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TWENTY-FIRST YEAR OF PUBLICATION

The CANADIAN MINING REVIEW

Established 1882

Vol. XXII—No. VII. OTTAWA, JULY 31st, 1903. Vol, XXII—No. VII

FRIED. KRUPP GRUSONWERK

Magdeburg-Buckau (Germany)

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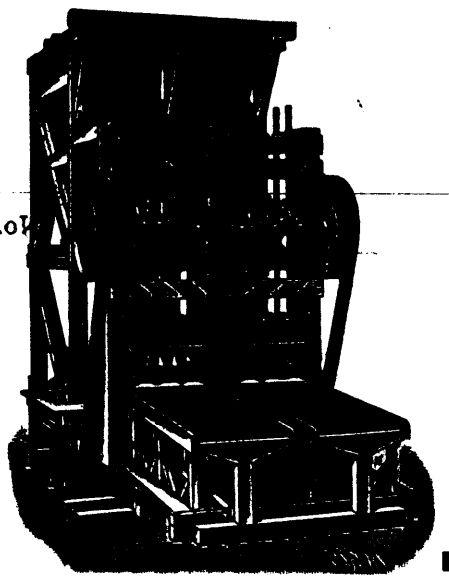

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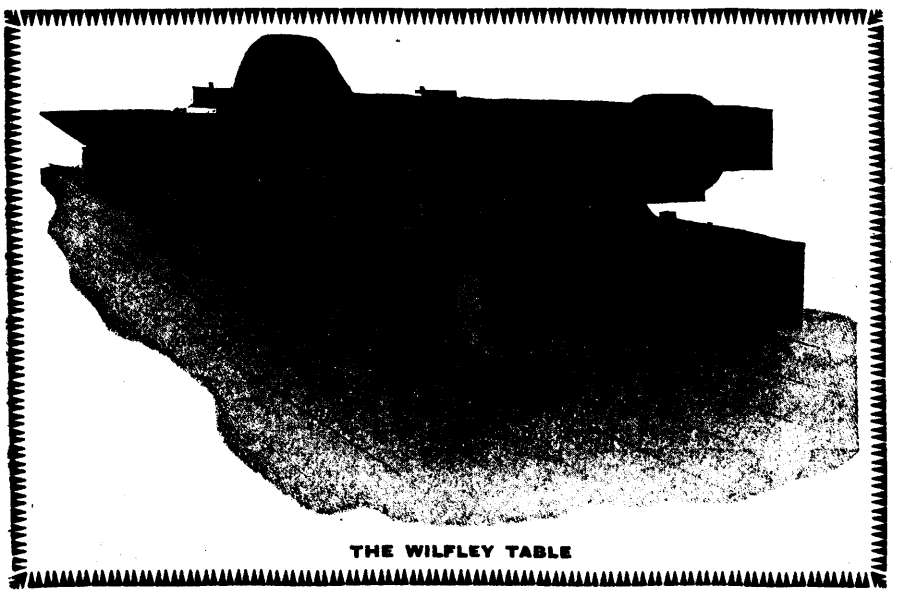

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We contract for the Design and Construction of Complete Stamp Mills, Concentration, Chlorination, Cyanide and Smelter Equipments.

DIRECTORY OF MINING ENGINEERS, CHEMISTS, ASSAYERS, ETC.

21st YEAR OF PUBLICATION.

The Canadian Mining Review

Established 1882

THE OLDEST AND ONLY OFFICIAL MINING AND ENGINEERING JOURNAL PUBLISHED IN THE DOMINION OF CANADA.

B. T. A. BELL, Editor and Proprietor. Secretary, Canadian Mining Institute, etc. Published Monthly. OFFICES {Orme's Building, Ottawa; Windsor Hotel, Montreal.

VOL. XXII., No. 7. JULY, 1903. VOL. XXII., No. 7.

Our Iron and Steel Industries.

Our iron and steel industries can be expected to reach much larger dimensions within the next ten years. It is well within the mark to say that Canada will build more miles of railway within that time than any other country. There will be a very large consumption of steel rails, car wheels and other material which, even if our manufacturers furnish only a comparatively small part of it, should make us take a prominent position as an iron producing country.

Under present conditions, however, it can hardly be expected that this increased production of metal will benefit our iron miners to any great extent. This is evident from the effect which the blast furnace industry, which has been in operation seven or eight years, has had on the iron mines of Ontario. In the eastern part of the Province there are deposits of ore similar in character to those which are being continuously worked in New York and others of the Eastern States. These Ontario deposits are, with one exception, lying idle. If the duty of forty cents a ton on iron ore entering the United States were removed, these Eastern Ontario deposits would be worked. Their output would be shipped across Lake Ontario to enter into competition with ores of similar character which are mined in the Eastern States. Our furnaces being few and small in size use little of this eastern ore which is suitable for mixing with the softer ores of Lake Superior. Iron ores of all kinds from the United States come into Canada duty free and, in Ontario at least, they displace ores of domestic origin. Two or three of the four Ontario furnaces are believed to be interested in iron deposits in the United States and thus have little object in attempting to develop mines in Canada. The great iron ranges of Michigan and Minnesota have numerous deposits which are well opened up. Hence the Ontario consumers of ore are enabled to get cheap supplies without giving any attention to the development of mines. Unless the bounties on iron produced from domestic ores are extended beyond 1907, or conditions are otherwise equalized either by the United States taking off their import duty on ore, or by Canada imposing a similar one, there will be little encouragement for the development of iron mines in this country.

Recent press despatches state that the United States Steel Corporation is seriously thinking of erecting a large plant at one of the ports on the Canadian side of Lake Erie. Ore from the Michigan and Minnesota ranges can be laid down at the same cost at these ports as at any of the ports on the south side of the lake to which it is now shipped. Instead of hauling ore from the lake ports to Pittsburg, coke will have to be brought to the smelters on the north shore. As regards shipment of manufactured material to Europe, the ports on the north shore of Lake Erie would seem to be as well situated as is Pittsburg. Steamers loaded with steel rails in Germany for the Canadian Northern Railway have arrived at Port Arthur during the present season. And of course if the European market demands it rails can be shipped as well down the St. Lawrence route as up it It would seem, however, that for the next ten years or so the Canadian market will consume all the output of the plants now in existence or which are likely to be erected in this country during that time.

In connection with this invasion of Canada by the Steel Corporation as manufacturers, it is of interest to know that the Corporation has since its organization been gradually getting control of the raw materials of the Lake Superior ranges and now controls a high percentage of the ore reserves. The Corporation also already controls a considerable area of the most promising iron lands of Northern Ontario, which possess characteristics similar to those of the developed Lake Superior ranges. It has been feared in Ontario that these lands of the Province were being gotten under control by the Corporation in order. not to develop them, but to hold them in reserve and prevent their falling into the hands of competitors. Under the present Provincial regulations the Government has the power to compel the mining of at least 2,000 tons per annum on every 40 acre iron claim located within the last few years. It is not likely it will ever be necessary to exercise this power, now that the Corporation has decided to manufacture on a large scale in the Province. It would be a very unpopular act for any corporation to seek to tie up the iron ore supply of the Province, without developing some, at least, of the deposits, and judging from the operations of the Steel Corporation on the Mesabi and other ranges they consider it poor policy to run counter to public opinion. They own the railways on these ranges in addition to controlling most of the mines and the public have nothing of which to complain. Good train service is given and a liberal and progressive policy is followed in the management of the mines. Knowing this, we have every reason to give the Corporation a cordial welcome to this side of the line.

The Corporation having its mines, both coal and iron, already developed, its fleet of ore boats well organized and, moreover, having an experienced technical staff upon which to draw is much more likely to make a success of the industry than is a group of mere promoters, such as some of those which we unfortunately know too well in connection with mining and metallurgical enterprise in this country.

If the Corporation do not manufacture steel rails and other railway supplies in Ontario they will have to pay more for the carriage

of their materials to those parts of the line of railway where they are to be used. At any of our Ontario ports the rails can be loaded directly on to boats for Port Arthur and other points, while shipping from Pittsburg and other places south of the lake there is extra handling. Duty and bounty have also to be taken into consideration.

Cars of coke arriving at a Lake Erie port can be ferried across the lake in the way that coal cars have been carried for some years by the Grand Trunk Railway from Erie to Port Dover. Instead of hauling, say one and two-thirds tons of 60 per cent. iron ore to Pittsburg from Lake Erie, one ton of coke will be hauled from Pittsburg to the Canadian shore.

It may also be noted that without a plant in Canada the Steel Corporation will not be in a position to get a share of the bounties on wire rods which the Dominion Government have recently decided to grant. By having a plant in this country much more of the ore from the Corporation's mines will enter into the various manufactured forms of iron than it would otherwise would, and its only two serious rivals, Germany and Great Britain, having both bounties and duties, on some material, against them, will be placed at a great disadvantage in competing for the large amount of railway and other supplies which will be consumed in this country during the next few years. The Steel Corporation has a larger output than have all the iron manufacturers of Great Britain combined.

German iron manufactures on a large scale are comparatively new comers to our market, but the volume of the exports from that country has recently greatly increased despite the growth of the trade between the Dominion and the United States. In 1902 German exports to Canada under the head of iron and steel amounted to 65,405 tons, which is an increase of 34,993 tons, or over 100 per cent. on the exports for the previous year. This is a large business and the rapid rate of its recent growth, together with the knowledge that the consumption of iron is to greatly increase in this country through railway building, has naturally induced the United States Steel Corporation to consider the building of a plant in Ontario where they will have important advantages over their foreign competitors.

Mining Progress in Nova Scotia.

During the past few months the interest in Dominion Iron and Steel stocks might suggest a falling off in mining development in Nova Scotia. Fortunately, outside of the speculative section, there is a well grounded belief in the future of iron and steel in the province, and in its coal, gold, etc.

The damage caused by the fire in the No. 1 colliery of the Dominion Coal Company is being gradually rectified, and it is to be hoped that the management will profit by the lesson. A fire arising from a similar cause at the Joggins mines was promptly extinguished. The future interests of the country would be benefited to the lay mind if no open lights, etc., were allowed in coal mines. All the coal mines are working steadily, and the Pictou and Cumberland districts are benefiting by the re-opening of the Londonderry iron plant, which draws its coal and coke supplies from these two districts.

Arrangements are being completed for prospecting the district lying between Springhill and Apple River by the aid of the Government calyx drills. In Colchester county a company has opened a seam of coal near Debert Station, and is preparing to connect it with the Intercolonial Railway.

A mine at this point, only three miles from the Intercolonial Railway, will command the Truro, Halifax, and Annapolis Valley trade, and if the coal proves on trial to possess coking properties the Londonderry furnaces will have a fuel almost at their doors.

The explorations carried on between New Glasgow and Pictou were hampered by difficulties met in penetrating the carboniferous conglomerates overlying the coal measures. The rock, compact near the surface, became too soft to permit of drilling at a depth of a few hundred feet. This conglomerate is now being bored by a cutting drill, and tubed, when boring will be resumed by the Government calyx drill in the coal measures.

An attempt to find coal on the southern side of this coal field has not yet proved successful. In fact, experts have pronounced the locality to be outside the coal field.

In Cape Breton county some American and Canadian capitalists are reported to have purchased the New Campbellton Colliery and a number of other areas. In the district lying between Mira Bay and Sydney, long classified as unproductive, the energy of the late Mr. Moseley opened a six feet seam of coal. This seam has been acquired by the Cape Breton Coal Exploration and Development Company, together with a number of others, in all about 30 square miles of coal land.

This company, organized in New York, has begun the work of opening their property, and has given large contracts for the equipment of their mine with electric haulage, power, etc. The development of this company is being watched with interest as they may prove a most formidable rival to the Dominion Coal Co., and to the Nova Scotia Steel and Coal, working the old Sydney mines.

The work of exploration in the Richmond coal fields which would, it was hoped, have had the effect of showing its structure, etc. is arrested pending a rearrangement of title.

In the gold mines there is little of interest to report. The Evan Thompson mine at Renfrew, which attracted attention some time ago by rich returns, is under option to parties at a price it is said of $165,000 00. The Dolliver Mountain Company are nearly through with their preliminary work. Should their anticipations be realized, they will have a low grade mine capable of handling several millions of tons of ore at a good profit. A few other properties are working steadily, but no new discoveries are reported. Gold mining in Nova Scotia is passing through the stage intermediate between that of the small rich veins and that of large deposits of low grade ore. While the former will continue for years to attract the attention of local miners, the latter will, as their merits become better known, fail to the capitalists

It will be remembered that at the last session of the Legislature a large sum of money was voted to assist in furnishing the sinking of deep shafts in the gold fields. At present only in the Caribou and Queens districts are there workings exceeding in depth 500 feet, the point at which the Government subsidy becomes available. As yet no steps have been taken to carry the Act into effect, but an application is expected from the Caribou district where all the workings have reached a depth of about 800 feet.

The Torbrook iron mine at Nictaux has recommenced working, and is making shipments to Londonderry furnaces, where the testing of the old iron mines is making satisfactory progress.

Halifax parties who have for some time studied the Cheticamp district in Northern Inverness, report finding large deposits of copper ore. It is claimed that these are of workable value in addition to their gold and silver values.

These hopes appear to be well founded, and they are adopting the proper course of determining their underground values first, instead of, as is too often the case, building concentrators, smelters, etc., and then starting to see what kind of a mine they have.

The Silica Brick Company of North Sydney have started to manufacture brick, which is reported as satisfactory in quality. Several steamer loads of selenite and crystallized plaster have been shipped from the vicinity of Halifax to the United States It is stated that this higher grade of gypsum is used for filling paper in place of talc, etc.

THE LATE JAMES COOPER, MONTREAL,

PRESIDENT OF THE JAMES COOPER MFG. CO. AND THE DOMINION WIRE ROPE CO.

EN PASSANT.

We record this month the death of Mr. James Cooper with sincere sorrow. While Mr. Cooper held mining interests in different parts of this country, and in the early days was a prominent figure in the phosphate industry, it was as the head of the large mining machinery establishment of the James Cooper Manufacturing Company and its sister corporation, the Dominion Wire Rope Company, that he was most widely known and esteemed throughout the country. Mr. Cooper had been ill about three weeks. By his death the REVIEW loses one of its oldest and best friends.

In accordance with an almost unanimous vote of the Council the Library and Reading Room of the Canadian Mining Institute has been removed from the Windsor Hotel, Montreal, to Orme's Building Wellington Street, Ottawa, where in future it will be under the immediate direction of the secretary. The new location is readily accessible, facing the Parliament Buildings, and the premises are sufficiently large to meet the growth of the collection for many years to come. The library will be open to the public every week day from 9 to 5, and has been fitted up specially for the use, not only of mining men, but any one seeking information concerning the resources and mining industries of the country. The collection now numbers over 2,000 works of reference, and a complete record is kept of all active Canadian mining undertakings.

Vol. VI. of the Journal of the Canadian Mining Institute, which was destroyed by fire, is being reset, and it is hoped will be ready for distribution about the 1st of October. It is a large volume, containing some forty papers contributed by the members, and will be handsomely illustrated and bound.

The following is the text of the new lead and iron and stee bounties which are to come up for discussion in Parliament this month:—

That it is expedient to repeal Chapter 9 of the Statutes of 1901 intituled: "An Act to provide for the payment of bounties on Lead refined in Canada," and to enact as follows;—

1. The Governor-in-Council may authorize the payment of a bounty of seventy-five cents per one hundred pounds on lead contained in lead-bearing ores mined in Canada; such bounty to be paid to the producer or vendor of such ores, upon evidence that such ores have been smelted in Canada. Provided, that the sum to be paid as such bounty shall not exceed five hundred thousand dollars in any fiscal year. Provided, also, that when it appears to the satisfaction of the minister charged with the adminstration of this Act that the standard price of pig lead in London, England, exceeds twelve pounds ten shillings sterling per ton of two thousand two hundred and forty pounds, such bounty shall be reduced proportionately by the amount of such excess.

2. Payment of the said bounty may be made from time to time to the extent of sixty per centum of the full bounty authorized, subject to adjustment at the close of each fiscal year. If at the close of any year it shall appear that during the year the quantity of lead produced, on which the bounty is authorized, exceeds thirty-three thousand three hundred and thirty-three tons of two thonsand pounds, the rate of bounty shall be reduced to such sum as will bring the payments for the year within the limit mentioned in section one.

3. If at any time it shall appear to the satisfaction of the Governor-in-Council that the charges for transportation and treatment of lead ores in Canada are excessive, or that there is any discrimination which prevents the smelting of such ores in Canada on fair and reasonable terms, the Governor-in-Council may authorize the payment of bounty at such reduced rate as may be deemed just, on the lead contained in such ores mined in Canada and exported for treatment abroad.

4. The said bounties shall cease and determine on the thirtieth day of June, one thousand nine hundred and eight.

5. The Governor-in-Council may make regulations for carrying out the intention of this Act.

Commenting on the lead duties, Mr. J. L. Parker, M.E, in charge of the North Star mine, at Kimberley, B.C., writes:—

As long as the bonus last, we may consider that we will have good times, for the following reasons:—

1st. The mines that are in a shipping condition, but which are not shipping, will naturally ship their ores.

2nd. Those in a developing condition, but not developing, will naturally develop.

3rd. Those properties which have a favorable surface mineral condition, will naturally either have some work done on them, or the owners will find a more favorable market for them than has been the case the past two years.

4th. Encouragement will be given the prospector to hunt for new finds, probably resulting in the later opening up a new district or two.

5th. The wage expenditure will return to the old standard of about $2,500,000 per annum instead of less than $500,000.

6th. The merchants, who have been reducing their stock, will replenish it, resulting in the merchants east getting fresh orders, and giving the railroads more work.

7th. The smelters will have live furnaces, instead of dead ones, and this will give employment to more men, and through this certain ores available for fluxes can be used and purchased by them which would otherwise have to remain in the ground. This latter feature is an important one, giving employment to more men.

The amount of bonus to be distributed in five years time on the basis of $15 per ton, will be about $2,500,000, and as the mine owners will spend $10,000,000 more during the same period, than they would have done under the past bad conditions, it will be seen that the Government aid, although tardy, will mean a direct aid to the district of $2,500,000 besides an indirect aid to the amount of $10,000,000.

The following will be the amounts of bonus on the different grades of ore that each grade will earn:—

30 per cent. lead ore, $4.05 per ton.
40 per cent. lead ore, $5.40 per ton.
50 per cent. lead ore, $6.75 per ton.
60 per cent. lead ore, $8.10 per ton.

On iron and steel the following:—

(a) On rolled, round wire rods not over three-eighths of an inch in diameter, when sold to wire manufacturers for use in making wire in their own factories in Canada, a bounty of six dollars per ton;

(b) On rolled angles, tees, channels, beams, joists, girders, or bridge, building or structural rolled sections, and on other rolled shapes not round, oval, square or flat, weighing not less than thirty-five pounds per lineal yard, and also on flat eye bar blanks, when sold for consumption in Canada, a bounty of three dollars per ton;

(c) On rolled plates not less than thirty inches in width and not less than one-quarter of an inch in thickness, when sold for consumption in Canada for manufacturing purposes for which such plates are usually required and not to include plates to be sheared into plates of less width, a bounty of three dollars per ton.

2. The Governor-in-Council may make regulations to carry out the intentions of the foregoing section.

3. That Chapter 8 of the Statutes of 1899 be so amended as to provide that the bounties on steel and iron authorized by Chapter 6 of the Statutes of 1897 shall be continued until the thirtieth day of June, one thousand nine hundred and seven, and that the rates of such bounties shall be as follows:—

(a) From the first day of July, one thousand nine hundred and three to the thirtieth day of June, one thousand nine hundred and four, both inclusive, the bounties shall be ninety per centum of the amount fixed by the said Chapter 6 of the Statutes of 1897;

(b) From the first day of July, one thousand nine hundred and four, to the thirtieth day of June, one thousand nine hundred and five, both inclusive, the bounties shall be seventy-five per centum of the amount fixed by the said Chapter;

(c) From the first day of July, one thousand nine hundred and five, to the thirtieth day of June, one thousand nine hundred and six, both inclusive, the bounties shall be fifty-five per centum of the amount fixed by the said Chapter.

(d) From the first day of July, one thousand nine hundred and six, to the thirtieth day of June, one thousand nine hundred and seven, both inclusive, the bounties shall be thirty-five per centum of the amount fixed by the said Chapter.

Imports of Mining Machinery.

The imports of free and dutiable mining and smelting machinery for the first five months of the present year compared with 1902, are as follows:—

Months	1903			1902		
	Free	Dutiable	Total	Free	Dutiable	Total
January	$ 77,298	$ 7,676	$84,974	92,984	2,549	95,533
February	30,106	1,587	31,693	43,123	2,380	45,503
March	83,535	11,534	95,069	55,255	2,629	57,884
April	104,967	4,638	109,605	61,227	5,087	66,314
May	155,493	1,469	156,962	90,820	4,782	95,602
Total	451,399	26,904	478,303	343,409	17,427	360,836

The principal sources from which this machinery has been imported were:—

Months	United States		Great Britain		Other Countries	Total
	Free	Dutiable	Free	Dutiable		
January	$75,235	$ 7,676	$ 417	—	$1,646	$84,974
February	29,467	1,587	639	—	Nil	31,693
March	82,680	11,534	158	—	697	95,069
April	104,902	4,638	65	—	Nil	109,605
May	155,127	1,263	366	206	"	156,962
Total	447,411	26,698	1,645	206	2,343	478,303

The Tyee Smelter.

Mr. Thomas Kiddie, manager of the smelting department of the Tyee Copper Company, contributes to the last issued report of this company the following description of the smelting plant installed at Ladysmith, Mount Sicker District of British Columbia. The plant was designed by Mr. Kiddie.

The site is admirably adapted for a smelting plant, lying between the Esquimalt and Nanaimo Railway track and Oyster Bay, 84 ft. elevation above high water mark. In section, the works are located as follows:—Converter floor, 31 ft.; furnace room floor, 37 ft.; charging floor, 51 ft.; top of burnt ore bins, 68 ft.; bottom of burnt ore cuttings at roast yard, 68 ft.; roast yard floor, 72 ft.; top of permanent trestles through roast yard, 80 ft.; top of ore bins, 100 ft. above high water mark. In order to utilize the ground at the Roast Yard, it was necessary to elevate the ore bins 16 ft. above the level of Esquimalt and Nanaimo track, to which that company built their approach; the other levels, as given above, gave us the maximum dumpage for slag, viz: 31 ft. Sidings for the delivery of coke and coal to the 51 ft. level, and the delivery of matte to the 37 ft. level were also put in. The railway company also, according to the terms of their contract, supplied all the water necessary for steam power, furnace, and slag-shotting purposes, all of which work was well and promptly done by them.

Roast Yard.—This was laid out on the 68 ft. level, north, or opposite the ore bins, and connected therewith by a system of tracks running out over the roast yard, carried on permanent trestles, while between each set of trestles travelling bridges serve to distribute the ore over any part of the roast pile. This has worked splendidly, so that our total cost of roasting and delivering the burnt ore to the smelter bins is now 37 cents per ton of burnt ore. The roast yard is connected with the smelter by a surface tramway, operated by horse-power. All the work in this department is done by Chinese, while that at the smelter is done by white labor.

The total capacity of the ground for ore burning is about 7,000 to 8,000 tons per month.

Building Operations.—We commenced clearing the ground at Ladysmith (which was densely covered with timber) on April 11th, 1902; this was sufficiently advanced to allow grading for the smelter site to start on May 21st, which work was done by contract to our satisfaction. The ground required for a roasting yard was located at the west boundary of the property at Rock Creek, and cleared and graded, and here also the ore-receiving bins were erected, the Esquimalt and Nanaimo Company putting in the siding at their expense. The contract for the smelting and sampling plants, power, &c., was let to the Allis-Chambers Company, Chicago, Ill., and signed on May 4th. The contract for a steel stack 90 ft. by 7 ft. was let to the Vancouver Engineering Works, Vancouver; for a 6-in. water pipe line to McLennan, McFeely & Co., also of Vancouver; while all the lumber was supplied on contract by the Ladysmith Lumber Co., Ltd., Ladysmith; otherwise all the building, brick and rock work, installation of plant, &c., was done by the company in a thorough and workmanlike manner, preference being given to solidity rather than cheapness. As laid out, we have a very complete gravity system throughout the works, while ample provision has been made in each department for future extension in any direction.

Machinery and Plant.—The furnace, engine, boiler and plant supplied by the Allis-Chalmers Company is of the latest design and first-class in every particular, and so far has given the utmost satisfaction. Owing to strikes at their works, delivery of the plant was very slow, causing much delay in starting up; at the same time it enabled

us to carry on the work of building and installation in a very thorough manner, all of which will tend to better results in the future. and low cost of repairs.

SMELTER BUILDING.—The smelter building is framed with 12 in. by 12 in. timbers, while all the foundations are of concrete or stone work. It has ample ventilation and light, and is fitted with fire hose and hydrants, lift, matte cracker and grinder for sampling Cast iron moulds are used for the matte instead of matte pots, and nearly all of the floor is covered with 1 in. cast iron plates.

ENGINE AND BOILER ROOM.—The engine and boiler room is framed on the same lines as the smelter building. The foundations for the Corliss engine and Connersville blower are of concrete. An electric plant was also installed and all the buildings wired for electric light. A general storeroom has been petitioned off from the boiler room in which all smelter stores and supplies are kept in charge of the engineer on each shift. All steam pipes are covered with pipe covering, and exhaust pipes are carried out underground to the edge of the dump. From the plans submitted, it will be seen that ample space remains in this department for further machinery, when required, while between this and the smelter building we have 60 ft. of ground already excavated.

ORE BINS.—The ore bins are all of the best design and workmanship, and fitted with iron ore bin gates for rapid work. Plans of the receiving bins were submitted to the railway company and passed by them. The burnt ore bins at the rear of the smelter building are roofed over, while those at the roast yard are open.

OTHER BUILDINGS.—Other buildings erected were a temporary office, blacksmiths' and carpenters' shop. A permanent assay office of four rooms, complete with 30 ft. stack, melting and muffle furnaces, and fitted up with all necessary apparatus for general assaying and analytical work, has been completed, and is in every way a building well suited to the work. A manager's residence was also built near the east boundary of the property; it contains eight rooms and cellar, is wired for electricity, and fitted with bath, etc. Being on the property, it is very convenient for business and equally comfortable.

We have since built a permanent blacksmith and carpenter shop, west of the smelter building, oil-house, closets and powder house, and generally much finishing work has been completed.

ORE RECEIPTS.—The ore receipts from September 22nd, 1902, to April 30, 1903, have been as follows:—

Rough Copper Ore..	15,060.725 tons.
Fine " "	5,173.785 "

a total of 20,234.510 tons of ore, the average assay of which was as follows:—

Copper (Wet)	4.43 per cent.
Silver	2.76 ozs.
Gold	0.12 "

The average assay for the three months ending January, 1903, was as follows:—

Copper (Wet)	4.32 per cent.
Silver	2.71 ozs.
Gold	0.129 "

And for the three months ending April 30th, 1903:—

Copper (Wet)	5.28 per cent.
Silver	3.21 ozs.
Gold	0.142 "

an increase of copper .96 per cent., silver, 5 oz., and gold .013 oz.

The other receipts were as follows:—

Schistose Flux Ore	1,340.90 tons
Sandstone	396 "
Iron	550.97 "
Coke	2,346 "

BURNT ORE.—The average analysis of the burnt ore delivered to the smelter is as follows:—

Iron	10.44 per cent.
Zinc	8.14 "
Alumina	3.61 "
Barium Sulphate	34.08 "
Magnesia	Trace.
Lime	3.46 "
Silica	22.51 "
Combined Sulphur	7.42 "
Total Sulphur	13.86 "

During the past three months the burnt ore has shown an increase of:—

Iron	1.86 per cent.
Zinc	.93 "
Barium Sulphate	7.66 "
Lime	.50 "
Sulphur Combined	.54 "

and a decrease of 11.49 per cent. silica.

SMELTING OPERATIONS.—Since the furnace blew in on. December 16th, 1902, it has run 107 days of 24 hours each, and smelted as follows:—

Burnt Ore ...13,853.841 tons. Green ore .... 2,237.624 "	Total Ore....	16,091.465 tons.
Schist		539.636 "
Silica Flux		774.687 "
Slag		338.108 "
Iron Ore		301.653 "
Matte		963.818 "
Total Mixture		19.009.367 "

Coke used ..... 2,166.313 long tons.

showing an average per day of 150.387 tons of ore, and 177.657 tons of mixture. The ratio of coke to ore was one ton of coke to 7.428 tons of ore, and one ton of coke to 8.775 tons of total mixture.

SLAGS.—The following is an average assay of the slags produced:—

Copper	0.65 per cent.
Iron	15.71 "
Silica	28.79 "
Alumina	11 51 "
Zinc Oxide	10.43 "
Barium Oxide	30.35 "
Calcium Oxide	3.38 "

PRODUCT.—The product for the 107 days ending April 30th, 1903, was as follows:—

Matte produced 1,394.3195 tons containing:—

Copper	1,169,896 lbs.
Silver	41,372.78 ozs.
Gold	2,068.398 "

Total value, less refining charges only:—

Settlements received	$74,879 60

Balance not settled for (estimated):—

717,069 lbs. Copper at 11.5; 24,878.35 ozs. Silver at 95 per cent. of 53.5 = 50.82 cents; 1,293.416 ozs. Gold at $20.00	120,974 42
	$195,854 02

Showing an average matte of:—

Copper (Dry)	41.95 per cent.
Silver	29.67 ozs.
Gold	1.483 "

And a yield per ton of ore of:—

Copper (Dry) 3.63% at 11.5 cents	$8,349
Silver .....2.57 ozs. at 50.82 cents....	1,306
Gold.....0.128 " at $20.00	2,560
Value per ton of ore	$12,215

Gold Dredging in British Columbia.*

In the Cariboo District the only dredge known to have been worked during the past year was a small experimental one operated by Mr. Thos. Drummond. This dredge, of the dipper type, was built in 1899 by the Newall Dredging Co., to test certain leased ground near Quesnel Forks, but for the last couple of years it has lain idle. In the latter part of August Mr. Drummond leased the dredge and

*Report, Minister of Mines, 1902.

moved it 16 miles down stream, to a point on certain leaseholds which are held by him on the Quesnel river, and which extend for a distance of 10 miles above the mouth of the Beaver. The dredge was at work for about two months, and Mr. Drummond reports that the results obtained were very satisfactory, so far as proving the value of the ground is concerned.

The Cobeldick dredge was working on the Fraser river at Lytton, and, although Lytton is not in the Cariboo District, as this was the only dredge actually found in operation, it may be well to include it here. The Cobeldick Dredge No. 1 Co, with all its belongings, including the dredge itself and five leases of five miles each, was bought out by the Fraser River Gold Dredging Co., Limited, a company formed for that purpose, and chiefly consisting of the same shareholders. The dredge machinery was made in England by Robey & Co., and the scow was made and equipped at Lytton. This dredge is of the chain bucket elevator type, with buckets of 5½ cubic feet capacity. The ladder was made of wrought iron I beams, but, although very strongly constructed, proved not quite stiff enough. The ladder was set at an angle of about 20°. The chain is made of steel links jointed with steel pins fitted in removable bushings, so that the wear is taken up entirely with these pins and bushings, which are easily, cheaply and quickly replaced, a marked contrast to the bucket elevator in use at Barkerville. The elevator was run at the rate of about 14 buckets to the minute, at which rate it was estimated to be raising about two cubic yards per minute. The dirt elevated in 24 hours was calculated at about 1,800 cubic yards. This dirt was dumped by the elevator on to a revolving iron screen, with ⅜ and ⅝-inch round perforations, the tailings passing out over the stern and the screenings dropping through on to gold-saving tables covered with cocoanut matting with expanded metal above. The motive power was a 150 horse-power compound engine, with two locomotive boilers. There is also a separate engine, geared direct to four drums, to handle guy ropes and lift the foot of the ladder. A 12-inch rotary pump supplies the necessary water for washing the gravel. The plant in operation consumed six cords of wood per day, costing $4 per cord delivered, and employed six men and the dredge-master.

The dredge was found, at the time of the writer's visit, at work on the right bank of the Fraser river, about three-quarters of a mile above Lytton, and was dredging a bar, not on bed-rock, at a depth of from 20 to 35 feet. The dredge was in charge of Mr. F. Graham as superintendent, while Mr. W. N. Turner, an English mechanical engineer, had been sent over as managing director to investigate the working of the plant. Mr. Turner soon became convinced that the lifting of the gravel on board was the lesser difficulty he had to contend with, and that the real trouble was that they were not saving the gold contained in the gravels brought up. To test this he arranged that, at frequent and regular intervals, the dredge should be stopped and the bucket nearest the deck emptied out, and of this dirt a measured boxful was taken as a sample. These "samples" were "assayed" by a Chinaman, on the deck of the dredge, with a rocker—if not a very scientific method of assaying, certainly one of the most accurate known for such material, although the results are necessarily always low, if the work is honestly done. These tests were not completed when the writer visited the dredge, but the following is taken from the report of directors at a meeting held in London on December 30th, 1902, at which Mr. John White, the chairman, said .—

"We have an average of the tests from September 29th to the first week in December. The average comes out at 49.50 grains per cubic yard (a grain of gold is worth about 5 cents). Of course these tests vary very greatly; I find on this sheet that one comes out 21.3, the next 12.63 and another 8.91, but we never had one barren test."

This gives an idea as to the value of the ground being dredged, and there is no reason for thinking that this is an unusually rich bar or portion of the river. Mr. Turner dug a hole in the bar with a dredger and found below nine feet of water that "the first two feet below gave 23.62 grains (of gold) per yard; the next two feet, 10.12 grains; and the next six feet is hardly worth working." As to working costs, the chairman said :—"At present everything over an average of 20 ounces of gold per week is profit."

These values, as given, are in the dirt actually dredged up, but Mr. Turner reported to the writer he was not saving on the tables over 10 per cent. of the gold so dredged up. To again quote from the director's report :—"The gold recovered amounted to £939. We know positively, instead of that representing all the gold we should have recovered, we have 'checked' 99 per cent. of the gold we had on board overboard."

These statements, both as to the value of the ground and the values recovered, made by a responsible engineer, after careful tests, are remarkable, and indicate the necessity of a thorough investigation of the question of gold-saving, which, when solved, will render the Fraser a very profitable field for gold dredging.

Taking into consideration the foregoing rather remarkable data as to the dredging grounds on the Fraser river, it might be well to draw particular attention to the terms and conditions of British Columbia dredging leases, as compared with those of other Colonies. The average width of the river in the vicinity of these leaseholds is 15 chains. This makes the holding 120 acres per mile of dredging lease, or 600 acres for the usual lease of five miles. Acreage is estimated as in the Australian Colonies, from which comparisons will be drawn. Dredging leases, in common with other classes of alluvial mining, are granted upon payment of a rental based upon the acreage. First, as regards rental and working conditions, those of this Province are much more favorable than in other Colonies where dredging operations are carried on. Compare the following :—

BRITISH COLUMBIA (Circular of 28th October 1898.)

Period—20 years, with privilege of renewal at same terms.

Area—Not more than five miles along stream (in the cases under discussion averaging 600 acres).

Rental—$50 per mile per annum, minimum. (This has never been exceeded on the Fraser or Thompson rivers.)

Working conditions—Development work, $1,000 per mile per annum. The value of new plant and machinery employed to count as money expended.

The only Colonies whose statutes specifically dealing with this matter are available are New Zealand, New South Wales and Western Australia. The conditions obtaining, with citations of Acts, &c., follow :—

NEW ZEALAND (Mining Act, 1898).

Period—Not limited, during continuous compliance with working conditions and payment of rental. After default of payment, which is in advance, for 21 days, distraint and confiscation of plant. (Regulation 83 (2), p. 9).

Area—Not more than one mile along stream, nor total acreage of more than 100 acres. (Sec. 76).

Rental—1st year, 2s. 6d. per acre, say 60 cents.

2nd	"	5s. 0d.	" $1.25
after		7s. 6d.	" 1.85

Working conditions—Holder of lease is required to work "continuously, with reasonable diligence and skill," (sec. 85). The Warden may require that each dredging claim shall employ up to seven men for each dredge (sec. 86, sub-sec. 2), but, in lieu of half the number of workmen, capital may be expended instead of such employment;

at the rate or £1,000, say $5,000, for each man not employed; see sub-section 4, sub-sec. 1 (*d*), of sec. 85, which provides:—"The holder shall commence and prosecute the construction or acquisition of a dredge for working the claim within such time as the Warden fixes."

New South Wales (Gold and Mineral Dredging Act, 1899).

Area—Maximum of 100 acres. (Sec. 3, sub-sec. 2).

Rental—20s (£5) per acre per annum. (Sec. 11, sub-sec. 4 (*a*).

Period—Not more than 15 years. (Sec. 3, sub-sec. 4).

Working conditions—Not less than seven men continuously employed on each 100 acres, which number may be increased by the Warden to 10. In lieu of such employment, an expenditure of $50 say ($250) for each acre. (Sec. 3, sub-sec. 2).

Western Australia.

The following summary is taken from the report of the Department of Mines for that Colony for 1899. It may be noted that this Act was framed in order to facilitate the exploitations of some gold deposits found in the salt lakes in the interior of that Colony, where the conditions are much more unfavorable than here, and, accordingly, is not a fair comparison. However, the particulars, so far as obtainable, are given:—

Area—Not to exceed 5,000 acres.

Rent—6d. per acre per annum.

Working conditions—Within one year after granting of lease machinery to the value of £3,000 for every 2,000 acres of leases is to be employed.

This, it will be noticed, seems slightly more favorable than this Province in regard to rental, but the working conditions are very similar. The rental for 600 acres in Western Australia is only $75 against $250 here, but the working conditions are an expenditure on machinery alone of $4,500 within a year, while in British Columbia the working conditions only require a total of $5,000, including both machinery and labor.

In Queensland and Victoria no difference, so far as can be discovered, is made between dredging and other mining leases. Their rates follow. In both cases continuous working if necessary or immediate forfeiture takes place.

Queensland (Statutes, p. 1868).

Period—21 years, or nearly the same as British Columbia.

Area—Not exceeding 25 acres (British Columbia averaging 600 acres).

Rental—£1 per annum per acre.

Victoria (Statutes, 1890, p. 2508).

Period—Not exceeding 15 years (British Columbia, 20 years).

Area—Not limited by the Statute.

Rental—5s. ($1.25) per acre per annum.

To put it shortly, acre for acre, British Columbia is cheaper than any other of the Colonies mentioned. Taking the average mile acreage as 120, it makes the British Columbia rent only 41⅔ cents per annum, while the others are:—New Zealand, 1st year, 60 cents; 2nd, $1.25; after. $1.85 New South Wales, $5, or more than ten times British Columbia. Queensland, the same as New South Wales; and Victoria, $1.25 per acre.

The labor requirements, also, are more onerous than here. New South Wales. as pointed out before, for the same area would require continuous working of 42 men (which might be increased to 60) for each five miles. In New Zealand, vide section 85, sub-section 1 (*d*), to quote, "the holder shall commence and prosecute the construction or acquisition of a dredge for working the claim within such time as the Warden fixes." By regulation 81, made under the authority of the Act, it ts further provided that the Warden may require not more than seven men to be employed on each of such dredges, making a total of 42 men, the same as New South Wales. Further, the mileage of a British Columbia lease covering five of those of New Zealand, five dredges must in that Colony be immediately constructed within the area of one of British Columbia lease.

Compressed Air in the Elevation of Tailings.*

A good deal of experimental work has been done from time to time on the application of compressed air to the elevation of wet pulp. On account of the flat nature of most of our mill sites, elevation of the pulp has to be provided for, and the various methods in vogue show considerable loss of time in the replacing of wearing parts. During the last two years the writer has carried out a great many experiments with a view of devising an elevator that will give continuous work with a minimum of wear.

The results do not show a high efficiency for the power employed, but the lift is continuous in operation, very cheaply installed, and possesses no wearing parts. The lift was tried working in a bore hole of 8 in. diameter, but in many cases it is more convenient to sink a small well for the purpose. The result to date showed that the most efficiency was obtained when the depth of the well was not less than the height of the lift required. The pressure of air required in pounds per square inch was (approximately) half the number of feet to be lifted. In the majority of cases the lift required varied between 20 ft. and 50 ft., and the air pressure required between 10 lbs. and 25 lbs. per square inch.

In most existing installations the air compressors in use were delivering air to the receivers at about four times that pressure, and when air so compressed was expanded to perform its work at a reduced pressure, it was apparent that the power exerted in originally compressing the air above the working pressure required at the lift was absolutely lost.

Thus, at the Mount Malcolm mines it was found that the lift only gave an efficiency of 35 per cent. of the compressor, under the following conditions:—

Height of lift above surface of well.....	52 ft.
Depth of well.....	54 ft.
Air pressure at receiver per square inch.....	58 lb.
Reduced air pressure at lift	27 lb.

The air was conducted from the receiver through a reducing valve to the lift. The rising main was a 4 in. black pipe, and the air inlet through 1 in. pipe. This elevator was capable of lifting 100 tons tailings in 24 hours. The most wear was shown on the top bend, which had a life of about six months; in the rest of the pipe the wear was normal.

In this instance had the air been taken direct from the compressor at the working pressure of 27 lbs., the lift would have shown a much higher efficiency.

It became apparent that to work this system with economy, an independent compressor, designed expressly for giving large quantities of air at low pressure, must be employed. The writer subsequently installed two such—one at the Guests Gold Mine, Mount Morgan, and a similar one at the Lancefield Gold Mine, Laverton. In both cases small compressors were geared on to the line shaft, and they delivered their air, without any receiver, direct to the foot of the lift. Under such conditions the only back pressure on the compressor was the weight of a column of water equal to the submerged part of the lift, and the rising or falling of the level of the surface of the well was a perfect governor to the compressor. Unfortunately, it has been found impracticable up to the present to calculate the efficiency returned by

* Paper. J. W. Archibald, Transactions, Australasian Institute M.E.

the lift under these conditions, on account of the difficulty in arriving at the actual horse power used by the compressor; but in both cases these lifts are regarded as eminently satisfactory by the managers.

It appeared to the writer that under the last named conditions the efficiency of this lift was much greater than had hitherto been estimated. The following data, however, taken from observations at the Guests Gold Mine do not show a high efficiency This was probably due to the fact that the compressor was a very crude one, and that being above the capacity required, the back pressure of air may have averaged less than the figures taken. At this mill, of 20 stamps, there is 11.25 cubic feet of pulp, containing 93 lbs. sand, delivered per minute. This was elevated 28 ft., equal to a lift of 21,000 lbs. 1 ft. per minute. Theoretically this would require 11.25 cubic feet of air, at a pressure of one atmosphere (or 22.5 cubic feet atmosphere) delivered to the lift per minute, and this would work out at the equivalent of one horse power. But as the capacity of the lift was considerably greater than was required, the surface of the pulp was generally about 4 ft. below the top of the well, and the lift air gauge showed a pressure of from 9 lbs. to 11 lbs. This lift has a 4 in. column air inlet through 1 in. pipe; depth of well, 28 ft.; height of lift, 27 ft. The compressor took 50 cubic feet of atmosphere per minute, which, at 11 lbs. pressure per square inch, was (approximately) 32 cubic feet, and as that was brought from the air compressor cylinder directly into contact with the cold pulp, there would be a considerable loss due to the lower temperature. This had not been accurately determined, but he estimated it at about 14 per cent. (on the basis of 18 per cent. of one atmosphere), and, making allowance for that, they would have 29.7 cubic feet of air at the temperature of the pulp. Therefore, the volume of compressed air in the rising main would be at 2.64 to 1 of pulp—an average compression of 6 lbs. of air. At 11 lbs. pressure the average load against the compressor piston was 8.914 lbs. per square inch, which would work out in the compressor employed at 2.165 horse-power. This was employed to lift (approximately) 21,000 lbs. 1 ft. per minute, showing an efficiency of only 32 per cent. of the power required for the compressor.

The principal points in favor of this system are:—

1. Cheapness of installation.
2. Absence of wearing parts.
3. Uniform continuity of operation.

The cost of installation involves the sinking of a well or bore hole to the depth required to be lifted, and an ordinary pipe of the size required from the bottom of the well to the delivery point, and an air pipe from the compressor to the bottom of the delivery pipe. When the rising column was of a size proportionate to the volume required to be lifted, there was very little sign of wear on the pipes, except on the top bend, which wore out on top in about six months.

Regarding uniformity of operation, when the installation was once made, there was no chance for anything to go wrong. Pieces of stone, which might be washed into the well through the breaking of screens, were carried up through the pipe without difficulty.

At both the mines mentioned there had been no stoppage during the last nine months from any cause due to the faulty working of the elevator. At the Guests mine the pipe was vertical to the required height, and thence horizontal over a series of vats; but the rising column may also be taken in a sloping direction.

As the efficiency of all compressors decreases in proportion to the pressure required, it is evident that the pneumatic elevators will give greatest efficiency where the lift required is not very high. In cases where the lift required is not excessive, the cheapness of installation, coupled with the unfailing continuity of operation, may be found to be strong recommendations for employing this form of elevator.

The Refining of Lead Bullion.*

By F. L. PIDDINGTON.

In presenting this account of the Parkes' process of desilverising and refining lead bullion the writer claims no originality, but hopes that a description of the process as carried out at the works of the Smelting Company of Australia may be of interest to members; it is possible, also, that the subject may borrow some additional interest from recent developments on these fields.

The Parkes' process may be conveniently summarised as follows:—

1. Softening of the base bullion to remove copper, antimony, etc.
2. Removal of precious metals from the softened bullion by means of zinc.
3. Refining the desilverised lead.
4. Liquation of gold and silver crusts obtained from operation 2.
5. Retorting the liquated alloy to drive off zinc.
6. Concentrating and refining bullion from 5.

Softening is done in reverberatory furnaces. In large works two furnaces are used—copper, antimony and arsenic being removed in the first and antimony in the second. The size of the furnaces is naturally governed by the quantity to be treated. In these works (refining some 200 tons weekly) a double set of 15-ton furnaces were at work. The sides and ends of these furnaces are protected by a jacket with a 2 in. water space, the jacket extending some 3 in. above the charge level and 6 in. to 9 in. below it. The furnace is built into a wrought iron pan, and if the brickwork is well laid into the pan there need be no fear of lead breaking through below the jacket. The bars of bullion (containing as a rule 2 to 3 per cent. of impurities) are placed in the furnace carefully avoid injuring the hearth and melted down slowly. The copper dross separates out and floats on top of the charge, which is stirred frequently to expose fresh surfaces. If the furnace is overheated some dross is melted into the lead again and will not separate out until the charge is cooled back. However carefully the work is done some copper remains with the lead and its effects are to be seen in the later stages. The dross is skimmed into a slag pot with a hole bored in it some 4 in. from the bottom; any lead drained from the pot is returned to the charge. The copper dross is either sent back to the blast furnace direct or may be first liquated. By the latter method some 30 per cent. of the lead contents of the dross is recovered in the refinery. Base bullion made at a customs' smelter will often vary greatly in composition and it is, therefore, difficult to give any hard and fast figures as to percentage of metals in the dross. As a rule our dross showed 65 to 70 per cent. lead, copper 2 to 9 per cent. (average 4 per cent.), gold and silver values varying with the grade of the original bullion, though it was difficult to detect any definite relation between bullion and dross. It was, however, noticed that gold and silver values increased with the percentage of copper.

Immediately the copper dross is skimmed off, the heat is raised considerably and very soon a tin (and arsenic, if present) skimming appears. It is quite "dry" and may be removed in an hour or so. It is a very small skimming and the tin not being worth saving, is put with the copper dross.

The temperature is now raised again and antimony soon shows in black boiling oily drops, gathering in time into a sheet covering the surface of the lead. When the skimming is about ½ in. thick, slaked lime, ashes or fine coal is thrown on and stirred in. The dross soon thickens up and may be skimmed off easily. This operation is repeated

*Paper read before the Chemical, Metallurgical and Mining Society of South Africa.

until all antimony, is eliminated. Constant stirring of the charge is necessary. The addition of litharge greatly facilitates the removal of antimony, or steam or air may be blown on the surface of the metal to hasten oxidation, though they have anything but a beneficial effect on the furnace lining. From time to time samples of the dross are taken in a small ladle and after setting hard the sample is broken in two. A black vitreous appearance indicates plenty of antimony yet in the charge. Later samples will look less black, until finally a few yellowish streaks are seen, being the first appearance of litharge. When all antimony is out the fracture of a sample should be quite yellow and the grain of the litharge long, a short grain indicating impurities still present, in which case another skimming is necessary. The analysis of a representative sample of antimony dross was as follows:—

PbO	=	78.11 per cent.
Sb_2O_4	=	8.75 "
As_2O_3	=	2.18 "
CuO	=	0.36 "
CaO	=	1.10 "
Fe_2O_3	=	0.42 "
Al_2O_3	=	0.87 "
Insol.	=	4.10 "

Antimony dross is usually kept separate and worked up from time to time, yielding hard antimonial lead, used for type metal, Britannia metal, etc.

DESILVERISATION.—The softening being completed the charge is tapped and run to a kettle or pan of cast iron or steel, holding, when conveniently full, some 12 to 13 tons. The lead falling into the kettle forms a considerable amount of dross, which is skimmed off and returned to the softening furnace. By cooling down the charge until it nearly "freezes" an additional copper skimming is obtained, which also returns to the softener. The kettle is now heated up to the melting point of zinc and the zinc charge, determined by the gold and silver contents of the kettle, is added and melted. The charge is stirred, either by hand or steam, for about an hour, after which the kettle is allowed to cool down for some three hours and the first zinc crust taken off. When the charge is skimmed clean a sample of the bullion is taken for assay, and while this is being done the kettle is heated up again for the second zinc charge, which is worked in the same way as the first; sometimes a third addition of zinc is necessary. The resulting crusts are kept separate, the second and third being added to the next charge as "returns" allowing 3 lbs. of zinc in returns as equal to 1 lb. of fresh zinc. An alternative method is to take out gold and silver in separate crusts, in which case the quantity of zinc first added is calculated on the gold contents of the kettle only. The method of working is the same, though subsequent treatment may differ in that the gold crusts are cupelled direct.

As to the quantity of zinc required:—

1. Extracting the gold with as little silver as possible the following figures were obtained:—

			Au.
Total gold in kettle—	300 oz.:	1 lb. zinc takes out	.....1.30 oz.
" "	200 oz.:	" "	.....1.00 "
" "	150 oz.:	" "	.....0.79 "
" "	100 oz.:	" "	.....0.59 "
" "	60 oz.:	" "	.... .0.45 "

2. Silver zincing gave the following general results with 11-ton charges:—

Silver in kettle—	1,450 oz..	1 lb. zinc takes out	.....5.6 oz.
" "	1,200 oz.:	" "	.....4.1 "
" "	930 oz.:	" "	.....3.8 "
" "	755 oz.:	" "	..... 3.5 "
" "	616 oz.:	" "	.....3.4 "
" "	460 oz.:	" "	.....2.6 "

3. Extracting gold and silver together:—

Total contents of kettle.		1 lb zinc takes out.	
Au. oz.	Ag. oz.	Au. oz.	Ag. oz.
494	3,110	0.59	3.60
443	1,883	0.64	2.80
330	2,417	0.45	3.34
204	1,638	0.36	2.86
143	1,330	0.28	2.65
123	1,320	0.23	2.54

It will be noticed that in each case the richer the bullion the greater the extractive power of zinc. Experiments made on charges of rich bullion showed that the large amount of zinc called for by the table in use was unnecessary and 250 lbs. was fixed on as the first addition of zinc. On this basis an average of 237 charges gave results as follows:—

Total contents		Zinc used	1 lb. zinc takes out	
Au. oz.	Ag. oz.	lbs.	Au. oz.	Ag. oz.
520	1,186	407.5	1.27	2.91

The zinc used was that necessary to clean the kettle, added as follows:—1st, 250 lbs.; 2nd (average), 127 lbs.; 3rd (average), 57 lbs. In 112 cases no third addition was required. From these figures it appears that in the earlier work the zinc was by no means saturated.

REFINING THE LEAD.—Gold and silver being removed, the lead is siphoned off into the refining kettle and the fire made up. In about 4 hours the lead will be red hot, and when hot enough to burn zinc, dry steam, delivered by a ¾in. pipe reaching nearly to the bottom of the kettle, is turned on. The charge is stirred from time to time, and wood is fed on the top to assist de-zincing and prevent the formation of too much litharge. In 3 to 4 hours the lead will be soft and practically free from zinc. When test strips show the lead to be quite soft and clean the kettle is cooled down and the scum of lead and zinc oxides skimmed off. In an hour or so the lead will be cool enough for moulding; the bar should have a yellow lustre on the face when set; if the lead is too cold it will be white, if too hot a deep blue. The refining kettles are subjected to severe strain during the steaming process and hence their life is uncertain—an average would be about 60 charges—the zincing kettles on the other hand last very much longer. Good steel kettle (if they can be obtained) are preferable to cast iron.

TREATMENT OF ZINC CRUSTS.—Having disposed of the lead, let us return now to the zinc crusts. These are first liquated in a small reverberatory furnace, the hearth of which is formed of a cast iron plate (the edges of the long sides being turned up some 4 in) laid on brasque filling with a fall from bridge to flue of ¾in. per foot and also sloping from sides to centre. The operation is conducted at a low temperature, and the charge is turned over at intervals, the liquated lead running out into a small separately fired kettle. This lead rarely contains more than a few ounces of Ag per ton; it is baled into bars and returned to the zincing kettles or worked up in a separate charge. In 2 to 3 hours the crust is as "dry" as it is advisable to make it, and the liquated alloy is raked out over a slanting perforated plate to break it up and goes to the retort bin.

RETORTING THE ALLOY.—This is carried out in Du Faur tilting furnaces—simply a cast-iron box swinging on trunnions and lined with firebrick. Battersea retorts (class 409) holding 560 lbs. each are used —their average life is about 30 charges. The retorts are charged hot, a small shovel of coal being added with the alloy. The condenser is now put in place and luted on; it is made of ⅛in. iron bent to form a cylinder 12in. in diameter, open at one end; it is lined with a mixture of lime, clay and cement. It has three holes, one on the upper side close to the furnace and through which a rod can be passed into the retort, a vent hole on the upper side away from the furnace, and a tap

hole on the bottom for condensed zinc. In an hour or so the flame from the vent hole should be green, showing that distillation has begun. When condensation ceases (shown by the flame) the condensor is removed and the bullion skimmed and poured into bars for the cupel. The products of retorting are bullion, zinc, zinc powder and dross. Bullion goes to the cupel, zinc is used again in the desilverising kettles, powder is sieved to take out scraps of zinc and returned to the blast furnace, or it may be, and sometimes is, used as a precipitating agent in cyanide work; dross is either sweated down in a cupel with lead or litharge, together with outside material such as zinc gold slimes from cyanide works, jeweller's sweep, mint sweep, &c., or in the softening furnace after the antimony has been taken off. In either case the resulting slag goes back to the blast furnace. The total weight of alloy treated is approximately 7 per cent. of the original base bullion. The zinc recovered is about 60 per cent. of that used in desilverising. The most important source of temporary loss is the retort dross (consisting of lead-zinc-copper alloy with carbon, silica and other impurities), and it is here that the necessity of removing copper in the softening process is seen, since any copper comes out with the zinc crusts and goes on to the retorts, where it enters the dross, carrying gold and silver with it. If much copper is present the dross may contain more gold and silver than the retort bullion itself. In this connection, I remember an occasion on which some retort dross yielded gold and silver to the extent of over 800 and 3,000 ounces per ton respectively.

CUPELLATION.—Retort bullion is first concentrated up (together with bullion resulting from dross treatment) to 50-60 per cent. gold and silver in a water jacketed cupel. The side lining is protected by an inch water pipe embedded in the lining at the litharge level or by a water jacket, the inner face of which is of copper; the cupel has also a water jacketed breast so that the front is not cut down. The cupel lining may be composed of limestone, cement, fireclay and magnesite in various proportions, but a simple lining of sand and cement was found quite satisfactory. When the bullion is concentrated up to 50-60 per cent. gold and silver it is baled out and transferred to the finishing cupel where it is run up to about 995 fine; it is then ready either for the melting pot or parting plant. The refining test by the way is not water cooled.

Re-melting is done in 2,000 oz. plumbago crucibles and presents no special features. In the case of doré bullion low in gold, "sprouting" of the silver is guarded against by placing a piece of wood or charcoal on the surface of the metal before pouring, and any slag is kept back. The quantity of slag formed is, of course, very small, so that the bars do not require much cleaning.

The parting plant was not in operation in my time, and I am therefore unable to go into details. The process arranged for was briefly as follows:—Solution of the doré bullion in H_2SO_4; crystallisation of silver as monosulphate by dilution and cooling; decomposition of silver sulphate by ferrous sulphate solution giving metallic silver and ferric sulphate, which is reduced to the ferrous salt by contact with scrap iron. The gold and silver are washed thoroughly with hot water and cast into bars.

In conclusion some variations in practice may be noted. The use of two furnaces in the softening process has already been mentioned; by this means the drossing and softening are more perfect and subsequent operations thereby facilitated; further, the furnaces being kept at a more equable temperature are subject to less wear and tear. Zinc crusts are sometimes skimmed direct into an alloy press in which the excess of lead is squeezed out while still molten; liquation is then unnecessary. Refining of the lead may be effected by a simple scorification in a reverberatory, the soft lead being run into a kettle from which it is moulded into market bars.

These and similar points, however, do not fall within the scope of this paper, which is simply an account of some personal experience in a most interesting branch of metallurgy; this, it is to be feared, must be the writer's only apology for introducing a subject somewhat outside the range of "practical politics" as at present defind on the Rand.

Electrolytic Lead-Refining at Trail, B.C.*

By ANSON G. BETTS, TROY, N.Y.

A solution of lead fluosilicate, containing an excess of fluosilicic acid, has been found to work very satisfactorily as an electrolyte for refining lead. It conducts the current well, is easily handled and stored, non-volatile and stable under electrolysis, may be made to contain a considerable amount of dissolved lead, and is easily prepared from inexpensive materials. It possesses, however, in common with other lead electrolytes, the defect of yielding a deposit of lead lacking in solidity, which grows in crystalline branches towards the anodes, causing short circuits. But if a reducing-action (practically accomplished by the addition of gelatine or glue) be given to the solution, a perfectly solid and dense deposit is obtained, having very nearly the same structure as electrolytically-deposited copper, and a specific gravity of about 11.36—that of cast-lead.

Lead-fluosilicate may be crystallized in very soluble, brilliant crystals, resembling those of lead-nitrate and containing four molecules of water of crystallization, with the formula $PbSiF_6,4H_2O$. This salt dissolves at 15° C. in 28 per cent. of its weight of water, making a syrupy solution of 2.38 sp. gr. Heated to 60° C., it melts in its water of crystallization. A neutral solution of lead-fluosilicate is partially decomposed on heating, with the formation of a basic insoluble salt and free fluosilicic acid, which keeps the rest of the salt in solution. This decomposition ends when the solution contains, perhaps, 2 per cent. of free acid; and the solution may then be evaporated without further decomposition. The solutions desired for refining are not liable to this decomposition, since they contain much more than 2 per cent. of free acid. The electrical conductivity depends mainly on the acidity of the solution.

My first experiments were carried out without the addition of gelatine to the fluosilicate solution. The lead-deposit consisted of more or less separate crystals that grew toward the anode, and, finally, caused short-circuits. The cathodes, which were sheet-iron plates, lead-plated and paraffined, had to be removed periodically from the tanks and passed through rolls, to pack down the lead. When gelatine has been added in small quantities, the density of the lead is greater than can be produced by rolling the crystalline deposit, unless great pressure is used.

The Canadian Smelting Works, Trail, British Columbia, have installed a refinery, making use of this process. There are 28 refining-tanks, each 86 in. long, 30 in. wide and 42 in. deep, and each receiving 22 anodes of lead-bullion with an area of 26 by 33 in. exposed to the electrolyte on each side, and 23 cathodes of sheet-lead, about $\frac{1}{16}$ in. thick, prepared by deposition on lead-plated and paraffined-iron cathodes. The cathodes are suspended from 0.5 by 1 in. copper-bars, resting crosswise on the sides of the tanks. The experiment has been thoroughly tried, of using iron-sheets to receive a deposit thicker than $\frac{1}{16}$ in.; that is, suitable for direct melting without the necessity of increasing its weight by further deposition as an independent cathode; but the iron-sheets are expensive, and are slowly pitted by the action of the acid-solution; and the lead-deposits thus obtained are much less smooth and pure than those on lead-sheets.

* Paper read before the American Institute of Mining Engineers.

The smoothness and the purity of the deposited lead are proportional. Most of the impurity seems to be introduced mechanically through the attachment of floating particles of slime to irregularities on the cathodes. The effect of roughness is cumulative; it is often observed that particles of slime attract an undue amount of current, resulting in the lumps seen on the cathodes. Samples taken at the same time showed from 1 to 2.5 oz. silver per ton in rough pieces from the iron cathodes, 0.25 oz. as an average for the lead sheet cathodes, and only 0.04 oz. in samples selected for their smoothness. The variation in the amount of silver (which is determined frequently) in the samples of refined-lead is attributed not to the greater or less turbidity of the electrolyte at different times, but to the employment of new men in the refinery, who require some experience before they remove cathodes without detaching some slime from the neighboring anodes.

The shape of the electrodes, and the method of handling them to and from the tanks, are shown in Fig. 1.

Each tank is capable of yielding, with a current of 4000 amperes, 750 lbs. of refined-lead per day. The voltage required to pass this current was higher than expected, as explained below; and for this reason, and also because the losses of solution were very heavy until proper apparatus was put in to wash thoroughly the large volume of slime produced (resulting in a weakened electrolyte), the current used has probably averaged about 3000 amperes. The short-circuits were also troublesome, though this difficulty has been greatly reduced by frequent inspection and careful placing of the electrodes. At one time, the solution in use had the following composition in grammes per 100 c.c.: Pb, 6.07; Sb, 0.0192; Fe, 0.2490; SiF_6, 6.93, and As, a trace. The current passing was 2800 amperes, with an average of about 0.44 volts per tank, including bus-bars and contacts. It is not known what was the loss of efficiency on that date, due to short-circuits; and it is, therefore, impossible to say what resistance this electrolyte constituted.

Hydrofluoric acid of 35 per cent. used as a starting-material for the preparation of the electrolyte, is run by gravity through a series of tanks for conversion into lead-fluosilicate. In the top tank is a layer of quartz 2 ft. thick, in passing through which the hydrofluoric acid dissolves silica, forming fluosilicic acid. White lead (lead-carbonate) in the required quantity is added in the next tank, where it dissolves readily and completely with effervescence. All sulphuric acid and any hydrofluoric acid that may not have reacted with silica settle out in combination with lead as lead-sulphate and lead-fluoride. Lead-fluosilicate is one of the most soluble of salts; so there is never any danger of its crystallizing out at any degree of concentration possible under this method. The lead-solution is then filtered and run by gravity into the refining-tanks.

The solution originally used at Trail contained about 6 per cent. Pb and 15 per cent. SiF_6.

The electrical resistance in the tanks was found to be greater than had been calculated for the same solution, plus an allowance for loss of voltage in the contacts and conductors. This is partly, at least, due to the resistance to free motion of the electrolyte, in the neighborhood of the anode, offered by a layer of slime which may be anything up to ½ in. thick. During electrolysis, the SiF_6 ions travel toward the anodes, and there combine with lead. The lead and hydrogen travel in the opposite direction and out of the slime; but there are comparatively few lead ions present, so that the solution in the neighborhood of the anodes must increase in concentration and tend to become neutral. This greater concentration causes an E. M. F. of polarization to act against the E. M. F. of the dynamo. This amounted to about 0.02 v. for each tank. The greater effect comes from the greater resistance of the neutral solution with which the slime is saturated. There is, consequently, an advantage in working with rather thin anodes, when the bullion is impure enough to leave slime sticking to the plates. A compensating advantage is found in the increased ease of removing the slime with the anodes, and wiping it off the scrap in special tanks, instead of emptying the tanks and cleaning out, as is done in copper-refineries.

It is very necessary to have adequate apparatus for washing solution out of the slime. The filter first used consisted of a supported filtering-cloth with suction underneath. It was very difficult to get this to do satisfactory work by reason of the large amount of fluosilicate to be washed out with only a limited amount of water. At the present time the slime is first stirred up with the ordinary electrolyte several times, and allowed to settle, before starting to wash with water at all. The Trail plant produces daily 8 or 10 cu. ft. of anode residue, of which over 90 per cent. by volume is solution. The evaporation from the total tank-surface of something like 400 sq. ft. is only about 15 cu. ft. daily; so that only a limited amount of wash-water is to be used—namely, enough to replace the evaporated water, plus the volume of the slime taken out.

The tanks are made of 2-in. cedar, bolted together and thoroughly painted with rubber-paint. Any leaks are caught underneath on sloping-boards. Solution is circulated from one tank to another by gravity, and is pumped from the lowest to the highest by means of a wooden pump. The 22 anodes in each tank together weigh about 3 tons, and dissolve in from 8 to 10 days, two sets of cathodes usually being used with each set of anodes. While 300-lb. cathodes can be made, the short-circuiting gets so troublesome with the spacing used that the loss of capacity is more disadvantageous than the extra work of putting in and taking out more plates. The lead-sheets used for cathodes are made by depositing about $\frac{1}{16}$ in. metal on paraffined steel-sheets in 4 of the tanks, which are different from the others only in being a little deeper.

The anodes may contain any or all of the elements, gold, silver, copper, tin, antimony, arsenic, bismuth, cadmium, zinc, iron, nickel, cobalt and sulphur. It would be expected that gold, silver, copper, antimony, arsenic and bismuth, being more electronegative than lead, would remain in the slime in the metallic state, with, perhaps, tin, while iron, zinc, nickel and cobalt would dissolve. It appears that tin stands in the same relation to lead that nickel does to iron, that is, they have about the same electromotive forces of solution, with the consequence that they can behave as one metal and dissolve and deposit together. Iron, contrary to expectation, dissolves only slightly, while the slime will carry about 1 per cent. of it. It appears from this that the iron exists in the lead in the form of matte. Arsenic, antimony, bismuth, and copper have electromotive forces of solution more than 0.3 volt below that of lead. As there is no chance that any particle of one of these impurities will have an electric potential of 0.3 volt above that of the lead with which it is in metallic contact, there is no chance that they will be dissolved by the action of the current. The same is even more certainly true of silver and gold. The behavior of bismuth is interesting and satisfactory. It is as completely removed by this process of refining as antimony is. No other process of refining lead will remove this objectionable impurity so completely. Tin has been found in the refined-lead to the extent of 0.02 to 0.03 per cent. This we had no difficulty in removing from the lead by poling before casting. There is always a certain amount of dross formed in melting down the cathodes; and the lead-oxide of this reacts with the tin in the lead at a comparatively low temperature.

The extra amount of dross formed in poling is small, and amounts

to less than 1 per cent. of the lead. The dross carries more antimony and arsenic than the lead, as well as all the tin. The total amount of dross formed is about 4 per cent. Table I shows its composition.

TABLE I.—*Analyses of Dross.*

* Analyses of the lead from which this dross was taken, see Table II.

No.	No. in Table II.	Cu. per cent.	As. per cent.	Sb. per cent.	Fe. per cent.	Zn.
1	2	0.0005	0.0003	0.0016	0.0016	None
2	3	0.0010	0.0008	0.0107	0.0011	"

The electrolyte takes up no impurities, except possibly, a small part of the iron and zinc. Estimating, that the anodes contain 0.01 per cent. of zinc and soluble iron, and that there are 150 cu. ft. of the solution in the refinery for every ton of lead turned out daily, in one year the 150 cu. ft. will have taken up 93 lbs. of iron and zinc, or about one per cent. These impurities can accumulate to a much greater extent than this before their presence will become objectionable. It is possible to purify the electrolyte in several ways. For example, the lead can be removed by precipitation with sulphuric acid, and the fluosilicic acid precipitated with salt as sodium-fluosilicate. By distillation with sulphuric acid the fluosilicic acid could be recovered, this process, theoretically, requiring but one-third as much sulphuric acid as the decomposition of fluorspar, in which the fluorine was originally contained.

The only danger of lead-poisoning to which the workmen are exposed occurs in melting the lead and casting it. In this respect the electrolyte process presents a distinct sanitary advance.

A plant for the operation of this process will consist of a power-plant, furnishing an electrolyzing-current of several thousand amperes, with a voltage depending on the number of tanks; a tank-house, with electric-cranes for handling a tank-load of anodes or cathodes at once; apparatus for making "starting"-cathodes of sheet lead; preferably of lead cut from sheets rolled at the refinery; pumps and storage-tanks for handling the electrolyte; and a cellar beneath the tanks for the passage of tank-cars removing that part of anode-slimes which falls from the plates. The finished cathodes, after rinsing, would be carried off to the lead-casting kettle. The casting-room would contain either a rotating- or belt-conveyor, for passing the open anode-molds beneath the end of the siphon through which lead is flowing from the bullion-kettle. The bars of lead would be molded, as is usually done in refining works, by siphoning into a semi-circular row of molds. There would be either a washing-, drying and sampling-plant for the slime, in case it is sold, or a reduction-mill, if it is worked into bullion. The latter is much the best, if the location of the plant is not so remote that the express charges on the bullion will balance the saving.

For the treatment of slime, the only method in general use consists in suspending the slime in a solution capable of dissolving the impurities and supplying, by a jet of steam and air forced into the solution, the air necessary for its reaction with, and solution of, such an inactive metal as copper. After the impurities have been mostly dissolved, the slime is filtered off, dried and melted, under such fluxes as soda, to a doré bullion.

The amount of power required is calculated thus: Five amperes in 24 hours make 1 lb. of lead per tank. One ton of lead equals 10,000 ampere days, and at 0.35 volts per tank, 3500 watt-days, or 4.7 E.H.P. days. Allowing 10 per cent. loss of efficiency in the tanks (we always get less lead than the current which is passing would indicate), and of 8 per cent. loss in the generator increases this to about 5.6 H.P. days, and a further allowance for the electric lights and other applications gives from 7 to 8 H.P. days as about the amount per ton of lead. At $39 per year, this item of cost is something like 65 cents per ton of lead. So this is an electro-chemical process not especially favored by water-power.

The cost of labor is not greater than in the zinc desilverization process. A comparison between this process and the Parkes process, on the assumption that the costs for labor, interest and general expenses are about equal, shows that about $1 worth of zinc and a considerable amount of coal and coke have been done away with, at the expense of power, equal to about 175 H.P. hrs., of the average value of perhaps 65 cents, and a small amount of coal for melting the lead in the electrolytic method.

More important, however, is the greater saving of the metal-values by reason of increased yields of gold, silver, lead, antimony and bismuth, and the freedom of the refined lead from bismuth.

Tables II., III. and IV. show the composition of bullion, slimes and refined lead.

Tables V., VI., VII. and VIII. give the results obtained experimentally in the laboratory on lots of a few pounds up to a few hundred pounds. The results in Tables VI. and VII. were given me by the companies for which the experiments were made.

TABLE II.—*Analyses of Bullion.*

No.	Fe. per cent.	Cu. per cent.	Sb. per cent.	Sn. per cent.	As. per cent.	Ag. per cent.	Au. per cent.	Pb. per cent.	Ag. Oz. p. T.	Au. Oz. p. T.
1	0.0075	0.1700	0.540(	0.0118	0.1460	1.0962	0.0085	98.0200	319.7	2.49
2	0.0115	0.1500	0.6100	0.0158	0.0960	1.2014	0.0086	97.9068	350.4	2.52
3	0.007(	0.1600	0.4000	0.0474	0.1330	1.0738	0.0123	98.1665	313.2	3.60
4	0.0165	0.1400	0.7000	0.0236	0.3120	0.8914	0.0151	97.9014	260.0	4.42
5	0.0.20	0.1400	0.8700	0.0432	0.2260	0.6082	0.0124	98.0882	177.4	3.63
6	0.0055	0.1300	0.7300	0.0316	0.1030	0.6600	0.0106	98.2693	192.5	3.10
7	0.0380	0.3600	0.4030	.....	tr.	0.7230	0.0180	98.4580	210.9	5.25

TABLE III.—*Analyses of Slimes.*

Fe. per cent.	Cu. per cent.	Sb. per cent.	Sn. per cent.	As. per cent.	Pb.	Zn.	Bi.
1.27	8.83	27.10	12.42	28.15	17.05	None	None
1.12	22.36	21.16	5.40	23.05	10.62	"	"

TABLE IV.—*Analyses of Refined Lead.*

No.	Cu. per cent.	As. per cent.	Sb. per cent.	Fe. per cent.	Zn. per cent.	Sn. per cent.	Ag. Oz. p. T.	Ni, Co, Cd. per cent.	Bi. per cent.
1	0.0006	0.0008	0.0005	.....	.....	.....	.....	.....	.....
2	0.0003	0.0002	0.0010	0.0010	None	.....	.....	.....	.. ..
3	0 0009	0.0001	0.0009	0.0008	"		0.24	.....	.....
4	0.0016	.....	0.0017	0.0014	.....	.....	0.47	None	.....
5	0.0003	.....	0.0060	0.0003	.....	.....	0.22	.....	.....
6	0.0020	.....	0.0010	0.0046	.....	.....	0.22	None	.....
7	0.0004	None	0.0066	0.0013	None	0.0035	0 14	.....	.....
8	0.0004	.....	0.0038	0.0004	"	0.0035	0.25	.....	.....
9	0.0005	.....	0.0052	0.0004	"	0.0039	0.28	.....	.....
10	0.0003	None	0.0060	0.0003	"	0.0049	0.43	.....	.....
11	0.0003	"	0.0042	0.0013	"	0.0059	0.32	.....	.....
12	0.0005	"	0.0055	0.0009	"	0.0049	0.22	.....	.....
13	0 0005	"	0.0055	0.0007	"	0.0091	0.11	.....	.....
14	0.0004	"	0.0063	0.0005	"	0.0012	0.14	.....	.....
15	0.0003	"	0.0072	0.0003	"	0.0024	0.24	.....	.....
16	0.0006	"	0.0062	0.0012	"	0.0083	0.22	.....	.....
17	0.0006	"	0.0072	0.0011	.....	0.0080	0.23	.....	.....
18	0.0006	"	0.0057	0.0010	.....	0.0053	0.34	.....	.....
19	0.0005	"	0.0066	0.0016	.....	0.0140	0.38	.....	.....
"	0.0005	"	0.0044	0.0011	.....	0.0108	0.35	.....	.....
20	0.0004	"	0.0047	0.0015	.....	0.0072	0.22	.....	.....
"	0.0004	"	0.0034	0.0016	.....	Trace	0.23	.....	.....
21	0.0022	"	0.0010	0.0046	None	0.0081	0.38	None	None

TABLE V.—*Analyses of Bullion and Refined Lead.*

	Ag. per cent.	Cu. per cent.	Sb. per cent.	Pb. per cent.
Bullion.....	0.50	0.31	0.43	98.76
Refined Lead.....	0.0003	0.0007	0.0019	99 9971

TABLE VI.—*Analyses of Bullion and Refined Lead.*

	Cu. per cent.	Bi. per cent.	As. per cent.	Sb. per cent.	Ag. Oz. p. T.	Ag. per cent.	Au. Oz. p. T.	Fe. per cent	Zn. per cent.
Bullion	0.75	1.22	0.936	0.6832	358.8	....	1.71	.....	.....
Refined lead.	0.0027	.0037	0.0025	0.0000	...	0.0016	None	0.0022	0.0018

TABLE VII.—*Analyses of Bullion, Refined Lead and Slimes.*

	Pb. per cent.	Cu. per cent.	As. per cent	Sb. per cent.	Ag. Oz. p. T.	Ag per cent.	Fe, Zn, Ni, Co. per cent.	Bi.
Bullion	96.73	0.096	0.85	1.42	About 275	.....	.....	....
Refined lead.	.....	0.0013	0.00506	0.0028	....	0.00068	0.0027	Trace
Slimes (dry sample)	9.05	1.9	9.14	29.51	9366.9	.....	0.49	Trace

TABLE VIII.—*Analyses of Bullion, Refined Lead and Slimes.*

	Pb. per cent.	Cu. per cent.	Bi. per cent.	Ag. per cent.	Sb. per cent.	As. per cent.
Bullion	87.14	1.40	0.14	0.64	4.0	7.4
Lead	.....	0.0010	0.0022	....	0.0017	Trace
Slimes	10.3	9.3	0.52	4.7	25.32	44.58

The process here described has been patented in the United States, Canada, Mexico, Belgium, France, Great Britain, Germany, Italy, Spain, New South Wales, Victoria and South Australia.

The success thus attained in the electrolysis of lead, generally accepted hitherto as impracticable, may give some encouragement to the employment of similar methods in the treatment of some of the other metals, especially as it is shown to be possible to apply simple means to obviate the chief trouble, spongy deposits.

I wish to express my thanks to Mr. W. H. Aldridge, Dr. Edward F. Kern, and Dr. William Valentine, of the Canadian Smelting Works, for their kindness in giving information and analyses.

* Silver not given. This was the case, also, with the gold in the bullion. The slimes contained 0.131 per cent. of gold, or 39.1 oz. per ton.

GEOLOGICAL SURVEY.

Minister of the Interior will reorganize it on economic lines recommended by the Canadian Mining Institute. More attention to be given to Mining.

Discussing the annual grant to the Geological Survey in the House of Commons :—

The MINISTER OF THE INTERIOR (Hon. Clifford Sifton). This vote has been decreased by $10,000 in pursuance of an arrangement that I will explain later on for the purpose of doing the work more especially connected with mining. I intend to introduce a resolution on the subject

Mr. MONK.—It would be interesting to know what plan of survey and exploration is being pursued. In what direction are the officers going to operate this year?

The MINISTER OF THE INTERIOR.—There are fifteen exploring parties now in the field ; one in the Yukon, one in the Peace River district, one connected with the boundary survey north of the forty-ninth parallel in British Columbia, one in the anthracite region of the Rocky Mountains, one in the Keewatin district, three in Northern Ontario, one in the Bay of Quinte district, one in the Lake St. John district, two in New Brunswick, two in Nova Scotia, and two whose locations are not yet definitely decided.

Mr. MONK.—Could the hon. minister tell us who is going in the party to the Lake St. John district, and can he give us a little more precise information as to the direction that the exploration is going to take? Is it to be due north of Lake St. John or to the east or to the west?

The MINISTER OF THE INTERIOR.—I could not say. If my hon. friend (Mr. Monk) has any suggestion to make in connection with it I would be glad to consider it. The work has not progressed very far in so far as this season is concerned. The information comes from the director of the survey, and I am not quite familiar with the exact location or nature of the work they are doing.

Mr. MONK.—Who is going to be in charge of the party?

The MINISTER OF THE INTERIOR.—One of the technical officers. I cannot say which one

Mr MONK.—Who is now at the head of the Geological Survey?

The MINISTER OF THE INTERIOR.—Dr. Bell.

Mr. MONK.—Does he hold a permanent appointment?

The MINISTER OF THE INTERIOR.—No.

Mr. MONK.—How long has he held a temporary appointment?

The MINISTER OF THE INTERIOR.—Ever since the death of Dr. Dawson.

Mr. MONK.—Is there any reason why he should not be confirmed in his appointment? I ask that because I know of him. I know that he has been a very long time employed by the department, and I believe has given great satisfaction. Is there any reason why the appointment should be only of a temporary character?

The MINISTER OF THE INTERIOR.—The question which my hon. friend has asked is a somewhat delicate one. Dr. Bell has been in the service of the Geological Survey for some fourteen years. He was at once appointed to take charge of the work when Dr. Dawson died. All I care to say at this moment is that I have not felt like recommending his permanent appointment up to the present time. I anticipate being able to make some changes which I have had in mind for the last two or three years in connection with the survey and possibly the permanent appointment of Dr. Bell, might be facilitated by these changes. What I propose to suggest is that that which may more properly be called economic work, or work directly connected with mining, shall be separate from the other work and that change I propose to carry out by means of legislation this session, and I was proposing an appropriation for that purpose which will account for the difference in the appropriation which is before us at the present time. I think the question of Dr. Bell's appointment can be settled if the plan is carried out, but I am not prepared to say any more at the present time. The discussion of the scientific qualifications of scientific men is rather a delicate subject and I hesitate to say any more about it.

Mr. MONK.—I mentioned the matter because I have known Dr. Bell for a great many years and although not in a position to judge of his qualifications he appears to have the reputation of having fulfilled his duties properly.

The MINISTER OF THE INTERIOR —I would not like to be understood as even remotely suggesting that Dr. Bell's qualifications, as far as scientific knowledge is concerned, are not sufficient, but in addition to scientific knowledge the management of the survey and the executive work connected with it have to be considered and the various qualifications that are necessary to carry it out successfully have to be taken into account. I will be responsible for the appointment when it is made, and I shall try to feel that I have discharged that responsibility properly when I do make it. But in the meantime I do not care to say any more about it.

Mr. KAULBACH.—In what part of Nova Scotia is the geological party operating this season?

The MINISTER OF THE INTERIOR.—I have not the exact location. The work of the parties is under the direction of Dr. Fletcher and they are now, I think, in the coal district.

Hon. Mr. ROSS (Victoria).—They are in the County of Cumberland.

Mr. KAULBACH.—They have been in the eastern part of the province for several years. I would like to have them visit the county I have the honour to represent as it is supposed that there are in that county coal deposits of a very valuable character. We would like to ascertain positively whether such is the case or not, and if so we would like these deposits of coal developed?

The MINISTER OF THE INTERIOR.—I did not hear my hon. friend (Mr. Kaulbach) very well, but I understand him to suggest that it is desirable that some work should be done in the county of Lunenburg. I will be happy to note that and discuss it with my hon. friend.

Mr. KAULBACH.—My reason for making that request is in consequence of its being supposed there are deposits of coal in the county of Lunenburg and we are desirous of ascertaining whether there are or not, and if so, we would like to have that article developed.

The MINISTER OF THE INTERIOR.—I have at various times discussed the work of the survey in Nova Scotia with members in the House from Nova Scotia and have received suggestions from them, and to the best of my ability I have endeavoured to carry them out. I am not familiar enough with the particular localities to be able to speak of them by name from recollection, but as far as possible I will endeavour to carry out the work that can be done. I will be very happy to consider my hon. friend's suggestion

Mr. BELL.—In reference to the Geological Survey I understand that the hon. minister anticipates at an early day dividing the work of the department so as to constitute one section that will be more particularly devoted to work from an economic point of view and another which will be more purely scientific.

The MINISTER OF THE INTERIOR.—Yes, more purely scientific and largely topographical.

Mr. BELL.—I would be very glad to contribute in any way towards the appointment of Dr. Bell on a permanent basis. I have had a good deal of interest always in watching the work of the Geological Survey and in reading the annual reports, and it seems to me that the work has been carried on very efficiently in that department since Dr. Bell has taken charge. I would be only too happy to learn that the changes contemplated by the minister will enable him to make a permanent appointment in that case.

The MINISTER OF THE INTERIOR.—I may say to the committee something that I will say at greater length, when I make the definite proposition I intend to make, that while I have no doubt of the great value of the work that has been done by the Geological Survey, the result of my observation and supervision of the work during the last seven years has led me to the conclusion that sufficient attention has not been given to making the results of the work of practical value and easily available to the public. The difficulty is that information which has been collected at such a vast amount of expense to the country is not in a position to be availed of by the ordinary commercial man or the ordinary prospector. If, for instance, I were asked to furnish a person coming from a foreign country who desired to invest in Canada with the information available on the subject of iron in Canada, I would be utterly at a loss. All I would be able to do would be to refer him to the library of the Geological Survey. There is no place now in which such information is collected. My purpose in organizing a mining branch is primarily to bring about the result that we will have in succinct and in somewhat popular form, all the information of a practical and economical character made readily available, and the duty of the branch would be to put that in shape. During last year I gave some instructions that have been carried out pretty fully in respect to one particular subject, for instance, the subject of nickel. Dr. Barlow, a very capable officer, has been devoting himself last year to preparing a report on nickel. When that report is out I think we will have all the information required with regard to nickel in Canada, so that anyone who reads that book and understands it will know everything that is to be known about our nickel deposits. If anyone asks for information with regard to the economic value of metals we ought to be able to give him that information in the best possible form. That is the principal fault I find with the survey as it is organized at the present time. Of course it is very difficult to make changes; everybody who is connected with an institution is inclined to think that that institution is managed on just about the proper line, but after six or seven years experience I am clear in my opinion that a change is not only desirable but necessary if the country is to get value for the work it is doing.

Mr. BELL.—It seems to me that a very great deal of valuable work might be done at once by simply compiling the material at hand. As it is now, one has to read through a lengthy history and here and there he might find a casual reference to this or that mineral, and in that shape the information is not available for practical men. I am pleased to learn that the minister contemplates so arranging things that he will be able to place in the hands of those interested, information as to the different minerals to be found in our country. It might be well that a special search should be made with a view of discovering certain minerals; for instance, a thorough exploration of the iron areas of our province. If a geological officer is merely sent to a certain district to examine it in a general way it cannot be expected he will achieve such valuable results as would be obtained if a trained officer were sent there with the special object of devoting his whole time to one particular subject. That would be of the highest importance in Nova Scotia with reference to its iron and coal deposits.

The MINISTER OF THE INTERIOR.—That is quite in line with my own observation as the result of the work of the survey, and some of the best officers in the survey have practically said to me that while the general work of the survey should go on, yet at this present stage of development one of the most necessary things is to do that special work to which the hon. gentleman (Mr. Bell) refers. Dr. Barlow has been doing that in the case of nickel, and I think we should detail a competent officer to take up a certain mining field and to examine it thoroughly in its economic features and make a complete and full report about it, so that any person desiring to operate in that field would be in possession of all the information available. Such examination would be more detailed and complete than under a general survey. The coal fields of Nova Scotia are an illustration of the benefit of that kind of work. We have had Mr. Fletcher who is well known to hon. gentleman opposite, I suppose, and who has devoted practically his life to the study of coal in Nova Scotia. He would at once be detailed, with competent assistants, because he could not do all the work himself, to write a monograph on the subject of coal in Nova Scotia, and give us all the information he could get.

Mr. MONK.—Who is in charge of the international boundary survey?

The MINISTER OF THE INTERIOR.—Dr. Daly. He is a Canadian by birth originally educated in Canada and afterwards became a professor of Harvard University. He is a very capable man indeed.

Mr. MONK.—I find in the Auditor General's Report that $1,065 was paid to D. R. Fletcher of Vermont for granite monuments to mark the boundary line.

The MINISTER OF THE INTERIOR.—We mark the boundary line with iron posts on granite foundations.

Mr. MONK.—Perhaps it is that these were purchased by the United States authorities and that we are bound to share the cost, but if they were purchased by ourselves there is very good granite near where those posts were erected, and we might have got it in our own country.

The MINISTER OF THE INTERIOR.—The cost was divided, but I do not know exactly how.

Mr. MONK.—Who is the officer specially charged with the purchase of instruments?

The MINISTER OF THE INTERIOR.—The officer in charge of any instruments purchased in connection with the land survey, which has to do with the work of marking the boundaries, is not the same as the officer in charge of the purchase of instruments in connection with the Geological Survey. W. F. King, chief astronomer, has charge of all the boundary surveys, and any instruments required for that work would be purchased by him or on his recommendation. For the Geological Survey the acting director makes the purchases.

Mr. MONK.—Then there are two separate officers to attend to the purchase of instruments. Is there any outside purchasing agent employed by the department?

The MINISTER OF THE INTERIOR.—No, no such thing.

Mr. MONK.—I mention the matter to the minister, because at the time the firm of Hearn & Harrison existed in Montreal, which has since gone into liquidation, I heard something of a purchasing agent who resided in Montreal, and through whom all these instruments were alleged to be purchased, though he had no special knowledge of the subject.

The MINISTER OF THE INTERIOR.—I am glad my hon. friend has brought that matter to my attention, because there is absolutely nothing in the suggestion. There is nothing purchased for the Department of the Interior except on the requisition of the deputy minister, and his recommendation is made out by himself upon the recommendation of the officer in charge of the survey. As to recognizing anybody outside the department as purchasing agent, or go-between, or anything of that kind, there is absolutely nothing of the kind, in any shape, form, or manner, and the same thing is true of the Geological Survey, where all the instruments are purchased on the recommendation of the acting director.

Mr. MONK.—I am very glad to hear the hon. minister give us that assurance. What are the principal firms in Canada with which the department deals for the purchase of these instruments?

The MINISTER OF THE INTERIOR.—My deputy tells me that he thinks, speaking from recollection, that as a rule they have to be purchased in the United States. That is entirely so in regard to astronomical instruments.

Mr. MONK.—Most of the purchases seem to be made in the United States, and I realize that for many instruments that may be necessary. But

still I think that before dealing with American firms, it would be advisable to see if those who deal in similar instruments in Canada might not be able to furnish what the department required

The MINISTER OF THE INTERIOR.—My hon. friend may rely on this, that we do not buy anything outside of Canada that we can get in Canada of equal quality, unless by oversight. Even in cases where the prices are a little higher in Canada, we still patronize Canadian dealers. Speaking from my own knowledge, I do not think there are any manufacturers of scientific instruments of the quality and class referred to in Canada with whom we could deal. Any dealers in Canada would be simply small dealers, with only a few instruments on hand. Of manufacturers I am satisfied there are none.

Mr. SPROULE.—The minister touched on a subject which I intended to make a little inquiry about. It is as to where one can get most readily information in regard to any particular mineral. The reason I ask the question is this. A gentleman came here with the view of finding where our iron deposits were and the nature of those deposits. I endeavoured to get the information for him, but found it almost impossible to get any. Is there any way in which that information could be got without much trouble?

The MINISTER OF THE INTERIOR.—That is a matter which has been brought to my attention constantly for some years past. Our information, while in some respects very full, is in such a condition that it cannot be got at. In that respect my hon. friend is as well off as I am. If a gentleman came to my department and asked for information about iron, all I could do would be to call an officer to take him to the Geological Survey and show him to the library, and show him the books in which he could search; and the probability is that he would not know much more after he got through than he did before. To remedy that defect would take some time; but I am going to suggest a change with that object in view.

Mr. SPROULE.—I sent this gentleman to the library; but after sea-ching through it, he said that life was too short to try to get the information from such an imperfect source, and he was afraid it was of little value to him. I thought there would be a complete list of the geological reports in the library, and some index kept up-to-date, so that one could ascertain at once where any of these minerals could be found, and in what volume they could be found. He said further, that even though he could get the information in these geological reports, it was very meagre. It might say whether the ore was magnetic iron or bog iron or sulphurous iron; but it gave very little information beyond that as to the relative quantities of each, as to whether the deposits were large or small or as to the state of development. In all these respects this gentleman, who was from Pittsburg, said the Geological Survey was very imperfect; it was almost impossible to get any intelligent idea of it without a great deal of work. It seems to me that that could be remedied without very much trouble or expense, and I would suggest that the minister devise some way to overcome it, because it is a matter of importance, especially in view of the fact that our mineral deposits are attracting so much attention abroad, and that they are a valuable source of revenue to the country.

Mr. MONK.—I would like to make a suggestion to my hon. friend with reference to this item. I have received letters from different parts of the Province of Quebec, requesting me to go to the Geological Department and try to obtain specimens of mineral, vegetable and animal life; and I must say that in that department every effort is made to give us satisfaction. I think it would be of great use in the education of our people, if the minister could see his way clear to giving instructions to the exploring parties going out each year to secure as many specimens as possible, in order that there should be some for free distribution. In the Province of Quebec we have ten or fifteen colleges maintaining natural history museums. It would be very easy, in most cases, for the officers, when proceeding with their explorations, to secure these specimens and reserve a certain quantity for the educational establishments who would make a demand for them. If that could be done without too much difficulty, the Government could in that way enrich most of those educational establishments and diffuse knowledge throughout the country of its resources

The MINISTER OF THE INTERIOR—I do not see any serious difficulty in carrying out the suggestion of my hon. friend. To some extent it has already been done, but perhaps not as systematically as it might have been. I shall endeavour to carry out the suggestion.

Mr SPROULE.—From time to time we have had discussions regarding the propriety of building another museum, but have not heard much about it lately. Has anything been done lately in that connection? The museum building we have is quite inadequate.

Mr. LOGAN.—I intend bringing this matter up when we are on the Public Works estimates, but in the meantime, as my hon. friend from Grey has introduced it, I should like to emphasize what he has said regarding the inadequacy of the present building. If hon. members would only visit the Geological Survey on Sussex Street, they would be convinced that the building is a national disgrace while at the same time they would be proud of the collections within its walls. Unfortunately, we cannot do justice to the many valuable specimens collected. Some most valuable Canadian mineral exhibits are stored away in boxes or in high shelves, obscured from sight, instead of being exposed to view. This state of affairs should not be allowed to continue. I would urge every member of Parliament, who has not visited the Geological Survey, to do so, so that when we come to discuss the Public Works estimates, they will be able to give their views on this matter.

The MINISTER OF THE INTERIOR.—I have no dissent to offer to what my hon. friend has said. No one can doubt that we require a suitable building within the least possible delay. We intended proceeding last year, but there were differences of opinion regarding the site, and as this building will be a national museum, the question of site is an important one. The subject has been lately discussed by my colleagues, and I have no doubt that my hon. colleague, the Minister of Public Works, when his estimates are down, will make a full statement.

Mr. INGRAM.—The hon. gentleman from Cumberland (Mr. Logan) has referred to a very important subject. There are some valuable collections in this country, and I think perhaps the Department of the Interior have been approached on the subject of purchasing them. It would be well for the department to secure these valuable collections, which are to be found throughout the country, and I trust the hon. gentleman will lose no time in doing so.

Mr. SPROULE.—Has the Government yet decided on the site?

The MINISTER OF THE INTERIOR.—It has been definitely decided to construct the building and the delay has been due to the difficulty of deciding about the site. It has been suggested that the building should be erected in the park, and then other sites have been suggested. I am not in a position to make any statement, but no doubt the Minister of Public Works will do so. We hope to commence this year and will push the work forward with all rapidity.

Mr. LEFURGEY.—I understand that some surveys were made with regard to locating coal in Prince Edward Island last year. Have the reports been furnished?

The MINISTER OF THE INTERIOR.—Yes, I will bring down the report.

Mr. SPROULE.—I notice that there was a geologist sent down to the Sudbury district, where it is said there is coal. Has the Government any definite information regarding that?

The MINISTER OF THE INTERIOR.—The work of the geologists sent out to the neighbourhood of Sudbury had reference only to deposits of nickel. His report will be available shortly and will be printed separately. I do not remember any report about coal in Sudbury.

Mr. SPROULE.—I saw an item in the paper to the effect that the Government had detailed a special officer to look into that question.

The MINISTER OF THE INTERIOR.—In the Sudbury district?

Mr. SPROULE.—Somewhere near Sudbury—in the nickel region.

The MINISTER OF THE INTERIOR.—I think the report is incorrect. There is no work of that kind done near Sudbury.

Mr. LEFURGEY.—May I ask who it was who recommended the work of surveying for coal in Prince Edward Island?

The MINISTER OF THE INTERIOR.—This was done on the recommendation first of the hon. member for East Queen's (Mr. MacKinnon).

Mr. LEFURGEY.—A large expenditure was made by the local Government a year or two ago just about the time of the elections there by this same gentleman. A large hole was bored, but without any result except that, possibly, the hon. gentleman gained some few votes by the distribution of the money. I cannot understand why, after a failure of this kind such a short time ago, the hon. Minister of the Interior (Hon. Mr. Sifton) should undertake this needless expense in connection with his department, when he should have all the facts at his disposal. I would like to know a little in advance whether the minister is going to continue to dig holes just before the elections in the near future.

The MINISTER OF THE INTERIOR.—My knowledge of the geology of Prince Edward Island is not very extensive. I can only say that I received a communication from the hon. gentleman (Mr. MacKinnon) asking that this work be done I referred the matter to Dr. Bell, and he recommended the work, and it was done accordingly As to the details, I think the hon. gentleman (Mr. Lefurgey) will have to talk that matter over when the hon. member for East Queen's is here.

Mr LEFURGEY I would like to have the hon. minister bring down the report at as early a day as possible

The MINISTER OF THE INTERIOR —I will bring it down at once.

"To provide for the salary of a geologist to the international "boundary survey from July 1, 1903, to June 30, 1904, $2 000.

Mr. INGRAM.—Is there any report from this geologist?

The MINISTER OF THE INTERIOR.—Yes, he makes his report every year. It will be found embodied in the usual publications of the Survey.

Mr. INGRAM.- Is it in one of the two large volumes given to each member of the House?

The MINISTER OF THE INTERIOR.—Yes, the regular report of the Survey. Dr. Daly is the geologist, and it is to his report that I refer:

"To provide for plotting and compiling of surveys, plans, maps and "utilizing field-notes, &c., (persons having technical or professional "qualifications may be paid out of this vote at rates exceeding $400 "per annum, notwithstanding anything in the Civil Service Act, or "any other Act), $5,500."

Mr. BORDEN (Halifax) —There is an increase of $1,800 in this item. Will the hon. gentleman please explain?

The MINISTER OF THE INTERIOR.—This vote is to enable us to catch up with work now in arrears. The maps were not got up as promptly as they ought to be. Since Dr. Bell took charge, to his credit be it said, he has endeavoured to get the work up to date, and this is a special vote to enable him to do so. He reports to me that this vote of $5,500, being an increase of $1,800 over that of 1902-3, is necessary because the vote of last year was insufficient to pay the salaries of draftsmen employed for the fiscal year. Five draftsmen are engaged, two at $3.25 a day, two at $3 a day, and one for eight months at $2.75 a day, this officer being for the other four months engaged in field work and paid out of the general vote. This vote is practically to enable us to employ draftsmen and other technical officers to finish maps and plans so as to make available for the public the work the Survey has already done.

Mr. BORDEN (Halifax).—Is the work tabulated in any way by these men, or do they simply do the work from the field-notes?

The MINISTER OF THE INTERIOR.—They work from the field-notes of the technical officers.

Mr. BORDEN (Halifax).—The work the hon. gentleman (Hon. Mr. Sifton) spoke of a while ago would be further work in connection with analyzing the results and putting them in tabular form.

The MINISTER OF THE INTERIOR.—This is different.

Mr. BORDEN (Halifax).—I understand. But that work of tabulating has never been done before?

The MINISTER OF THE INTERIOR.—No. The only work of that kind that we have done has been the work that Dr. Barlow was doing last year.. The work to be paid for by the vote now under discussion consists in putting in shape to be available the work of the technical officers in the field. The other work consists in collecting from the different reports of the Survey during the years it has been in existence the information which is embodied there, analyzing it, casting out what is obsolete, perhaps making re-examinations to supplement the information where it is defective, and putting the whole thing in shape where it will be practically valuable to the ordinary reader.

Mr. SPROULE.—If you are collecting this information, it can be done by these officers?

The MINISTER OF THE INTERIOR.—No. This is for technical office work necessary to make available the work done in the field.

Mr. SPROULE.—But that gives no information. The hon. minister employs two classes of men, and he proposes to take a vote of $1,800 more than last year. That means that he will employ additional hands. What are those additional hands. What are those additional hands to work at?

The MINISTER OF THE INTERIOR.—When an officer goes into the field and makes an examination of a certain district he makes his field-notes of the work he does. When he comes back he extends those field-notes, and then upon those field-notes are drawn the geological maps of the districts which he has surveyed. The preparation of the geological map is the work necessary in order to make available the work which the technical officer has done in the field. That is the foundation of the usefulness of the survey. That has been allowed to get behind, and we are trying to catch it up.

Mr. SPROULE.—How far are you behind now?

The MINISTER OF THE INTERIOR.—The large map of the western section has been got out, that of the eastern section we expect out very soon. The arrears in connection with the general work of the survey, I think, will probably be overtaken in a year.

NORTH STAR.

Mr. J. L. Parker, superintendent of the North Star Silver-Lead Mine at Kimberley, B. C., reports to shareholders as follows.—

The work outlined in last year's report has been carried out and the contacts of porphyry have been kept in touch with the result that quite an appreciable amount of ore has been found, both in No. 1 and No. 2 ore channels Whilst much of the expenditure has been on what has been surface and shallow prospecting work, yet this has been the means of finding more ore, and also of enabling the decision to be made of the best points at which deeper development could be most advantageously commenced.

Two exploratory places have been started, each pregnant with possibilities, namely, the East Incline Shaft, which is following the porphyry contact, and the North Incline, which is following the No. 1 ore channel.

As outlined in last year's report, contacts in porphyry and country rock have been kept in sight by means of gravel drifts in the mine and surface cuts, and also adit tunnels and shallow rock development on the 60 ft level.

Whilst not finding any large deposits, the work done during the year in conjunction with the previous work has fully demonstrated the fact that the porphyry contacts possess a most important bearing on the ore deposits, and judging from the length of the principal ore shoots, and the smaller ones, which in each case were lying in contact with the porphyry dike, some very close relation between the two must exist. Drill holes were therefore placed in such a position as to prove that these dykes probably extended to the deep, and a stringer of ore was also followed down, at the north end of the No. 1 ore body, by a shaft. The information thus gained has proved that the dyke extended to the deep and that there is a possibility of further development opening up ground favorable to the deposition of ore.

This shaft, which is known as the East Incline Shaft, is 200 feet deep, and drifts and crosscuts have been driven with the result that stringers of ore have been encountered in the contact, which, whilst low grade, averaging 8 to 10 oz. silver and 23 to 38% lead, show that there is a possibility of striking something better later on. This shaft will be sunk deeper as soon as the necessary buckets, which have been ordered, have arrived.

The North Incline has been driven 250 feet, and has followed the ore channel all this distance, and good stringers of ore have been met intermittently all the way down, which have assayed as high as 90 oz. silver and 70% lead.

The total amount of development work done during the year amounts to 12,166 feet of drifting, cross-cutting, sinking, raising and diamond drilling. The work from now on will be more confined and not so scattered as last year, and will I hope be encouraging. The theory that the ore deposits were only to be found on the surface, or rather that there was small chance to find any at depth, has been in my opinion proved to be too early a snap-shot judgment.

During the year 3,426 tons of ore have been shipped, the assay value of which averages 29.5 oz. silver and 36.2% lead.

In conclusion, I may state that the conditions are now more encouraging than at this time last year, and I have certainly not lost hope of more ore being found as the development work continues.

TYEE COPPER.

Mr. E. C. Musgrave, Superintendent of the Tyee Mine, Mount Sicker, gives some interesting figures of costs at this mine during the past year's operations of the Company.

The total amount of development work done during the year has been: drifting 1,095 ft.; cross-cutting, 511 ft.; sinking, 193 ft.; and upraising,

319 ft.; and the average costs per lineal foot have been: drifting $9.15; cross-cutting, $6.77, sinking, $18.31, and upraising, $11.59.

The costs of stoping are also very small, being only an average of $1.359 per ton, for stoping and raising to the surface, which of course includes timbering, supplies, etc.

The following table gives the costs which can be charged against the ore, and their total amounts to the small sum of $2.173 per ton of ore, shipped.

Stoping	$1.359	per ton.
Proportion for exploration	.499	"
Surface work	.124	"
Ore sorting	.041	"
Transporting to railway	.15	"
Total	$2.173	per ton.

The total tonnage delivered to the smelter during the year has been 21,565½ tons, of which 20,688½ tons was first-class ore, and 877 tons copper-bearing schists. Of the ore 2,930 tons was sent from the dump, and 17,758½ tons from the mine.

The only test of values, besides the actual smelter test has been a number of assays taken from the roast piles during the last three months, and the average of these has been; copper, 5 per cent; silver, 3.2 oz.; and gold, .15 oz.

This grade of ore has been secured by mixing all grades from the highest to the lowest, and thus instead of following up the rich ore and taking it out, and being then left with a very large proportion of low-grade ore, it is possible, by mixing the ore, to work the mine more economically, and thus to get a greater profit on the low-grade ore than could be done if it were taken out and shipped separately. By this method the ore is broken out from wall to wall, and while the absolute waste is eliminated on the sorting belt, all the ore is shipped.

COMPANY NOTES.

Costs of Aerial Transmission at the Tyee Mine.—Mr. E. C. Musgrave, Superintendent of the Tyee Mine, Mount Sicker, B.C., gives in his annual report to the shareholders some particulars of the aerial tramway installed last September. It is a double-rope system, and consists of a standing cable 1 in. diameter on the loaded side and ¾ in. diameter on the light side; and a hauling cable ⅝ in. diameter, supported on fifty-two derricks or towers. There are fifty four buckets, each having a capacity of half a ton, which travel on small trolleys on the standing cable, and are fastened to the hauling cable at regular intervals. The tramway works practically by gravity, receiving only a small amount of assistance from a small engine at the upper terminal. The buckets, after being dumped automatically at the lower terminal, travel up to the mine inverted, to prevent their getting filled with snow or rain, and at the upper terminal are righted and locked automatically; then go round the terminal, and take their load automatically, and without stopping. The costs of transporting the ore from the mine to the railway, a distance of 3½ miles has been 15 cents per ton, which includes all working expenses, repairs, and loading it on to the railway cars. This works out at 4½ cents per ton per mile.

Velvet Rossland.—The manager cables.—"Have received the following returns from smelters, namely:—187 tons first-class ore yielded 197 ozs. gold, 8,706 lbs. copper; net returns from smelters, $3,750 or an average of £4 2s. 10d. per ton. 46 tons 'fines' yielded 17 ozs. gold, 2,250 lbs. copper; net returns from smelters, $292, or an average of £1 6s. 3d. per ton."

Le Roi No. 2—The following report has been received from the mine manager for the month of May:—"Josie Mine; 500 ft level.—Instead of drifting we widened out towards the footwall, following the streak of ore hitherto left behind on account of its low values.—It has proved much better than anticipated. 300 ft. level.—13 ft. were driven, and we again broke through, for the second time, into the main drift, nothing but stringers being encountered. In an eastward direction 18 ft. were driven; but the ore there pinched out, and we abandoned the drift. We raised on a good showing of ore about 9 ft. west of our cross-cut. Here we got occasionally very good assays, but the ore was broken up, and we had to abandon this also. (Height of rise, 22 ft. above sill floor.) 700 ft. level.—96 ft. were driven on route of diamond-drill hole No. 27, with a view to undercut Annie No. 3 ore body. 500 ft. level.—Hanging-wall drift driven 18 ft. Some good values were encountered, but average grade of ore is second-class. Diamond-drill work.—Hole No. 27 advanced from 243 ft. to 363'5 ft but nothing met with. 900 ft. level.—Hole No. 28 run 270 ft. Nothing met with so far. No. 1 mine, 200 ft. level, west drift—20 ft. were driven. There were occasional good showings of ore, but they were hardly so good as anticipated. East drift—17 ft. were driven to meet west drift. About 5 ft. of this were in ore of milling grade. This is now spoken of as stope 11. We widened out on footwall side about 3 ft, where a streak of mixed ore occurred. 300 ft. level.—The cross-cut shown on plan was driven 11 ft. in very good ore. Ore production.—Ore has been taken from the stopes in the following propositions: Josie Mine: Stope 19, 300 ft. level, 558 tons; stope 20, 500 ft. level, 1,845 tons; stope 5, 400 ft. level, 354 tons; stope 6, 600 ft. level, 203 tons; stope 11, 700 ft. level, 175 tons; total, 3,135 tons. No. 1: Stope 10, 200 ft. level, 26 tons; stope 11, 200 ft. level, 137 tons; stope 2a, 200 ft. level, 66 tons; stope 4, 300 ft. level, 487 tons; stope 5, 300 ft. level, 12 tons; total, 728 tons; total, Josie Mine and No. 1 Mine 3,863 tons. General remarks on above stopes: Josie: Stope 19.—Back of this stope has again become badly broken up; ore penetrating into dyke on third floor. Stope 20.—This is very good, and has improved greatly during last month. Stope 5.—We stopped shipping from here early on in the month; there is a large tonnage of ore broken, which we can draw from at any time. Stope 11 We have also stopped shipments from here as value became very low grade. No. 1 Mine: Stope 4 is giving very good ore; another streak has been found in footwall giving very high values, and we are now following this up. Cross-cut previously mentioned is very good-looking stuff, and promises to be an important find."

Cariboo Consolidated.—The following report has been received by the secretary of the company, dated 25th May, from the resident manager: "I am very glad to be able to give you most encouraging information in regard to the Lightning Creek work. In sinking borehole No. 4 we encountered highly auriferous gravel having a thickness of about three feet immediately above the bedrock. The total depth of this hole to bedrock was 129 ft. In this strata of gravel we recovered between four and five hundred small colours or fine particles of gold, the largest being a flake about 1-16 in. square As this gold is forced from the bottom to the surface through a three-inch pipe by a small stream of water, it is, of course, impossible to secure heavier colours, the velocity of the water not being sufficient to do this It is a most remarkable showing under the circumstances, and proves that the ground we propose drifting is very rich. We are now preparing to sink borehole No. 5, distant 100 ft. from borehole No 4, towards the south rim. In this hole we will endeavour to secure heavier gold by means of a pipe fitted with a valve in end of same, acting as a sandpump. This borehole No 4 was the first hole in which we have struck gravel on the bedrock, showing that we must now be into the channel. By next mail I will send you the cross section developed to date, of this Lightning Creek Channel."

Canadian Mining Institute

INCORPORATED BY ACT OF PARLIAMENT 1898

AIMS AND OBJECTS.

(A) To promote the Arts and Sciences connected with the economical production of valuable minerals and metals, by means of meetings for the reading and discussion of technical papers, and the subsequent distribution of such information as may be gained through the medium of publications.

(B) The establishment of a central reference library and a headquarters for the purpose of this organisation.

(C) To take concerted action upon such matters as effect the mining and metallurgical industries of the Dominion of Canada.

(D) To encourage and promote these industries by all lawful and honourable means.

MEMBERSHIP.

MEMBERS shall be persons engaged in the direction and operation of mines and metallurgical works mining engineers, geologists, metallurgists, or chemists, and such other persons as the Council may see fit to elect.

STUDENT MEMBERS shall include persons who are qualifying themselves for the profession of mining or metallurgical engineering, students in pure and applied science in any technical school in the Dominion, and such other persons, up to the age of 25 years, who shall be engaged as apprentices or assistants in mining, metallurgical or geological work, or who may desire to participate in the benefits of the meetings, library and publications of the Institute. Student Members shall be eligible for election as Members after the age of 25 years.

SUBSCRIPTION.

Members yearly subscription.....$10 00
Student Members do 2 00

PUBLICATIONS.

Vol. I, 1898, 66 pp., out of print.
Vol. II, 1899, 285 pp., bound red cloth.
Vol. III, 1900, 270 pp., " "
Vol. IV, 1901, 333 pp., " "
Vol. V, 1902, 700 pp., " "
Vol. VI, 1903, 600 pp., now in press.

Membership in the Canadian Mining Institute is open to everyone interested in promoting the profession and industry of mining without qualification or restrictions.

Forms of application for membership and copies of the Journal of the Institute, etc., may be obtained upon application to

B. T. A. BELL, Secretary,
Orme's Hall, Ottawa.

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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.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite, asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction or 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less, but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in-Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental—such royalties, unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at th mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

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—AND—

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GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. A. DRYSDALE,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order-in-Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end of the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 per acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee, $5.00, renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings, but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed or bars in the rivers below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River, and Hill claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim must hold a Free Miner's certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of 2½ per cent. on the value of the gold shipped from the Territory to be paid to the Comptroller.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek, or gulch, but the same miner may hold any number of claims by purchase, and Free Miners may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch, or river, by giving notice, and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00, and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette*.

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, at the rate of 2½ per cent. on the value of the gold shipped from the Territory. Operations must be commenced within one year from the date of the lease, and not less than $5,000.00 must be expended annually. The lease excludes all base metals, quartz, and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery, at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council

JAMES A. SMART,

Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.

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