we trust our friends will promptly inform us of any attempts to convey such impressions.

As we go to press the breach is still wide between the Dominion Iron and Steel Company and the Dominion Coal Company. It is believed, however, by those who are in a position to know most of what is going on, that the Honorable Mr. Fielding is interesting himself in bringing about an amicable arrangement between these powerful corporations. That their differences may be soon adjusted, is, we are sure, the earnest desire of all those who wish to see the mining and metallurgical industries of the Dominion enjoy the prosperity that seems within their grasp.

What is a mining engineer? This question has been agitating our esteemed contemporary the Mining and Scientific Press, of San Francisco; the editor has finally decided that, though a man may graduate from an engineering college, the passing of his examinations does not make him an engineer. Emphatically, he must do things, he must have put his training into practice. The obvious duties of a min-

ing engineer are to superintend operations, plan the work of a mine, to choose, to erect, to supply machinery, to sample and examine properties in order to appraise them, and, finally, to make a mine out of a hole in the ground. The last qualification seems to us an almost insurmountable barrier in the case of the ordinary man. There are numberless holes in the ground, especially up Cobalt way, but the man who can turn some of them into mines, has not yet been born.

WHERE WILL IT END?

Amidst the unrivaled prosperity of the present moment far-sighted men think they see a danger ahead; a danger that will require common sense, firmness and honesty to ward off. We refer to the *increasing inclination of the laboring man to strike.* Our railways have already suffered heavily, and, now, the mining industry is getting its share of trouble. In such widely scattered provinces as British Columbia and Nova Scotia we find the walking delegate making trouble. Men who were well paid and well treated grew restive under his sinister influence, and in trying to hurt their employers, hurt themselves in a far greater measure. There is some satisfaction in this; yet it is poor consolation when we reflect that gigantic industries may be throttled by such ill-advised rebellion against employers.

Two classes of labor are especially prone to go out on strike: the overpaid and the underpaid. A man, who, owing to the scarcity of labor, is getting a wage that would seem fabulous in many parts of the world, grows fat and kicks—the underpaid man, on the other hand, may be almost forced to strike, if the conditions under which he exists become so hard that he can barely earn bread for himself and those dependent upon him. But of this class we have none working in Canadian mines. The big strike at Fernie is over. General Manager Lindsay's position was completely vindicated. Thomas Burke, the National Board Member, was forced to acknowledge that the strike was a mistake, so the men went back to work and for the present there is peace in the Pass. But what guarantee have we that this happy state of affairs will be allowed to last? Capital is proverbially timid, and if we once acquire the strike habit it will hold Canada back, and her progress, notwithstanding her great natural resources, must, inevitably, be slower than we have a right to expect. It is imperative that every manager of mines, smelting works, or other large and important industry, use good judgment in handling his men and do the best that in him lies to ward off trouble. Then, if the men will persist in striking, our legislators will have to consider what relief may be given by enactment. Law is the expression of the will of the people—and the will and desire of the Canadian people is that there shall be peace and goodwill between the man who plans and the man who toils.

THE NEW TARIFF.

The changes in the new tariff that affect the mining industry, have been officially given out as follows:—

Changes have been made in the mining machinery items in the free list. There are a number of articles which are now made in Canada which are transferred from the free list. The following articles, under the head of mining machinery, are dropped from the free list, and will become dutiable as "machinery" or as "manufactures of iron or steel," as the case may be:—Coal washing machinery, coke making machinery, charcoal making machinery, ore drying machinery, ore roasting machinery, ball and rock emery grinding machinery, jigs, classifiers, separators, blast furnaces, water jackets, monitors, and giants. All of these articles are now being made in Canada. We drop them from the free list. There have been added to the free list the following:—Parts of miner's safety lamps and accessories for cleaning, filling and testing such lamps, blast furnaces for the melting of *copper and nickel; integral parts of all machinery specified* in the item, the diameter of the tubing covered by the item has been increased from 2½ to 4 inches.

Now, here is one of the few cases where we make an exception as to the importation of articles for the use of the Government or of other Governments. The following articles and materials when imported by manufacturers of automatic gas buoys and automatic gas beacons, for use in the manufacture of such buoys and beacons for the Government of Canada or for export under regulations prescribed by the Minister of Customs, namely:

Iron or steel tubes over 16 inches in diameter; flanged and dished steel heads made from boiler plate, over five feet in diameter; hardened steel balls not less than three inches in diameter; acetylene gas lanterns and parts thereof; these things are made free of duty for this purpose. They could now be imported free by the Government, but we are abolishing the general item, while we reserve this for two reasons: It is not only for our Government, but for export. These are articles which are made for governments and for governments only. They are made by an extensive establishment in Ottawa, an establishment which we have reason to believe will grow very large indeed. It may be said that they do not get these articles free, that if it is for the export trade, they could get a drawback. But this is a business which would have to be carried on on a very large scale, and it is represented to us that if they had to pay their duties they would have such a vast amount of material in stock at the one time that they would have to deposit with the Government several hundreds of thousands of dollars, and keep it there all the time, the articles being very costly and taking a long time to produce, and the operations of *the company being on a very large scale.* If there was any danger of difficulties arising from this we would not make these articles free, but if these articles are to be made for our Government, or for foreign governments, and if there is proper supervision, we see no reason why they should not be allowed to import the articles free rather than have them pay the duties and then get a refund. There is every indication that this is going to be a very large industry indeed, and one that the whole country is interested in. It is claimed that on existing contracts the company will spend no less than $800,000 for labor in Canada in the next two years.

Blast furnace slag trucks, of a class or kind not made in Canada, are placed on the free list.

A NEW DEPARTURE.

The Geological Survey have lately published Volume XV of the New Series initiated by that department in 1885. Perhaps this volume, more than any of the preceding fourteen, points the moral we

have long maintained, that the binding together a certain set of reports that have no relation whatever to each other, is a scheme that is almost as clumsy as it is unpractical. It has always been a rule of the Survey that the Summary and the Statistical Reports shall form part of the annual volume. This may have been an excellent rule so long as the Summary remained what its name implies—a summary. Year by year, however, the Summary Report became longer and yet longer; a humble seventy pages in 1885 expanded to nearly 500 pages in 1902, and the contained reports left nothing—or at least very little—of practical interest to be added. The same may be said of the statistical reports. This series, which was commenced in 1886, reviews, in a concise and well-arranged manner, the mineral production of the Dominion for the past year. In the first report eighty-six pages were found sufficient in which to include all the required information. With the growth of the mineral industry the report naturally expanded, and of late years has generally run to over 200 pages.

It soon became evident that, a volume of more than 1,000 pages being too bulky for every day use, very little space would be left for other matter after the needs of the Summary and the Statistical Report had been provided for. This is ridiculously apparent in Volume XV, which, although a bulky tome of over eleven hundred pages, only contains one small report (a paper on the Souris coal field) in addition to the summaries for 1902-3 and the Statistical Report.

It is, therefore, with a good deal of satisfaction that we learn that Director Low has decided after the issue of Volume XVI, now in press, to abandon the issue of any further volumes. For, apart from what we have already said, there has always been a very strong reason for objection to these volumes. They have invariably appeared, not weeks or months, but years after they were of most practical use. The Survey Report for 1902, for instance, is published in 1906, a state of affairs creditable neither to the Geological Survey nor the Printing Bureau, though to whom the blame should be apportioned it is, of course, impossible for outsiders to say.

We congratulate the Director on his decision to abandon this cumbersome and belated series, and we look forward to the prompt issue of future reports just as soon as they can be prepared by the officer on his return from the field.

FRANKLIN CAMP, B.C.

In 1900 Mr. R. W. Brock, of the Geological Survey, whose name is so well known in connection with the geology and mining industries of the Kootenay district, made an examination of the Franklin camp, B.C., situated up the north fork of the Kettle River, about forty-five miles by railway from Grand Forks. After describing the gold-bearing rocks of the district Mr. Brock gave particulars of the more promising claims, especially the Banner and the McKinley, and spoke encouragingly of the prospects and possibilities. At the time of Mr. Brock's visit the camp was considerably hampered by two difficulties—first, that of transportation, being three days from Grand Forks, and, second, that bug-bear, which is so often the reason of delay in development in mining camps, namely, the ridiculous prices put on their claims by prospectors, who seem to think that because a lode happens to contain a valuable mineral it necessarily contains it in paying quantity.

Mr. Brock has lately returned from a visit to this camp and his views on it will shortly be included in the Summary Report of the Geological Survey whose Director has, we understand, decided to bring the report out as soon as possible after the return of the field officers, instead of publishing it in June or July of the following year, when it has lost half its value. Meanwhile we learn that Mr. Brock is very well satisfied with the progress that has been made in the camp during the last five years. The McKinley, which has probably had $30,000 expended on it, and the Banner are still two of the principal mines and are under development by a company, while the Gloucester, which at the time of Mr. Brock's visit was only down fifteen feet, has been taken over under bond by the Dominion Copper Company.

In general the ores carry only a small value in gold, although the Gloucester ore is reported to carry nearly $6, a proportion sufficiently large to be treated as a by-product if there are no chemical difficulties.

Several small companies are doing a little work on the Maple Leaf and other groups, and a number of prospectors are busy on their claims.

The two above mentioned initial difficulties have disappeared or at least are disappearing. The camp can now be reached in a day from Grand Forks and a railway is being constructed from that place, which will naturally considerably reduce mining expenses.

Moreover, the prospectors have brought their ideas of prices and values down to a business basis, and have realized that the mine purchaser of to-day wants something more for his money than a hole in the ground.

Mr. Brock sums up his views of the camp in the following words: "While none of the claims are yet past the prospect stage (though the McKinley is developing satisfactorily), and none have been proved to any considerable depth, the camp possesses some of the ear-marks of a mineral-bearing district. Additional discoveries are extremely probable, and there seems to be a reasonable prospect of something in the camp developing into a mine."

A TOPOGRAPHICAL SURVEY.

We hear much and we read much of the enormous strides made by this Dominion during the past

decade, yet in one very important matter progress seems to have been almost at a standstill. We refer to the fact that there is not now—and there seems very little chance of being in the near future—an accurate topographical map of this northern portion of the American continent. Maps there are in plenty of a sort, but of the sparsely inhabited or semi-explored regions, which, after all, comprise ninety-five per cent. of this Dominion, maps with any pretence to accuracy are few and far between.

It may, indeed, be said that beyond some lately made contour maps of the Rocky Mountains, the only maps worth having of the less known regions of Canada are those issued by the Geological Survey. It is not, however, the duty of that department to map the topography of the country, and the natural result is that, though the Survey's maps satisfy the miner, prospector and scientist, they are of little practical good to the lumberman and settler.

This absence of reliable topographic mapping is all the more incongruous when we remember that there is a plenitude of mapping departments that would seem to guarantee, not a dearth but an excess of such information. The Department of Agriculture issues maps, the Post Office issues maps, the Dominion Land Branch issues maps, the Astronomical Branch, the Boundary Surveys, the Department of Marine and Fisheries, the Department of Militia and Defence, the Department of Indian Affairs—all, from time to time, issue maps; and yet remains the bald result—the topography of Canada is as yet unmapped.

For many years a cry has gone up from the Survey officers—but it has often literally been a cry in the wilderness—that they have had to employ fifty per cent. of their field time in mapping the topographical features before they could attack the geological. This is manifestly unfair to the field officer and is bad business for the Dominion, for it is always bad business to pay a special salary for ordinary work. Any one with average intelligence can aspire to be a topographer, a first-class geologist can only be rightly so-called when he has had a special training, both in science and the art of observation.

Since 1883, when a committee of the House recommended that a topographical survey of Canada be undertaken, the Royal Society of Canada, the Canadian Society of Civil Engineers, the Canadian Mining Institute and many other bodies of scientific men who appreciated the need of such work have moved in the matter. What is required are maps showing accurately the surface features of the country, which would not only be of great value for depicting upon them the geology, mineral wealth, forests and other natural resources, but would also be very useful in ordinary commercial enterprises by showing accurately the distances between various places, the nature of the intervening country, the catchment or drainage basins of streams, the location and size of water-powers, the grade between points where railways, canals, drainage and irrigation works are contemplated and many other purposes. With such a map many of the preliminary surveys for railways and canals now made by the government and by private companies, often at great cost, would be unnecessary, and a saving annually of large sums would be made in these undertakings.

The present methods of producing maps are costly and not up to a sufficiently high standard, while an amount of duplication is entailed that would never be allowed in any but a government undertaking.

THE GEOLOGICAL SURVEY.

Each succeeding exploration in the northern part of Western Canada serves to extend our estimate of the area of cultivable lands in that region and to curtail correspondingly the inhospitable wastes looked upon in the past as too cold for settlement by Europeans.

Mr. William McInnes of the Geological Survey, who has just returned from a geological exploration of a tract of country lying to the north of the Lower Saskatchewan, between that river and the valley of the Upper Churchill, speaks highly of the agricultural capabilities of a large area of wooded country lying between N. lat. 54° 30′ and 56°.

This country is essentially a rolling clay-covered plateau 700 to 900 feet above the sea, the valleys of its streams and lakes lying generally but little over a hundred feet below its uplands.

The clay mantle, a hundred feet or more deep in the eastern portion and gradually thinning out westwards, is the result of sedimentation over the bottom of an ancient glacial lake that has been named Lake Agassiz, once covering all the lower parts of Manitoba, including the fertile valley of the Red River nearly to its head, but now represented only by the basins of Winnipeg, Manitoba, Winnipegosis and other smaller lakes. The waters feeding this ancient lake, passing out from the face of the glacier, were heavily charged with rock flow that, in the quiet waters of the lake, quickly settled to the bottom to form the deposits referred to.

Careful records of temperature made during the summer show that the region is by no means so cold as is commonly supposed. With the exception of one night in August, when the thermometer fell just below freezing point, there was no frost from the middle of June, when the records were begun, until the 29th of September.

Throughout the whole northern part of the area the Indians grow potatoes with good success, and to any one familiar with the Indian this means that they are grown, to say the least, without much trouble. Some of the most northerly Indian fields were visited on July 13th, when the potato vines were eleven inches high and about ready to blossom.

George Cowan, a trapper long settled in the neighborhood, was harvesting in September a large crop of potatoes of exceptional size, quite like the exhibits one sees occasionally at county fairs, and his garden contained all the common vegetables.

In latitude 54°, where the Hudson Bay Railway, now under construction, crosses the Saskatchewan River, Indian corn was quite ready for table use, with large and full ears, on September 5th, and, as there was no frost until the 29th had ample time to ripen.

The more southerly section of this district bordering the Saskatchewan and extending for about seventy miles to the northeast, is underlain by flat magnesian limestones of Silurian and Cambro-Silurian age, and, owing to the thin soil cover on the uplands, offers only limited areas along the river valleys that are adapted for cultivation. There are a few good forests of white spruce and much larger areas that would furnish good material for pulpwood. Many of the limestones are well suited for building purposes, breaking readily into blocks of very even thickness.

Belts of Huronian age, underlying the limestones and coming to the surface beyond its northern edge, are characterized by many of the rocks found in that mineral-bearing series in the east. Traces of copper were noticed in these rocks.

The larger lakes of the district are well stocked with whitefish, lake trout, doré and pike, and sturgeon occur in some of them. One of the large fishing companies, in anticipation of the advent of the railway, has already put in a plant on some of the lakes.

The region is a good one for large game, particularly for moose, which are abundant and little disturbed, as the Indians visit the interior only on their winter hunts, living almost continuously on their reserves during the summer. Work on the railway south of the Pass was being pushed forward with all the speed that the scarcity of labor would permit, and location parties, who expected to be out all winter, started from the Saskatchewan to locate through to the Churchill.

THE WESTERN COAL INDUSTRY.

If the development of the coal industry is to be taken as indicative of the prosperity and development of a region, then Western Canada is making almost unprecedented strides. Mr. T. C. Denis, of the Geological Survey, has just returned from a visit through the principal western coal fields of the mainland, and he reports that everywhere coal mining is going ahead at a tremendous rate. It is only a very few years since the only coal mines worthy of the name operating in Alberta were the Lethbridge and the Canmore mines. These have expanded into large enterprises, and many other similar ventures have since achieved success. There are now in the provinces of Alberta and Saskatchewan over twenty well established and well equipped collieries, besides countless smaller mines which are worked spasmodically to supply local wants.

Figures speak louder than words. The records kept by the Mines Section of the Geological Survey show that in 1887 the coal production of the then Northwest Territories was for that year 74,152 tons, valued at $157,577. In 1905 the figures for Alberta and Saskatchewan had attained over 1,000,000 tons, representing a value of over $2,000,000. In other words, in eighteen years the production had increased about fourteen-fold.

But even at a very greatly increased rate of production, the question of exhaustion of the fossil fuel is yet in a future exceedingly remote, for it has been calculated that the coal-bearing region of the great plain provinces, between the international boundary and the 56th parallel of latitude, has an area of over 65,000 square miles.

In this vast expanse of country all the different grades of coal are represented—from a lignite, containing 14 per cent. moisture, 36 volatile matter and 44 per cent. fixed carbon, to an anthracite with as much as 90 per cent. fixed carbon. This variety of coal allows of each industry to be suited to a nicety according to its requirements, and coals of superior quality may be found for steam-raising, blacksmithing, coke manufacture and domestic use.

One of the features of the coal industry of Alberta in 1906 has been the inauguration of new methods of mining in the Edmonton region. Heretofore the coal for the use of the district was mined by means of tunnels driven on the coal seams which outcrops on the steep and high banks of the Saskatchewan; this coal was then shipped by means of scows. But with the growth of the region these means were thought inadequate, and within the last three months three shafts have been sunk, the deepest to 200 feet, which will greatly facilitate the extraction, and the coal production is now ready to keep apace with the growth of the region expected by the most sanguine Edmontonian. The product of the mines of this district is a lignitic coal well adapted to domestic uses.

At Bankhead, near Banff, the Pacific Coal Company is mining anthracite. The preparation of this coal for the market is attended with the production of a very large proportion of coal dust. After a long series of experiments as to the best means of utilizing this dust, the coal company is at present erecting a very complete and up-to-date briquetting plant, and it is expected that within a few months an excellent fuel, new to Canada, will be placed on the market in the form of "anthracite coal dust briquettas."

On the mainland of British Columbia the coal industry has not been less active. It is true that in 1906 the only producing company besides the Vancouver Island collieries was the Crow's Nest Coal Company, but preparations were being made in the Crow's Nest field, in its northern extension and

along the line of the Canadian Pacific Railway for the establishment of new and important mines.

At present the largest individual colliery of British Columbia, and of Western Canada for that matter, is the Coal Creek colliery of the Crow's Nest Coal Company, which can handle 4,000 tons of coal in a day of ten hours.

Over and above all the producing fields, there are yet in these provinces vast tracts, underlaid by incalculable quantities of coal, which are waiting the advent of the railroad to be developed and to become important producers; and Mr. Dems believes that, judging from all appearances, they will not have to wait very long.

THE COAL FIELDS OF NEw BRUNSWICK.

For nearly a century coal has been mined in New Brunswick in a desultory fashion from the somewhat thin seams which spread over a wide area. The coal basin itself contains an area of over 10,000 square miles, but of this area it is safe to say that a large proportion does not carry seams of sufficient thickness to be profitably worked by any known system of mining. At several localities, however, as at the head of Grand Lake, in the Newcastle creek basin, now known as Minto, two seams occur, one of which has a thickness of 24 inches, the other of six inches. Occasionally these seams come almost together or are separated by a thin parting of black shale, so that a thickness of 28 to 30 inches of coal can be mined. For many years the entire output of this area was shipped as run of mine, but little care being taken to separate shale or sulphur; so that the coal as shipped was dirty, and the entire output was regarded with great disfavor as a mineral fuel. Within the last four years, however, a change in mining methods has been inaugurated, and the coal after mining, is carefully screened, inspected and shipped by rail to the Intercolonial at Norton, where it is used on that railway between St. John and Moncton, and gives good satisfaction as a steam producer.

It is but fair to say that this increased value in the coal is largely due to the improved methods. Formerly the coal was dug out of the thin seam, haulage to entrance being by small cars; then shovelled into waggons carrying a ton and a-half, hauled to the landing on the lake and dumped. After lying here for a time it was loaded on wood boats by barrow, and again dumped into the vessel whence it was transhipped to St. John or Fredericton. Here it was again barrowed to wharf, shovelled into cart and hauled away. In all then. this coal from the mining to the final destination was handled six to eight times. As a consequence the coal, with the contained shale and sulphur, was badly broken up, so that the resulting fuel could scarcely be expected to give very good satisfaction as a house fuel or in any other way. At the present time a considerable proportion of the output from the mines of this district, say 10 per cent., is handled in the same crude manner. The mining by modern methods furnishes a very different fuel. As examined on the loaded and inspected cars at the pit mouth, the coal is bright and clean, no stone or sulphur was visible and the fuel was apparently as good as any from the mines of Nova Scotia.

The total output from this group of mines has now reached for the past year not far from 50,000 tons. The coal is valued at $3 per ton at Norton station, while the screenings are worth about 90 cents to $1 per ton. In all there are now 20 companies or owners mining coal in the Newcastle district. Of these, nine ship their output by rail, working all the year, while the rest work intermittently and ship by water from Newcastle landing. It is clear that though the seams worked are thin, ranging from 30 inches, which represent the two seams together, down to 18 or 20 inches, in which only the larger seam is worked, the parting in this case being so thick that the thinner seam cannot be handled, a well defined profit is made on the higher grade of coal, and the output could be largely increased if the necessary miners could be obtained. If several of these companies at Minto could be brought under one management much better results would also be obtained, and efforts in this direction are now being made. If the slack or screened coal could be coked, of which there seems no doubt provided suitable ovens were erected, a still further source of profit would be found, since there is in St. John a market for all the coke which could be manufactured. This scheme is well worth consideration by the mine owners of this district.

The only other locality where coal mining is now being carried on in the province is at Beersville, in Kent county, where a similar seam outcrops on the coal branch, with a thickness of 16 to 18 inches. Drifts are driven in from the outcrop on the bank, and the coal raised from the mouth by horse-whim to the end of the branch railway which connects with the Intercolonial at Adamsville, a distance of seven miles. The force working here is small, but it is claimed that the mining is done at a small profit, the coal selling for $3.25 at the Intercolonial Railway. The quality of this coal is very similar to that from the mines at Minto.

Some years ago several borings were made at Dunsinane, on the Intercolonial, about 60 miles north of St. John and about 38 miles from Moncton. One of these sunk to a depth of 1,300 feet evidently passed through the carboniferous formation and penetrated some hundreds of feet into grayish grits of Devonian age. In several of these holes two seams, practically the same as those of the Minto basin, were passed. The coal at the outcrop is about 18 to 20 inches thick, similar to that worked in most of mines at that place. If the two seams passed through in boring come together, as they should do from the logs, not far from Dunsinane and form a

seam of 30 inches at no great depth, it should be possible from its proximity to the Intercolonial to mine and deliver coal to the main line at a reasonable profit also.

Of course, in mining these thin seams it will be impossible to erect expensive plants. What mining is done must be carried on as economically as possible, with a plant for hoisting which, while efficient for the purpose intended, must not involve the outlay of much capital. This seems to have been done at King's mine in Minto, which is the only one using a steam hoist. It will also be evident that it is impossible to compete with the large mines of Nova Scotia for foreign trade, but, if economically managed, there does not appear to be any reason why a large amount of coal, possibly sufficient to supply the provincial demands, should not be raised, while if the improved methods recently inaugurated at Minto as regards mining and screening are made general, there should be no farther complaints as regards the quality of the general output.

The provincial government now own several drills which should be useful in testing the actual value of the coal basin. Some years ago a scheme for this purpose was suggested by the officers of the Geological Survey, which, if carried out, would long since have determined this question. These holes should be located on areas carefully selected, where the rock conditions are most favorable. Logs and cores should be carefully preserved as a guide in other locations, and in this way probably a large amount of unnecessary expenditure would be avoided, and satisfactory results would be obtained.

THE PRESENT STATE OF METALLURGY OF PURELY SILVER ORES.*

By James Wilding, E.M., Parral, Chihuahua, Mexico.

The object of these remarks is to point out that a certain branch of metallurgy, which ought to well repay attention, has been very much neglected of late years.

For a long time there has been, apart from smelting metallurgy, no marked advance in the treatment of purely silver ores such as has taken place in that of gold ores, due to the introduction of the cyanide process and the continuous and close study that has been given to it. We are still without a method of treatment that can at all be compared in metallurgical results with that of smelting ores in conjunction with those of silver or gold.

Unfortunately in many mining camps it is only possible to procure suitable fuel and the different classes of ores or fluxes, necessary to make up a good smelting mixture, at such cost as precludes the employment of smelting. This has led to the centralization of smelting operations in localities well provided with railway facilities, in plants of great capacity, equipped at great cost with all the necessary mechanical labor-saving appliances. The large amount of capital involved in the establishment of these plants, has led to the employment of the highest technical skill available, which has well repaid its employment by the results achieved in the reduction of operating costs and the better recovery of the values in the ores, enabling the central plants to compete with local establishments to an extent not anticipated in former years.

The very perfecting of smelting metallurgy has, however, caused a certain apathy with regard to the possibilities of local treatment. The miner has, of late, paid attention only to such ore as can be profitably shipped, ignoring the often large bodies of ore which neither can be shipped nor treated by any of the older processes at a profit. The metallurgist has received but little encouragement to undertake investigation, and we have remained in the local treatment field almost where we were twenty years ago.

It may be considered in place to here review shortly the processes at present in use to extract the silver from ores at the place of their production.

Of these processes, the amalgamation of raw ore in pans has almost gone out of use, owing to the exhaustion of suitably-oxidized ores.

Chloridizing of the ore, followed by pan amalgamation, has the disadvantages of high losses and, in most localities, of high costs. The losses are partly due to imperfect chlorination and partly to the volatization of silver chloride in the roasting, which is probably never less than seven per cent. of the silver content of the ore, and may exceed thirty per cent. with certain ores, if the roasting temperature be not very accurately controlled.

Chloridizing of the ore followed by leaching with hyposulphite of soda has the same disadvantage of high loss as the above, with the additional one that the end product, "sulphides," has to be further treated. This is usually compensated, however, by the lower cost of leaching.

The Russell process, introduced in 1885, has generally failed to give satisfactory results with raw ores. It can only be regarded as an aid to the older "hypo" process in cases of imperfect chlorination, or in which the chlorination "goes back" during the preliminary washing with water.

"Patio" amalgamation still renders good service in a few places in Mexico. In Pachuca, where it was invented and has attained its highest development, it is usually preceded, and often also followed, by concentrating out the sulphides and a large part of the small amount of gold contained in the ore. An extraction of as much as ninety per cent. of the values is claimed on ore containing 1,500 grams of silver per metric ton, though, of course, the proportion extracted from ore of half this grade is much

* A paper read at the Eighth Annual Session of the American Mining Congress.

less. The recent improvements noted are the finer grinding of the ore, and the introduction of mechanical devices for turning over the ore in the "torta" in the place of the time-honored use of animals.

Potassium cyanide has recently been used as a solvent for silver, and in cases in which a sufficient proportion of the silver is associated with sulphides removable by concentration fair metallurgical results have been attained, even though the proportion of the silver content of the concentration tailings extracted by the cyanide has not exceeded fifty to sixty-five per cent. The cost of treatment is not high, and we look for a further spread of this method for such ores.

It might be supposed from our friend Mr. Malcolmson's valuable paper that it is no longer necessary to consider the advisability of local treatment, but this, of course, was not the intention of the author, as there must always be a limiting grade for every locality, under which it will be impossible to ship at a profit. This will vary with the degree of superiority of the smelting process over that locally used, the amount of profit demanded by the smelter, the class of ore, the distance of the mine from the central plant. This limit is reached in many places in Mexico situated on a railway where the ores are silicious with 1,000 to 1,200 grams of silver per metric ton. Ore of this grade can usually be dealt with profitably in such camps by one of the older processes, but ore of a value of $10, United States currency, per metric ton, which exists so often in great quantities cannot be made profitable, although gold ores of this grade under similar conditions of mining are nearly always a source of profit throughout the United States and Mexico.

The intention of these remarks is then to impress on the mine owner that, although he may not be able to deal with his low-grade ore by any method employed up to the present, the resources of metallurgical knowledge are not necessarily exhausted, but that it may often be to his ultimate profit to devote money to the prosecution of systematic research. But for the old Cassel Company's experimental plant in Glasgow we might have waited years more for the introduction and improvement of the modern cyanide process for the treatment of gold ores.

BEYOND THE CLEARINGS.

By John McKay.

The labors and explorations of the parties that passed the summer in the Chibougamau region show that this district is, inevitably, destined to a great future. Far away as it is—one hundred and sixty miles by the new winter road from Lake Doré—the country is so flat, such an easy country for a railroad to be built through, that there is no doubt whatsoever, that, within a very few years, the Lake St. John Road, now controlled by the Canadian Northern, will haul passengers and freight between Quebec city and the mining town, that is destined to spring up under the shadow of Juggler's Mountain.

The Chibougamau Gold and Asbestos Mining Company, Ltd., possesses a strong quartz vein carrying gold, upon Portage Island, and, also some asbestos claims on Asbestos Island. The Portage Island vein is from 40 to 80 feet wide, and it has been traced for 1,000 feet, while it is believed that it extends to a greater length, as here and there, along what should be the strike of the same vein, have been found out-croppings that seem to be identical with the vein that has been opened. We have stripped the vein for some distance and have sunk on it for 30 feet, and to say that we are satisfied with the showing, is certainly not to exaggerate matters.

The asbestos fibre that we have obtained from Asbestos Island is of the very best quality. Over half the island the asbestos is found in veins of long fibre; over the other half, it is disseminated in veinlets, that must be treated by crushing. The amount of asbestos in sight is very large.

The finds made in this region are: asbestos, gold, copper, nickel, iron, both hematite and magnetite, silver, cobalt, molybdenum. The gangue is, as a rule, full of white iron pyrites, which in Northern Quebec and Ontario usually accompany more valuable minerals. No iron ore has been shipped on account of the difficulty of transportation, but a considerable amount has accumulated on the dumps of the different claims. This summer 200 men were at work in the district, and the results obtained were so encouraging that it is absolutely certain next summer will find the population very considerably increased.

Now, a few words as to the country and climate: The most southernly portion of the road between Lake St. John and Chibougamau is through bush. The climate is dry. Beyond this the road runs through a flat country, and there is good timber in sight, for 100 miles. The spruce forest contains a fair proportion of merchantable logs, and I have seen trees that measured seven feet in circumference at the butt. Last winter we occupied nearly two months in going from Lake St. John, and in the summer canoes, fairly loaded and with good weather, go from point to point in about 15 or 16 days; but we anticipate that farmers' sleds laden with some 800 lbs., will be able to go there this winter in 6 days. The lowest rates on freight have been $8.30 a hundred, but we hope to get this rate reduced to $5.00 a hundred before the spring.

The snowfall at Chibougamau is just about the same as at Quebec city, perhaps less. Winter begins in earnest by the middle of November and the spring is late, for, though the snow has largely disappeared by mid-May, Chibougamau Lake is,

To Chibougamau: Hat Rapids, Chamouchouan.

Serpentine carrying Asbestos, on "J. F." Claim, Chibougamau.

usually, clear of ice by this time. Such a long winter makes the prospecting season short, yet it will, in many respects, be an advantage when we get down to actual mining and shipping.

Another promising district lies to the westward of Chibougamau. At the Obatogaman Forks a canoe route runs off to a lake district, in which some rich silver and cobalt ore has been found during the present summer. This district is said to be about half way between Father Lake and Chibougamau. The ore brought out is similar in character to that found at Cobalt, and some of it has assayed as high as $2,800 to the ton.

Mr. John E. Hardman visited this district in the spring of 1905, and wrote very favorably of it, both as regards asbestos and gold. He concluded that, although the distribution of gold in the largest veins so far discovered is not uniform, that there are enrichments, which opinion has been justified during the present season. Mr. A. P. Low, now director of the Geological Survey of the Dominion, studied the geology of this district, which he had already passed through on his numerous journeys toward the Labrador. He found that more than three-fourths of the surface is composed of igneous rock, the remaining quarter being of sedimentary origin. The flat-lying limestones and cherty, dolomites of Mistassini appear to correspond to the upper Huronian as found about Lake Superior, but, owing to these ancient formations being without fossils, it is not possible to state this definitely. Conglomerate and fine, green arkose rocks are associated with diabase around Wakoniche Lake, and parts of the shore of Chibougamau, and along the Chibougamau River. The boulders of this conglomerate, which are large, are made up mostly of granites, diabase and dark green schists. The boulders are cemented by a dark green basic rock, almost similar to that forming the boulders of the conglomerate. This has often been changed, either wholly or in part, to chlorite or sericite. Mr. Low concluded from the presence of those minerals that the cementing material was of igneous origin, and, thought it probable that showers of ashes or an outburst of diabase covered the loose materials of the conglomerate and arkose in the shallow waters along the shores of an ancient sea.

In Wakoniche Lake isolated masses of conglomerate, together with individual boulders are found at different levels in the green basic rock, making it appear that the latter was originally a sheet of trap in which the conglomerate had floated.

The point of these conclusions is that these rocks have every appearance of being similar to those in the region west of Temiskaming, where the Cobalt silver minerals have been found in such remarkable profusion. Here, also, they are found to rest unconformably upon rocks thought to be equivalent to the Keewatin; in which case the overlying conglomerates are probably Lower Huronian. The economic minerals discovered, so far, seem to be confined to the diabase, or to its altered products, the green schists and surpentine, together with its associate conglomerate and arkose, all probably of Lower Huronian age.

The mining laws of the Province of Quebec are generous to prospectors, much more so than those of the adjoining Province of Ontario. A prospecting license may be secured on unsurveyed lands for $5.00 a square mile, and such licenses convey the right to lease, or purchase, the mines that may be on the land. These licenses are valid for three months, and are renewable at the discretion of the Minister of Mines. Should a mine be discovered a yearly mining lease is issued for a fee of $5.00, and an annual rental of $1.00 per acre. Not exceeding 200 acres may be granted to one person. Mining lands may be sold outright at prices from $2.00 to $10.00 an acre, in lots of 100 acres only.

COBALT MINES.*

W. J. Blair, B.A. Sc.

A year ago, little could have been written or said of the mines at Cobalt. To a few men on the ground there came but a faint glimmer of the richness of the deposits. The general public had not even heard of Cobalt, and those who had heard disbelieved the reports.

The town of Cobalt is situated in the Township of Coleman, about five miles from Lake Temiscaming. It is on the new Government railway, The Temiscaming and Northern Ontario, one hundred and three miles from North Bay and nearly straight north from Toronto, three hundred and thirty miles. These rare deposits of valuable mineral lay from decade to decade within a very short distance of this large lake, so well known to the earliest voyageurs and frontier missionaries. They are within four miles of a waggon road used for a quarter of a century by the Hudson's Bay Company, between the Montreal River and Lake Temiscaming. It is twenty years since the meridian which forms the east boundary of the township of Coleman was run by O. L. S. Niven, and nearly as long since C. D. Bowman, O.L.S., sub-divided the township of Bucke, which adjoins Coleman on the north. Both these surveys were within a mile of Cobalt. For many years lumbering operations were carried on right on top of these deposits. In fact camps were built within a stone's throw of a spot where over $1,000 worth of nuggets of native silver were picked off the surface. But it was left until July, 1903, for the first real discovery of mineral in the Cobalt district to be made.

It was made by two men connected with the con-

* Transactions of the Engineering Society of the School of Practical Science, Toronto.

struction of the Temiscaming Railway, the spot afterwards becoming "The McKinley-Darragh Mine," after the discoverers. This claim was not surveyed nor recorded at the time. Other discoveries made during the same year were the La Rose vein, the Little Silver vein, and the large vein on Cobalt Hill. No development work was attempted during 1903. An examination of the deposits and the immediate vicinity was, however, made under the direction of the Bureau of Mines, and this examination showed that they were extremely rich. As a consequence a careful geological survey of the district was begun in the spring of 1904, and instructions issued for the survey of Coleman Township.

With the opening of spring, a half dozen or so prospectors were attracted to the locality and two important discoveries were made in the month of May. These are on Mining Location J. B. 6, and J. B. 7, and are what are now known as the Trethewey mine. No other discoveries are noted until July of the same year, when we have those in the immediate locality of Cross Lake. A few weeks later the first discoveries were made in what is now known as the Kerr and Giroux Lake belt. This brings us to October, 1904.

Up to this time, no development had been done except on those discoveries mentioned as having been made in 1903, and on the vein on J. B. 7. The steel on the Temiscaming Railway did not reach Cobalt until late in October, and it was some time after this before the first car of ore was sent to the sampler. The winter of 1904-05 saw things progress quietly at Cobalt. On the properties, when development was started, work was carried on steadily, and occasional shipments made. With the spring of 1905, however, things put on a new appearance. The mining world had heard a little of Cobalt, and outsiders began to come in. Prospecting began in earnest and new properties were opened. Developed properties began to prepare for more extensive operations. The town of Cobalt began to grow. The obstacles which nature had put in the way were met and overcome. It might be said that up to this time, the discoveries made were accidental; at any rate all had been made on the bare exposed rock. Systematic work, trenching and clearing away moss, etc., was begun and throughout the known mineral area discoveries of proven value are now numerous.

At present the following are shipping mines. For their relative location a map of the locality may be consulted: The Buffalo mines, (Dennison), the O'Brien mines, the Earle mines, the New Ontario (Trethewey), the Savage mines, the Temiscaming and Hudson Bay, the McKinley and Darragh, the Violet mine, McLeod and Glendinning, the Watts, the Victoria, the University, the Silver Leaf, the White-Silver, the Kerr Lake Mining Co. (Jacobs), the Drummond Mining Co., the LaRose, the McLeod-Lawson.

Besides these, there are some five or six other properties which are in early stages of development, but which can hardly yet be considered shippers. As to the value and quantity of the output, the writer is not in a position to state with any exactness. It would not be extravagant to place the value at from $2,500,000 to $3,000,000, and the average value per ton at $800 to $1,000. This would give in the neighborhood of 3,500 tons, or at 20 tons to the car load, 175 car loads.

It is not the purpose of this paper to enter into the geology of the district. A complete description of this is given in the recently published report of the Bureau of Mines, Part II. The ore practically occurs in small veins of white or pink calcite in a slaty conglomerate rock of the Huronian series. A few veins are, however, found in the adjoining diabase. The metals occurring in economic quantities in these ores are arsenic, cobalt, nickel and silver. Other metals which have been found associated with these in the same veins are bismuth, copper, iron, lead, zinc and gold. The ore bodies are so variable in their composition that it is difficult to give even approximately the percentages of the metal. However, taking averages off car lots, we may quote the following: Silver, 2 per cent. to 12 per cent.; cobalt, 3 per cent. to 15 per cent.; nickel, 3 per cent. to 15 per cent.; arsenic, 30 per cent. to 60 per cent.

Those who are familiar with the history of the Cobalt camp and what has been accomplished there, have no fear of its future. However cautious the experiences of other camps in Northern Ontario would teach us to be, there can be absolutely no doubt that Cobalt is a reality. It has already been proven so. The greatest depth that has been reached by any shaft is at the LaRose mine, where they have gone to a depth of 185* feet. This alone, so far as this property is concerned, proves its value to be in the millions, while the diamond drill has shown that 185 feet is far above the known depth of mineral. There are several other shafts down to a depth of 100 feet, and show no sign whatever of giving out.

Up to the present, practically all the ore has gone to New York City and to Newark, N.J. It is shipped in sacks containing from 75 to 150 pounds of ore. This unique ore presents very many difficulties to the smelter. The peculiar combination of cobalt and nickel causes the greatest trouble, and this is augmented by the presence of arsenic. Owing to this fact, up to the present, the producers have not been able to realize the full amount of silver values. They have been able to realize very little on the cobalt and nickel, and nothing at all on the arsenic and other metals above mentioned. The greatest problem that confronts the mines at present, then, is

* This shaft is now said to be down 300 feet.

the economical smelting and refining of these products.

The question is often asked, "What is the likelihood of the mineral area widening so as to extend for several miles on all sides of Cobalt?" Like many other questions asked about these deposits, the answer must be one which leaves the enquirer without any added information. The conglomerate rock wherein the mineral most frequently occurs at Cobalt is, roughly speaking, the country rock for fifty miles on all sides. This will seem encouraging to the prospector who is just starting in, and yet perhaps is not much of a comfort to the many who spent the summer of 1905 with shovel and pick and hammer and drill on the rocks of Temiscaming Cobalt bloom, and in most cases the ore cobalt (smaltite), have been found in the following places, viz.: west side of Bay Lake (near Trout Lake); on the east side of the Montreal River, near Bay Lake; in Lot 19, Concession IV., Coleman Township, close to Bay Lake; in very many places in Bucke Township; in the Townships of Firstbrook, Dymond, Hudson, and Lorrain, in several places in Lots 9 and 10, Concession VI., Ingram, and in the unsurveyed territory north of the Townships of Ingram and Pense. It is also reported that the same indications have been found near Lake Kenogami, north of the Township of Burt. From this it would appear that the field is likely to be very large. However, nothing of value has been proved in the case of these last mentioned discoveries, and none of them appear to run above a few ounces per ton in silver values. These facts, however, ought rather to encourage rather than to discourage, when we remember that the first discovery of mineral on Lake Temiscaming was made over a century ago, and is probably what is now known as Wright's Mine on the east shore.

THE ECONOMICAL PRODUCTION OF COMPRESSED AIR.

"It is the rule, rather than the exception, to find a compressed air plant fitted with the best of pneumatic tools and appliances but the most wasteful apparatus for compression." This statement, made upon the authority of Allis-Chalmers Company, of Milwaukee,* is sufficiently startling to command attention, as is also the fact that for such a condition inventors and designers of apparatus utilizing compressed air are to a certain extent held resposible; "for while they have been actively engaged in improving efficiencies and widening the field of application, they have apparently considered compressed air only as delivered to their machines, without giving much thought to cost of production and delivery." As the use of compressed air is extended to each individual plant, and increased compressing capacity is required, this indifference should give place to a wideawake consideration of the economies possible in the cost of production.

To illustrate its meaning the company mentioned enters into a very full explanation, from which we quote the following:

The work performed by an air compressor is, broadly speaking, that of increasing pressure of the air (or other gas) from a lower to a higher stage by reducing its volume or compressing it into smaller space. Usually in air compressor practice the lower or initial pressure is the "atmospheric pressure" at point of location of compressor, while the higher or terminal pressure is fixed by the requirements of the particular case, and may be anywhere from 10 to 30 lbs. (gauge pressure) per square inch, as in blowing engine practice up to 80 to 100 lbs. per square inch for rock drills, pneumatic tools, etc., and up to 1,500 to 2,000 lbs. per square inch, or even higher, for special purposes. Compressors which work against pressures under 30 lbs. gauge are usually called blowing engines. Atmospheric pressure (or zero gauge pressure) equals 14.7 lbs. absolute pressure per square inch at sea level (equivalent to 30 in. barometer) and becomes less as the altitude above sea level increases, the decrease being approximately one-half pound, or one inch in mercury column, for each 1,000 feet increase in altitude. As the work of compression depends upon the initial and terminal absolute pressures (absolute pressure being equivalent to gauge pressure plus atmospheric pressure) the altitude at which the compressor is to work is of great importance and should always be taken into consideration.

When air is compressed into a smaller volume, if the temperature remains constant, the pressure increases directly in proportion to the decrease in volume: that is, if the volume is one-half, the pressure will be doubled; if one-third the pressure will be trebled, and so on for any decrease in volume. There is, however, another and most important factor in the problem which must be considered in all cases except the lowest terminal pressures, viz.: the increase in temperature and consequent increase in volume due to the heat developed during compression. When air is compressed, the work done during compression is converted into heat, which must be taken up by the air compressed, the result being to very materially raise its temperature and increase its volume, thus adding largely to the work required to be done. Without going into a theoretical discussion of this factor in the problem, a brief statement of facts will show its great importance.

If air at atmospheric pressure and 60° Fah. could be compressed to 100 lbs. gauge pressure and all the heat due to the work of compression taken away as fast as generated, so that the temperature dur-

* Represented in Canada by the Allis-Chalmers-Bullock Co., Ltd., of Montreal.

ing compression would remain constant, the mean effective pressure during one stroke of the air piston would be 30.2 lbs. If, on the other extreme, none of the heat due to the work of compression is taken away, the mean effective pressure during the stroke will be 41.6 lbs., and the terminal temperature will reach 485° Fah. As the power required for compression is directly proportional to the mean effective pressure, it will be seen that the additional power required in the latter case is 37½ per cent. of that in the former. In practice neither extreme can be reached, for it is impossible to completely cool the air during compression, and, on the other hand, some of the heat of compression will be radiated; but the lower extreme is the ideal, and the nearer it can be approached the more economical the compressor will do its work.

Various plans for taking away the heat during compression, such as injecting a spray of water into the cylinder, circulating cooling water through the piston and around the heads and cylinder barrel, etc., have been tried. The use of the cooling spray, or so called "wet compression," has long since been abandoned, as has also the plan of circulating water through the piston, for the disadvantages more than offset the possible gains. Cylinder heads and barrels are still water-jacketed, not so much on account of the heat that can be taken from air as to keep the cylinder cool enough for proper lubrication. The most effective means for taking away the heat of compression and reducing the amount of power required consists in dividing the compression into two or more stages, depending upon the terminal pressure desired, and cooling the air as much as possible between stages by means of suitable cooling apparatus; the water-jacketing of the cylinders and heads being retained for the reason above stated. Where the work of compression is done in two or more tainment. In the first place, even with an unobstructed inlet passage air will not flow into the cylinder without some difference in pressure to force it in, and when, as in many compressors, the inlet valves are of the spring weighted poppet type, this difference as to its effect upon capacity and efficiency becomes a serious matter. Then, again, the entering air comes in contact with the cylinder walls and clearance surfaces which have become highly heated from the compression in the preceding stroke, and is thereby heated to a higher temperature than before entering. This not only reduces the volume of free air at the outside temperature which can be handled, but also raises the terminal cylinders, it is customary to so fix the ratio of cylinder volumes as to divide the work equally between the cylinders. By using two stage compression and cooling the air between the stages to its initial temperature (60° Fah.), without considering the cooling by water-jacketing, it is possible to reduce the mean effective pressure to 35.5 lbs., as compared to 41.6 lbs. in the case above given, which is equivalent to a saving of 15 per cent. At the same time the terminal temperature will be only 245° Fah. instead of 485° Fah. In practice the saving may be a little less and the terminal temperature somewhat higher, as the initial temperature in both cylinders will usually be higher than 60° Fah., but, after making all allowances, the figures afford an indisputable argument in favor of two stage compression for pressures commonly used.

Another important factor in compressor design is the clearance in the compressor cylinders. It is not possible to run a compressor without some space between the piston and the cylinder head at the end of the stroke, and in addition there is the volume in the inlet and discharge passages between the valves and cylinder space. It is the aim of all good designers to make this clearance space as small, in proportion to the volume swept through by the piston, as possible; for at the end of the stroke the clearance space is filled with air at the terminal pressure which must expand back to the initial pressure before the inlet valve is opened. This is particularly important in single stage compression, as at discharge pressures ordinarily used the expanding of the compressed air in the clearance space back into the cylinder seriously affects the volumetric efficiency of the compressor. If the volume swept through by the piston in one stroke is one thousand cubic inches and the clearance volume is twenty cubic inches, the compressor has two per cent. clearance. In this case if the discharge pressure is 75 lbs. gauge (89.7 lbs. absolute) and the initial pressure is atmospheric at sea level (14.7 lbs.) the air in the clearance space will expand to six times the clearance volume, or to 120 cubic inches, and, as the clearance volume is only 20 inches, the remaining 100 cubic inches must be in the cylinder: that is, the piston must travel back ten per cent of the return stroke before opening the inlet valve, and the actual room for the admission of free air is only 1000-100=900 cubic inches; or, as commonly stated, the volumetric efficiency of the compressor is only 90 per cent.

It is the common practice of compressor builders to call the free air capacity of their machines the volume theoretically swept through by the piston, without making any deductions; that is, if the area of the piston is two square feet and it travels 500 feet per minute, the capacity is called 1,000 cubic feet per minute. It will readily be seen that in the case above cited, if the clearance is two per cent. the actual capacity is only 900 cubic feet per minute, and if 1,000 cubic feet is wanted the compressor must be speeded up to 555 feet per minute. It may be stated in this connection that in the majority of the compressors in daily use the clearance exceeds two per cent., and the volumetric efficiency is less than ninety per cent. The clearance also adversely

affects the efficiency of the machine, for, in addition to the loss from greater friction on account of the increased speed required for a given actual capacity, the air in the clearance space in expanding to the initial pressure never gives back quite as much power as was used in compressing it. Inasmuch as with any given diameter and travel of piston the clearance space is practically a constant quantity, the longer the stroke the less the percentage of clearance. If a cylinder of 30 in. diameter by 60 in. stroke has one and one-half per cent. of clearance and the stroke is shortened one-half, i.e., to 30 in., the percentage of clearance will be doubled, or three per cent. It is therefore better to get the required capacity by using a small diameter and long stroke rather than larger diameter and shorter stroke, even if the advantages of greater reliability in operation, durability and lower cost of maintenance and repair arising from slower rotative speed for a given piston travel are not considered. As a matter of fact, advantages, together with the increased efficiencies, will more than offset the disadvantages arising from higher first cost, increased floor space, and greater expense of installation.

The loss of volumetric efficiency due to clearance is less in two-stage than in single stage compressors, because for any given capacity the first or low pressure cylinder of the two stage machine is practically of the same size and has the same percentage of clearance, while the terminal pressure is much lower; consequently the expansion back into the cylinder volume is much less and the volumetric efficiency higher. This fact affords another strong argument for the use of two-stage compressors.

Another factor affecting compressor capacities and efficiencies merits careful consideration. It is the common practice to not only rate the capacity at the full volume swept through by the piston, but to assume that the cylinder is filled at the beginning of the stroke with air at full atmospheric pressure and at no higher temperature than the outside source of supply. A moment's consideration will show that such ideal conditions are impossible of attemperature of compression. The latter effect may become cumulative, for the higher the terminal temperature the more the surfaces become heated, and the higher the entering air is heated, resulting in still higher terminal temperature. In cases where the water-jacketing is inefficient or the water circulation becomes interrupted, the cumulative effect may result in heating the compressor cylinder to a dangerous degree. We recall one instance of a small high speed single-stage compressor which, while working in a rather dark room against eighty pounds discharge pressure, became so heated as to show a dull red. It is essential to good economy that the air be brought to the compressor and gotten into the cylinder with as little heating as possible. To accomplish this the inlet ports should be short and direct and the air admitted in a solid stream and not cut up into thin sheets. Admitting air through a hollow piston and piston rod, or straining it through metal guards which are frequently used to prevent poppet inlet valves from getting into the cylinder in case of breakage of valve stems, manifestly results in undue heating and consequent loss. In this matter of initial heating of the air, the two-stage compressor has a marked advantage over the single-stage, because the terminal temperatures are much lower, consequently the cylinder walls and clearance surfaces do not become so highly heated and the transfer of heat to the incoming air is much slower.

What has been said above applies to compressors of every type, whether for air or other gases, and no matter how driven.

Mean Effective Pressure and Indicated Horse Power

Required to compress a cubic foot of free air (Adiabatically) from atmospheric pressure (14.7 lbs.) to various gauge pressures. Initial temperature of air in each cylinder taken as 60° Fh. Jacket cooling not considered.

			Single Compression.		Two-stage Compression.		
Gauge pressure pounds.	Absolute pressure pounds.	Ratio of compression.	Mean effective pressure, friction included.	Indicated H.P. per cubic ft., free air friction included.	M.E.P. per sq. in., reduced to low pressure, air cylinder friction included.	Indicated H.P. per cubic ft., free air friction included.	Per cent. of power saved by two stage over single compression (theoretical).
5	19.7	1.34	5.12	.022	.....	....	....
10	24.7	1.68	9.44	.041	.....	....	....
15	29.7	2.02	13.17	.057	.....	....	....
20	34.7	2.36	16.44	.071	.....	....	....
25	39.7	2.70	19.47	.085	.....	....	....
30	44.7	3.04	22.21	.096	.....	....	....
35	49.7	3.38	24.72	.103	.....	....	....
40	54.7	3.72	27.05	.118	.....	....	....
45	59.7	4.06	29.21	.127	.....	....	....
50	64.7	4.40	31.31	.136	.....	....	....
55	69.7	4.74	33.23	.145	.....	....	....
60	74.7	5.08	35.10	.153	.....	....	....
65	79.7	5.42	36.91	.161	....	....	....
70	84.7	5.76	38.59	.168	33.71	.147	12.7
75	89.7	6.10	40.25	.175	34 99	.153	13.0
80	94.7	6.44	41.80	.182	36.15	.158	13.5
85	99.7	6.78	43.27	.189	37.32	.163	13.8
90	104.7	7.12	44.71	.195	38.36	.167	14.2
95	109.7	7.46	46.12	.201	39.41	.172	14.5
100	114.7	7.80	47.46	.207	40.48	.176	14.7
110	124.7	8.48	50.09	.218	42.34	.185	15.4
120	134.7	9.16	52.53	.229	44.20	.193	15.9
130	144.7	9.84	54.87	.239	45.83	.200	16.5
140	154.7	10.52	57.08	.249	47.46	.207	16.9
150	164.7	11.20	59.18	.258	48.99	.214	17.2
160	174.7	11.88	.....	....	50.39	.219	....
170	184.7	12.56	.....	....	51.66	.225	....
180	194.7	13.24	.....	....	52.95	.231	....
190	204.7	13.92	.....	....	54.22	.236	....
200	214.7	14.60	.....	....	55.39	.241	....
250	264.7	18.00	.....	....	60.76	.264	....
300	314.7	21.40	.....	....	65.20	.283	....
350	364.7	24.81	.....	....	69.16	.301	....
400	414.7	28.21	.....	....	72.65	.317	....
450	464.7	31.61	.....	....	75.81	.329	....
500	514.7	35.01	.....	....	78.72	.342	....
550	564.7	38.41	.....	....	81.30	.354	....
600	614.7	41.81	.....	....	83.75	.364	....

Table Showing the Relative Volumes of Compressed Air at Various Pressures.

Gauge Pressure Pounds.	Volume of free air, corresponding to one cubic ft. of air at given pressure.	Corresponding volume of one cubic ft. of free air at given press.
0	1.00	1.00
1	1.068	.9356
2	1.136	.8802
3	1.204	.8305
4	1.273	.7861
5	1.34	.7462
10	1.68	.5951
15	2.02	.4949
20	2.36	.4236
25	2.7	.3703
30	3.04	.3288
35	3.38	.2957
40	3.72	.2687
45	4.06	.2462
50	4.40	.2272
55	4.74	.2109
60	5.08	.1967
65	5.42	.1844
70	5.762	.1735
75	6.102	.1638
80	6.442	.1552
85	6.782	.1474
90	7.122	.1404
95	7.462	.1340
100	7.802	.1281
110	8.483	.1178
120	9.170	.1090
130	9.843	.1016
140	10.52	.0950
150	11.20	.0892
160	11.88	.0841
170	12.56	0796
180	13.24	.0755
190	13.92	.0712
200	14.60	.0684

Relative Volumetric Efficiencies at Various Altitudes Above Sea Level.

Altitude above sea level, in ft.	Barometer, in inches.	Percentage of volumetric efficiency.	Decreased power required, 80 lbs., single stg %
0	30.00	100	.000
500	29.45	93.5	.015
1000	28.90	97	.025
1500	28.35	95.5	.04
2000	27.78	94	.05
3000	26.75	91	.07
4000	25.75	88	.09
5000	24.70	85	.11
6000	23.86	82	.13
7000	22.97	79	.14
8000	22 10	76	.16
9000	21.30	73	.17
10000	20 60	70	.18
11000	19.75	68	.20
12000	19.00	65	.21
13000	18.30	62	.23
14000	17.60	59	.24
15000	16.95	57	.25

THE LIME-ROASTING OF GALENA.*

(By W. R. Ingalls.)

During the last two years, and especially during the last six months, a number of important articles upon the new methods for the desulphurization of galena have been published in the technical periodicals, particularly in the *Engineering and Mining Journal* and in *Metallurgie*. I proposed for these methods the type-name of "lime-roasting" of galena as a convenient metallurgical classification,[1] and this term has found some acceptance. The articles referred to have shown the great practical importance of these new processes, and the general recognition of their metallurgical and commercial value which has already been accorded to them. It is my present purpose to review broadly the changes developed by them in the metallurgy of lead, in which connection it is necessary to refer briefly to the previous state of the art.

The elimination of the sulphur-content of galena has been always the most troublesome part of the smelting-process, being both costly in the operation and wasteful of silver and lead. Previous to the introduction of the Huntington-Heberlein process at Pertusola, Italy, it was effected by a variety of methods. In the treatment of non-argentiferous galena concentrate, the smelting was done by the roast-reduction method (roasting in reverberatory furnace and smelting in blast-furnace); the roast-reaction method, applied in reverberatory furnaces; and the roast-reaction method, applied in Scotch hearths.[2] Precipitation-smelting, simple, had practically gone out of use, although its reactions enter into the modern blast-furnace practice, as do also those of the roast-reaction method.

In the treatment of argentiferous lead-ores, a combination of the roast-reduction, roast-reaction and precipitation-methods had been developed. Ores low in lead were still roasted, chiefly in hand-worked reverberatories (the mechanical furnaces not having been proved well adapted to lead-bearing ores), while the high loss of lead and silver in sinter or slag-roasting of rich galenas had caused those processes to be abandoned, and such ores were charged raw into the blast-furnace, the part of their sulphur which escaped oxidation therein reappearing in the form of matte. In the roast-reduction smelting of galena alone, however, there was no way of avoiding the roasting of the whole, or at least a very large percentage of the ore, and in this roasting the ore had necessarily to be slagged or sintered in order to eliminate the sulphur to a satisfactory extent. This is exemplified in the treatment

*Read at the London Meeting of the American Institute of Mining Engineers.

[1] *Engineering and Mining Journal*, September 2, 1905.

[2] This term is inexact, because the hearths employed in the United States are not strictly "Scotch hearths," but they are commonly known as such, wherefore my use of the term.

of the galena concentrate of south-eastern Missouri at the present time.

Until the two new Scotch-hearth plants at Alton and Collinsville, Ill., were put in operation, the three processes of smelting the southeastern Missouri galena were about on an equal footing. Their results per ton of ore containing 65 per cent. of lead were approximately as follows. (Percentages of lead in Missouri practice are based on the wet assay; among the silver-lead smelters of the West the fire-assay is still generally employed.)

Method.	Cost.	Extraction. Per Cent.
Reverberatory	$6.50-$7.00	90-92
Scotch-hearth..	$5.75-$6.50	87-88
Roast-reduction..	$6.00-$7.00	90-92

The new works employ the Scotch-hearth process, with bag-houses for the recovery of the fume, which previously was the weak point of this method of smelting. This improvement did not originate at either Alton or Collinsville, having been previously in use at the works of the Missouri Smelting Company at Cheltenham, St. Louis, but the idea originated from the practice of the Picher Lead Company, of Joplin, Mo. This improvement led to a large increase in the recovery of lead, so that the entire extraction is now approximately 98 per cent. of the content of the ore, while, on the other hand, the cost of smelting per ton of ore has been reduced through the increased size of these plants and the introduction of improved means for handling ore and material. The practice of these works represents the highest efficiency yet obtained in this country in the smelting of high-grade galena-concentrate, and probably it can not be equalled even by the Huntington-Heberlein and similar processes. The Scotch-hearth and bag-house process is therefore the one of the older methods of smelting which will survive.

In the other methods of smelting, a large proportion of the cost is involved in the roasting of the ore, which amounts in hand-worked reverberatory furnaces to from $2 to $2.50 per ton. Also, the larger proportion of the loss of metal is suffered in the roasting of the ore, this amounting to from 6 to 8 per cent. of the metal content of such ore as is roasted. The loss of lead in the combined process of treatment depends upon the details of the process. The chief advantage of lime-roasting in the treatment of this class of ore is in the higher extraction of metal which it affords. This should rise to 98 per cent. That figure, indeed, has been surpassed in operations on a large scale, extending over a considerable period.

In the treatment of the argentiferous ores of the West, different conditions enter into the consideration. In the working of those ores, the present practice is to roast only those which are low in lead, and charge raw into the blast-furnace the rich galenas. The cost of roasting is from $2 to $2.50 per ton; the cost of smelting is about $2.50 per ton. On the average about 0.4 ton of ore has to be roasted for every ton that is smelted. The cost of roasting and smelting is therefore about $3.50 per ton. In good practice the recovery of silver is about 98 per cent. and of lead about 95 per cent., reckoned on the fire-assay.

In the treatment of these ores, the lime-roasting process offers several advantages. It may be performed at less than the cost of ordinary roasting. (This refers especially to the Savelsberg process.) The loss of silver and lead during the roasting is reduced to insignificant proportion. The sulphide-fines which must be charged raw into the blast-furnace are eliminated, inasmuch as they can be efficiently desulphurized in the lime-roasting pots without significant loss; all the ore to be smelted in the blast-furnace, therefore, can be delivered to it in lump form, whereby the speed of the blast-furnace is increased and the wind-pressure required is decreased. Finally, the percentage of sulphur in the charge is reduced, producing a lower matte-fall, or no matte-fall whatever, with consequent saving in expense of retreatment. In the case of a new plant, the first cost of construction and the ground-space occupied are materially reduced. Before discussing more fully the extent and nature of these savings, it is advisable to point out the differences among the three processes of lime-roasting that have already come into practical use.

In the Huntington-Heberlein process, the ore is mixed with suitable proportions of limestone or silica (or quartzose ore), and is then partially roasted, say, to reduction of the sulphur to one-half. The roasting is done at a comparatively low temperature, and the loss of metals is consequently small. The roasted ore is dampened and allowed to cool. It is then charged into a hemispherical cast-iron pot, with a movable hood which covers the top and conveys off the gases. There is a perforated grate in the bottom of the pot, on which the ore rests, and air is introduced through a pipe entering the bottom of the pot, under the grate. A small quantity of red-hot calcines from the roasting furnaces is thrown on the grate to start the reaction; a layer of cold, semi-roasted ore is put upon it, the air-blast is turned on and reaction begins, which manifests itself by the copious evolution of sulphur-fumes. These consist chiefly of sulphur dioxide, but they contain more or less trioxide, which is evident from the solution of copperas that trickles from the hoods and iron smoke-pipes, wherein the moisture condenses. As the reaction progresses, and the heat creeps up, more ore is introduced, layer by layer, until the pot is full. Care is taken by the operator to compel the air to pass evenly and gently through the charge, wherefore he is watchful to close blow-holes which develop in it. At the end of the operation, which may last from 4 to 18 hrs.,

Nikabau River, on the Route to Chibougamau.

Big Quartz Vein, near Calcite Bay, Chibougamau.

the ore becomes red hot at the top. The hood is then pushed up, and the pot is turned on its trunnions, by means of a hand-operated wheel and worm-gear, until the charge slides out, which it does as a solid, semi-fused cake. The pot is then turned back into position. Its design is such that the air-pipe makes automatic connection, a flanged pipe, cast with the pot, settling upon a similarly flanged pipe communicating with the main, a suitable gasket serving to make a tight joint. The pots are set at an elevation of about 12 ft. above the ground, so that when the charge slides out the drop will break it up to some extent; moreover, it is caused to fall on a wedge, or similar contrivance, to assist the breakage. After cooling, it is further broken up to furnace-size by wedging and sledging; the lumps are forked out, and the fines screened and returned to a subsequent charge for completion of their desulphurization.

The Savelsberg process differs from the Huntington-Heberlein in respect to the preliminary roasting, which, in the Savelsberg process, is omitted, the raw ore, mixed with limestone and silica, being charged directly into the converter. The Savelsberg converter is supported on a truck, instead of being fixed in position, but otherwise its design and management are quite similar to those of the Huntington-Heberlein converter. In neither case are there any patents on the converters. The patents are on the processes. In view of the litigation that has already been commenced between their respective owners, it is interesting to examine the claims.

The Huntington-Heberlein patent (U.S. No. 600,347, issued March 8, 1898, applied for December 9, 1896) has the following claims:—

1. The herein-described method of ozidizing sulphide-ores of lead preparatory to reduction to metal, which consists in mixing with the ore to be treated an oxide of an alkaline-earth metal, such as calcium oxide, subjecting the mixture to heat in the presence of air, then reducing the temperature, and finally passing air through the mass to complete the oxidation of the lead, substantially as and for the purpose set forth.

2. The herein-described method of ozidizing sulphide-ores of lead preparatory to reduction to metal, which consists in mixing calcium oxide or other oxide of an alkaline-earth metal with the ore to be treated, subjecting the mixture, in the presence of air, to a bright-red heat (about 700° C.), then cooling down the mixture to a dull-red heat (about 500° C.), and finally forcing air through the mass until the lead-ore, reduced to an oxide, fuses, substantially as set forth.

3. The herein-described method of oxidizing lead sulphide in the preparation of the same for reduction to metal, which consists in subjecting the sulphide to a high temperature in the presence of an oxide of an alkaline-earth metal, such as calcium oxide, and oxygen, and then lowering the temperature, substantially as set forth.

Adolf Savelsberg, in U.S. Patent No. 755,598 (issued March 22, 1904, applied for December 18, 1903), claims:—

1. The herein-described process of desulphurizing lead-ores, which consists in mixing raw ore with limestone and then subjecting the mixture to the simultaneous application of heat and a current of air in sufficient proportions to substantially complete the desulphurization in one operation, substantially as described.

2. The herein-described process of desulphurizing lead-ores, which process consists in first mixing the ores with limestone, then moistening the mixture, then filling it without previous roasting into a chamber, then heating it and treating it by a current of air, as and for the purpose described.

3. The herein-described process of desulphurizing lead-ores, which consists in mixing raw ores with limestone, then filling the mixture into a chamber, then subjecting the mixture to the simultaneous application of heat and a current of air in sufficient proportions to substantially complete the desulphurization in one operation, the mixture being introduced into the chamber in partial charges introduced successively at intervals during the process, substantially as described.

4. The herein-described process of desulphurizing lead-ores, which process consists in first mixing the ores with limestone, then moistening the mixture, then filling it without previous roasting into a chamber, then heating it and treating it by a current of air, the mixture being introduced into the chamber in partial charges introduced successively at intervals during the process, as and for the purpose described.

5. The herein-described process of desulphurizing lead-ores, which process consists in first mixing the ores with sufficient limestone to keep the temperature of the mixture below the melting-point of the ore, then filling the mixture into a chamber, then heating said mixture and treating it with a current of air, as and for the purpose described.

6. The herein-described process of desulphurizing lead-ores, which process consists in first mixing the ores with sufficient limestone to mechanically separate the particles of galena sufficiently to prevent fusion, and to keep the temperature below the melting-point of the ore by the liberation of carbon dioxide, then filling the mixture into a chamber, then heating said mixture and treating it with a current of air, as and for the purpose described.

The Carmichael-Bradford process differs from the Savelsberg by the treatment of the raw ore mixed with gypsum instead of limestone, and differs from the Huntington-Heberlein both in respect to the use of gypsum and the omission of the preliminary roasting. The Carmichael-Bradford process has not been threatened with litigation, so far

as I am aware. The claims of its original patent read as follows:[3]—

1. The process of treating mixed sulphide-ores, which consists in mixing with said ores a sulphur compound of a metal of the alkaline earths, starting the reaction by heating the same, thereby oxidizing the sulphide and reducing the sulphur compound of the alkali metal, passing a current of air to oxidize the reduced sulphur compound of the metal of the alkalies preparatory to acting upon a new charge of sulphide-ores, substantially as and for the purpose set forth.

2. The process of treating mixed sulphide-ores, which consists in mixing calcium sulphate with said ores, starting the reaction by means of heat, thereby oxidizing the sulphide-ores, liberating sulphurous-acid gas, and converting the calcium sulphate into calcium sulphide, and oxidizing the calcium sulphide to sulphate preparatory to treating a fresh charge of sulphide-ores, substantially as and for the purpose set forth.

The process described by W. S. Bayston, of Melbourne (Australian Patent No. 2,862), appears to be identical with that of Savelsberg.

Irrespective of the validity of the Savelsberg and Carmichael-Bradford patents, and without attempting to minimize the ingenuity of their inventions and the importance of their discoveries, it must be conceded that the merit for the invention and introduction of lime-roasting of galena belongs to Thomas Huntington and Ferdinand Heberlein. The former is an American, and this is the only claim that the United States can make to a share in this great improvement in the metallurgy of lead. It is to be regretted, moreover, that of all the important lead-smelting countries of the world, America has been the most backward in adapting it.

The details of the three processes and the general results accomplished by them have been rather fully described in a series of articles recently published in the *Engineering and Mining Journal*. There has been, however, comparatively little discussion as to costs; and, unfortunately, the data available for analysis are extremely scanty, due to the secrecy with which the Huntington-Heberlein process, the most extensively exploited of the three, has been veiled. Nevertheless, I may attempt an approximate estimation of the various details, taking the Huntington-Heberlein process as the basis.

The ore, limestone and silica are crushed to pass a 4-mesh screen. This is about the size to which it would be necessary to crush as preliminary to roasting in the ordinary way, wherefore the only difference in cost is the charge for crushing the limestone and silica, which in the aggregate may amount to one-sixth of the weight of the raw sulphide, and may consequently add 2 to 2.5c. to the cost of treating a ton of ore. The mixing of ore and fluxes may be costly or cheap, according to the way of doing it. If done in a rational way it ought not to cost more than 10c. per ton of ore, and may come to less. The delivery of the ore from the mixing-house to the roasting-furnaces ought to be done entirely by mechanical means, at insignificant cost.

The Heberlein roasting-furnace, which is used in connection with the "H.-H." process, is simply an improvement on the old Brunton calciner—a circular furnace, with revolving hearth. The construction of this furnace, according to American designs, is excellent. The hearth is 26 ft. in diameter; it is revolved at slow speed, and requires about 1.5 h.p. A flange at the periphery of the hearth dips into sand in an annular trough, thus shutting off air from the combustion-chamber, except through the ports designed for its admittance. The mechanical construction of the furnace is workmanlike, and the mechanism under the hearth is easy of access and comfortably attended to.

A 26-ft. furnace roasts about 80,000 lb. of charge per 24 hrs. In dealing with an ore containing from 20 to 22 per cent. of sulphur, the latter is reduced to about 10 or 11 per cent., the consumption of coal being about 22.5 per cent. of the weight of the charge. The hearth-efficiency is about 150 lb. per sq. ft., which, in comparison with ordinary roasting, is high. The coal-consumption, however, is not corresponding low. Two furnaces can be managed by one man per 8 hr. shift. On the basis of 80 tons of charge ore per 24 hrs., the cost of roasting should be approximately as follows:—

Labor: 3 men at $2.50.	$7.50
Coal: 18 tons at $2.00.	36.00
Power	3.35
Repairs	3.35
Total..	$50.20 for 80 tons, or 63c per ton.

In the above estimate repairs have been reckoned at the same amount as is experienced with Bruckner cylinders, and the cost of power has been allowed for with fair liberality. The estimated cost of 63c. per ton is comparable with the $1.10 to $1.45 per ton, which is the result of roasting in Bruckner cylinders in Colorado, reducing the ore to from 4.5 to 6 percent. of sulphur.

The Heberlein furnace is built up to considerable elevation above the ground-level, externally somewhat resembling the Pearce turret-furnace. This serves two purposes: (1) it affords ample room under the hearth for attention to the driving mechanism; and (2) it enables the ore to be discharged by gravity into suitable hoppers, without the construction of subterranean gang-ways. The ore discharges continuously from the furnace, at dull-red heat, into a brick bin, wherein it is cooled by a water-spray. Periodically, a little ore is diverted into a side-bin, in which it is kept hot for starting a subsequent charge in the converter.

[3] A. D. Carmichael, U. S. Patent No. 705,904, July 29, 1902.

The cooled ore is conveyed from the receiving-bins at the roasting-furnaces to hopper-bins above the converters. If the tramming be done by hand the cost, with labor at 25c. per hr., may be approximately 12.5c per ton of ore, but this should be capable of considerable reduction by mechanical conveyance.

The converters are hemispherical pots of cast-iron, 9 ft., in diameter at the top and about 4 ft. in depth. They are provided with a circular, cast-iron grate, which is 0.75 in. thick and 6 ft. in diameter, and is set and secured horizontally in the pot. This grate is perforated with holes 0.75 in. in diameter, 2 in. apart, centre to centre, and is similar to the Wetherill grate employed in zinc oxide manufacture. The pot itself is about 2.5 in. thick at the bottom, thinning to about 1.5 in. at the rim. It is supported on trunnions, and is geared for convenient turning by hand. The blast-pipe which enters the pot at the bottom is 6 in. in diameter.

Two roasting-furnaces and six converters are rated nominally as a 90-ton plant. This rating, however, is considerably in excess of the actual capacity, at least on certain ores. The time required for desulphurization in the converter apparently depends a good deal upon the character of the ore. The six converters may be arranged in a single row, or in two rows of three in each. They are set so that the rim of the pot, when upright, is about 12 ft. above the ground-level. A platform gives access to the pots. One man per shift can attend to two pots. His work consists in charging them, which is done by gravity, spreading out the charge evenly in the pot, closing any blow-holes which may develop, and at the end of the operation raising the hood (which covers the pot during the operation) and dumping the pot. The work is easy. The conditions under which it is done are comfortable, both as to temperature and atmosphere. Reports have shown a great reduction in liability to lead poisoning in the works where the "H.-H." process has been introduced.

A new charge is started by kindling a small wood or coal fire on the grate, then throwing in a few shovelfuls of hot calcines, and finally dropping in the regular charge of damp ore (plus the fluxes previously referred to). The charge is introduced in stages, successive layers being dropped in and spread out as the heat rises. At the beginning the blast is very low—about 2 oz. It is increased as the height of the ore in the pot rises, finally attaining about 16 oz. The operation goes on quietly, the smoke rising from the surface evenly and gently, precisely as in a well-running blast furnace. While the charge is still black on top, the hand can be held with perfect comfort inside of the hood, immediately over the ore. This explains, of course, why the volatilization of silver and lead is insignificant. There is, moreover, little or no loss of ore as dust, because the ore is introduced damp, and the passage of the air through it is at low velocity. In the interior of the charge, however, there is high temperature (evidently much higher than has been stated in some descriptions), as will be shown further on. The conditions in this respect appear to be analogous to those of the blast-furnace, which, though smelting at a temperature of about 1,200° C. at the area of the tuyeres, suffers only a slight loss of silver and lead by volatilization.

At the end of the operation in the "H.-H." pot, the charge is dull red at the top, with blow-holes, around which the ore is bright red. Imperfectly-worked charges show masses of well-fused ore, surrounded by masses of only partly altered ore, a condition which may be ascribed to the irregular penetration of air through the charge, affording good evidence of the important part which air plays in the process. A properly-worked charge is tipped out of the pot as a solid cake, which, in falling to the ground, breaks into a few large pieces. As they break, it appears that the interior of the charge is bright red all through, and there is a little molten slag which runs out of cavities, presumably spots where the chemical action has been most intense. When cold, the thoroughly desulphurized material has the appearance of slag-roasted galena. Prills of metallic lead are visible in it, indicating reaction between lead sulphide and lead sulphate.

The columns of the structure supporting the pots should be of steel, since fragments of the red-hot ore dumped on the ground are likely to fall against them. To hasten the cooling of the ore, water is sometimes played on it from a hose. This is bad, since some is likely to splash into the still inverted pot, leading to cracks. The cracked pots at certain works appear to be due chiefly to this cause, in the absence of which the pots ought to last a long time, inasmuch as the conditions to which they are subjected during the blowing-process are not at all severe. When the ore is sufficiently cold it is further broken up, first by driving in wedges, and finally by sledging down to pieces of orange size, or what is suitable for the blast-furnace. These are forked out, leaving the fine ore, which comes largely from the top of the charge, and is therefore only partially desulphurized. The fines are, therefore, retreated with a subsequent charge. The quantity is not excessive; it may amount to 7 or 8 per cent. of the charge.

The breaking up of the desulphurized ore is one of the problems of the process, the necessity being the reduction of several large pieces of fused, or semi-fused, material weighing two or three tons each. When done by hand only, as is usually (perhaps always) the practice, the operation is rather expensive. It would appear, however, to be not a difficult matter to devise some mechanical aids for this process—perhaps to make it entirely mechanical. When done by hand, a six-pot plant requires six men per shift sledging and forking. With 8-hr.

shifts, this is 18 men for the breaking of about 60 tons of material, which is about 3 1-3 tons per man per 8 hrs. With labor at 25c. per hour, the cost of breaking the fused material comes to 60c. per ton. It may be remarked, for comparison, that in breaking ore as it ordinarily comes, coarse and fine together, a good workman would normally be expected to break from 5 to 5.5 tons in a shift of 8 hrs.

The ordinary charge for the standard converter is about 8 tons (16,000 lb.) of an ore weighing 166 lb. per cu. ft. With a heavier ore, like a high-grade galena, the charge would weight proportionately more. The time of working off a charge is decidedly variable. Accounts of the operation of the process in Australia tell of charge-workings in from 3 to 5 hrs., but this does not correspond with the results reported elsewhere, which specify times of from 12 to 18 hrs. Assuming an average of 16 hrs., which was the record of one plant, six converters would have capacity for about 72 tons of charge per 24 hrs., or about 58 tons of ore, the ratio of ore to flux being 4:1. The loss in weight of the charge corresponds substantially to the replacement of sulphur by oxygen, and the expulsion of carbon dioxide. The finished charge contains, on the average, from 3 to 5 per cent. of sulphur. This is about the same as the result achieved in good practice in roasting lead-bearing ores in hand-worked reverberatory furnaces; but curiously the "H.-H." product, in some cases at least, does not yield any mattte, to speak of, in the blast-furnace,—the product delivered to the latter being evidently in such condition that the remaining sulphur is almost completely burned off in the blast-furnace. This is an important saving effected by the process. In calculating the value of an ore, sulphur is commonly debited at the rate of 25c. per unit, which represents approximately the cost of handling and reworking the matte resulting from it. The practically complete elimination of matte-fall rendered possible by the "H.-H." process, however, may not be an unmixed blessing. There may be, for example, a small formation of lead sulphide which causes trouble in the crucible and lead-wall; and results in furnace difficulties and the presentation of a vexatious between-product.

It may now be attempted to summarize the cost of the converting process. Assuming the case of an ore assaying lead, 50; of iron, 15; sulphur, 22; silica, 8, and alumina, etc., 5 per cent., let it be supposed that it is to be fluxed with pure limestone and pure quartz, with the aim to make a slag containing silica, 30; ferrous oxide, 40; and lime, 20 per cent. A ton of ore will make, in round numbers, 1,000 lbs. of slag, and will require 344 lbs. of limestone and 130 lbs., or, we may say roughly, one ton of flux must be added to four tons of ore, wherefore the ore will constitute 80 per cent. of the charge. In reducing the charge to 3 per cent. of sulphur it will lose ultimately through expulsion of sulphur and carbon dioxide (of the limestone) about 20 per cent. in weight, wherefore the quantity of material to be smelted in the blast-furnace will be practically equivalent to the raw-sulphide-ore in the charge for the roasting-furnaces, but in the roasting-furnace the charge is likely to gain weight, because of the formation of sulphates. Taking the charge, which I have assumed above, and reckoning that as it came from the roasting-furnace it will contain 10 per cent. of sulphur, all in the form of sulphate, either of lead or of lime, and that the iron be entirely converted to ferric oxide, in spite of the expulsion of the carbon dioxide of the limestone and the combustion of a portion of the sulphur of the ore as sulphur dioxide, the charge will gain in weight in the ratio of 1 : 1.18. This, however, is too high, inasmuch as a portion of the sulphur will remain as sulphide, while a portion of the iron may be as ferrous oxide. The actual gain in weight will consequently be probably not more than one-tenth. The theoretical calculation elsewhere will illustrate the changes.

Raw Charge.		Semi-Roasted Charge.		Finished Charge.	
ore	1,000 lb. Pb.	ore	1,154 lb. PbO.	ore	1,154 lb. PbO.
	300 lb. Fe.		428 lb. Fe_2O_3.		428 lb. Fe_2O_3 (?)
	160 lb. SiO_2.		160 lb. SiO_2.		160 lb. SiO_2.
	100 lb. Al_2O_3, etc.		100 lb. Al_2O_3, etc.		100 lb. Al_2O_3, etc.
	440 lb. S.		300 lb. S.		68 lb. S.
flux	130 lb. SiO_2.	flux	130 lb. SiO_2.	flux	130 lb. SiO_2.
	344 lb. $CaCO_3$.		193 lb. CaO.		193 lb. CaO.
	.....		450 lb. O.		.....
	2,474 lb.		2,915 lb.		2,233 lb.
			10 per cent. S.		3 per cent. S.

Ratios:
2,474 : 2,915 : : 1 : 1.18.
2,915 : 2,233 : : 1 : 0.76⅔.
2,474 : 2,233 : : 1 : 0.90.

It may be assumed that for every ton of charge (containing about 80 per cent. of ore) there will be 1.1 ton of material to go to the converter, and that the product of the latter will be 0.9 of the weight of the original charge of raw material.

Each converter requires 400 cu. ft. of air per min. The blast-pressure is variable, as different pots are always at different stages of the process; but assuming the maximum of 16 oz. pressure, with a blast main of sufficient diameter (at least 15 in.)

and the blower reasonably near the battery of pots, the total requirement is 21 h.p. The cost of converting will be approximately as follows:—

Labor: 3 foremen at $3.20. ..	$9.60
9 men at $2.50..	22.50
Power: 21 h.p. at 30c.	6.30
Supplies, repairs and renewals..	5.00
Total..	$43.40=60c per ton of charge

The cost of converting is, of course, reduced directly as the time is reduced. The above estimate is based on unfavorable conditions as to time required for working a charge.

The total cost of treatment from the initial stage to the delivery of the desulphurized ore to the blast-furnaces, will be, per 2,000 lbs. of charge, approximately as follows:—

Crushing, 1.0 ton at 10c..	$0.10
Mixing, 1.0 ton at 10c..	0.10
Roasting, 1.0 ton at 63c..	0.63
Delivering, 1.1 ton to converters at 12c..	0.13
Converting, 1.1 ton at 60c..	0.66
Breaking, 0.9 ton at 60c..	0.54
Total	$2.15

The cost per ton of ore will be $216÷80=$2.70. Making allowance for the crushing of the ore, which is not ordinarily included in the cost of roasting, and possibly some overestimates, it appears that the cost of desulphurization by this method, under the conditions assumed in this paper, is rather higher than in good practice with ordinary hand-worked furnaces, but it is evident that the cost can be reduced to approximately the same figure by introduction of improvements, as, for example, in breaking the desulphurized ore, and by shortening the time of converting, which is possible in the case of favorable ores. The chief advantage, however, must be in the further stage of the smelting. As to this, there is the evidence that the Broken Hill Proprietary Co., after the introduction of the Huntington-Heberlein process, was able to smelt the same quantity of ore in seven furnaces that formerly required thirteen. A similar experience is reported at Friedrichshutte. Silesia.

This increase in the capacity of the blast-furnace is due to three things: (1) In delivering to the furnace a charge containing a reduced percentage of fine ore, the speed of the furnace is increased, *i.e.*, more tons of ore can be smelted per sq. ft. of hearth-area. (2) There is less roasted matte to go into the charge. (3) Under some conditions the percentage of lead in the charge can be increased, reducing the quantity of gangue that must be fluxed.

It is difficult to generalize the economy that is effected in the blast-furnace process, since this must necessarily vary within wide limits because of the difference in conditions. An increase of from 60 to 100 per cent. in blast-furnace capacity does not imply a corresponding reduction in the cost of smelting. The fuel-consumption per ton of ore remains the same. There is saving in the power requirements, because the smelting can be done with a lower blast-pressure; also, a saving in the cost of reworking matte. Moreover, there will be a saving in other labor, in so far as portions thereof are not already performed at the minimum cost per ton. The net result under American conditions of silver-lead smelting can be determined closely only by extensive operations. That there will be an important saving, however, there is no doubt.

The cost of smelting a ton of charge at Denver and Pueblo, exclusive of roasting and general expense, is about $2.50, of which about $0.84 is for coke and $1.66 for labor, power and supplies. General expense amounts to about $0.16 additional. If it should prove possible to smelt in a given plant 50 per cent. more ore than at present without increase in the total expense, except for coke, the saving per ton of charge would be 70c. That is not to be expected, but the half of it would be a satisfactory improvement. With respect to sulphur in the charge, the cost is commonly reckoned at 25c. per unit. As compared with a charge containing 2 per cent. of sulphur there would be a saving rising toward 50c. per ton as the maximum. It is reasonable, therefore, to reckon a possible saving of 75c per ton of charge in silver-lead smelting, no saving in the cost of roasting, and an increase of about 3 per cent. in the extraction of lead, and perhaps 1 per cent. in the extraction of silver, as the net results of the application of the Huntington-Heberlein process in American silver-lead smelting.

On a charge averaging 12 per cent. of lead and 33 oz. of silver per ton, an increase of 3 per cent. in the extraction of lead, and 1 per cent. in the extraction of silver would correspond to 25c and 35c respectively, reckoning lead at 3.5c per lb., and silver at 60c per oz. In this, however, it is assumed that all lead-bearing ores will be desulphurized by this process, which practically will hardly be the case. A good deal of pyrites, containing only a little lead, will doubtless continue to be roasted in Bruckner cylinders, and other mechanical furnaces, which are better adapted to the purpose than are the lime-roasting pots. Moreover, a certain proportion of high-grade lead-ore, which is now smelted raw, will be desulphurized outside of the furnace, at additional expense. It is comparatively simple to estimate the probable benefit of the Huntington-Heberlein process in the case of smelting-works which treat principally a single class of ore, but in such works as those in Colorado and Utah, which treat a wide variety of ores, we must anticipate a combination process, and await results of experience to determine just how it will work out. It should be remarked, moreover, that my estimates do not take into account the royalty on the process, which is an actual debit, whether it be paid on a tonnage-basis or be commuted in the form of a lump sum for the license to its use.

However, in view of the immense tonnage of ore smelted annually for the extraction of silver and lead, it is evident that the invention of lime-roasting by Huntington and Heberlein was an improvement of the first order in the metallurgy of lead.

In the case of non-argentiferous galena, containing 65 per cent. of lead (as in southeastern Missouri), comparison may be made with the slag-roasting and blast-furnace smelting of the ore. Here no saving in cost of roasting may be reckoned, and no gain in the speed of the blast-furnaces is to be anticipated. The only savings will be in the increase in the extraction of lead from 92 to 98 per cent., and the elimination of matte-roasting, which may be reckoned as amounting to 50c. per ton of ore. The extent of the advantage over the older method is so clearly apparent that it need not be computed any further. In comparison with the Scotch-hearth bag-house method of smelting, however, the advantage, if any, is not so certain. That method already saves 98 per cent. of the lead, and, on the whole, is probably as cheap in operation as the Huntington-Heberlein could be under the same conditions. The Huntington-Heberlein method has replaced the old roast-reaction method at Tarnowitz, Silesia, but the American Scotch-hearth method, as practiced near St. Louis, is likely to survive.

A more serious competitor, however, will be the Savelsberg process, which appears to do all that the Huntington-Heberlein process does, without the preliminary roasting. Indeed, if the latter be omitted (together with its estimated expense of 63c. per ton of charge, or 79c. per ton of ore), all that has been said in this paper as to the Huntington-Heberlein process may be construed as applying to the Savelsberg. The charge is prepared in the same way, the method of operating the converters is the same, and the results of the reactions in the converters are the same. The litigation which is pending between the two interests, Messrs. Huntington & Heberlein claiming that Savelsberg infringes their patent, will be, however, a deterrent to the extension of the Savelsberg process until that matter be settled.

The Carmichael-Bradford process may be dismissed with a few words. It is similar to the Savelsberg, except that gypsum is used instead of limestone. It is somewhat more expensive, because the gypsum has to be ground and calcined. The process works efficiently at Broken Hill, but it can hardly be of general application, because gypsum is likely to be too expensive, except in a few favored localities. The ability to utilize the converter-gases for the manufacture of sulphuric acid will cut no great figure, save in exceptional cases, as at Broken Hill; and, anyway, the gases of the other processes can be utilized for the same purpose, which is, in fact, being done in connection with the Huntington-Heberlein process in Silesia.

The cost of desulphurizing a ton of galena-concentrate by the Carmichael-Bradford process is estimated by the company controlling the patents as follows, labor being reckoned at $1.80 per 8 hrs., gypsum at $2.40 per 2,240 lbs., and coal at $8.40 per 2,240 lbs.:—

0.25 ton of gypsum	$0.60
Dehydrating and granulating gypsum	0.48
Drying mixture of ore and gypsum	0.12
Converting	0.24
Spalling sintered material	0.12
0.01 ton coal	0.08
Total	$1.64

The value of the lime in the sintered product is credited at 12c., making the net cost $1.52 per 2,240 lbs. of ore.

The low cost allowed for converting may be explained by the more rapid action that seems to be attained with the ores of Broken Hill than with some ores that are treated in North America, but the low figure estimated for spalling the sintered material appears to be highly doubtful.

The theory of the lime-roasting processes is not yet well established. It is recognized that the explanation offered by Huntington and Heberlein in their original patent specification is erroneous. There is no good evidence in the process, or any other, of the formation of the higher oxide of lime, which they suggest.

At the present time there are two views. In one, formulated most explicitly by Professor Borchers, there is formed in this process a calcium plumbate, which is an active oxidizing agent. A formation of this substance was also described by Carmichael in his original patent; but he considered it to be the final product, not the active oxidizing agent.

In the other view, the lime, or limestone, serves merely as a diluent of the charge, enabling the air to obtain access to the particles of galena, without liquefaction of the latter. The oxidation of the lead sulphide is therefore effected chiefly by the air, and the process is analogous to what takes place in the Bessemer converter or in the Germot process of smelting, or perhaps more closely to what might happen in an ordinary roasting-furnace, provided with a porous hearth, through which the air-supply would be introduced. Roasting-furnaces of that design have been proposed, and, in fact, such a construction is now being tested for blende-roasting in Kansas.

Up to the present time, the evidence is surely too incomplete to enable a definite conclusion to be reached. Some facts, however, may be stated.

There is already reaction to a certain extent between lead sulphide and lead sulphate, as in the reverberatory smelting-furnace, because prills of metallic lead are to be observed in the lime-roasted charge.

There is a formation of sulphuric acid in the lime-roasting, upon the oxidizing effect of which

Savelsberg lays considerable stress, because its action is to be observed on the iron-work in which it condenses.

Calcium sulphate, which is present in all of the processes, being specifically added in the Carmichael-Bradford, evidently plays an important chemical part, because not only is the sulphur trioxide expelled from the artificial gypsum, but also it is to a considerable extent expelled from the natural gypsum, which is added in the Carmichael-Bradford process; in other words, more sulphur is given off by the charge than is contained by the metallic sulphides alone.

Further evidence that lime does, indeed, play a chemical part in the reaction is presented by the phenomena of lime-roasting in clay dishes in the assay-muffle, wherein the air is certainly not blown through the charge, which is simply exposed to superficial oxidation, as in ordinary roasting.

The desulphurized charge dropped from the pot is certainly at much below the temperature of fusion, even in the interior, but we have no evidence of the precise temperature conditions during the process itself.

Pyrite and even zinc-blende in the ore are completely oxidized. This, at least, indicates intense atmospheric action.

The papers by Borchers,[4] Doeltz,[5] Guillemain[6] and Hutchings[7] may profitably be studied in connection with the reactions involved in lime-roasting. The conclusion will be, however, that their precise nature has not yet been determined. In view of the great interest that has been awakened by this new departure in the metallurgy of lead, it is to be expected that much experimental work will be devoted to it, which will throw light upon its principles, and, possibly, develop it from a mere process of desulphurization into one which will yield a final product in a single operation.

McGILL MINING SOCIETY.

A meeting of the McGill Mining Society was held in the McDonald Mining Building, on Friday, November 23rd, at 8.15 p.m.

The lecturer of the evening was Dr. F. D. Adams, F.G.S.A., F.R.S.C., Vice President of the Canadian Mining Institute, who gave a most interesting and instructive talk on "The Undeveloped Mineral Resources of the Dominion."

He first remarked how really important the mineral development of Canada is, being equivalent in value last year to two-thirds of our total agricultural exports. He pointed out that in the last twenty years the mineral production of Canada had increased over 600 per cent

Dr. Adams then took up our six most important mineral products beginning with coal and passing successively to gold, nickel, copper, silver and iron. He spoke first of the coal fields being worked in Nova Scotia and British Columbia, noticing that in the fields now being worked there are enormous reserves of coal, and then indicated the position and extent of other great coal fields, more particularly in the western part of the Dominion, which while they contained enormous supplies of mineral fuel remained as yet untouched by the miner.

Proceeding to the different metals he gave a short sketch of the chief places where they are found at present and indicated where, in all probability, our reserves will be discovered in future. He next took up our cement industries, mentioning the immense demand that was springing up for this material in all kinds of construction work and concluded by discussing the probability of diamonds being found in our Huronian rocks to the north.

A few minutes were taken up in the discussion of various points.

A hearty vote of thanks was then given to Dr. Adams and the meeting adjourned.

The audience numbered 125, consisting of members and their friends.

The next meeting of the society will be held in the McDonald Mining Building on Friday, January 11th, at 8.15 p.m., when Mr. Fritz Circle, E.M., will lecture on "Concentrating and Concentrating Plants."

All those who are interested are cordially invited to attend.

FROM THE BOUNDARY.

At the annual general meeting of the Granby Consolidated Mining, Smelting & Power Co., Ltd., at the company's New York office, 52 Broadway, the following financial statement was submitted to the shareholders for the year ending June 30, 1906, by George W. Wooster, the treasurer:—

Produced.

10,939,004 lbs. copper fine, sold at average price of $0.1778.

316,947 ounces silver, sold at average price of $0.6468.

50,020 ounces gold, sold at average price of $20.00.

Total amount realized, $4,751,058.69.

Cost.

Working expenses at mines and smelter, freight, refining, selling and general expenses	$2,697,164.81
Foreign ores purchased	230,276.83
	$2,927,441.64

Cost per ton of ore, including all expenses, $3.2988.

Net cost per pound of copper, after deducting values of gold and silver, $0.0835.

Surplus carried over from previous year	$1,554,875.27
Net profit for the year ending June 30, 1906	1,823,617.05
	$3,378,492.32
Less—	
Exploring expenses	$ 20,753.71
Dividends paid	810,000.00
	$ 830,753.71
Net surplus, June 30, 1906	$2,547,738.61

There has been expended in new construction, equipment at the mines, smelter and converter plants, etc., $105,075.14. For additional mining properties, $350,480.25. A total of $456,460.39.

[4] *Metallurgie*, 1905, II, No. 1, 1-6; *Engineering and Mining Journal*, Sept. 2, 1905, 398.

[5] *Metallurgie*, 1905, II, No. 19, 460-463; *Engineering and Mining Journal*, Jan. 27, 1906, 726.

[6] *Metallurgie*, 1905, II, No. 18, 433-443; *Engineering and Mining Journal*, March 10, 1906, 470.

[7] *Engineering and Mining Journal*, Oct. 21, 1905, 726.

The Big Vein on Portage Island, Chibougamau.

Shaft of a Cobalt mine from which much ore has come.

All development work, repairs and renewals have been charged to working expenses.

Mine development, 8,698 lineal feet.

Diamond drilling development, 11,505 lineal feet.

Granby ore smelted, 796,188 dry tons.

Foreign ore smelted, 36,158 dry tons.

Assets—June 30, 1906.

Cost of land, real estate, machinery, buildings, dwellings, and equipment	$14,859,044.22
Stocks, bonds and bills receivable	45,429.32
Cash and copper on hand	1,023,833.96
Fuel and store supplies	187,334.38
Total	$16,151,641.88

Liabilities.

Capital stock	$15,000,000	
In treasury	1,500,000	
Issued stock		$13,500,000.00
Accounts payable, current for month		102,466.87
Dividends collected on liquidator shares		1,436.40
Surplus		2,547,738.61
Total		$16,151,641.88

In his address to the shareholders President Jacob Langeloth referred with deep regret to the death, which occurred in February last, of John Stanton, one of the board of directors of the company. He stated that the tonnage output had largely increased in the last fiscal year, amounting to an increase of over 40 per cent. over the previous year. Briefly, he referred to the chief events of the year in the operations of the company, paying a high compliment to the local management for the way the emergency was met last winter when one of the huge ore crushers was burned, which was done without largely decreasing current production. In view of the higher price of copper ruling since last fall, it has been deemed wise to mine large quantities of ore carrying a smaller percentage of copper than the average run of the mines. Active work had been going on continually and large bodies of ore had been opened up by diamond drills in the Victoria and Aetna claims, where a new shaft is now being sunk and the necessary improvements installed for crushing and shipping this output, the first shipment from this outlet probably to be made at the end of this year.

He stated that development of the Gold Drop group, purchased a year ago, proved satisfactory, and for some months ore shipments from this part of the Granby group averaged over 200 tons per day. A tunnel is being pushed towards the Monarch property, owned by the company, also opening up satisfactory ore bodies. The length and width is not yet fully determined, but indications point to large bodies of ore, a considerable portion of which will soon be available for hoisting. These developments, Mr. Langeloth stated, have largely increased the tonnage of ore in sight over that extracted last year.

Further economies had been effected in practically every department, again resulting in great savings, and the board had felt justified in the payment of two three per cent. dividends, amounting together to $810,000, another one of three per cent. having meanwhile been paid on September 15 last.

Ex-senator Warner Miller, of New York, president of the Dominion Copper Co., Ltd., whose chief mines are located in this camp, has just sent a communication to shareholders, regarding the status of the corporation, the progress made since the present company took hold a year ago, and the favorable statement of the company as at July 31, 1906. Mr. Miller states that the work of pushing development has been steadily pursued under the supervision of the consulting engineer, M. M. Johnson, and that the Idaho and Rawhide mines are now in a position to furnish the additional tonnage necessary when the new furnace at the smelter goes into commission, thus doubling the output to 1,200 or 1,400 tons of ore daily. He also tells of the saving that will be made by the substitution of electricity for steam, shortly, the difference being as $30 per h.p. per annum is to $135, and resulting in an estimated saving of $100,000 per annum to the company in this one item alone.

The new giant furnace referred to, said to be the largest ever erected in British Columbia, has been shipped from the manufacturers in the east, and will be installed as soon as it arrives. Its capacity is to be about 800 tons per day, and by reason of labor saving and other devices it will, it is expected, make a saving of 20 per cent. in fuel, or an estimated saving of $100 per day. A new contract for converting the matter, the president states, will reduce the cost of this work about 25 per cent.

For the eight months that the company's smelter has been in blast—part of the time when one furnace—from December 31st, 1905, to July 31st, 1906, which has been largely a period of construction and development, 133,084 tons of ore were smelted, producing 3,220.89 tons of matte, having a total value of $640,128.97. The total operating cost, mining, smelting, marketing, etc., was $500,984.93, leaving a net profit for the eight months of $139,144.04.

President Miller also states that the results of the economies already introduced are beginning to be reflected in the company's earnings, the operations for the month of July producing earnings of $31,431.70. On this basis, the net profits of the present smelter for 12 months would exceed $300,000. As the new furnace will double the capacity of the plant and more, and with more economies yet to be put into effect, it is believed that the cost of producing copper can be reduced to not over eight cents per pound. The company has taken options on a number of claims in the district, and is now engaged in prospecting and exploring these properties, with a view to purchasing such as may prove valuable to the company.

Following is the balance sheet of the company, dated July 31, 1906:—

Assets.

Mines, smelter and other properties, including beneficial interest in certain of this company's stock, acquired under a plan of re-organization. Costs as of 31st July, 1905, including expenses of re-organization		$3,744,312.79
Additions since:—		
Smelter equip., etc.	$49,278.66	
Mine dev. and equip.	78,407.71	
Real estate, B.C.	3,975.00	
Miscellaneous	312.00	
		130,973.37
		$3,875,286.16
Stocks and shares		1,792.50
Office furniture, N.Y. and B.C.		740.00
Stores and fuel on hand		38,085.37
Sundry debtors:—		
B. C. Copper Co. matte	$117,476.50	
Mis. N.Y. and B.C.	3,013.06	
		120,489.56
Cash in banks and on hand:—		
New York	$17,789.93	
British Columbia	18,114.60	
		35,904.53
Total assets		$4,072,298.12

Liabilities.

Capital stock, auth., $5,000,000, 500,000 shares, $10 each.		
Whereof issued		$3,200,037.00
320,003, 7-10 shares at $10 each.		
First mortgage, 6 p.c., due July 1, 1915, $1,000,000.		
Whereof issued		700,000.00

Sundry creditors:—		
Open accounts, N.Y., B.C.	$61,371.66	
Res. Ins., taxes	3,573.84	
Bond int., coup. uncol.	1,440.00	
Bond int. accrued	7,000.00	
Surplus accounts:—		
		73,885.50
Profit 8 months' oper. to date		98,875.62
Total		$4,072,298.12

Operating Account, Dr.

Mine operating accounts:—		
Operating expenses	$203,875.29	
Freight on ore	32,263.29	
		$236,021.58
Ore purchased		3,315.58
Smelter operating expenses:—		
Sample mill	$ 12,005.39	
Blast furnace	164,657.53	
Slag railway	10,457.08	
Power and light	20,571.26	
Pumping	2,227.77	
General expenses	1,370.11	
		211,289.14
General expenses, B.C.:—		
General	$10,718.25	
Office	5,015.36	
Laboratory	4,077.51	
Travelling	1,445.85	
		21,256.97
Matte freight		418.66
Salaries, offices, etc.	$11,537.24	
Professional services	11,358.75	
Travelling	2,408.78	
Rent N.Y. offices	520.00	
General office expenses	4,323.12	
		30,147.89
Bal. profit 8 months' operation		139,593.33
		$ 641,593.33

Profit and Loss Account, Dr.

Interest on 6 p.c. mortg. bonds	$ 42,545.26
Exchange	128.78
Bal. being profit, car. to bal. sheet	98,875.62
	$141,549.66

Cr.

Sales of matte	$640,128.97
Rents	1,464.36
	$641,593.33

Year to July, 1906, Cr.

Profit, operation acc., brot. down	$139,144.04
Interest bank deposits	2,405.62
	$141,549.66

The suitability of the Potter process for the recovery of zinc, from the tailings of any given ore, may be ascertained in the laboratory by placing a small portion of the ore in a large test tube, and adding about three or four times its bulk of a solution of sulphuric acid in water (containing say 2½ per cent. of the acid) and heating the mixture to about 190 degrees Fahrenheit. The sulphides will be seen to rise to the surface of the liquid as a scum whilst the gangue will be left at the bottom of the test tube.

MINERAL OUTPUT OF CALIFORNIA.

State Mineralogist Lewis E. Aubury, has issued from the State Mining Bureau a tabulated sheet showing the output in amounts, values and by counties of the mineral products of California, for the year 1905. This appears somewhat later than usual as the records of many companies were destroyed in the great fire and it took a longer time to get corrected addresses and obtain the desired information.

The following table shows the yield and value of mineral substances of California for the year 1905, as per returns received at the State Mining Bureau, San Francisco, in answer to inquiries sent to producers:—

	Quantity.		Value.
Asbestos	112	tons	$ 2,625
Asphalt	40,304	"	285,290
Bituminous Rock	24,753	"	60,436
Borax	46,334	"	1,019,158
Brick	286,618	M	2,273,786
Cement	1,265,553	bbls.	1,791,916
Chrome	40	tons	600
Clay	133,805	"	130,146
Coal	46,500	"	144,500
Copper	16,997,489	lbs.	2,650,605
Fuller's Earth	1,344	tons	38,000
Gems			148,500
Glass Sand	9,257	tons	8,121
Gold			19,197,043
Granite	228,738	cu. ft.	353,837
Gypsum	12,850	tons	54,500
Infusorial Earth	3,000	"	15,000
Lead	533,680	lbs.	25,083
Lime	616,995	bbls.	555,322
Limestone	192,749	tons	323,325
Lithia Mica	25	"	276
Macadam	1,440,455	"	942,503
Magnesite	3,933	"	16,221
Marble	73,303	cu. ft.	129,450
Mineral Paint	754	tons	4,025
Mineral Water	2,194,150	gals.	538,700
Natural Gas	148,345	M. cu. ft.	102,479
Paving Blocks	3,408	M.	134,347
Petroleum	34,275,701	bbls.	9,007,820
Platinum	200	oz.	3,320
Pyrites	15,503	tons	63,958
Quicksilver	24,655	flasks	886,081
Rubble	1,183,802	tons	774,267
Salt	77,118	"	141,925
Sandstone	302,813	cu. ft.	483,268
Silver			678,494
Slate	4,000	squares	40,000
Soapstone	300	tons	3,000
Soda	15,000	"	22,500
Tungsten		"	18,800
Total value			$43,069,227

The total yield of metallic substances, including gold and silver, was, for the year, $23,523,984 and in these are also copper, quicksilver, chrome, lead, pyrites, platinum and tungsten. This is the first year the latter substance has been produced in California.

IN GAY NEW YORK.

The following from "Bulls and Bears," may serve to beguile an idle ten minutes:

The Nipissing sensation which has been convulsing the Curb market has proved of sufficient size to excite the whole financial district. The sharp tongue of gossip is busy with the affair and everybody is trying to get at its true inwardness.

Stated in briefest phrase a syndicate headed by Daniel and Murray Guggenheim obtained from Captain Joseph De La Mar, Ellis P. Earle, E. C. Converse, and Ambrose Monell an option on 400,000 shares of Nipissing stock at $25 a share. This option was secured about the middle of October and was exercised the first day of November, upon which date the Guggenheim syndicate paid $2,500,000, the first of four instalments of $2,500,000 each, due at in-

tervals of thirty days. The vendors held 60,000 shares as a forfeit. Immediately after announcement was made that the Guggenheims had bought one-third of the capital stock of the company on a basis of $30,000,000 for the entire issue the stock jumped from $25 a share to $34 a share amid great excitement and heavy trading. A few days before the second instalment fell due vague hints began to circulate that something was wrong with the title to the property; that ore taken from the lower workings was disappointing and that the Guggenheims were likely to abandon the deal. The management of the mine heard of these things and ran most of the rumors down to 71 Broadway, the building in which the Guggenheims have their offices. When approached for information the Guggenheims refused to say anything.

Up to within a few minutes before the close of the market Saturday the vendors and the Nipissing management were led to believe that the Guggenheims would make the second payment of $2,500,000 before twelve o'clock. Announcement to the contrary was not made until late in the afternoon, hours after the market and the banks had closed.

Meanwhile the price of Nipissing had broken from the high point of 34 down through 20 and yesterday it had a further slump to 15½, an apparent or paper loss on the whole capitalization of $22,000,000. Of course, no such loss in real money actually occurred, as about 700,000 out of the 1,250,000 shares still remain in the hands of the original Nipissing syndicate, which stock cost them at the beginning $2 a share, that being about the bed rock cost price to which was subsequently added something like $2 a share for promotion profits, commissions and inside graft of one sort and another.

It is reasonably certain that the Guggenheims while apparently out anywhere from $400,000 to $750,000 made up this loss by selling the market on the way down. They were not born yesterday. There is a report current on the Curb that they sold about 50,000 shares within two or three points of the top. It is noted in this connection that the Street was full of wild tips about that time that the stock would presently sell at $50 a share. Many speculators who were proud to be enrolled in the Guggenheim following bought Nipissing stock freely above 30. These devoted followers and the general public are the unlucky ones who were stung on the decline, and who lost real money. They may have suffered to the extent of $2,500,000 to $4,000,000. The rest of the shrinkage can properly and legitimately be put under the head of "paper losses."

The reputation of the Guggenheims has not been benefited by this Nipissing fiasco. For twenty years or more they have been in the business of smelting and refining ores and of developing mining properties. In the last named branch of their business they had achieved a reputation of driving sharp bargains. Their enemies called them mining "pawn brokers."

Nobody gives serious consideration to the plea that they discovered 45 days after getting the option, and 30 days after paying the first instalment of $2,500,000 thereon, that the title was defective. They had been buying properties for twenty years and are keenly alive to the necessity of having a clean bill of health on everything they touch. They never became immensely rich, paying $2,500,000 as an initial instalment on properties about which there could be a shadow of a doubt in title, at least, not with the astute "Sam" Untermeyer at their elbow. The fact is the Guggenheims were stung by the Cobalt Bug and while under the delirious influence of the virus took over at a high figure an option on a mining property, and afterwards regretted the bargain. The price might not have been extravagant, but it signalized a new departure by the Guggenheims. In the gray dawn of the morning after they wished they had not done it and immediately set about devising a means of escape.

The abandonment of the option was the result. But it was no sudden impulse that led to this finale; it was the deliberate judgment of shrewd mining men that they had possibly overstepped the bounds of strict pawnbroker prudence in agreeing to pay $10,000,000 for a third interest in a mining novelty—a strictly "tender-foot" proposition. The property might be worth more than they gave for it three-fold or five-fold, but they had made a venture, which, on cold reflection, did not strike them as being altogether in line with their past policy.

The course of Nipissing mining stock on the Curb during the last two weeks savors of stock rigging not in keeping with the high reputation hitherto borne by the Guggenheims. Their skirts may be clear of any connection with the jobbery but the trail leads unpleasantly close to their doors.

A mephitic and penetrating odor envelops the whole affair so far as it relates to Broad and Wall Streets—and Broadway.

It must be borne in mind, however, that the real value of the Nipissing mine has not in the slightest degree been affected. The management will continue to take out ore and convert it into money and dividends. On the other hand, the Guggenheims officially announce that so far as they are concerned the incident is closed, and that they are engaging themselves in the mining and smelting business. Furthermore, they deprecate the prevailing speculative craze in mining stocks and hope that the people will recover soon from the malady.

It is stated on high authority that on Thanksgiving Day John Hays Hammond wired from Cobalt to the Guggenheims that in his opinion Nipissing mine was better than ever but advising not to pay the second instalment until he could see them. This despatch adds another chapter to the mystery, and will still further arouse curiosity as to what was really behind the job which reached its sensational climax yesterday.

It is stated that fourteen cars loaded with ore from the Nipissing mine have been awaiting an opportunity to be treated at the Guggenheim Perth Amboy works for several days. This item is given for what it is worth and without comment.

COBALT SHIPMENTS.

The shipments of ore from the Cobalt District for the month of November consisted of 27 carloads, making in all, 1,449,580 lbs.

Nipissing mine, 4 shipments (199,720) lbs.) of carload each to New York.

Buffalo mine, 6 carloads (280,000) lbs.) to Perth Amboy.

La Rose mine, 8 shipments (495,000 lbs.) to New York.

Trethewey mine, 2 shipments (106,770 lbs.) to Perth Amboy.

Coniagas mine, 3 shipments to Perth Amboy and 1 shipment to Bergen Junction, in all 240,000 lbs.

Foster mine, 1 shipment (47,000 lbs.) to Bergen Junction.

Green Mehan mine, 1 shipment (84,050 lbs.) to Bergen Junction.

Nova Scotia mine, 1 shipment (47,040 lbs.) to New York.

BOOK REVIEWS.

The School of Mines Quarterly for November contains the second part of a paper on North American Index Fossils, by Messrs. A. W. Grabau and H. W. Shimer.

The following publications have been received:—

The Production of Bismuth in 1905, by C. C. Schnatterbeck.

The Production of Copper in 1905, by C. C. Schnatterbeck.

The Translations of the Engineering Society, School of Practical Science, Toronto, contains some interesting papers on Electrolytic Assaying, by H. E. T. Haultain; Notes on Pumping Conditions, by W. S. Pardoe; Cobalt Mines, by W. J. Blau, and a sympathetic history of the life of the highly popular Professor of Applied Chemistry, Dr. W. Hodgson Ellis.

The following publications, issued by the United States Geological Survey, have been received:—

The Production of Lead in 1905, by Charles Kirchhoff.

The Production of Borax in 1905, by Charles G. Yale.

The Production of Nitro-gas in 1905, by W. T. Griswold.

The Production of Bauxite and Aluminum in 1905.

We are in receipt of a Bulletin of the Geological Society of America, being pages 329-376 of Vol. 17. It deals with The Okanagan Composite Batholith of the Cascade Mountain System, the author being Reginald A. Daly. Mr. Daly sums up the result of his investigations in this region, by saying: "The problems of the Okanagan composite batholith illustrate once again, and on a large scale, the utmost dependence of a sound petrology upon structural geology. A suggested chief problem involves the relation of mountain-building to the repeated development of large bodies of superheated magma only a few miles beneath the surface of the mountain range. The fact of this association is apparent; its explanation is not here attempted.

The papers and addresses read and made, during the Eighth Annual Session of the American Mining Congress at El Paso, Texas, in November, 1905, have been issued in pamphlet form.

The volume includes papers on The Federal Government and the Mining Industry; the Geological Survey Coal Testing Plant; Forest Reserves and the Mining Industry; the Zinc Industry in the Rocky Mountain region; the Geological Survey and State Mining Bureau; Mine Drainage Districts; a Remedy for Inaccurate Patent Surveys; the Present State of Metallurgy of purely Silver Ores, (reproduced in the present issue), and other papers that will be found of interest to all connected with the mining industry. It is published at the office of the Secretary, Denver, Colo.

The sixth annual edition of the Copper Handbook, the only publication devoted exclusively to the copper industry, has been issued, being several months later than usual in appearance, owing to the sickness of the author, last spring, but matter of much later date has been used than in preceding issues, so that the book is as nearly up-to-date as its predecessors, and far more bulky and exhaustive in its treatment of the manifold phases of an industry that is world-wide in scope.

The Copper Handbook is encyclopaedic in scope, but is written throughout in plain language, easily understandable by those lacking a technical education. The work begins with a chapter on the history of copper followed by articles on the geology, chemistry, mineralogy, metallurgy and uses of the metal, with eight chapters devoted to condensed descriptions of the known copper deposits of the globe. A glossary of mining terms will be found useful to all readers not thoroughly conversant with practical mining, milling and smelting. The statistics of the copper trade and of copper share finances are covered in forty pages of highly condensed and accurate tables.

The major portion of the book is devoted to a chapter describing all known copper mines of the world, and listing every copper mining company of importance. This chapter is arranged alphabetically, by titles, rendering it self-indexing, and saving more than 50 pages of double-column index that otherwise would be required to merely give the titles of the 4,626 mines and companies listed in the book, there being 777 more titles than in the preceding annual edition. The descriptions range in length from two lines, in the case of unimportant, old and idle properties to nearly sixteen pages in the case of the Calumet & Hecla, a mine that employs seven thousand men and will have paid one hundred million dollars in dividends by April next.

The publisher makes the unusual offer of sending this book, on a week's approval, fully prepaid, to any address in the world, without any advance payment. This offer has been made for six years past, and the publisher states that of the many thousands of books so sent out less than three per cent. of the books retained remain unpaid for, the percentage of loss, on this plan of unlimited credit, being less than the average allowed by most business houses maintaining credit bureaus, which speaks well for the inherent honesty of the average man when put upon honor.

The Copper Handbook, Vol. VI, for 1906, issued Oct. 15th, 1,116 pages, octavo, brevier type; $5 in buckram binding, with gilt top, $7.50 in full library morocco, full gilt, Horace J. Stevens, editor and publisher, 278 Post Office Block, Houghton, Michigan.

PERSONALS.

W. H. Woodin, vice-president of the American Car & Foundry Company, will be elected to the board of the McKinley-Darragh-Savage Company at the meeting to be held this week.

A despatch from Cobalt says:—John Hays Hammond, the prospective president of the Nipissing Mines Company, arrived in Cobalt yesterday in a private car. It is expected he will remain a week in the camp and make a thorough inspection of the Nipissing.

MINING NOTES.

NOVA SCOTIA.

The Nova Scotia Steel and Coal Co. are preparing to add another blast furnace to their plant at Sydney Mines early next spring, which will enable them to produce about four hundred tons of pig iron per day. At present no ore is being smelted on account of the extensive repairs which are being made to the furnace, and which will not be completed before the latter part of December. The repair work, however, is being rushed, three shifts of bricklayers being kept constantly employed.

The rupture between the D. I. and S. S. Co. and the Dominion Coal Co. will keep all the collieries of the Nova Scotia Coal Company rushed all winter as a large percentage of the coal supply of the big syndicate company will be obtained here.

QUEBEC.

Mr. Rodolphe Forget, M.P., has for some time been in communication with the Bagnell Electric Company, of Cleveland, Ohio, in regard to the magnetic ore to be found at Bay St. Paul, and after sending their experts to Bay St. Paul they have purchased extensive property owned by Mr. E. H. Duval, of Levis, for the sum of $25.000. It is stated that operations on a very large scale will be commenced in the early spring, and several hundred men will be employed at the start. The proposed plant will be for the purpose of treating the magnetic ore, which exists at St. Urbain in the rear of Bay St. Paul. It may be said that some forty capitalists spent over three hundred thousand dollars developing these same mines, but as they did not have the proper machinery they were obliged to give up the enterprise.

A company is being formed for the purpose of developing 40,000 horse-power on the Quinze River, at the head of Lake Temiskaming. The power will be used for mining purposes in the Cobalt region, which is only eighteen miles away, and also for lighting purposes, and for an electric railway to run from New Liskeard to the source of the power, and thence to the foot of Quinze Lake, on which it is proposed to run a line of steamers to forward supplies for the construction of the Grand Trunk Pacific. Steamers will also ply on Lake Expanse.

There will also be ample power to operate a large pulp and saw-milling industry, to be established on the Quinze River. The surrounding country for over 300 miles square is a rich spruce forest, and the wood is easily accessible from the waters of the Upper Ottawa.

The names mentioned in connection with the undertaking are F. L. Wanklyn, vice-president of the Dominion

Coal Co.; Sturley Ogilvie, one of the directors of the Ogilvie Milling Co.; J. J. McFadden, lumberman, Sault Ste. Marie; John Ferguson, Renfrew; A. Barnett, Renfrew; James B. Klock, Montreal; Rinaldo McConnelly, of Ottawa, and P. J. Loughrin, of Toronto. Mr. Loughrin is for the present acting as secretary and will furnish any additional information that may be required.

ONTARIO.

A strong evidence of the wisdom with which the Ontario Government and the Railway Commission have dealt with the problem presented by the Temiskaming and Northern Ontario Railway is seen in the profits which that young road is already reaping, and the prophesy that it will pay a handsome revenue to the Provincial Treasury at the close of the year. For September the total earnings were $43,428, and the expenses were $31,816, leaving a net profit of $11,612. The cost of operation was thus about 73.3 per cent. of the gross receipts instead of the usual average of between 50 and 53 per cent. The reason for this was that several items which might have been charged to construction or capital account were included in the cost of operation. The commission has been undertaking the elevation of curves and the ballasting of the line. In addition the repairs to locomotives were added to the bill of cost, as were the charges for advertising at the Toronto and Ottawa fairs.

For the period of 1906, ending on Sept. 30, the gross earnings were $388,300, the expenses aggregated $243,789, and the net profits were $144,511. For a slightly shorter period in 1905 the net receipts were $71,342. At the same time the mileage travelled by trains on the road, which has been extended to Englehart, has risen from 12,030 miles in 1905 to 23,344 in 1906.

COBALT.

The White Silver Mining Co., better known under the name of Hargraves, has disposed of 120 acres of its holdings in the Kerr Lake district. The purchasers were Thomas Nevin & Sons, who, it is thought by some are acting for the United Exploration Co.

A despatch from Cobalt says:—The White Silver Company has disposed of 160 acres of its holdings in the Kerr Lake district, where they have parted with 120 acres to Thomas Nevins & Sons, who are thought by some to have been acting for either the United Cobalt Exploration Company or the Colonial. The property consists of three 40-acre claims, one of which adjoins the Drummond. They all lie in the third and fourth concessions, not far from the Jacobs, and brought a high figure.

An appeal has been entered in the Divisional Court on behalf of Alex. Cavanagh, a broker of Toronto, from a judgment of Chancellor Boyd, given at the non-jury trial last September, in favor of the defendant Glendinning in an action brought by Cavanagh for a commission on the sale of Cobalt property, known as the Cross Lake property. The plaintiff claimed ten per cent. commission on a selling price of $250,000, while the defendant maintains the commission was to be only five per cent.

Hon. F. R. Latchford, in discussing the Cobalt mining situation, has said he believed there was danger to the public and to the welfare of the country in the floating of numerous companies for speculative purposes. "They advertise extensively, and although the statements in these advertisements may not be exactly false, they are often misleading and extravagant."

"What is the prospect for the treatment of ore in this country next summer?" he was asked.

"That seems to be rather uncertain yet, so far as I know," he replied. "It would be a great boon if it could be brought about. The miners would get from $1,000 to $3,000 a carload more for the ore shipped. They get nothing now for the nickel arsenic and cobalt contained in the ore, and these are all valuable minerals."

At the last meeting of the Trethewey directors an interim dividend of 4 per cent. was declared. It is said to be the intention to pay this quarterly. The control of the company having changed hands, Messrs. W. G. Trethewey and F. W. Strathy retired from the board. Col. A. M. Hay and S. A. Wickett were elected in their stead and appointed president and vice-president respectively. The directorate otherwise remains as before, comprising Messrs. W. E. Carter, S. W. Black, and Ald. J. H. McGhie. The financial report showed 100,000 shares of stock in the treasury, a substantial amount of cash on hand, and returns from the last car shipment of $36,000. To pay the interim dividend $40,000 will be required. The plant is hitched to 185 horse-power and giving splendid results, according to the statement of the former president, Mr. W. G. Trethewey.

While it is proper to caution Ontario people against Cobalt investment, there is no reason they should be scared out of the market by wholesale warnings, says the editor of the Ottawa Citizen. If they had not been overcautious and incredulous during the past eighteen months they might have made a lot of money. Now the Americans are coming in and buying large interests in the camp and the cry will eventually go up that they have got everything and Canadians have got none of it. Meantime the Canadians who use good business judgment and enterprise stand no ordinary chance of making money. There is just the danger that the clamor of warning to the fool against being parted from his money may deter the men who have the brains and capacity to make money from taking advantage of the opportunity of a lifetime. Such men should go to Cobalt, examine into the opportunities and act accordingly.

The following official statement has been given out, signed by Mr. W. H. Blake, regarding the Foster mine:—The directors of the Foster Cobalt Mining Company have received the return of the first car of ore shipped by them. The net amount is $26,070.98. As there were a good many misstatements as to the value of the car, they think it well to make these figures public, but as cars grade very differently, do not intend in the future, unless it seems advisable, to make announcements with respect to other shipments. It might be misleading rather than the reverse to do so. Returns, however, will be given from time to time.

The development of the mine is progressing steadily and satisfactorily. Progress will be much more rapid when the steam plant is installed, and it is hoped that it will be in operation by the 1st of January.

The present management has been in control of the mine for about two months, and the shipments of ore which have been made and those which it is expected to make justify a dividend of 5 per cent., which was declared, and will be paid on the 1st of January to shareholders of record on the 15th day of December.

It is not deemed wise at the present time to fix the dates and amounts of subsequent dividends.

Twelve years ago, a settler named Anderson, located on lot 13, concession 1 Bucke township, comprising 320 acres. Part of the lot is excellent farming land and Anderson cleared it, stumped it, fenced it in part and built on it. He lived on it till 1904 when Thomas Little purchased his rights as a settler. Anderson had not obtained a patent for the land, but Little put in evidence that the requirements of the Public Lands Act were complied with by his predecessors. He put in in payment two veteran's certificates.

A man, Hunter, on the other hand, went out on the property of lots 13 and 14 and located mining claim R.L. 411, filed a plan by Surveyor Laird in December, 1904, and applied for the mining rights on 40 acres. He sunk a shaft and in July, 1905, sold for a good price to Ottawa and New York people, the payment being made after enquiry at the Crown Lands Department resulting in finding that in the patent Little got the mining rights were reserved to the Crown.

Hunter at once made application for a patent for the 40 acres known as Hunter's claim. The half is on lot 14 and Hunter made an arrangement with the settler Ferrell for the surface rights and the patent issued for the east half of 20 acres. As to the other portion the Department pointed out that it was usual to have consent from the owner of surface rights.

This was refused as Little claimed to have given an option to Frank M. Perry, who now claims the mining rights, because he alleges the patent given to Little was a mistake and should have included mining rights. Mr. Perry is applying to the Attorney-General for a fiat to bring suit to cancel the original patent to Little and have a new patent issue to carry the mining rights to Little or Perry.

ALBERTA.

Sir Sandford Fleming, in the course of an interview given by him recently in Winnipeg, stated.—

"We did not go quite so far as the summit of the range, but we sojourned for three days at a point which is now shown as Exshaw, some sixty miles this side of the continental divide. Exshaw will be better known in future generations than it is to-day. This spot has been selected for good and sufficient reasons as the site of a great industrial enterprise, which is warranted by the progress of Canada, and moreover, is necessary to the development of the great prairie region. There are minerals for the manufacture of Portland cement on the main line of the Canadian Pacific at Exshaw and here they are in close proximity and in greater profusion than elsewhere in the Dominion By means of the railway the manufactured article can be widely distributed to the great advantage of the whole country. Incidentally, the new industry will permanently benefit the railway to the extent of furnishing for transportation something like a full trainload daily, perhaps eventually a great deal more.

"Already nearly a million dollars has been expended and the work of construction is in an advanced state. In five or six months it is expected that the factory will be in operation and the manufacture of Portland cement at Exshaw on a large scale will be commenced."

BRITISH COLUMBIA.

"Mason T. Adams, of New York, the newly-appointed manager of the Howe Sound Copper Company, is now in Vancouver, having just completed a three months' tour of inspection of the various properties controlled by the late George H. Robinson and his associates," says the Vancouver News-Advertiser. "It is reported that under the new management extensive improvements will be made both at the Britannia mines and at the Crofton smelter. At the mines it is probable that another aerial tram-line will be installed. The present tram cannot handle more than 600 tons per day. The daily output of ore at the mine is far in excess of this amount, and much more ore could be got out if it were possible to get it over the intervening three miles to tide-water.

"The water supply is also to be improved by some method of conservation. Last summer, during the hot weather, Britannia creek fell so low as to cause great inconvenience in the operation of the concentrating plant, which consumes a great deal of water. In addition to this the hydro-electric plant at the beach makes a heavy demand on the water supply. Plans for the installation of a 60-ton furnace at the smelter at Crofton are also under consideration. Mr. Adams will also have control of the Mount Andrews mines at Prince of Wales Island. He was appointed to his present position on the resignation of Mr. Henry Stern, who found that he had not sufficient time to devote to the work."

YUKON.

Klondike may figure before long in the world's output of asbestos. Two asbestos discovery claims were located on Hunker a few days ago, just above Gold Bottom town. Sherman Reid and Joseph O. Baker are the discoverers. They took enough asbestos from the surface of the seams on their claims to cover boilers which they are operating on Hunker. Some time ago asbestos was discovered on the hillsides back of Dawson, and quite a number of claims were staked. The same lead has an outcropping on the Klondike. Asbestos has also been found on the high bluff back of St. Mary's Hospital.

Some who have studied local conditions would not be surprised to see a big asbestos output in this country before long.

Extensive winter work is being prosecuted by the Sourdough Coal Company with the purpose of being ready to undertake important new traffic in the Yukon next spring. The Sourdough company is a part of the Fuller-Grant combination.

The company has many other details to follow up in establishing its big electrical generating plant at the mouth of the mine at Coal Creek and in conveying the power to Dawson and other places of utility.

Instead of hauling coal to Dawson it will send the electrical energy there by wire. The dredge on the Grotschier concession, the Williams dredge and other big plants will be supplied with power from the plant. The Dawson electric light service also will be supplied from the same source.

COAL NOTES.

NOVA SCOTIA.

The approximate output of the Dominion Coal Company's collieries for the month of November was 219,952 tons.

Shipments from the Cumberland Railway and Coal Company's collieries for the month of November were 14,123 tons.

The Port Hood mine is producing 250 tons daily. Development work is being driven with the view of a larger output next year. The workings to the deep have flattened off a little.

November will witness the start in sinking for two more lifts in the Inverness mine. This will mean an addition of some 1,400 feet to the length of the slope. It is proposed to work the new lifts on the long wall system which at the present time is in much favor.

The shaft of the Mulloch Hill Copper Company at Whycocomagh has been sunk thirty feet. The parties interested are greatly elated over the latest reports. The improvements in the quality of the ore surpasses what was expected at that depth. The company are enthusiastic and intend sinking a series of small shafts along the vein, to a depth of from 50 to 100 feet. By this method it is hoped to prove beyond doubt the value of the property.

THE MINING AND INDUSTRIAL SHARE MARKET.

(Specially reported for the CANADIAN MINING REVIEW by ROBERT MEREDITH & Co., Mining Brokers, 57 St. François Xavier St., Montreal.)

British Columbia stocks have not been active during the month, prices are firm and there is a steady demand for the better class. Consolidated Mining has had a rise on the settlement of the coal strike and the good returns from the St. Eugene.

The feature in the industrial shares has been the troubles of the Dominion Coal & Steel companies. Prices of these stocks have fluctuated, according to the different reports regarding the difficulties. In the mean time the investing public is standing aloof and no interest is being taken in any industrial securities outside of these two.

The latest quotations are as follows:—

	Bid.	Asked.
Consolidated Mines	150	155
Can. Gold Fields	7¼	8½
Granby Consolidated	13¾	14
Rambler-Cariboo	28	30
North Star	15	20
Monte Christo	2	3
White Bear	9	10
California	...	6
Virginia	6½	10
Deer Trail	...	2
International Coal	65½	70
Sullivan	7½	10
Cariboo-McKinney	3½	5½
Denoro	10½	16
Diamond Vale Coal	26	30
Dominion Copper	5	5¼
Novelty	3	3½
Dominion Coal (com.)	68	68½
Dominion Coal (pref.)	...	...
Dominion Iron & Steel (com.)	26¼	26½
Dominion Iron & Steel (pref.)	69	70
Intercolonial Coal (com.)	...	...
Intercolonial Coal (pref.)	...	...
Nova Scotia Steel & Coal Co.	70	71
Nova Scotia Steel & Coal (pref.)	115	...

INDUSTRIAL NOTES.

The Canadian Mine and Smelting Company of Vancouver, B.C., have bought a standard Dodge Crusher from Allis-Chalmers-Bullock, Limited, of Montreal.

The O'Brien Mines have added a number of "Ingersoll" rock drills and a "Lidgerwood" hoisting engine to their equipment already purchased from Allis-Chalmers-Bullock, Limited, of Montreal.

The Cleveland-Cobalt Mining Co., has purchased from Allis-Chalmers-Bullock, Limited, of Montreal, a mining plant, including three-belt driven compound "Ingersoll" air compressors, "Ingersoll" rock drills, plunger sinking pump, "Lidgerwood" hoisting engine and necessary fittings.

The Sullivan Machinery Company desires to announce the opening of a branch office and warehouse at 319 Howard street, San Francisco, California. The best obtainable facilities are provided for the prompt handling of business. Mr. Howard T. Walsh will be manager of this branch.

The McKinley-Darragh-Savage Mines have purchased from Allis-Chalmers-Bullock, Limited, of Montreal, a large amount of mining machinery, including a powerful cross-compound air and compound steam "Ingersoll" air compressor, "Ingersoll" rock drills, two 80 h.p. boilers, a feed water heater condenser, air pump, "Lidgerwood" standard mining hoisting engine, air receiver, etc.

Within the last few years Hadfield's Steel Foundry Company, Limited, Sheffield, have gone extensively into the manufacture of machines for stone and ore-breaking, and have established a special department for handling this portion of their business. This department also deals with all orders and inquiries for repair parts in connection with crushing machinery, such as jaw faces for stone breakers, tires for crushing rolls, edge-runner rings, tube and ball mill-lining plates, etc.

We illustrate one of the Hadfield and Jacks patented "Heclon" rock and ore breakers. These are of the gyratory type, and are made in various sizes, ranging from in capacity from two to 100 tons per hour. At present we understand that the company has in hand ten of the largest size, and one of these forms the subject of the illustration. They are intended for the Premier (Transvaal) Diamond Mines, Limited, and will be used for breaking the diamondiferous blue ground preparatory to its further reduction by large crushing rolls. This, we are informed, is one of the largest single orders ever placed for crushers of this type and the combined capacity of the ten machines will be upwards of 1,000 tons per hour. Great attention has been given to the perfection of details in the Heclon breaker, and it claims to be, from an economical point of view, the best machine on the market for the coarse breaking of stone or ore.

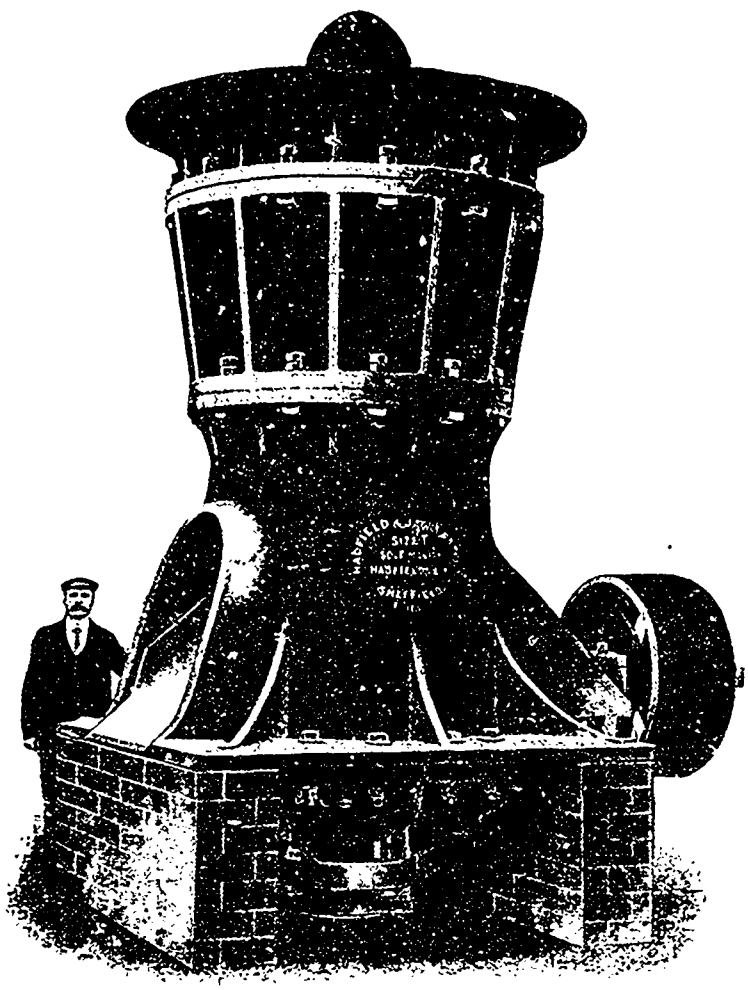
The machine embodies several improvements as compared with similar machines heretofore constructed. For the benefit of those who are not already familiar with the gyratory type of breaker we may point out that this machine has a true breaking action. At first sight it is difficult to understand that this is so, but if one bears in mind that the head and hollow shaft, which are practically one piece, do not revolve, and that all the motion is due simply to the excentric turning inside the bottom end of the hollow shaft it will be apparent, that, as regards any two diametrically opposite points on the crushing cone, the motion is simply backwards and forwards.

In the breaker under consideration a central shaft, with a ball at the upper end, is used to support the hollow shaft at a point were the motion is practically nothing, while the hollow shaft fitting over the outside of the excentric is said effectually to exclude all dust and dirt. The hollow shaft is much stronger than the usual solid shaft, and as this is the part that has to bear the whole of the crushing strain, the advantage is obvious.

Any lost motion in the gyratory type of breaker is detrimental to the output of broken stone. Therefore, it is important so to design the machine that renewals be easily and quickly made. As regards the upper end of the hollow shaft, when the bearing in the spider becomes worn, there is a steel bush provided which can be taken out and replaced with a new one, bored to suit the worn condition of the shaft. In the case of the excentric the bushes which are subject to wear are of anti-friction metal, and arranged in such a manner that spares can be carried in stock and slipped into position as required in order to reduce the lost time to a minimum. By raising or lowering the hollow shaft and crushing cone it is possible to vary the size of the broken product within certain limits, and the arrangement of worm wheel and worm in combination with a thread cut on the lower end of the central shaft has proved, so we are informed, a most satisfactory and effective method of accomplishing this purpose.

As might naturally be supposed the excentric bearing requires careful lubrication. The use of only the best oil is recommended by the makers, and the method of conducting it to the excentric is simple. Small tubes carried up through a hollow in the central shaft, with projecting drip pieces, deliver the lubricant in a thin, but steady stream to both inside and outside surfaces of the excentric. The flow is maintained by connecting pipes to a source of supply slightly higher than the discharge.

In the foregoing remarks we have only mentioned the novel features in the design of the breaker, but there are several points as regards the material employed in the construction which are worthy of attention. For example, the parts most subject to abrasive action of the stone are all protected with renewable linings of Hadfield's patented "Era" manganese steel, and the machine is designed especially with the idea of using these various linings in this material. The crushing cones, as already explained being of "Era" manganese steel, are simply thin mantles, secured to cast steel centres in such a way that when they are worn beyond further usefulness only a very small proportion remains to go to the scrap pile. As compared with solid chilled iron cones, the saving in this one item alone amounts, we are informed, to a very considerable economy. The lower body, bottom plate, and driving pulley are made in best cast iron, as this material is amply strong for these parts, but in the case of the top shell, spider hopper and driving gears, which have to stand the strains of crushing, Hadfield's best toughened cast steel is used. The arms of the spider and the upper surface of the inclined diaphragm are protected from the cutting action of the stone by means of renewable covers of "Era" manganese steel. All parts are made interchangeable.



Hadfield Rock and Ore Crusher.

MINING INCORPORATIONS.

ONTARIO.

The Cobalt Portage Mines, Limited. Capital, $1,000,000, divided into one million shares of one dollar each. Head office, Toronto. Provisional directors: John Lewis, Frederick Watt, and Joseph John Hubbard, all of Toronto.

The Nipissing Power Company, Limited. Capital, $100,000, divided into one thousand shares of one hundred dollars each. Head office, Toronto, Ont. Provisional directors: Allice Scott, Ewart Reginald Lynch and James Philip Crawford, all of Toronto.

The Cobalt Annex Silver Mines, Limited. Capital, $500,000, divided into five hundred thousand shares of one dollar each. Head office, Haileybury, Ont. Provisional directors, Albert Thomas Budd, Gordon M. Murdo Petrie and Frank Pottage, all of Toronto.

The Forest Reserve Mining Company, Limited Capital, $100,000, divided into one hundred thousand shares of one dollar each. Head office, Toronto, Ont. Provisional directors: Frank Pottage, Robert Francis Wilks, and Percival John Montague, all of Toronto.

The New York Cobalt Silver Mines, Limited. Capital, $1,000,000, divided into one million shares of one dollar each. Head office, Toronto, Ont. Provisional directors: John Lewis, William Hogen, Frederick Watt, Joseph John Hubbard and Harry Sidney Pritchard, all of Toronto.

The Lorram Mining Company, Limited. Capital, $400,-$500,000, divided into five hundred thousand shares of one dollar each. Head office, Toronto Ont. Provisional directors: John Douglas, Casimir Stanislaus Gzowski, James Atwood, George Laird and Joseph Atkins Daggett, all of Toronto.

The Green-Meehan Mining Company, Limited. Capital, $2,500,000, divided into five hundred thousand shares of five dollars each. Provisional directors: Charles Wesley Kerr, Charles Stephen MacInnes, Christopher Charles Robinson, Margaret Gleeson and Annie Eliza Lloyd, all of Toronto.

The Lorain Mining Company, Limited. Capital, $400,000, divided into four hundred thousand shares of one dollar each. Head office, Toronto Ont. Provisional directors: George Hubert Draper, Charles McEachren, Thomas Erastus Smith, Walter Blake Laidlaw, and Alfred Henry Smith, all of Toronto.

The Imperial Cobalt Silver Mining Company, Limited. Capital, $1,000,000, divided into one million shares of one dollar each. Head office, Toronto. Provisional directors, John Walter McDonald, Gertrude Eleanor Cherpaw, George Joseph Valin, Eva Lena Bradley and Thomas Brown, all of Toronto.

The Cobalt Smiley Mining Company, Limited. Capital, $40,000, divided into forty thousand shares of one dollar each. Head office, Toronto, Ont. Provisional directors, William Ruston Percival Parker, George McPhail Clark, John Alexander McEvoy, Gordon Russell and Ethyl Mabel Lindsay, all of Toronto.

The Ontario Nickel Company, Limited. Capital, $1,000,000, divided into ten thousand shares of one hundred dollars each. Head office, Worthington, Ont. Provisional directors: Herbert Henry Dow, William L. Baker both of Midland, Michigan; Albert E. Convers and George Edward Collings, of Cleveland, Ohio.

The Manhattan Cobalt Mining Company, Limited. Capital, $100,000, divided into one hundred thousand shares of one dollar each. Head office, Toronto. Provisional directors: Joseph Wilbur Coffin, Daniel Urquhart, Alexander MacGregor, Harry Williamson Page and Basil William Essery, all of Toronto.

The Edward Cobalt Mines, Limited. Capital, $100,000, divided into one hundred thousand shares of one dollar each. Head office, Toronto, Ont. Provisional directors, William Ruston Percival Parker, George McPhail Clark, John Alexander McEvoy, Gordon Russell and Ethyl Mabel Lindsay all of Toronto.

The Empress Cobalt Silver Mining Company, Limited. Capital, $500,000, divided into five hundred thousand shares of one dollar each. Head office, Toronto, Ont. Provisional directors: John Walter McDonald, Gertrude Eleanor Cherpaw, George Joseph Valin, Thomas Brown and Margaret Cairncross, all of Toronto.

The Northern Ontario Consolidated Copper Company, Limited. Capital, $1,500,000, divided into one million five hundred thousand shares of one dollar each. Head office, Sault Ste. Marie, Ont. Provisional directors: John Niven Oldham, Charles Alexander Paul and Alexander Donald McNabb all of Sault Ste. Marie, Ont.

The Cobalt and New Ontario Prospectors, Developers and Investors, Limited. Capital, $500,000, divided into five hundred thousand shares of one dollar each. Head office, Toronto. Provisional directors: James Leith Ross, Arthur Wellesley Holmsted, Frank Hamilton Potts, and Arthur Richard Bickerstaff, all of Toronto.

The Temiskaming Mining Company, Limited. Capital, $2,500,000, divided into five hundred thousand shares of one dollar each. Head office, Toronto, Ont. Provisional directors: Charles Wesley Kerr, Charles Stephen MacInnes, Christopher Charles Robinson, Margaret Gleeson, and Annie Eliza Lloyd, all of Toronto, Ont.

The United Silver Company, Limited. Capital, $1,000,000, divided into one million shares of one dollar each. Head office, Cobalt. Provisional directors, James Edward Day, John Michael Ferguson, Edward Vincent O'Sullivan, Arthur Winlow Bixel, Arthur Day, John Joseph O'Sullivan and James Henry Hallett, all of Toronto.

The Coin Silver Mining Company, Limited. Capital, $300,000, divided into three hundred thousand shares of one dollar each. Head office, Windsor, Ont. Provisional directors, Frank Edward Schoonmaker, Elias Horning Sellers, David Lawrence Murchey, George William Rice, Frank William Droelle, all of Detroit, Michigan.

The Cobalt Monarch Mining Company, Limited. Capital, $1,000,000, divided into one million shares of one dollar each. Head office, Toronto, Ont. Provisional directors, James Francis McLaughlin, John Thomas White, William Nassau Ferguson, Andrew Wentworth Hunter and Harcourt Ferguson, all of Toronto.

The Delta Lime Company, Limited. Capital, $30,000, divided into three hundred shares of one hundred dollars each. Head office, Delta, Ont. Provisional directors: William Moore Cameron, Findlay Hugh Cameron, both of Delta; William Henry Wood, William Senkler Buell and Charles Arthur McNaughton, all of Brockville, Ont.

The Rochester-Cobalt Mines, Limited. Capital, $1,000,000, divided into one million shares of one dollar each. Head office, Cobalt, Ont. Provisional directors: Nathan Stone Scott, Franklyn Brownell Sanders, Fred. Charles Becker, Frank Hause Baer, Sampson William Parsons, Joseph Howard Van Derveer, and Frank Julius Cody, all of Cleveland, Ohio, U.S.A.

The Leitch Collieries, Limited. Head office, Ottawa, Ont Capital, $1,000,000, divided into ten thousand shares of one hundred dollars each. Incorporators: D'Arcy Hugh MacMahon, financial agent; Arthur Abel Baylie, secretary; Edward Seybold, manufacturer; James Gibson, manufacturer; William Clark Perkins, barrister-at-law; James Goodwin Gibson, barrister-at-law, and Henry Healy Williams, accountant, all of the city of Ottawa.

BRITISH COLUMBIA.

Canadian Concentrating & Smelting Co., Ltd. Capital, $750,000, divided into 75,000 shares at ten dollars each.

The Little Valley Exploration Syndicate, Ltd. Office in England Capital, £3,500, divided in 3,500 shares at £1 each.

The Chilliwaack Oils Company, Limited. Capital, $10,000, divided into two thousand shares of five dollars each.

The Vancouver Island Copper Company. Capital, $100,000, divided into one hundred thousand shares of one dollar each.

The Ohio Mines Development Company, Limited. Capital, $1,000,000, divided into two hundred thousand shares of five dollars each

The Wallace Mountain Mining Company, Limited. Capital $250,000, divided into two hundred and fifty thousand shares of one dollar each.

The Skeena River Gold Creek Mining Company, Limited. Capital, $50,000. divided into one hundred thousand shares of fifty cents each.

The Five Metals Mining, Concentrating and Smelting Company, Limited. Capital, $1,000,000, divided into one million shares of one dollar each.

CATALOGUES.

The following catalogues have been received:—

Catalogue No. 31. Issued by the Jeffrey Manufacturing Company, of Columbus, Ohio, describing Jeffrey crushing and pulverizing machines.

Bulletin No. 51 D. Issued by the Sullivan Machinery Company, descriptive of the Sullivan pneumatic hammer drills for quarrying and contracting work.

Smallman's patent New Model Wire Rope Haulage Clips are described and illustrated in a pamphlet recently issued by Jas. W. Smallman, Nuneaton, England.

The Westinghouse Traction Brake Company, of Pittsburg, Pa., has issued a pamphlet descriptive of Straight-Line Brake Equipments, superseding that issued in July, 1904.

The Traylor Centrifugal Pumps, the Engelback ore-sample grinder, and Frisbie friction clutches and pulleys are described in recent publications issued by the John A. Traylor Machinery Co., of Denver, Colo.

The Blaisdell System of Automatic Cyaniding Machinery is described in Catalogue F, issued by the Blaisdell Company, Los Angelos, California, U.S.A. The New York office of this company is at No. 2600 Park Row Building.

The Canadian Westinghouse Co., Ltd., of Hamilton, Ont., have issued Circular No. 1068, descriptive of the Westinghouse type "S" dynamos and motors direct current. It consists of a carefully written, illustrated, description of these well-known dynamos and motors.

Those interested in mining machinery should apply to the Allis-Chalmers Company, Milwaukee, Wisconsin, whose Canadian representatives are the Allis-Chalmers-Bullock Co., Ltd., of Montreal, for the new index just issued. This gives the titles of nearly one hundred useful descriptive pamphlets, issued by the company's department of publicity.

PROVINCE OF QUEBEC

The Attention of Miners and Capitalists in the United States and in Europe is invited to the

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ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

All mines belong to the government of the Province on all unsold lands and on all those sold since the 24th of July, 1880, but gold and silver are always reserved, whatever may be the date when the land was sold, unless it be otherwise mentioned in the patent.

The government grants PROSPECTING LICENSES for lands on which the mines belong to it, giving the holders of such licenses the first right to purchase the mines. In the case of lands where the surface alone is sold, the owner of the surface may be expropriated if he refuses an amicable settlement.

The price of prospecting licenses is $5.00 per 100 acres on surveyed lands and per square mile on unsurveyed lands. If the surface has already been sold, the price is only $2.00. They are valid for three months and are renewable at the discretion of the Minister.

When mines are discovered, they can be bought or leased from the government. The purchase price is as follows :

Mining for superior metals on lands situate more than 12 miles from a railway in operation, $5.00 per acre, and on lands situate less than 12 miles from such a railway, $10.00 per acre ;

Mining for inferior metals—the price and the area of the concessions are fixed by the Lieutenant-Governor in council.

The words " superior metals " include the ores of gold, silver, lead, copper, nickel and also graphite, asbestos and phosphate of lime ; and the words " inferior metals " mean and include all the minerals and ores not included in the foregoing definition and which are of appreciable value.

MINING CONCESSIONS are sold in entire lots in surveyed townships or in blocks of not less than 100 acres in unsurveyed territories.

Patents are obtained subject to the following conditions : The full price must be paid in cash : specimens must be produced and accompanied by an affidavit ; a survey at the cost of the applicant must be made on unsurveyed lands ; work must be bona fide begun within the two years.

Mining licenses giving the right to work the mine and dispose of its products, are granted on payment of a fee of $5.00 and a rent of $1.00 per acre per annum. Such licenses are valid for one year and are renewable on payment of the fee and of the same rent. They may cover from 1 to 200 acres for one and the same person and must be marked out on the ground by posts. The description or designation must, however, be made to the satisfaction of the Minister.

Persons working mines must send in yearly reports of their operations to the government.

The attention of the public is specially called to the new territory north of the height of land towards James Bay, which comprises an important mineral belt in which remarkable discoveries of minerals have already been made and through which the New Grand Trunk Pacific Railway will run.

The government has made special arrangements with Mr. Milton L. Hersey, 171 St. James Street, Montreal, for the assay and analysis of minerals at very reduced rates for the benefit of miners and prospectors in the Province of Quebec. Tariffs of assays can be obtained on application to him.

The Bureau of Mines at Quebec, under the direction of the Superintendent of Mines, will give all the information asked for in connection with the mines of the Province of Quebec and will supply maps, pamphlets, copies of the law, tariff of assays, etc., to all who apply for same.

Applications should be addressed to :

THE HON. MINISTER OF COLONIZATION, MINES & FISHERIES,

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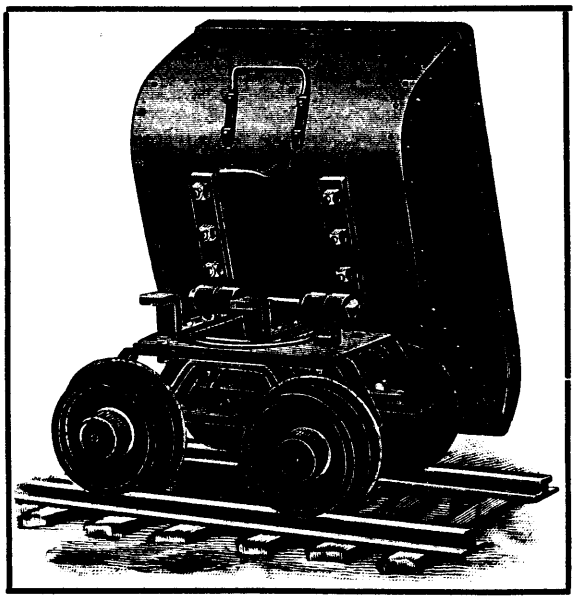

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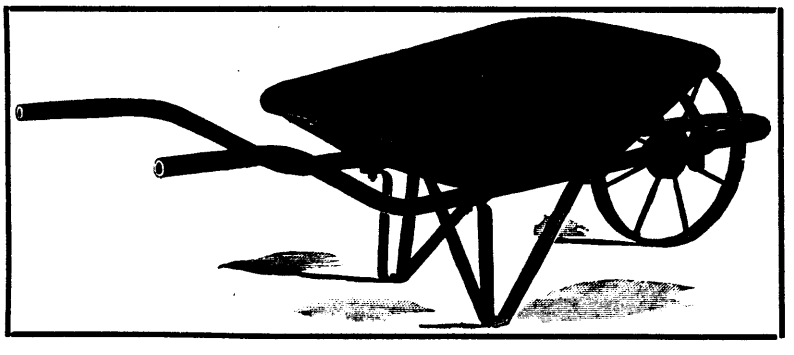

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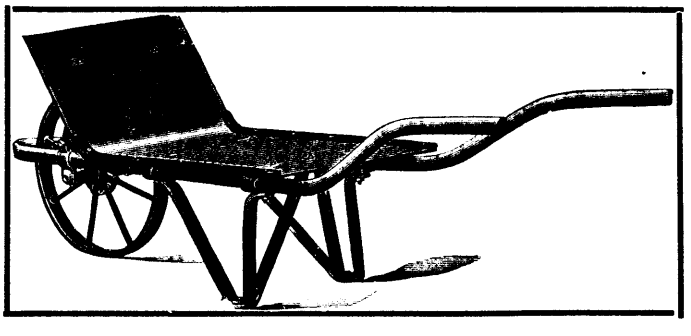

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Concrete Mixers

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