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CANADIAN MINING REVIEW

Established 1882

Vol. XXII—No. I. OTTAWA, JANUARY 31st, 1903. Vol. XXII—No. I.

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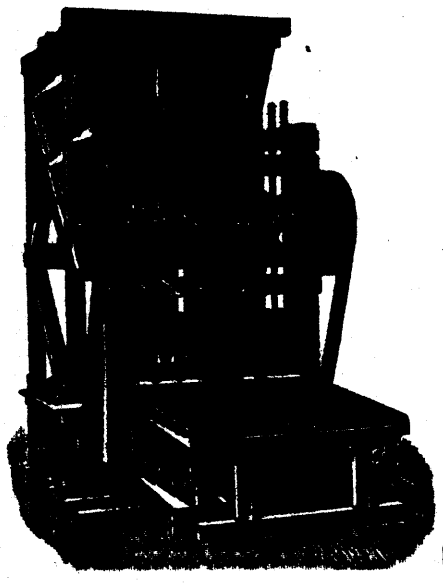

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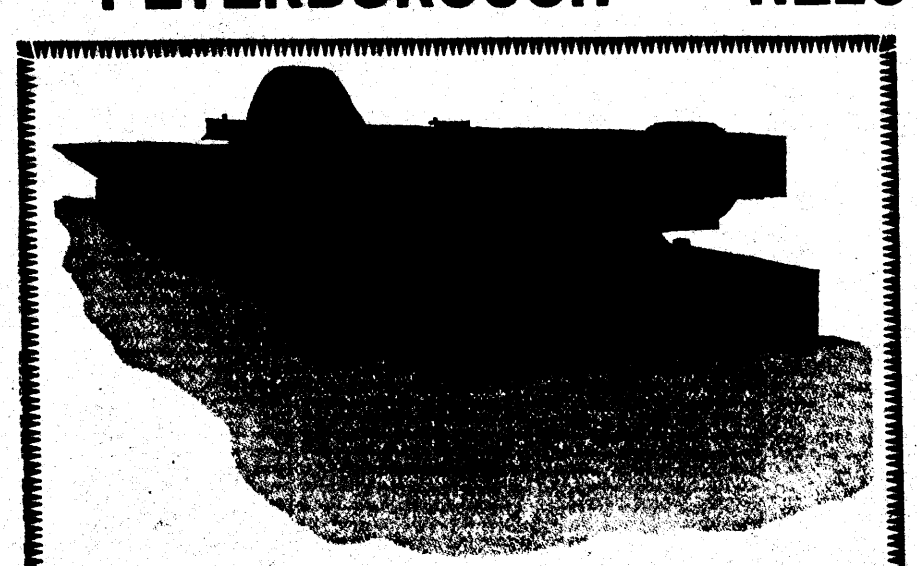

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EDITED AND PUBLISHED BY

B. T. A. BELL

Royal Commissioner on Yukon Hydraulic Concessions
Secretary of The Canadian Mining Institute
Secretary of The General Mining Association of Quebec
Secretary of The Ontario Mining Protective Association
Secretary Canadian Men Miners' Association

1903

Volume XXII.

Editorial Offices:—ORME'S HALL, OTTAWA, CANADA.

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CANADIAN MINING INSTITUTE

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The Annual General Meetings of the members of the Canadian Mining Institute for the transaction of business, the discussion of papers, etc., will be held in the

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GROUP III.—ORE DRESSING AND METALLURGY—Any branch of ore dressing or metallurgy may be treated as for example—crushing, jigging, milling, concentrating, smelting, roasting, cyaniding, etc., or some particular plant may be described or discussed.

Competitors must advise the titles of their subjects to the Secretary of the Institute not later than the 18th February next and MSS. must be sent to him on or before the opening session of the meeting on 2nd March.

SYLLABUS OF PAPERS.

Syllabus, embracing over forty papers, and detailed programme of arrangements for these meetings will be mailed to members in due course.

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Secretary, Canadian Mining Institute, etc.

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The Year in Ontario.

While the year 1902 has not seen any sensational developments in the mining industry of Ontario, there has been a large output of both metallic and non-metallic substances, and when the statistics for the twelve months are made up it will probably be found that notwithstanding checks sustained in the production of some important materials, the aggregate output both in quantity and value will show a substantial advance on the previous year.

Events during the past few years have demonstrated that in metalliferous mining the principal mainstays of the industry are iron, nickel and copper. In these articles of prime importance there has been and continues to be steady expansion alike in yield and productive territory. New mines are being opened up, old ones worked more extensively, and processes of treatment are carrying the ores more nearly to the stage of actual refinement than before. The yield of precious metals has not increased during the year, but indications of improvement are discernible.

The output of iron ore was the largest yet reached in Ontario, amounting to about 375,000 tons, about 100,000 tons more than in than in 1901. The bulk of this came from the Helen mine in Michipicoten, owned by the Lake Superior Power Company. The ore is a fair grade of hematite averaging about 55 per cent. iron, and working well in the furnace, but not up to Bessemer quality. The mines of Hastings county and other parts of eastern Ontario, which are on a much smaller scale, contributed about 20,000 tons to the total. Great activity has been shown in exploring for iron ores in the northern and north-western parts of the Province. Near Steep Rock Lake on the Canadian Northern persistent search is being made by the diamond drill for deposits of hematite, the presence of which is strongly inferred from surface and geological indications, and on the line of the Port Arthur, Duluth and Western Railway the extension into Ontario of the Mesabi range is being carefully examined for bodies of ore. In the township of Hutton, north of Lake Wahnapitæ, a body of magnetite has been located on an outcrop of the banded formation occurring so abundantly in northern Ontario. The find is regarded as an important one, concentration having formed a deposit of large size and of fair quality, though the ore is silicious and not of high metallic content. At present the region is without railway facilities.

The smelting of iron ore into pig iron is now a well-established industry in Ontario, and the furnaces at Hamilton, Deseronto and Midland were in full blast throughout the year, except when temporarily interrupted for repairs or by the difficulty of obtaining coke. The output of pig iron will be about the same as in 1901 when it was 116,730 tons. Steel by the open-hearth process has been made at the Hamilton blast furnace for two years or more, and during the past season the steel-making plant there has been doubled in capacity. The Lake Superior Power Company's Bessemer steel mill at Sault Ste. Marie began making rails last spring, and has rolled a large tonnage. Developments have shown that Mr. Clergue finds it difficult to compete with foreign-made rails, the existing tariff affording insufficient protection to the domestic article. The blast furnaces at Sault Ste. Marie, four in number, are not yet completed.

The transfer of the Canadian Copper Company's mines and works to the International Nickel Company, formed to control the nickel business in America, was followed by the stoppage of part of the plant and a lessened rate of production for some months of the year. Operations have since been resumed on the old scale. The low-grade mattes produced by this company are concentrated by the Ontario Smelting Works, and the nickel and copper contents raised to 70 or 80 per cent. The Mond Nickel Company at Victoria Mines has been steadily at work throughout the year, the product being a Bessemerized matte containing about 80 per cent. metal in equal proportions of nickel and copper, and the Lake Superior Power Company's smelters at the Gertrude mine, where is also treated ore from the Elsie, have turned out a considerable quantity of low-grade matte. Both the Mond and Lake Superior Companies are outside of the trust. The total output of nickel and copper contained in the mattes of the Sudbury district will probably exceed that of 1901, when it was 4,441 tons of nickel and 4,537 tons of copper, including the copper from the mines on the north shore of Lake Huron. Much prospecting for underground bodies of nickeliferous pyrrhotite by magnetic instruments was done in the Sudbury region during the past season, chiefly on behalf of Mr. Edison, the famous inventor. A large number of locations have been made, and it is the intention to test some of them by the diamond drill next Spring. The process depends upon the magnetic properties of pyrrhotite, but its utility remains to be demonstrated.

The copper district lying west of the nickel region is making progress. One mine, the Rock Lake, has reached the point of shipping concentrates. The Massey and others are in the development stage.

The yield of gold and silver will not exceed that of 1901. Most of the older mines in northwestern Ontario have suspended operations, temporarily at least, including the Sultana, Mikado and Black Eagle, formerly the Regina. Their places have been taken by the Big Master, Elizabeth, Twentieth Century and others, but the production of the latter group has not yet been large In Eastern Ontario the Belmont mine, which is maintaining its reputation for efficient and skilful managemen, has been organized as a separate company, and it is proposed

to add another 30 stamps, making 60 stamps in all The output of the silver mines of the Port Arthur district will be about the same as in 1901.

The metalliferous output of the Province for 1902 will be approximately as follows:—

Product.	Quantity.	Value.
Gold.....ounces	12,500	$212,500
Silver "	100,000	50,000
Copper tons	4,550	637,000
Nickel. "	5,000	2,000,000
Iron ore "	380,000	550,000
Zinc ore "	950	8,000
Pig iron "	115,000	1,650,000
		$5,107,500

Note.—The ton used is the statutory ton of 2,000 lbs.

Non-metallic minerals, in which Ontario is peculiarly rich, have well maintained their output. The great salt beds of the southwestern peninsula, which are capable of almost illimitable production, have been drawn upon for the quantity required to supply the home market. The yield for petroleum has for some years been slowly declining, but towards the close of the year what gives promise of being a new field has been opened up in the township of Raleigh in the county of Kent, where several productive wells have been sunk, one of them being a "gusher" yielding at first about 600 barrels per day.

The flow of natural gas has been decreasing of recent years, export from the Essex field to Detroit having been suspended a year ago by the Ontario Government. The Welland field is still producing a considerable quantity of gas, most of which is piped across the boundary to Buffalo. The reservoir which was struck in the Trenton rocks of the northern part of Bruce county has not been largely exploited during the past year.

The corundum deposits of Renfrew and Hastings are being worked by the Canada Corundum Company and the Ontario Corundum Company. The former is producing grain corundum of high quality in all the required sizes, while the latter is exporting the cobbed rock to the States for treatment.

The Canadian Goldfields at Deloro are still turning out large quantities of white arsenic, and the Atlas Arsenic Works adjoining are preparing to produce the same article. The projected combination which was to control the arsenic business in Ontario has fallen through, and there seems to have been a hitch in the arrangements for procuring a bounty on the product from the Governments of the Dominion and Province.

Other products such as mica, graphite, talc, gypsum and felspar have been mined on about the usual scale. There has been a good demand for iron pyrites, and more of this mineral was raised than in 1901.

Production of materials for construction has been going on apace. Brick, stone and lime are in demand, for building has been brisk. These articles account for a very large proportion of the value of the non-metallic production in Ontario. Other clay products, such as pottery, drain tile, etc , have been manufactured in the usual quantities. The Portland cement industry has been making great strides. In 1901 the output, which was the largest up to that time, was 350,660 barrels, the output of four factories. Last year eight factories were in operation and the production was materially increased. The county of Grey is the present headquarters of the cement industry, there being four factories in and about Owen Sound, and one—the largest in Canada—at Durham. Natural rock or hydraulic cement is also made at four establishments. The increase in the consumption of cement has been extraordinary, and it seems likely that this article will displace iron and wood for a large variety of uses.

Including metallic and non-metallic substances, the mineral production of Ontario in 1902 will be little if at all short of $12,000,000.

Mining in Nova Scotia During the Year 1902.

As heretofore, coal mining has occupied the principal position. A general increase has been shown, all the mining districts effecting larger sales than during the previous year. The total production was about 4,500,000 tons. The largest item of increase was in the consumption by the Dominion Iron and Steel Company, which may now be said to be in full blast, as far as the production of pig iron billets, etc. It is proposed to complete the rail mill to meet home requirements and to make structural forms. The scarcity of coal in the United States has called for about 100,000 tons of coal in addition to the regular requirements of the gas works at Boston. Shipments to New Brunswick, Prince Edward Island, and Newfoundland remained practically unchanged. Some 50,000 tons were shipped to European ports, but the growth of this trade is necessarily slow.

The operations of the Dominion Coal Company have continued to expand and the utmost efforts of the managers are taxed to keep development work ahead of the regular mining requirements. The collieries have been maintained in a high state of efficiency, and additions have been made to their equipment. The skill with which these efforts have been directed may be realized from the fact that the Reserve mine, at one time pronounced on its last legs, last year produced over 800,000 tons. Their big Dominion No. 2 Colliery will shortly be in a position to redeem the promise of being the largest single coal producing shaft in the world. The following comparative statement shewing the output of the collieries operated by this large enterprise during 1901 and 1902 will be of interest:—

Colliery.	1901.	1902.
Dominion No. I.....	641,543	697,241
Dominion No. II.	23,635	377,340
Dominion No. III.....	308,964	397,533
Dominion No. IV	8,341	.....
Caledonia.....	640,688	689,232
Reserve.....	730,378	801,945
International	208,234	210,876
Totals.....	2,561,783	3,174,227 tons

or a gain over the previous year amounting to 612,444 tons.

The Nova Scotia Steel and Coal Company have turned their attention to a large extent of coal standing in pillars in the old workings, and are successfully mining them. They are pushing their two new mines, and expect next summer to reach an output of over half a million tons. Their new shipping facilities will permit of quick despatch. At New Campbellton and Port Morien a steady business has been carried on.

In Inverness County the Inverness & Richmond Collieries & Ry. Co's road has been put in full operation, and their mines at Broad Cove are producing regularly. The Port Hood Colliery has worked steadily during the summer. The Broad Cove coal is shipped at an excellent pier near Port Hastings, while the latter is shipped at a pier a few yards from the mine. At Mabou an American company has sunk slopes into the submarine coal and commenced systematic development work. A railway has been constructed from the mine about five miles to a shipping point in Mabou Harbor. It is proposed to continue this road to a junction with the Inverness Railway and Coal Company's line, and to continue thence by Lake Ainslie and Whycocomagh to Orangedale on the Intercolonial Railway. The output of the county was about 100,000 tons divided between Broad Cove and Port Hood. These mines should command a good share of the trade of the Gulf of St. Lawrence, and will ultimately save in the development of the iron, copper and lead ores of the northern section of Cape Breton.

In Pictou County the Marsh Colliery of the Nova Scotia Steel and Coal Company has been worked regularly, all its product going directly to the Steel Works at Trenton. The other mines have con-

tinued their regular outputs, and have contributed to the trade up the St. Lawrence now expanded to over a million and a quarter of tons. During the fall a large drill, purchased by the Government of Nova Scotia, has been started to prove the district lying between New Glasgow and Pictou. If the hope is realized that there exists in this section beds of coal, it will undoubtedly extend over many square miles in the Counties of Pictou, Colchester and Cumberland.

A comparison of the output and shipments of the Acadia Company with 1901 shows:—

	1901.	1902.
Coal raised	270,253	319,123
Coal sold	230,567	278,838
Coke made	11,738	7,411
Coke sold	11,736	7,411

The returns from the adjoining company, the Intercolonial Company, also show an important increase, the returns by Provinces shewing disposals as follows:—

To	1901.	1902.
Nova Scotia	75,949	86,083
New Brunswick	17,883	9,941
P. E. Island	10,957	20,502
Quebec	64,882	74,893
Ontario	....	930
Coke ovens	9,398	8,108
Colliery employees	3 615	4,018
Colliery engines	15,270	15,762
United States	....	430
Total disposals	197,957	220,367 tons.

The total raised at the Drummond collieries amounted to 216,180 tons and the shipments by rail and water 191,560 tons. The company also made 4,685 tons coke.

In Cumberland County the output of the Springhill mines was nearly 500,000 tons, a large shipment being made to United States ports The explorations conducted by Mr. Fletcher of the Geological Survey having shown the western extension of the seams worked at Springhill, and boring operations are contemplated to prove their presence about six miles west of Springhill. Mining was continued at the Joggins, and at the small mines in the district extending from Maccan to the River Hebert. The disposals of the Cumberland Railway and Coal Co. were:—

To Nova Scotia	103,339
New Brunswick	171,602
Quebec	48,733
United States	112,123
Or a total of	432,797 tons

compared with a total of 341,876 tons in 1901.

Iron mining has shown little progress in Nova Scotia, the total production being about 20,000 tons by the Nova Scotia Steel and Coal Company. Bell Island, Newfoundland, contributed nearly 500,000 tons to meet the wants of the Sydney and Ferrona furnaces, including a few cargoes of high-grade foreign ores. The Dominion Iron and Steel Company have practically completed their original plant, and are now increasing their oven plant. In all probability two more blast furnaces will shortly be added. The Nova Scotia Steel and Coal Company are steadily pushing the construction of their steel and iron plant at Sydney Mines. To meet the needs of the blast furnaces, etc., last year about 450,000 tons of coke were made for a production of about 220,000 tons of pig iron.

At the Londonderry Furnaces, Colchester County, a revival has taken place. This plant has passed into the hands of the Messrs. Drummond and other Montreal capitalists, who are engaged in putting the plant in order and in reopening the mines. When in operation these works will call for considerable amounts of fuel from Pictou and Springhill coal mines.

The extent of the Nictaux iron ore fields has been enlarged by further prospecting, and it is reported that arrangements are completed for shipping ore from the Arisaig district to the Sydney furnaces.

The gold production of Nova Scotia continues lamentably small, being 29,000 ounces, compared with 31,000 ounces in 1901. The Richardson, Caribou, Sherbrook, Waverley, and Brookfield districts continued working steadily with satisfactory results. Other districts continued dull and few discoveries of promising veins have been reported.

The future of gold mining in this Province seems bound up in the development of its low-grade propositions. There is, however, a disinclination on the part of those locally interested in gold mining to incur the expense necessary to develop a low-grade property to such a point as will interest capitalists. Low-grade properties tested and developed to show large bodies of average values are readily saleable, but unless enough has been spent to warrant a purchaser to make the necessary large scale tests they will not be looked at.

The shipments of gypsum were about 180,000 tons, showing an increase over those of the preceding year. They were from the Windsor district, which by tugs and barges is in easy communication with United States ports via the Bay of Fundy.

The limestone quarries yielded as far as can be learned about 263,000 tons, the greater part coming from the deposits at St. George's River, Marble Mountain and Brookfield for the purposes of the blast furnaces. Small quantities of barytes, manganese, moulding sand, etc., were reported as having been extracted. The stone quarries and brick yards were kept employed steadily during the summer, but, it is to be regretted, there appears to be no way of arriving at the extent and value of their production.

Southern British Columbia in 1902.*

The greater part of the mineral product of British Columbia continues to be derived from the southern part, and particularly the southeastern part of the Province. In the north the output is entirely alluvial gold, as yet, and although the aggregate amount is important the writer is not particularly acquainted with these northern fields, and therefore makes only this passing reference to them. Atlin and Cariboo are the two important districts; from recent reports it would appear that the largest producing mines have not met with any pronounced success during the year.

In order to review briefly the industry of the southern portions of the Province, it may be well to consider the output according to its nature. The chief products of the year have been, as before: (a) silver-lead ores, (b) gold-copper ores, (c) gold milling ores, (d) coal and coke.

The silver-lead industry seems as though smitten by a plague. This is the result of very low prices and a distant market for its lead. Although we have the advantage of ample local smelting facilities, the fact that the Canadian market for lead is very limited, and that the American is not open to us, forces the bulk of our lead products to far-off and low-priced markets at great cost. Consequently, only those mines whose ore is rich in silver can continue to operate.

In East Kootenay, the St. Eugene, capable of an output of 3,000 tons of 65 per cent. lead concentrate monthly, has been idle throughout the year. The North Star has produced sparingly, and practically only enough to meet the expenses of development. The Paradise, the only mine in the Province having considerable amounts of carbonate of lead, is also low-grade in silver, and has shipped very little during the year. Here, again, development only is being done in hope of better times.

* By S. S. Fowler, S.B., Nelson, in the *Engineering and Mining Journal.*

In the Slocan District of West Kootenay, famous for the high ratio of its silver to lead, the number of operating properties has continued about as in previous years, and the output of ore and concentrates will be about 26,000 tons, approximately the same as for 1901. It must be stated, however, that this figure is maintained by the considerable output of dry silver ores, and the actual tonnage of lead will probably be shown to be much less than that of the previous year, while both lead and silver will not bear comparison with the output of the banner years of 1897 and 1898. The chief producers of the year, as to tonnage, have been, Whitewater, Rambler-Cariboo, Payne, Enterprise, Arlington and Bosun, and these, with some 25 or 30 others, which have produced during 1902, are employing at the close of the year probably not over 400 men. Such are the straits in which all manner of adverse external conditions have placed a large number of excellent properties.

The only other silver-lead district is that of Lardeau, which has not yet reached a stage of large production, owing, until recently, to its inaccessibility. Like the Slocan, its lead ores are high-grade in silver, and it suffers from the same adverse circumstances. The chief mines are the Nettie L., Silver Cup and Triune.

A determined effort is now being made by the lead producers to secure such changes in the Canadian Customs tariff as will conserve the entire Canadian market for Canadian lead. Under the present tariff, and because of the absence of corroding works, it is possible for the refiner to dispose in Canada of only such lead as is used in the metallic form. This amounts to only 3,000 or 4,000 tons per annum. All lead mined in British Columbia is bought by the smelter according to the English price, and after deducting the costs of freight on the bullion and marketing charges, the miner now receives a miserable pittance—about $1.35 per 100 lbs.—for his product

The gold-copper districts continue to be Rossland and the Boundary region. Rossland in 1902 turned out approximately 350,000 tons (an increase of about 50,000 over 1901), all of which is smelted either at Trail, B.C., or Northport, Washington. The camp has been has been free from any labor disturbances, which so much interfered with its output in 1901; and in spite of some distrust as to the result of "manipulation" in the shares of some of its mines in London, it appears to have entered on a period of permanent, if moderate, prosperity and progress. Aside from the large amounts of high-grade material which go direct to the smelters, Rossland's mines hold much larger quantities of low-grade ores, which are doubtless amenable to a preliminary concentration, and much thought is now being directed to the dressing of these ores, with success in sight. The great bulk of the tonnage of the year has come from the Le Roi No. 1, Le Roi No. 2, Centre Star and War Eagle. No. 2 declared a dividend in May last, but No. 1, although it has published large operating profits for several months past, appears to have devoted its earnings to cancellation of debts.

The Boundary District continues to uncover astonishing bodies of very low-grade smelting ores. The ores are, and will be for a long time to come, won by quarrying, and, being self-fluxing, are cheaply smelted (in the ratio of about 25 tons of ore into 1 of matte), at three plants, all within a few miles of the mines. The tonnage smelted in each furnace daily runs from 350 to 425, and the resulting matte is converted (to blister copper) at one of the smelting plants. Thus, with the assistance of the most economical exploitation, these extremely low-grade ores are turned to profitable account. Although no new producers have been added to the list, the old ones have materially increased their output, and it is probable that there will have been nearly 500,000 tons smelted during 1902. Along with the other smelters of the Province, those of the Boundary suffered from shortage of coke supplies, and one of them was handicapped severely by a lack of water-power. These retarding factors kept the tonnage much lower than it might have been, but during the coming year the tonnage will probably be largely increased, and the costs decreased, by the use of the power of the Kettle River, generated at Cascade, where the Cascade Water Power and Light Company, Limited, has recently completed the installation of an extensive electric equipment, with transmission lines to Phoenix, the center of the chief mines.

The important mines of the year are the Snowshoe, the B. C., Knob Hill and Old Ironsides, all near Phoenix; and the Mother Lode and Sunset, west of Greenwood. Beside these the Emma for several months past has been putting out daily over 100 tons of iron flux which is used by the smelters at Trail and Nelson.

The gold-milling ores of the Province are, apparently, not very abundant. They are found chiefly in the Nelson District, and the Ymir Mine continues to be the chief producer, having crushed about 50,000 tons of profitable ore during the year. At the Ymir mill about 60 per cent of the gold is amalgamable, although 7 per cent of concentrate is produced, carrying 20 per cent of lead, besides much zinc and iron sulphides. The Arlington, of Erie; the Willcox, of Ymir, and the Poorman, near Nelson, help to make a respectable total for the year. Another important mine of this class is the Cariboo, at Camp McKinney, Yale District, which has been a steady and profitable property for eight years or more. The free-milling ores at Fairview, Yale District, have not as yet proved of any importance, although it seems probable that one or two properties may yet turn out to be valuable.

A portion of the Lardeau District, a few miles from the head of Arrow Lake, West Kootenay, has been the scene of a good deal of activity in the development of free-milling quartz, of which there appears to be extensive bodies. Thus far, however, little has been accomplished in actual output.

The Similkameen River portion of Yale District is still without railway communication, and its several excellent copper-gold properties are therefore unable to produce.

On Vancouver Island several discoveries of copper pyrite of low-grade in gold, but comparatively high in copper, have been made, and they are developing favorably. On the east side of the island the Lenora and Tyee are important mines, and are now possessed of smelting facilities. The coming year will probably see a large production of copper from this district.

The coal measures of British Columbia are a source of much wealth to the Province. The mines of Vancouver Island continue, as they have for many years, to produce largely, mainly for export, The other producing mines are those of the Crow's Nest Pass Coal Company, in the southeastern corner of the Province. One of the company's mines suffered from a disastrous explosion in the early part of the year, and this was immediately followed by a prolonged strike of the employees. Agreement was finally reached in August, and, except during some minor labor disturbances, the several openings have since been outputting largely. The cessation of output seriously affected the operations of five smelters, and, through them, the whole community. Crow's Nest coke is exported in large quantity to Montana, and this demand, together with that of the local smelters, as well as the demand for coal for steam and other general fuel purposes, is causing a rapidly increasing yield from the mines. Now, putting aside the material phases of the mineral industry of Southern British Columbia during 1902, if we shut our ears to the noise of alarmists, on the one hand, and the boasting of optimists on the other, we shall perceive three dominant notes. First, we shall realize that the prospectors are feeling severely the effects of the check in the flow of mining capital to the Province, as indicated by the fact that few, if any, properties of im-

portance have been added to the list of mines during the year. Second we see that the mining community, forced to live on its income, has made a decided advance in the economies of production, which will be of benefit as long as the industry is permitted to exist. Thirdly, we observe that not only has nothing been done by the Government to improve the conditions under which mining is conducted, but during the last session of the legislature further responsibilities were placed on those who operate mines, with a resultant increasing tendency to keep back capital, and an increased risk to that already invested.

Although the returns which will be published by the Minister of Mines will probably show a fairly well maintained output, it is significant of the burdens which the industry has to bear that the published dividends of the year are pitifully small in proportion to the aggregate value of the output of metals. It is to be observed not only that our home markets for base metals are as far away as they well can be; and further, that the costs of labor and all supplies, except timber, are very great. If, therefore, the Province is to derive any permanent benefit from its bountiful mineral resources, the industry and the capital invested in it must be afforded every encouragement, and given every possible assistance, in its endeavor to sustain itself.

Lead Refining at Trail, B.C.

As evidencing the fact that the lead industry in Canada is keeping pace with the present era of progressive prosperity, it is interesting to note that, for the first time in history, the Canadian manufacturers of lead products are using a raw material which has not only been mined in Canada, but has been smelted and refined in this country as well. That is, after the ore is smelted, the gold, silver and impurities in the resulting bullion are separated, leaving commercial pig lead 99 999 per cent. pure, and ready for the manufacturer to convert it into lead pipes, sheet lead, shot, white lead and materials of paint generally.

Canadian smelters have been dependent, heretofore, upon the American Smelting and Refining Trust, which not only regulated the production and price of lead, but practically stifled the British Columbia industry, by refusing to purchase our ores.

Canadian bullion was sold to United States refiners, who refined it in bond for export to foreign countries. But under the United States tariff, it is necessary for the refiner to export only 90 per cent. of the resulting pig lead. For this, however, he receives the London quotation of, say, $50 per ton, although at this writing it is very much lower, while the remaining 10 per cent. he may retain free of duty and sell at the United States protected price of $82.50 per ton. Then, also, he saves the express and marketing charges on the gold and silver values, which a Canadian refinery distant from commercial centres would have to pay. Thus, the United States refiner can market Canadian lead at $53.25, saving also the expressage and marketing charges, while the Canadian refiner can realize only the London quotation on his own product. To partially offset this disadvantage, the Canadian Government has granted a bounty on lead refined in Canada, to the extent of $5 per ton the first year, $4 the second, $3 the third, and so on, but it is readlly apparent that such a bounty is inadequate to place a Canadian refinery at an equal advantage with one in the United States However, the action of the Government has been instrumental in enabling Canadian capitalists to take the initiative in a method of refining, which will be a pronounced factor in the encouragement of lead mining.

When the Canadian Smelting Works, in the little city of Trail, British Columbia (which is the largest lead reduction plant in the Dominion), determined to erect a refinery, a totally new process of separating the bullion contents was experimented with, and proved successful. It is styled the Betts Electrolytic process, and is the result of continued experiments on the part of Anson G. Betts, of Lansingburg, N,Y.

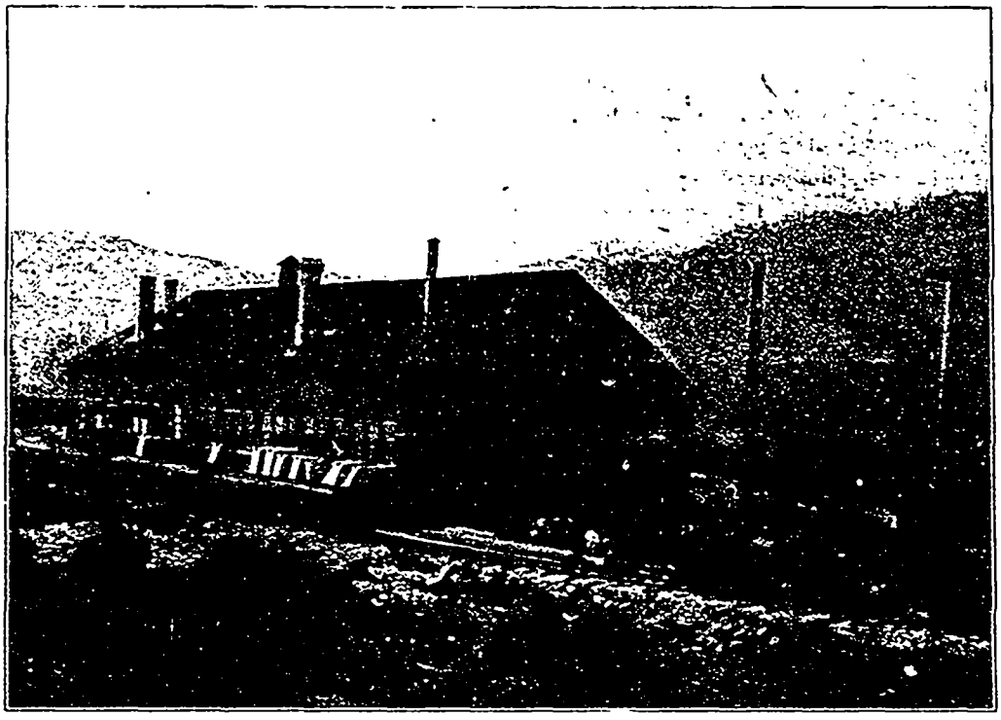
For many years experiments have been in progress, with the hope of eliminating the fire process in the separation of the values and impurities in lead bullion. This process is hard on those engaged in the work, and the dangerous lead fumes make it impossible for men to continue their vocation longer than three or four years, lead poisoning invariably resulting. German and American chemists endeavored to present a new method, but without success, until it became the prevalent opinion of electro-metallurgists that it was impossible to form solid lead by electrolysis. A spongy lead was the nearest approach, until Mr. Betts overcame all obstacles by his new process. As a result, the Trail refinery is producing the first electrolytic lead, on a commercial scale, in the world.

The Betts process involves the dissolution of the lead in the bullion, or anode, and its precipitation upon a steel plate, or cathode, by electrolysis. Electrolysis may be defined as the course of chemical changes induced by the passage of a current of electricity through a chemical compound, in solution. The solution, or electrolyte, with the aid of the current, dissolves the lead in the anode and transfers it to the steel plate, leaving the impurities behind as a slime.

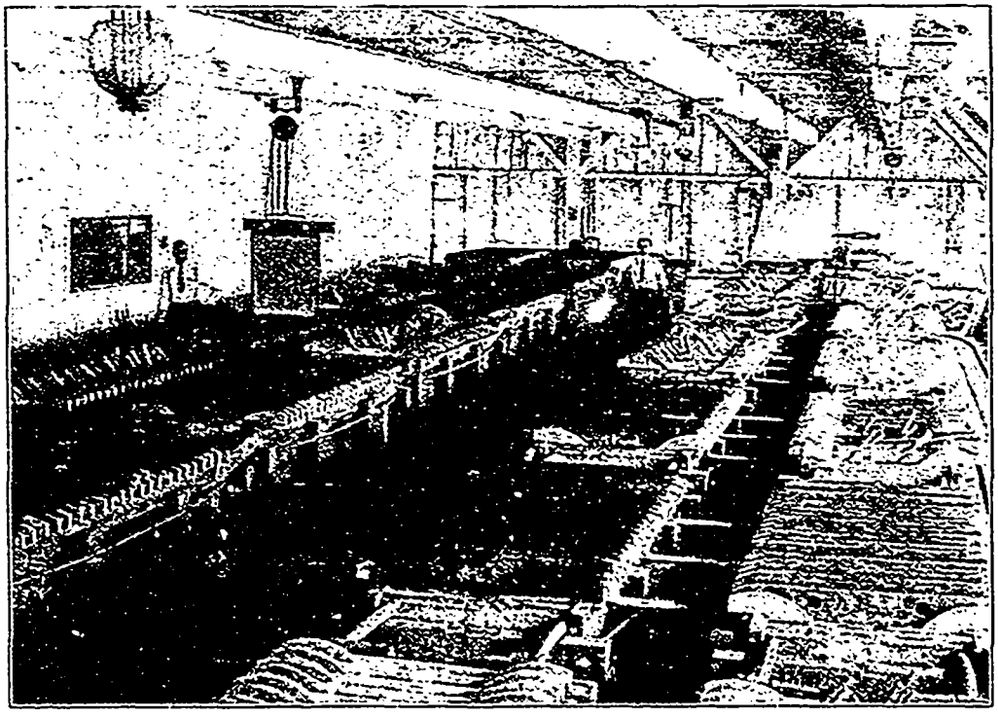
The plant consists of 28 cedar vats, well joined, and lined with rubber composition. They are in four rows, seven to a row, and so placed that each vat is three inches lower than the one above, in order to permit of the better circulation of the solution. The current is furnished by two dynamos, running in parallel, generating 2,000 amperes each, and conveyed to the vats by means of large copper bars. The vats are connected in series, so that the current passes from the first on through the twenty-eight, entering the solution in each vat through the anode and passing out through the cathode. To make the matter clearer, it may be well to state that the electrode by which the current enters the electrolyte is called an anode, and in this case is the base bullion, and that by which it leaves the electrolyte is called a cathode, which in this case is the steel plate.

After the lead ore is treated at the smelter, the resulting bullion, instead of being cast into bars, as it runs from the furnace, is moulded into anodes, 30 x 40 inches, and an inch in thickness. It is made into this form in order to provide a larger surface for the action of the acid. These anodes weigh about 350 pounds, and contain, approximately, 3 per cent. of impurities, consisting of arsenic, antimony, iron, zinc, silver, gold, bismuth and cadmium. They are carried on a runway and lowered so as to hang perpendicularly in the elecrolyte, which is a solution of lead salt. Twenty-two of these anodes are thus suspended, with a steel plate or cathode placed in like manner, between the anodes, at an equal distance of two inches. The selective action of the electrolyte dissolves the lead in the anode, and the current of electricity transfers it to the cathode, leaving the foreign substances in place on a mere skeleton or sheet of lead, which remains. The process by which the twenty-two anodes in each vat are dissolved requires about eight days, and in order that the action may be equal on the entire surface of each anode, the electrolyte is kept circulating from one vat to the other, and from the last vat it flows into a collecting tank, whence it is pumped back into each row, thereby maintaining a constant circulation of the solution. When the anodes are about spent, or eaten away by the action of the current, the cathodes are hoisted from the vats and a sheet of lead, 99.999 per cent. pure, is stripped from the steel plate and recast into bars, ready for shipment to the manufacturer of lead products. The anodes are then transferred to a separate vat, where the impurities, which have remained as a muddy slime, are

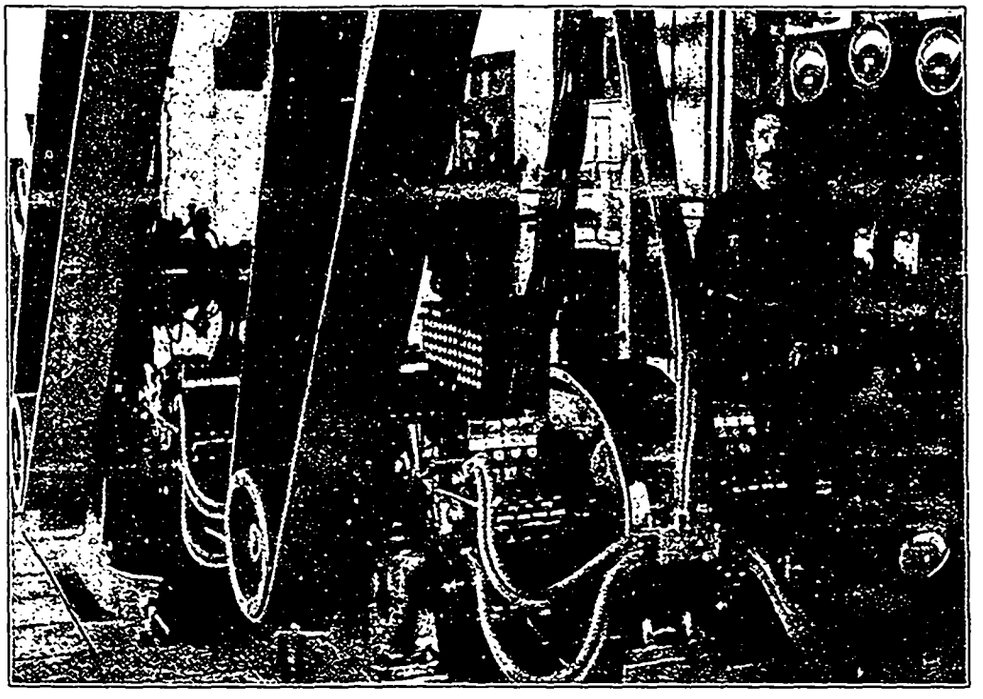
LEAD REFINING AT TRAIL, B.C.



Lead Refinery at Trail, B.C., showing, on the right, lead bullion ready for the vats, and, on the left, pure commercial pig lead.



Vat Room of the new Lead Refinery of the Canadian Smelting Works at Trail, B.C.



Dynamo Room of the new Lead Refining Plant at Trail, B.C.

washed from the skeleton sheets of lead, which sheets are recast into anodes, to undergo the same process of refining. About 15 per cent. of the original anode remains unspent when the slimes are removed. The impurities, or slimes, are of such a nature that they cannot be economically treated on a small scale at Trail, and for the present are being dried, boxed and shipped to the States, where the values are separated and marketed.

The solution used as an electrolyte contains lead fluosilicate and fluosilicic acid. It is prepared at the works by the simple solution of quartz in hydrofluoric acid, with the subsequent addition of lead carbonate or white lead. The white lead dissolves, with effervescence, to lead fluosilicate. This solution answers very well for an electrolyte, for the lead fluosilicate is very soluble in water. The salt does not crystallize on the sides of the tanks and the solution has no odour, nor is it otherwise disagreeable.

The Trail plant was erected on merely an experimental scale, and will be increased immediately. Its present capacity is seven tons per day.

The process is bound, eventually to replace the Parker process of desilverizing with zinc, on account of the greater economy possible in the cost of working, and the completeness of the recovery of the metal values, in much the same way that the Parker process has supplanted the Pattison process.

Imports of Mining Machinery.

The imports of free mining and smelting machinery during the month of November amounted to $56,292, of which $55,270 came from the United States. Dutiable mining machinery of a value of $9,395 was also brought in, bringing the total for the month up to $65,687. The total value of the imports for the eleven months, exclusive of diamond drills, amounted to $803,097.

The Walker Mining Co.

Just as we go to press we have received a copy of the prospectus of the Walker Mining Company which is offering in New York a bond issue amounting to $400,000. The company, which has been promoted by Mr. W. H. Walker, an Ottawa barrister, has been formed with an authorised capital of $1,125,000, in $100 shares, to acquire and work about 2,000 acres of graphite lands in the township of Buckingham, Ottawa county, Province of Quebec. This property has had a notoriously disastrous career and we should imagine quite a million dollars of British and Canadian capital have been sunk upon its exploitation during the past twenty years. It is not, however, our intention to comment upon this enterprise in this number of the REVIEW further than to say that while the property has undeniably some merit, the milling and concentrating plant is faulty and will require to be completely overhauled, while better business methods must be adopted by the management if the new enterprise is to be made what we all wish it to be—a commercial success. In our next REVIEW we may have something further to say about this prospectus.

Canadian Mining Institute.

Arrangements are well advanced for the annual meetings of the Institute to be held at Montreal on 4th, 5th and 6th of March next. The syllabus of papers is as usual a large one, embracing many topics of interest to Canadian mine managers and mining engineers.

Early in April the Institute will hold a meeting at Victoria, B.C., in conjunction with the B.C. Mine Owner's Association, and in August, in conjunction with the Lake Superior Mining Institute, an important series of meetings and excursions will be held at Sault Ste. Marie.

It is gratifying to learn that there has been a large increase in the membership of the Institute during the past year.

The Royalty Tax in B.C.

The Rossland Board of Trade has passed a resolution memorializing the Government of British Columbia to abolish the two per cent. mineral tax on account of the particularly burdensome restrictions which it imposes upon the production of low grade ores. The Resolution recites as follows:—"It differs from all ordinary forms of taxation in having a peculiarly repressive effect on the mining industry. This effect is not apparent on its face and is not measured by the amounts paid under it. It is nothing less than the stoppage or limitation of most new enterprises for the mining and treatment of low grade ores. Universal experience proves that the industry never becomes permanent until these ores are utilized, and any bar to this is fatal.

"The reason for this effect is that in going to ore of lower grade with a smaller margin of profit, the tax seizes a greater and greater percentage of the net profits. To illustrate on Rossland ores:—

HIGH GRADE SMELTING ORE.

Assume gross value of	$16 00
Cost of freight and smelting	6 00
Amount received by mine	$10 00
Cost of mining and development	$4 50
Net profit	$5 50

"The two per cent. tax figured on the above $10 is a 20 per cent. tax which amounts to 3.6 per cent. of the net profit.

LOWER GRADE SMELTING ORE.

Assume gross value of	$12 00
Cost of freight and smelting	6 00
Amount received by mine	$6 00
Cost of mining and development	4 50
Net profit	1 50

"The two per cent. tax figured on the above $6 is now 12 cents or 8 o per cent. of the net profit.

HIGH GRADE MILLING ORE.

Assume gross value of	$8 00
Cost of milling and smelting concentrates with tailings loss	4 00
Amount received by mine	$4 00
Cost of mining and development on larger scale	$3 50
Net profit	$0 50

"The two per cent. tax figured on the above $4 is eight cents or 16 per cent. of the net profits.

LOW GRADE MILLING ORE.

Assume gross value of	$6 00
Cost of milling and smelting concentrates with tailings loss	3 25
Amount received by mine	$2 75
Cost of mining on larger scale, (ore bodies already developed)	2 50
Net profit	$0 25

"The two per cent. tax figured on the above $2.75 is 5.5 per cent. or 22 per cent. of the net profits.

"It is needless to say that business enterprises cannot stand the confiscation of such large percentages of their profits. It is practically impossible to reform the tax so as to prevent this peculiar effect, and there is no escape from the two alternatives—either to suffer this effect or to abolish the tax.

"The low grade resources of British Columbia are practically unlimited, and this tax has long been the chief barrier to their development. The vast quantities known to exist in the Rossland ore deposits cannot be utilized until this bar to investors is removed. The Rossland Board of Trade desires to press this policy, not only for the benefits to its own district, but on the ground of the general relief which will be afforded to all the mining districts of the Province."

CORRESPONDENCE.

The Question of Free Coal.

To the Editor,

THE CANADIAN MINING REVIEW.

The opponents of reciprocity in free coal between Canada and the United States have not been slow to point out that the recent legislation at Washington is only a temporary expedient, devised to allay excitement in the States and to tide the politicians over a difficulty, and they are urging that on that account it should be entirely disregarded by Canadians. Even the least informed among Canadian newspapers have fallen into this sophistical line of agreement and have done their best to pooh pooh any suggestion which would lead to reciprocal action on the part of our Government. Undoubtedly this is a short-sighted view, although it would be as great a mistake to rush to the other extreme and to conclude that the action recently taken will be confirmed after the expiration of the twelve months now contemplated. We believe that the safe and wise position for the Canadian Government to take is that this action of the United States Government, from whatever motive it may spring, furnishes an opportunity which we have been seeking for years. To test the possibility of establishing a permanent agreement between the two countries for reciprocity in free coal. We propose to show that Canada has everything to gain and nothing to lose by accepting the challenge which has been thrown down, that if we take our friends at their word and pass similar legislation at Ottawa during the coming session it cannot have a prejudicial effect upon any branch of Canadian industries during 1903, and that we should be in a far stronger position if we were driven to abandon this reciprocal action by the retrocession of the American Government from the position they have just taken up than if we had not received their legislative overtures in the spirit in which we have a right to suppose they were intended. To question the "bona fides" of a friendly Government and refuse to follow their lead although we have professed to seek it for years, is to shut the door upon mutual agreements and to perpetuate the coal tax which Canadian consumers have paid, as we believe unnecessarily, for so long.

Let us examine the advantages and disadvantages of a reciprocal free coal agreement with the U. S. Government. It is obvious that in no instance could such an agreement work to the disadvantage of the consumer in any part of Canada as it would simply enable him to follow the natural law of purchasing his fuel in the cheapest market, whether Canadian or foreign. We are therefore confined to a consideration of the possible effect upon the producer in whose interest alone the present protective tariff exists. Now in this connection, what are the facts? There are only two coal producing districts in the Dominion of Canada, the one bordering on the Atlantic and the other on the Pacific. To deal with the latter first. The production at the Coast Collieries during 1902 was 1,200,000 tons, of which approximately 700,000 tons were exported, to the U. S., mainly to San Francisco, in spite of the existing duty. In the Crows Nest Pass the production of coal for the year was 425,000 tons of which more than one half was exported to the States, either as coal or coke, this again in spite of the duty. These figures are sufficient to indicate that local conditions prevail to such an extent that in the west Canadian coal is indispensable to our neighbours south of the line, and that the effect of removing the duty would be vastly to increase our market. Incidentally it may be mentioned that Mr. J. J. Hill, who has a large an interest in British Columbia coal mines, was one of the first to place himself on record in favour of free coal, and in this connection we should point out how greatly it would benefit the coast collieries, which have during the past two years felt very keenly the competition of crude oil for fuel purposes. It will be within the recollection of our readers, how, in his last annual report, Mr. S. M.

Robins, the general manager of the New Vancouver Coal Co., anticipated the extinction of his American export trade in consequence of the competition of oil. Nothing could be clearer then than that the removal of the duty would have a momentous effect upon the future of the coast mines.

Coming to Nova Scotia, the situation is different, because there is a common market within reach of the Canadian mines and of those operating in Pennsylvania, the possession of which is practically dominated by the question of tariff, or no tariff. From 1892 for several years the Dominion Coal Co. were fighting for free coal into the States. It is not necessary now to recapitulate the very voluminous and forcible arguments put forward by Mr. Whitney, and supported by all the chief officials of his company at that time. It is no exaggeration to say that according to their statement of the case, which lies before us as we write, the future success of their gigantic enterprise was dependent on their securing this measure.

It is a matter of history how, at the last moment, their project was frustrated in the Senate and their prospect of getting free coal received its quietus with the downfall of the Cleveland administration. If free coal was so desirable in 1892 and 1893 as to be almost a necessity for the survival of Nova Scotia mining, have the conditions since then changed so much that it is no longer desirable? Or, to what extent have the conditions modified the desirability? The one important factor which is causing Nova Scotia producers at the moment to look shyly upon any reciprocal action upon the part of the Canadian Government is that they are overwhelmed with orders, are unable to supply the present demand, and therefore, quite naturally, do not appreciate the necessity for securing any new markets. This is a delightful state of things, and one which, if its permanence could be guaranteed, might be extremely satisfactory to the various coal companies, but unless all history is to be belied, the present abnormal demand will before long begin to slacken with the inevitable consequences of reduced selling prices and reduced wages, and unless we are very much mistaken, in less than two years the question of a market for 1,000,000 tons of Nova Scotia coal a year will be a matter of weighty consideration. The mine owners may be under the impression that the present boom will last, but the only possible justification for this line of argument would be found in the fact that the natural development of our own country is so great that the coal producers have not yet overtaken it, and also that it will continue to furnish them with all the market they require. We think we can show that such an argument is fallacious. A study of the distribution of coal output from Nova Scotia for 1902, shows that 800,000 tons have been sent to the United States and 20,000 tons to Europe. No one who has studied the question believes that in a depressed time of trade it would be possible to export a ton of Nova Scotia coal into the States, for instance, except under some special contract, such as that existing between the Dominion Coal Co. and the Everett Gas Co., nor would it be possible to send coal to Europe when the selling price of the English product has fallen to a normal figure, except under similar conditions. With the expiration of the Everett contract, at an early date, the Dominion Coal Co. will have from 500,000 to 800,000 tons of coal for which they will have to seek a new market. Where will they place it? In Canada? Not unless even the present excessively busy time continues and the demand increases. Certainly not in Europe, as there is every indication that long before 1905 prices will have fallen to a practically unremunerative level. But not only will there be this surplus from the Dominion Coal Co., but all other Nova Scotia companies exporting coal to the States will find themselves face to face with the same difficulty. If, however, the duty of 60 cents were removed there is no reason, as was very properly contended by the Dominion Coal Co in 1892 and 1893, why the Nova Scotia mines should not practically dominate the New England market. In these States the consumption of soft coal now approximates to 10,000,000 tons a year. The distance from Nova Scotia ports to Boston is about equal to the distance from Newport News or Norfolk to Boston. In ordinary time American coal f.o.b. alongside Boston averages $3.40 per ton, made up as follows:—

Cost of coal per ton	$1.00
Average freight to Newport News	1 30
Insurance, sales, expenses, etc.	.10
Average ocean freight	1.00
Total	$3.40

Now compare this with the cost of laying down Nova Scotia coal at Boston without duty:—

Cost of coal f.o.b. Sydney or Louisburg	$1.25
Ocean freight to Boston	1.00
Insurance and sales expenses	.10
Total	$2.35

This would give the Nova Scotia producer a clear profit of $1.00 per ton, or in other words, allow practically $2.00 per ton f.o.b. for his coal, sufficient one would think in all conscience, but beyond that, as these figures clearly show, it would allow him a very considerable and elastic margin upon which he could trade under stress of circumstances. It is quite conceivable that this large market does not appear so desirable to the producer now as it did ten years ago, and it is true also that he sees in the gigantic industrial developments of his own Province a guarantee for a steadier trade than could have been possible at that time; but there is another side to this question in which the public are greatly interested, and that is the unbounded capacity of the Nova Scotia coal fields if properly developed.

The most competent experts have not reached the limit of possibilities in computing the contents of the Nova Scotia coal areas, largely due to the fact that the submarine areas cannot be investigated, and that there are large outlying tracts of country where it is possible and indeed probable that coal measures exist at a greater depth than has yet been explored, but the best judges agree that there are not less than 2,000,000,000 tons of workable coal in the Provinces, and in any event the quantity is almost beyond conception. Are we then to be satisfied with an annual production of 5,000,000, or even with a steady annual increase of some half million tons? We have for years regarded 10,000,000 to 15,000,000 tons per annum as a small output for the Maritime Provinces, and if free coal could be established and maintained with the United States, there is every reason to believe that nearly the whole of the 10,000,000 tons consumed in the New England States could be produced in Canada, thus raising the output of the Nova Scotia mines within a few years to something like 20,000,000 tons, due allowance being made for the natural expansion of our own industries. What this would mean for the country at large can better be imagined than described. It would certainly mean an unprecedented development in the Maritime Provinces, a large increase of population, and the establishment of many manufacturing industries which would use up the crude material now being produced at our large iron and steel works.

The gist of our argument in this articles is, that the coal producers of Nova Scotia should not be permitted, if that is their tendency, to rest content with existing tariff conditions, because they are at the moment reaping a golden harvest, but that the interests of the country demand that, whilst befriending and protecting our industries, we should at the same time keep in view the broader question of the general prosperity of the country and the policy that will most assuredly conduce to that end The only argument put forward at present by Nova Scotia operators who are opposed to action on the part of the Canadian

Government in this matter does not contest the fact that such action would give them control of the New England market, but is based entirely upon the contention that they would lose the St. Lawrence market, added to which representatives of the Dominion Coal Co. have argued that it would be a hardship for them to have to spend half a million dollars in providing suitable unloading stages and piers in the States for a trade that might not be permanent, especially as during the last ten years they have been put to similar expense in establishing those on the St. Lawrence. The answer to this contention seems to us to be very obvious. It is that whatever amounts have been spent on the St. Lawrence for these purposes have already yielded a very handsome return, and the structures provided will continue to be used whatever may be done in this matter of the tariff, and therefore that if similar amounts require to be spent elsewhere they are simply ordinary business expenditures to be incurred by any trader and not involving hardship of any kind. Not even coal companies have a right to ask protection against all the contingencies of the business in which they engage. They do not share their dividends with the country, and in taking all the profit must be prepared to sustain some of the disadvantages. But we agree with eminent authorities that the cry of losing the St. Lawrence market is simply a cry of "Wolf," and that it is absolutely impossible under any conceivable conditions for American soft coal to compete with the Nova Scotia product on the St. Lawrence, at any rate as far west as Montreal, and as practically no coal from the Maritime Provinces has ever been sold beyond that point it need not be considered in this discussion. The actual cost of laying down a ton of Cape Breton coal by water in Montreal does not exceed $2.00. For many years large contracts were made in Montreal at prices ranging from $2.25 to $2.50. During the present boom the cost of production has probably increased in some instances as much as 50 cents, but has ranged from 25 cents to 50 cents, while the selling price has increased $1.50. Without objecting in the least to the figures, which in exceptional times mine owners have been able to realize for their product, and remembering the many lean years which preceded the present years of plenty, we are very much disposed to think that the real crux of the question with them is not the fear of losing this market but of having to reduce their price. This, however, is not an argument which avails, because, as we shall presently show, the margin between the cost of Nova Scotia and American coal laid down in Montreal is so great that under no conditions could it leave the Nova Scotia producer less than a fair average profit. Allowing the American mine operator $1.00 per ton for his coal, f.o.b., the lowest cost of transportation from Ohio or Pennsylvania points to Montreal would be $1.90, making a total cost of $2.90. Between this and the Nova Scotia figure there is surely sufficient difference to satisfy any reasonable demand for profit.

In this argument we have made no reference to the important consideration of quality and the difficulty of disturbing Nova Scotia coal in the industries which have been using it for many years, and have found it thoroughly satisfactory. It might be urged that this argument cuts both ways, and that for a similar reason consumers in the New England market might be slow in purchasing Nova Scotia coal; such, however, is not the fact, because they have for many years been purchasing a small quantity, are well acquainted with its characteristics, and have demonstrated that it suits their requirements.

The last word to be said on this important subject, having as we believe successfully demonstrated that the producers would not suffer, and that while they might have to accept a lower price in the St. Lawrence market, they would still have a respectable margin of profit, with the added gain of a large new market in the States, which would more than double their present output, is that there is one section of our countrymen who would derive even a greater advantage from free coal. In Ontario and all through Central Canada geographical position determines that all our coal must be imported from the States. At present we are bringing in approximately 3,000,000 tons a year with a continual increase. Free coal would mean at the present time $2,000,000 a year to Ontario. *Viewed from the national standpoint* this should indeed be regarded as a weighty consideration, and in all the premises, should, in our opinion, be sufficient to determine the Canadian Government at any rate to test the possibilities by reciprocating the action of the Government at Washington. We may point out that if this were done for one year, and no one would suggest at the moment anything different, it could not possibly affect mine owners prejudically, because during that time at any rate they will not need to seek any new market. If, at the expiration of that time, the United States Government entered into an agreement with our own, renewing the arrangement for a term of years, we are satisfied that the ultimate gain to this country would be enormous without in any way injuring the position of our own coal producers, which would be the last thing your excellent journal would ever dream of doing.

W. BLAKEMORE.

MONTREAL, 22nd January, 1903.

Mining and Smelting in the Boundary District in 1902.

British Columbia's banner mining district is undoubtedly the Boundary, if general progress and results from an ore shipping standpoint can be taken as any criterion. Notwithstanding the many drawbacks that have prevailed during the past years for which neither mine workers nor mine owners were responsible, taken altogether, the calendar year of 1902 has shown a remarkable advancement in the Boundary.

In the matter of ore shipments first, the records show that in the year 1900—the year the Canadian Pacific Railway completed its four million dollar branch to the Boundary—a little less than 100,000 tons of ore were shipped. In 1901 the shipments increased to 390,000 tons for the full twelve months. In 1902, the figures for the last few days being estimated, and subject to slight correction, the splendid total of over 500,000 tons was reached, or an increase of nearly, or quite, 25 per cent over the previous year—nearly all the ore coming from six mines.

Had it not been for the unfortunate events following the terrible explosion in the Fernie coal mines in East Kootenay in May, whence only the coke supply for our smelters can be obtained at a price that will admit of a profit in treating our ores, there is every reason to believe that this record would have been much larger than it is. The ore was and is ready to be extracted from Boundary mines in almost unlimited quantities, the miners were satisfied with prevailing conditions, capital was available, and the three smelters were prepared to handle the output as fast as it could be delivered to them.

During the past year a few mines have been regular shippers from the Boundary district. As there are six of these that have figured steadily in the weekly reports of tonnage, they have become to be known as the "Big Six." They are the Granby and Snowshoe mines in Phoenix camp; the Mother Lode and Sunset mines in Deadwood camp; and the B.C., and Emma mines in Summit camp. The only one of these that has shipped regularly every week during the year was the Granby, with the Mother Lode as a close second in this regard. A few other smaller properties have contributed to the grand total.

In point of relative importance, as shown by the ore tonnage, and consequently the values recovered, these mines may be placed in the following order: Granby mines, Mother Lode, Snowshoe, B.C. mine, Sunset and Emma. Three of these properties have shipped only to their own smelters, namely, the Granby, Mother Lode and Sunset. Referring to the details of shipments from each mine, the following table will give the average respective tonnage of each, as nearly as it could

be ascertained without the actual data for the last few days, which has not yet been made up in all cases:

Mine	*Tons*
Granby mines, Phoenix camp	309,715
Snowshoe, Phoenix camp	21,158
Mother Lode, Deadwood camp	144,671
Sunset, Deadwood camp	11,615
B.C. mine, Summit camp	15,024
Emma, Summit camp	11,478
Winnipeg, Wellington camp	785
Golden Crown, Wellington camp	625
No. 7 mine, Central camp	482
Jewel, Long Lake camp	2,175
Sundry small shipments	2,300
Total for year 1902	520,026

One feature of the ore shipments from the Boundary for the past year is the fact that the month of December shows the largest tonnage of any other single month, being not far from 60,000 tons, and this notwithstanding that three of the furnaces in the three smelters were cold a part of the month. The next largest month of the year was October, when about 55,000 tons were mined and sent down to the smelters.

Throughout the year 1902 two of the Boundary's three smelters namely, the Granby and Mother Lode, were running continuously with the exception of the time when the coke supplies were cut off in the summer. At the Sunset smelter active operations were only begun about the time that the coke troubles started, but this smelter also has been running steadily since the coke began coming forward regularly after the settlement of the coal miners' strike in East Kootenay.

The Granby smelter is located at Grand Forks, having four furnaces and two copper converters, which latter handle the matte from the other two Boundary smelters also, and is a most complete plant in every way. Two additional furnaces have been ordered recently in Chicago, which will give a combined capacity for these reduction works of six furnaces, or 2,200 tons of ore daily. This smelter takes but little outside ore, with the exception of some Republic ore, which is largely used as converter linings. The ore nearly all comes from the company's mines in Phoenix camp.

The Mother Lode smelter is located at Greenwood, and is also very complete, having two furnaces, it being understood that two more furnaces will be added during the coming year. Mother Lode and some custom ore is reduced at this smelter, including shipments from the Snowshoe and B.C. mines.

The Sunset smelter is located at Boundary Falls, four miles below Greenwood, and was originally constructed by the Standard Pyritic Smelting Co. It was not blown in, however, until purchased and remodelled by the Montreal and Boston Copper Company last spring and summer. The same company owns and operates the Sunset mine in Deadwood camp, taking also at the smelter ores from Snowshoe and B.C. mines. The Sunset smelter now has one furnace, is installing second, to be ready for use in a few weeks, and has placed an order for a third, to be placed in commission in the spring.

Boundary's three smelters have reduced 500,000 tons of ore during 1902. The Granby smelter, which is the largest, has handled about three-fifths of this tonnage, the Mother Lode a third, and the Sunset smelter the balance. With twelve or thirteen furnaces in operation in 1903, the tonnage for that year should reach pretty close to the million mark.

Boundary mines have not yet quite gotten to the stage where dividends have been paid. As is usual with low grade properties, it requires years of development and the investment of much capital in an intelligent manner to reach this point. A fall of several cents in the price of copper has also had its effect. Nevertheless, several of them give promise of entering the dividend class in 1903. This being the case nothing official has yet been given to the public regarding the exact values of the ores being handled.

In this section the ore from the different mines is nearly all of the copper—gold variety, and generally speaking is well known to be of a low grade—but there are literally mountains of it, and the expense of extraction is reduced to the minimum. The values have been variously estimated at from $4 to $6 per ton, so that probably $5 per ton is a fair average. On this basis the mines of the Boundary have produced during 1902 ore that contained values amounting to over $2,000,000, the values being in copper, gold and silver, in the ordered named.

A few mines have been developing during the year having shown high values, notably the Providence, near Greenwood, from which a few cars have been shipped to the smelter running from $100 to $150 per ton. But the general run in the ore is low, and it is only by using the most modern equipment in both mines and smelters that the properties can be made to reach a profitable basis, as it is now believed they have.

One feature of the development in the Boundary mines this year is the system of open quarrying of ore, first used only at the Granby mines, but now adopted to a greater or less extent to advantage by all the large shipping mines of the district. By this plan the expense of hoisting is done away with, the ore being broken down and run by gravity to the railway dump cars. It promises to be used much more extensively in the future, as it is a most economical method of getting out large quantities of ore. W.

A Modern Coarse Concentration Plant for Silver Lead Ore.*

By Ernest R. Woakes, Nelson, B.C.

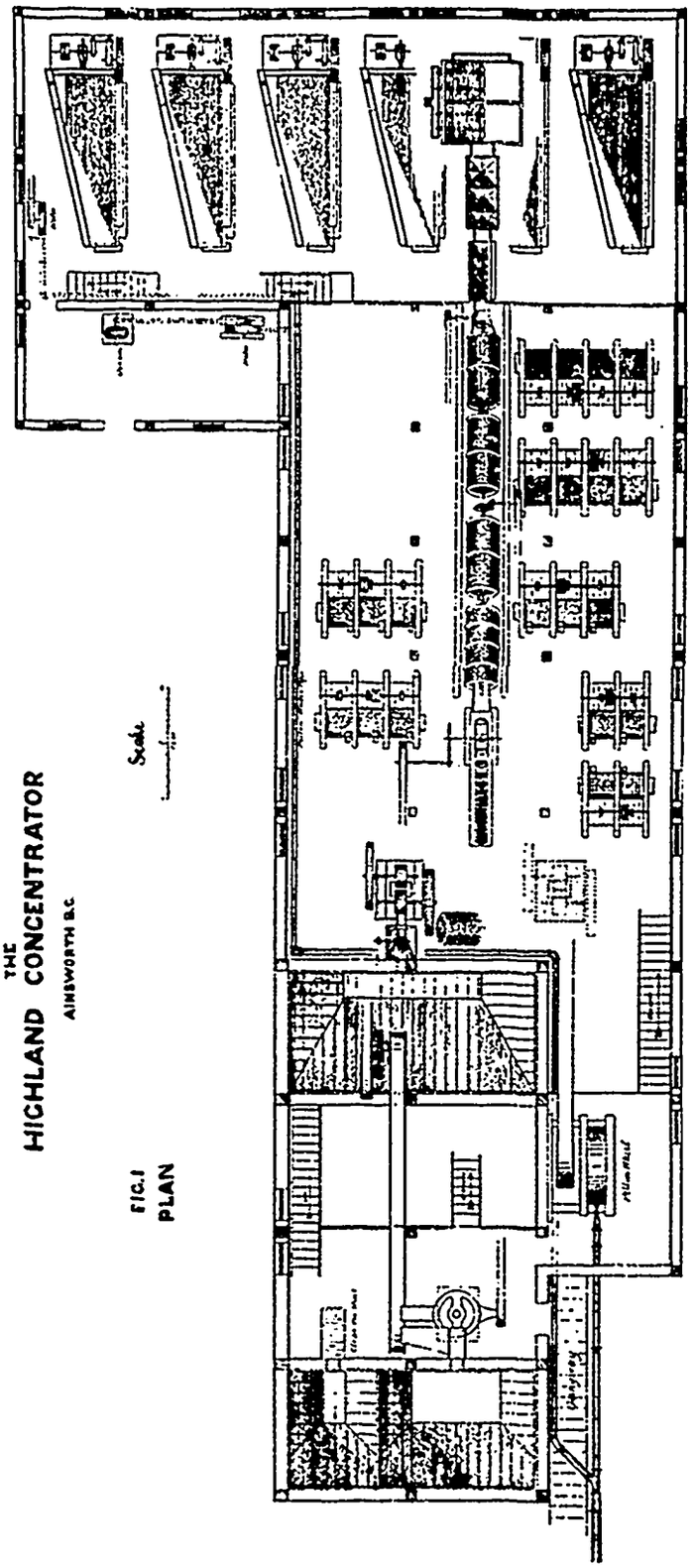
Of late years there have been so many improvements made in the machinery used for crushing and concentrating, and in the design of plants for this purpose, that a short description of an up-to-date concentrator of a quite simple construction cannot fail to be of interest to the members of this Institution.

Regarding first the improvements that have been made in the crushing machinery, we find these to be confined almost entirely to the rolls, for although the rotary rock-breakers of the Gates type are undoubtedly better for very large plants, the old Blake crusher is hard to beat. When we come to the improvements in concentrating machinery we find these are confiined to the various devices for concentrating the fine products of the mill, the old buddle, both stationery and revolving, having been quite superseded by the modern tables and vanners, whilst the old concentrating machine *par excellence*, the jig, still hold its own, though many have tried to improve it to death.

The improvements in the design of the mills are no less marked than those in the machinery, and have mostly been made with the view of obviating the handling and re-handling the various products by hand: indeed the contrast in this respect between a 100-ton concentrator, such as is to be described in this paper, and a similar plant of twenty years ago is most marked. In the former three men alone look after the various machines, and 100 tons of concentrating ore is crushed and concentrated and the concentrates delivered by gravity into the concentrate bins below the mill in each shift of twelve hours without a pound of ore being touched by hand; indeed, it is not necessary to have a shovel or barrow in the mill. In the old mills, or dressing floors as they were appropriately called, the plant was spread out over acres of ground and a regiment of men, women, and children were kept busy with hoes, shovels and barrows, whilst minature mountains of heads, middlings, and tailings were piled up in all directions. The following amusing incident occured some years ago on the dressing floors of a silver lead mine in South America. The manager noticed that the piles of middlings were accumulating on the buddle floor and remon-

*A paper to be read before the Institution of Mining and Metallurgy.

strated with the Welsh foreman; the ore was coming pretty rich at the time and the foreman did his best with the appliances available, but still the middling piles increased in size. Then the manager began to use more forcible language and said some means must be found to work off the pile and prevent the useless locking up of capital. The next time the manager came round he had nothing but smiles and good



words for the foreman as there was no sign of the pile left. The foreman explained that he had found an improved method of working, and there would be no more piles of middlings in the future to worry the manager. The simple man had just shovelled them into the tailings launder, and they had gone down the creek where they would be a cause of no more irritation to anyone.

The Highland concentrator was designed and built to treat the ore from the Highland mine owned by The Highland (Kootenay B.C.) Mining Company, Limited. The problem to be solved was a comparatively simple one, the character of the ore being such that practically all the silver values were carried by the galena; the pyrites, pyrrhotite and zinc blende carrying very small values. The ore was low grade in silver, carrying about ½ oz. silver to the unit of lead. It was evident, therefore, that a concentrator of such proportions was required as would treat a large amount of ore at the lowest possible cost. In fact, the concentrator should be a complete unit and such that each machine, or component part of that unit, should be so proportioned that the whole would treat the largest amount of material, whilst saving as large a percentage as possible of lead, at the lowest possible cost. The concentrator was to be to concentrators what a properly designed 40-stamp mill is to stamp mills,—namely, the most economical working unit of its class. The success or failure of a concentrator depends to a very large extent on this vital factor of proportion, it is so extremely difficult to say beforehand exactly how such and such an ore will crush, size, concentrate or slime, that it is by no means easy to arrive at all the proportions in the original design. It is of extreme importance that the coarse rolls should only crush the ore just to the size of the first or bull jig will save as much as possible of the coarsest and generally richest ore before it has been unduly broken up and slimed. In many cases, where the character of the ore to be treated is such that little regrinding is necessary, or that the galena separates itself easily from the gangue, an oversize jig, of ample dimensions, taking the product direct from coarse rolls and making tailings of a lot of partially crushed and worthless material, will be found to greatly increase the efficiency and capacity of a concentrator These conditions do not exist in the ore from the Highland Mine where the gangue consists largely of quartz. Only one elevator is needed, if the contour of the ground at the mill site approaches at all nearly to that shown in accompanying drawings (see Fig. 2). The whole plant or unit should, if possible, be so designed that only one elevator is necessary, and that one must be of very ample dimensions, the arrangement of the coarse trommel below the coarse rolls, to be subsequently described, is of the greatest assistance in this respect. Each concentrating machine, from the coarsest to the finest, must have its own sizer; each sizer, whether it be revolving trommel, hydraulic sizer, or settling tank, must be proportioned to the machine it is going to feed, and the proof that this proportion is true will be seen if the tailings from the machine are so poor that they can be run directly to tailing's spout; that is to say, every machine in such a mill as is being described, with the possible exception of the coarse jig, must make tailings. Of course the writer is perfectly aware that there are cases where the silver values are carried in other minerals than the galena, where tailings require re-grinding and retreating, but such cases are rarer than would be imagined if the proportions of the subunits of the concentrator be right. In the cases where the silver values are chiefly carried by minerals whose specific gravity differs so slightly from those minerals that are desired to be separated out, it would seem to be courting disappointment to attempt a concentration by water.

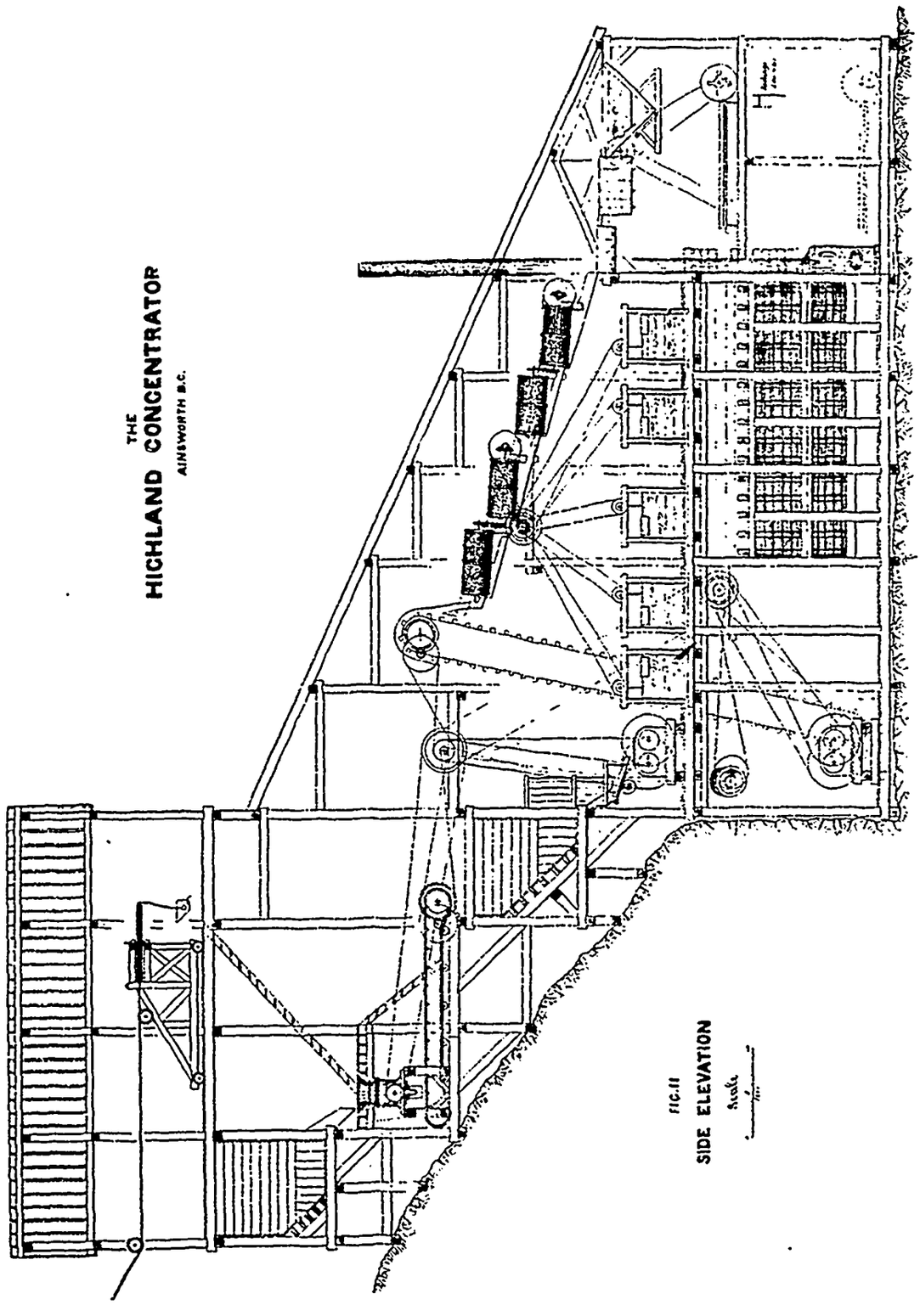
The capacity of a concentrator is not to be gauged by the capacity of its crushing plant, but by the amount of concentrates and tailings it makes. The writer has seen some beautiful looking concentrators, full of high speed rolls and elevators, all crushing and elevating to their utmost capacity, but in reality being little more than complicated circulating machines. The flow sheet of these mills, if ever such sheets were prepared, would be most interesting.

Light and cleanliness are coexistent, both are necessary for successful concentration; the practice of putting the crushing rolls at the bottom of what is to all intents and purposes a dark and dirty cellar is neither good engineering practice nor at all necessary in the design

of a concentrating mill, yet in most cases it is done. This plan, moreover, entails the lower boot of the elevator being in an inaccessible situation and practically under water. A properly designed and proportioned elevator can be run at a higher speed, and consequently have a greater capacity with less wear and tear, than one that does not possess these merits.

By referring to the plan (Fig. 1) and elevation (Fig. 2), the general design of the Highland concentrator will be clearly understood. The cross section (Fig. 3) shows the arrangement of the concentrate bins on the ground floor of the mill, into which all the products of concentration drain by gravity and are then run by gravity into cars which are pushed by hand over a platform weighing-machine on to a self-acting inclined tramway which transports them directly on to a wharf where they are automatically dumped into a barge on the lake.

The ore is brought down from the mine over an aerial rope tramway, on the Hallidie system, a distance of 4700 feet. At the upper terminal are separate ore bins for concentrating and clean ore; the breaks and automatic loader are worked by one man at that end. At the lower terminal, directly over the mill, as shown in the elevation is an automatic dumping and self-righting device, by means of which the tram buckets are dumped as they come over the ore bin and right themselves again before starting on the return journey to the mine. The ore



bins below the lower terminal are so arranged that concentrating ore is dumped before the buckets pass round the lower tail sheave of the tramway, and clean ore is dumped into a separate bin after the buckets have passed this sheave. When clean ore is being shipped over the tramway, it requires a man at lower terminal to attend to the dumping and righting of the buckets. The clean ore passes directly through an ore shoot to a lower ore bin on ground floor of mill, from whence it can be handled by same cars and arrangements as are used for shipping the concentrates. From the upper ore bin the concentrating ore passes over an inclined grizzly directly into a 3 D Gates crusher which discharges the crushed ore on to an 18-in. travelling belt conveyor, which delivers it into a second storage bin immediately above the coarse rolls.

Up to this stage the capacity of the plant is double that of the complete mill, the object being to run the tramway, crusher and conveyor, during day time only; thus two men operating this part of the plant are only required to work one shift. If it is necessary to sort out clean ore on the belt conveyor, an extra hand is required during the day shift, any ore so sorted out is dropped directly into a shoot that delivers it into the clean ore bin in basement. It is seldom, however, that it is desirable to sort out clean ore in the mill, this is done in the stopes in the mine.

The automatic feeder for the coarse rolls is an important item. The most satisfactory feeder is of very simple construction, and is shown in Fig. 2. It is a sheet steel trough made a little narrower than width of rolls and inclined slightly down to them, and arranged to work something like a bumping table, the backward motion being given to it by a revolving cam, a spring performing the forward motion and causing the bump against an adjustable stop. By means of this feeder a continuous stream of ore 3 in. to 4 in. thick, if desired, can be fed uniformly over the whole width of the rolls. The feed sample, to be afterwards described, can conveniently be taken from the stream of ore as it drops into the rolls

Rolls.—These, are no doubt, the most important item of the crushing plant, and the efficacy of the whole depends on their performance. It is, therefore, necessary that they should be of the very best design procurable. It is also desirable that the rolls should be all of uniform pattern, so that spare parts of all rolls in the same mill are interchangeable. The fine roll shells, with their arbors, can be transferred bodily to the coarse rolls and there worn out, after they are too much worn for efficient fine crushing, the new shells generally being put in at the fine end of the process. The writer has not had the opportunity of seeing the Argall roll, lately described by the inventor in a paper read before this Institution, but the high-grade rolls of the Gates Ironworks, Chicago, embody most of the essentials of a first-class roll. The plant at the Highland Mill consists of three sets of these machines, 26 in. by 15 in. The coarse rolls are arranged to run at 85 revolutions per minute, the medium at 95 revolutions, and the fine at 105 revolutions. The speeds for the coarse and medium rolls are slightly higher than those advocated for dry-crushing by Mr. Philip Argall in the valuable paper above referred to. From his arguments I gather that speeds should be the same for both dry and wet crushing for rolls of same size, working under similar conditions as regards size of feed and crushed product; it would be interesting to know if this is really Mr. Argall's opinion. I was glad to see that Mr. Argall has shown so clearly the absurdity of the craze for high-speed rolls for ordinary crushing: no doubt a great deal of the trouble so frequently experienced with rolls is due to the excessive speeds at which it is attempted to run them.

The coarse rolls and automatic feeder are set up about 3 ft. above the level of the jig floor, immediately to one side of the elevator, and are shown in Fig, 5, taken from a photograph. The medium and fine rolls are set up in a similar way, one on either side of the elevator boot on the ground-floor of the mill; the latter cannot be seen in the elevation (Fig. 2), it is eclipsed by the medium rolls. There are four twelve-light windows on either side of the building opposite to these rolls. Immediately below the coarse rolls is a revolving screen 36 in. diameter by 40 in. long punched with ⅞-in. holes; the product from coarse rolls passes through this screen, the oversize going directly to medium rolls and screened stuff to elevator. The advantages of this preliminary screening are considerable, nothing that will not pass the screen goes to the elevator, any flat pieces of rock that get through the coarse rolls pass on to the medium rolls and are there reduced in size before being elevated to main trommels. This entails a large saving in wear and tear of elevator. The coarse screen also sizes for the coarse jig which is a single two-compartment Hartz jig, with eccentric adjustable to a 4-in. throw, the screening area of each compartment is 34 in. by 22 in., the

THE
HIGHLAND CONCENTRATOR
AINSWORTH B.C.
Scale 1 foot

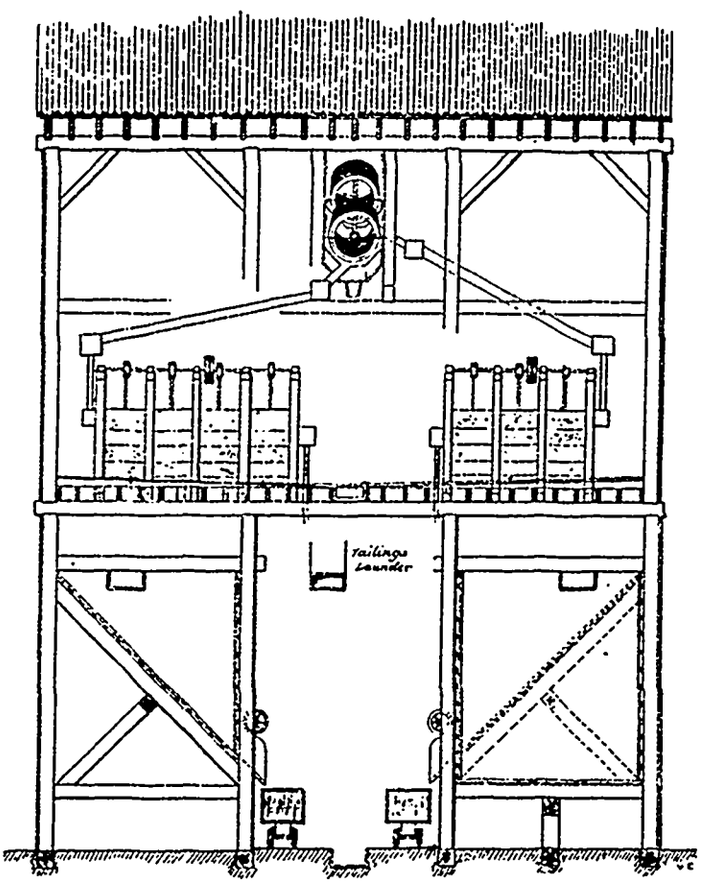


FIG. III
CROSS SECTION

actual dimensions of screens being 36 in. by 24 in. The tailings from this jig are generally run directly to tailings spout, but if the feed is particularly good they are returned to medium rolls, as indicated by dotted line on flow sheet.

The elevator is 48·5 ft. between centres of upper and lower pulleys, and it is believed that this height should only be exceeded by a very few feet if the best work is to be got out of an elevator. The head pulley is 48 in. diameter and tail pulley 36 in. diameter, the belt is a 14 in. by eight-ply "leviathan" canvas belt, the buckets are spaced

17 in. apart and are of No. 10 steel 12 in. by 6 in. The elevator has a geared drive, and runs at a speed of 350 ft. per minute. It worked very satisfactorily from the start and has shown a minimum of wear and tear.

The revolving sizing screens, or trommels, consist of four, all of ample dimensions; they are clearly shown in the plan and elevation of the mill. They are coupled up in sets of two which are separately driven by a geared drive. The driven screen drives the one above it by means of spurred gearing and not by sprocket wheel and chain. They are all 36 in. diameter, and housed in by large tongued and grooved wooden housings. The first trommel is 80 in. long, made in four sections, the first two of which have ½ in. punched holes and the second two $\frac{11}{16}$ in. holes; the oversize from this trommel goes straight to the coarse jig, it having been already sized in the manner previously described. The material that passes through the $\frac{11}{16}$ in. section goes to a two-compartment Hartz jig, similar to the coarse jig. The remaining three trommels are each 72 in. long and are covered respectively with ¼ in. round punched steel—3 m.m. round punched steel and 16 mesh slot punched steel. They each deliver their sized product to their respective jigs.

The fine product passes from the trommels into a set of four hydraulic classifiers, modifications of the Lake Superior trough type of classifiier. The series consist of a double **V** trough divided into hopper shaped sections of increasing area, the pulp flows through the inner trough passing over the divisions from one section to the next. Clean water, under slight pressure, is admitted into the space between the two troughs near the top of each section. There is an opening in the bottom of the inner trough, in the centre of each section which communicates with this space and opposite to the opening a piece of 1½ in. pipe passes through the outer trough through which the heavier material is drawn off passing in its course the upward current of clean water. The fines from the hydraulic classfiiers then pass into two pointed settling boxes, the first being 6 ft. by 3 ft. by 3 ft. divided into three compartments respectively, 18 in., 24 in., and 30 in. long. The last settling box being 8 ft. square at top and 5 ft. deep. In the former the current is arrested by partitions and "diving" boards, the coarser products being drawn off in the 18 in. compartment and the fines in successive stages in the larger ones. The opening in the bottom of each pointed box through which the sized pulp is delivered to its concentrating machine is connected with a goose neck or inverted syphon, which controls to a certain extent the amount of water that is delivered with the pulp. The water and fine slime overflows from the last large settling tank and goes to the tailings, whilst the fine settled product is taken off from the bottom by four goose necks and delivered to the last of the series of Wilfley tables. Wilfley tables were selected for the concentration of the fine products of the mill, the writer's experience being that they are the simplest and best machines for this class of work at present on the market. There was no difficulty in adjusting them, so that each machine made a clean product of the six different sizes with which they were severally fed.

We must now return to the jigs which take care of the products from the trommels. Besides the two coarse or bull jigs already referred to, there are three 3-compartment and two 4-compartment single Hartz jigs, with room on the jig floor for two more of the latter if found necessary. The jigs are all of the simple pattern above described, which is believed to be the best, but of very ample capacity, the screens in each compartment being 36 in. by 24 in. The fine jigs only deliver their product through the screens into the hutches. The jig frames and hutches were all constructed on the spot. The eccentrics are adjustable from 1 in to 3 in. throw, and the concentrates from each pass by gravity into the concentrate bins below the jig floor. By referring to the flow sheet, shown in Fig. 4, the course or flow of the material from start to finish can be readily seen. Owing to the variations in the quality of the feed coming into the mill, it is impossible and undesirable to draw hard and fast lines for the flow of the material from the third and fourth compartments of the jigs. The jig attendant must watch and adjust the height of discharge of the compartments of each jig, so that whilst the feed is good enough some of the jigs will be making practically no tailings. It will be found to be the case with most ores that the galena favours a particular size when crushed: in the case being described, the first 3-compartment jig taking the oversize product from the ¼ in. trommel generally made the most concentrates. The coarse product from the two first hydraulic classifiers goes to the two 4-compartment jigs, whilst the two remaining classifiers feed one each of the first

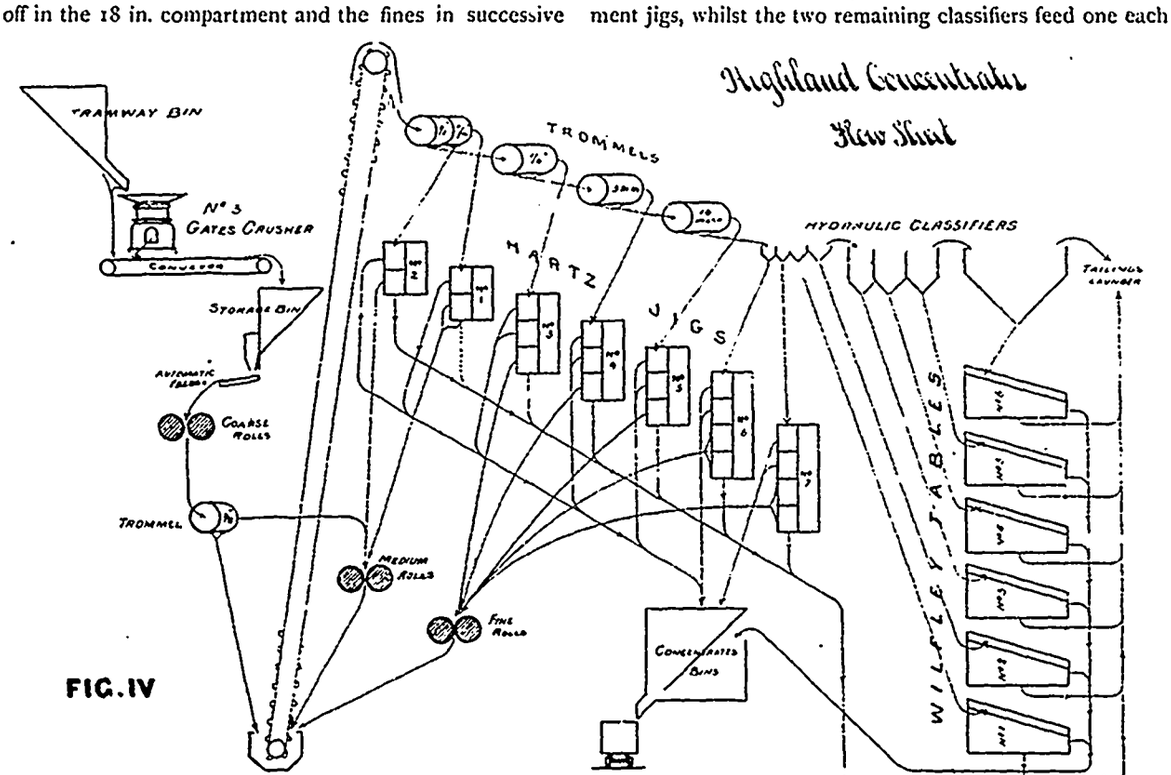


FIG. IV

two Wilfley tables, the third, fourth, and fifth Wilfley being fed respectively by the three compartments of the first pointed settling box, the sixth Wilfley taking the fine product of the last one. The mill thus produces thirteen distinct sizes of concentrates.

The mill is operated entirely by water power. A 4-ft. Pelton Wheel, with deflecting nozzle, is placed on the top floor, about on a level with top of the elevator; this wheel runs under a head of 450 ft., and the power water from it is caught in a tank and used for concentration purposes. This arrangement is the best to adopt wherever possible, as the slight loss of head entailed is more than gained by the ample supply of water available for the feeds to the various machines in seasons when the water supply is short. A special feed water pipe is taken from this tank for the Wilfley tables. A 6-in. main is taken off the pipe line to the large Pelton wheel, and branches from it supply a 2-ft. Pelton motor to operate the Wilfley tables, and a 12-in. motor to run the dynamo which supplies a 220 volt. current for lighting the mill and offices and bunk houses, &c., at the mine. A fire hose service is provided on each floor from this 6 in main. All the floors of the mill are heated by steam generated by a 10 h.p. boiler placed in the basement.

The crushing and concentrating machinery, shafting, pulleys and belting, with the exception of the Wilfley tables, were supplied by the Gates Ironworks, Chicago. The Pelton motors and gearing were supplied by the Pelton Water Wheel Co., San Francisco, and the Wilfley tables by the Mine & Smelter Supply Co., Denver, Colorado. The electric light plant was supplied and fitted by the Kootenay Electric Supply & Construction Co., Nelson, B.C. The erection of building and installation of machinery was done by the Highland Mining Company, under the superintendence of their foreman, Mr. J. A. Kelly.

The contour of the mill site and character of the bed-rock were such that no masonry was necessary. Lumber was cheap and was not spared in the construction of the building; 290,400 ft. of lumber and 118 twelve-light windows were used. The roof is of corrugated iron. By setting back the top ore bin and Gates crusher and using the conveyor belt to bring the ore forward to the storage bins, it was possible to set the whole of the upper works on a solid rock foundation, and at the same time reduce the height of the building. The sides of the mill are covered with two thicknesses of 1-in. dressed boards, with building paper between. The main driving-belts are "Leviathan" canvas brand, and the shaft-bearings are ball-and-socket type, with compression grease cups.

The cross section of the mill (Fig. 3) shows the construction of the concentrate ore bins and the inclination of the floors towards the centre, where there is a launder arranged to drain everything back into the elevator boot. Regarding the construction of these concentrate bins, it is necessary that great care be exercised in making them water-tight. The plan followed in this plant was to line them with double 2-in. tongued and grooved plank. A water-tight discharge door is made of wood, secured by wedges on the outside of the bins; outside this again is an ordinary ore bin gate, lifted by a rack and pinion. This latter is merely to regulate the discharge of the concentrates into the cars after the water-tight door has been removed. No difficulty was experienced in running the concentrates out of these bins. The bins for Wilfley concentrates are of different construction, the concentrates in them require to be shovelled into the cars. The discharge from the Wilfleys being at a lower level, the bins are made flat bottomed, as shown on right hand side of cross section (Fig. 3). The arrangement of the spouts or launders for carrying the crushed and sized ore to the various machines is indicated in this figure, and also in the photograph of Wilfley floor. These spouts should be as short as possible, the wear in them is great. Wherever a spout turns an angle, a box is provided; this prevents undue wear and the trouble from overflows. All the spouts carrying material coarser than 16-mesh should be lined with sheet-iron not less than ¼ in. thick. If there is an iron foundry in the district it will be found to be of very great saving, both in cost of material and time wasted in making repairs, to have these spouts lined with chilled cast iron plates ½-in. thick. In this case the spouts should be made of uniform section, so that only two sizes of liners be required *i.e.*, liners for bottom and narrower ones for the sides. The side elevation of the mill (Fig. 2) will serve to show the general arrangement of the plant and especially the trommels, hydraulic classifiers, and pointed boxes. The lower floor, under the Wilfley floor, is used as a workshop, and for settling tanks for the overflow water from the concentrate bins. There is also room there for three more Wilfley tables (shown dotted in Fig. 2) to take the tailings each from a pair of Wilfleys on the floor overhead, an arrangement which should have all the advantages of double deck concentrators without some of their disadvantages.

Work was started grading out the mill site towards the end of August, 1900. The carpenters started framing the timbers on 15th September. The mill was completed and in operation on 18th January. 1901, and no stoppages for structural alterations have been made. The skilled labour employed was first class and highly paid. The total cost of the plant complete was as follows:—

Machinery and hardware.....	$16,693.05
Freight and duty on above.....	4,126.98
Lumber.....	3,590.66
Wages and Salaries.....	11,555.07
	$35,965.76

Capacity of Plant, and cost of operation.—The contractors for the machinery were required to guarantee that it would crush a minimum of 100 tons per 24 hours. After erection it was found that the capacity of the plant was nearly double that amount, and as it stands may safely be said to be capable of treating 180 tons per day of 24 hours. The addition of two extra jigs and the three Wilfleys above referred to would bring the capacity up to 200 tons. Under the above circumstances it has never been necessary to run the mill continuous 24 hour shifts. The capacity of the mine at the time being about 3,000 tons per month, which amount can be treated during one shift. Working under these conditions it is necessary to have a night watchman, who also attends to the running of the electric light plant. The concentrator requires three men besides the foreman and a blacksmith, the latter assists in running the concentrates out of the mill to the barge.

The cost per ton of ore crushed on the above basis comes out at a fraction over 29 cents. This includes cost of stores and materials used, and of placing the concentrates produced on the barge ready for shipment to smelter. It is evident, therefore, that by running the plant to its full capacity this cost would be very materially reduced only two more men being required to treat 6,000 tons per month. Under these conditions the cost would be reduced to probably less than 16 cents per ton.

Very careful tests were made of the efficiency of the mill as a concentrator. Samples were taken of the feed going into the coarse rolls every quarter-of-an-hour, and the bulk sample so obtained was assayed daily for a period extending over several months. A similar sample was taken of the tailings going out of the mill, and this latter was checked by the tailing samples taken from each machine. All the assays for lead were done by wet method. The above results, taken in conjunction with the actual amount of lead and silver contained in the concentrates produced, would give approximately the percentage of extraction obtained by the mill. By these means it was found that 81·5 p.c. of the lead was saved, whilst the average tailings assay for silver was 0·6 oz. per ton. These results may be taken as showing good concentration. It is not claimed that the above method of sampling is by any means perfect; in fact it is impossible to get an

accurate feed sample of a mill without an elaborate system of mechanical sampling and recrushing, which is obviously out of the question in a silver lead concentrator. There are many simple mechanical devices which will take fairly accurate samples of tailings, that known as Lamb's Automatic being one of the most satisfactory. It is manufactured by The Allis Chalmers Company.

It is not safe now-a-days to talk, or even write, about concentration without mentioning the oil process. I do not think the sponsors of that process claim that it is preferable to water for coarse silver lead concentration. I am, however, inclined to believe, from the rough experiments made at the Highland concentrator, that with many ores there would be a very considerable saving effected by treating the tailings from fine jigs and Wilfleys or vanners by the oil process. I note that it is claimed that the process is quite cleanly. I can only say that our experiments were decidedly dirty.

I wish to acknowledge my indebtedness to Mr. Norman Carmichael, my assistant, for the very careful manner in which he has prepared the drawings to illustrate this paper.

Gold Dredges—Their Construction and Manipulation.*

By DAVID K. BLAIR, Consulting Dredging Engineer.

[Continued from the November Issue of THE REVIEW.]

For a "paddock" dredge the ladder should project well in front of the bows for the purpose of breaking down the ground in front of of her, and also permit her to work into the corners of the paddock with greater ease. If the ladder does not project, it is impossible for a dredge to cut her own flotation. When dredging is to be stopped for a time, say from Saturday night to Monday morning, always lift up the ladder. If left on the bottom, especially in a running river, it silts up, that is, the drift fills up all its interstices and practically cements the lower end of the ladder solid into the bottom, and it is a very serious job to get it up again. The mishap is the result of one of two causes, namely, carelessness or stupidity, and the average gold dredge carries a fair supply of each of those commodities.

When dredging into high banks (fifteen to forty feet) or terraces of stiff wash whose angle of repose is practically vertical, and it is found necessary to undermine with the buckets extensively to get the face to fall in at all, the greatest skill and judgment must be exercised, and the face should not under any circumstances be permitted to overhang, but a Worthington, Blake, or other form of pressure pumps should form part of the dredge's equipment, and a hose and nozzle connected thereto for the softening and breaking down the face and preventing heavy falls taking place. A heavy fall of the face, besides menacing the safety of the whole dredge, may completely bury the ladder under many tons of material, with a result similar to that mentioned in cementing in the ladder. When a fall occurs get up the ladder as quickly as possible before the material sets solid around it. On the high banks about Alexandria, in New Zealand, this class of accident is of frequent occurrence.

The tumblers are one of the most important details of the dredge's structure. The top tumbler has been very lavishly treated by designers, and I believe no individual part of the dredge has received more attention at their hands, and every dredging engineer has some particular pattern for which he claims that it exceeds in virtues all others. I am of the opinion that, after all, the solid cast steel square top tumbler of the box pattern eclipses them all for simplicity and general utility. The term solid is used (for it is not really solid but cored out) merely to distinguish it from those with removable and renewable steel angles, plates or cast steel dove-tailed in corners, all of which give more or less trouble. Harbour dredges almost invariably adopt the solid steel top tumbler of square or hexagonal form; gold dredges the four-sided top tumbler.

The duty of a top tumbler is to turn or drive the buckets, and in doing this it also tumbles them upside down and empties them (hence the name). The top tumbler is keyed securely to the same shaft as the main spur wheel.

The bottom tumbler is fitted between the jaws provided for it at the lower end of the ladder and is really only a roller being dragged round by the buckets, or we might call it a tool holder, for it maintains the buckets at the proper angle for cutting.

It is customary in gold dredges to make the bottom tumbler pentagonal in form and of solid cast steel, that is, without renewable parts. It either, as before stated, revolves on a stationary shaft or is keyed to the shaft and revolves in bearings provided for it on the cheeks of the ladder. Both types are in general use. It is advisable to have big flanges on the bottom tumbler to keep the bucket belt on. Steel tines or cutters have been fitted into the flanges of the bottom tumblers for the purpose of breaking down the wash and assisting and relieving the buckets of some of their work. The flange of the bottom tumbler, with its tines acting like a circular saw, cuts drafts or chambers in the face, the lips of the bucket in turn cutting the intervening block of wash out. It has not, however, been considered worthy of general adoption by dredging men. The duties of the bottom tumbler are of a very severe nature, being constantly associated with sand, gravel, and water, and revolving in this solution it wears away more or less rapidly according to the hardness of the material used in its manufacture.

The average life of a good cast-iron bottom tumbler in constant work is about twelve months; a cast steel one may last twice this period.

A common accident on a gold dredge is getting off the tumbler, that is, the bucket belt riding on to and over the projecting flange of the bottom tumbler. The cause is as a rule careless winching, or running with the bucket belt too slack. Sometimes, however, the design of the bottom tumbler is at fault, and very often a big projecting stone or log easily pushes the bucket belt off unless great caution is exercised. It is treated as an accident of little importance, and with a main engine capable of being reversed, (and they all should be), the two men on shift can generally get it on again in about an hour. The first step in the operation is to get the ladder up to the deck level. If a big snag or stone has become jammed among the tumbler, belt and hangers, and the ladder is one with a short overhang, or as in a river dredge, no overhang at all, it is not an easy matter to get the ladder up. After the ladder is up, short stiff billets of wood are put under the belt on the upper side, the engine is reversed so that the buckets run backwards, and the belt is run on the same way as an ordinary belt is run on to a pulley. It is sometimes possible to get a certain amount of assistance with lines led to the surging drum of the steam winch, or tackles from the gantry. With care in a well designed dredge this accident should be a rare one. Off the top tumbler is an almost unheard of accident.

The centrifugal pump is the type of pump in universal use for lifting the water for gold washing purposes. It is about the only part of the machinery of a gold dredge that is ever placed below the deck, and in my opinion, below the water line is the proper place for it. Occassionally the air and feed pumps and the electric lighting plant are below, but it is exceptional.

We have dealt with the dredge proper; it now remains to describe the gold-saving appliances employed and the methods of disposing of the tailings.

In early dredges the designers followed in the footsteps of the

*Paper read before the New South Wales Chamber of Mines.

old diggers and simply discharged their spoil into the primitive "sluice box," with its pitched bottom, or into one fitted with "grizzlies" perforated bottoms and mats, venetian ripples, or some of the various patterns in use in the early days, according to the taste of those in charge. These old sluice-box dredges never got any phenomenal returns, notwithstanding the much vaunted perfection of the sluice-box as a gold saving appliance.

Mr. Charles McQueen, of the now defunct firm of Kincaid, McQueen & Co., of Dunedin, N.Z. (with whom I had the honour of serving my apprenticeship) saw that the sluice-box could be improved upon, and introduced the revolving screen with the matted tables and ripples underneath.

The Araluen Central Dredge (a sluice-box dredge) in this State holds the record for Australia, and its success is attributed to the sluice-box rather than to the richness of the claim itself, and as a sequence the screens and tables are condemned.

On the Molyneux, where there is no necessity whatever for using an elevator, where the current itself carries the tailings far astern, where the sluice-box would be the cheapest gold-saving appliance possible to instal, and when installed would cost less for upkeep, in fact an ideal place for a sluice-box dredge; yet in the face of all these seeming advantages there has not for the past six years or more been a single sluice-box dredge constructed for the Molyneux or its main tributaries, the Kawaru and Clutha, and now there only remain on the river a few old derelicts to represent this style of dredge. Yet in this State there is a growing tendency among the amateur class of dredging men, or those whose experience dates from, or after, the inception of the industry here (three years at the most), to adopt what authorities in New Zealand years ago have discarded, namely, the sluice-box. In Victoria, to the best of my knowledge, no sluice-box dredge exists.

The "Lady Ranfurly" (Electric No. 3) with her magnificent return of 1234 ozs. for a week's work, the "Hartley and Riley" (1187 ozs.), "Meg and Annie," "Royal Maori," "Magnetic," "Cromwell," "Central Electric," "Alpine," "Vincent," "Perseverance No. 2," "Matau," "Unity," "Earnscleugh No. 1," "Earnscleugh No. 2," "Enterprise," "Ngapara No. 1," "Dunstan Lead," "Golden Beach," "Moa," "Manuerikia," "Golden River," "Fourteen Mile," "Golden Gate," etc., etc., are all Molyneux (or Kawaru) dredges, whose record returns range from close upon 100 ozs. to 1234 ozs. per week, and they are all dredges fitted with screens and tables; and there are others on the West Coast of New Zealand, such as the "Grey River," "Pactolus," "Nelson Creek," etc., with records from 100 ozs. to over 300 ozs. per week.

Sluice-box dredges in the past actually worked in some instances on the same claims as some of the above, but did nothing startling in the way of returns. Certainly they were small plants compared with those just mentioned, but they were quite big enough for experimental purposes, and their owners, when replacing them with larger and more powerful plants, were quite satisfied with the experience they had gained with the smaller ones not to adopt the sluice-box type in the larger ones.

In paddock dredging the sluice-box type of dredge can only be used in comparatively low lying and shallow ground, and only very low banks can be worked. So far, no one has devised any means of elevating the tailings from the sluice-box dredge and thereby permit her to work into the banks or terraces, but the writer does not see any very serious engineering difficulties in the way that could not be surmounted if it were found necessary to do it.

The screen, briefly, is a large revolving cylinder, perforated in such a way that the wash is distributed as evenly as possible over the matted tables on top of which it revolves. The size of the holes in the screen varies from ¼ to ⅜ of an inch in diameter at the top end of the screen, gradually increasing in size towards the lower end of the screen, where the maximum size in some dredges is as much as one inch in diameter. The nature and composition of the wash determines the correct size and number of the holes required. Extending down the centre of the screen, and as close as possible to the upper portion of the periphery as conditions will permit, is the sparge pipe. The sparge pipe is perforated on its lower side its entire length with several rows of holes. These holes, as a rule, are given an excess of area far above any likely requirements to enable the play of water on the wash to be perfectly regulated and controlled, and this is done by inserting wooden plugs in the holes not required, until the desired play of the water on the wash, in the screen and on the tables is attained. The water from the centrifugal pump is discharged into the sparge pipe and descends in a heavy shower on the wash within the screen, which is being kept constantly turned over and over as well as pushed along (or retarded in some cases) by the motion of the screen. Anything smaller than the holes drops through them on to the ripples and mats, anything larger goes through the screen into the stone shoot; or if an elevating dredge up the elevator, in each case arriving ultimately on the heap of tailings astern.

Screens are driven either by spur or friction gear.

Some dredges have double tables, that is, the screen is situated in the fore and aft centre line of the dredge, and the tables trend to either side; in others the tables trend to one side only, so the screen in this latter instance is at the head of the tables. Practice has proved that double tables do not act as well as the single, the play of the water on them cannot be controlled so well, and there are other defects. To overcome these defects twin screens were introduced, that is, two smaller screens side by side, each with its own independent tables; but even this system has not been followed up, and those initiating it have discarded them, and the conclusion arrived at is that one large long screen and single tables are the most efficient combination, and all those New Zealand record breakers before mentioned, with the exception of the "Golden Beach" and "Earnscleugh No. 2," are dredges with single screens and single tables.

In my opinion the screen is an ideal appliance for treating wash. The strong aversion to the screen by the old digger element is that it will not save nuggets, and because there happened to be found in the early days about Braidwood and the Upper Macquarie districts a few "specks" worth about £5,000 to £10,000 each, and anticipating an epidemic of these to occur again at any moment, they think it necessary to design the gold-saving appliances solely on the off chance of getting, say, a 20 oz. "speck." The small, light, flaky, dusty, shotty, etc., gold, which constitutes our present returns, goes for nothing in their endeavours to save the nuggets. The "Kiandra" (a sluice-box dredge) got a six ounce nugget a few weeks ago, and this strengthened the sluice-box cause considerably, but I think you could safely risk a ten to one bet that the "Kiandra" or any other dredge in this State does not get another of the same size, or larger, for the next twelve months.

In conclusion, I think that the dredging companies in this State in discarding the screen and tables and reverting to the sluice-box are taking a retrograde step, notwithstanding the fact that four of the most successful dredges in this State are sluice-box dredges, namely, "Araluen Central," "Jembaicumbene," "Kiandra," and "Tullock and Hughan's"; but there is no doubt that the dredges with screens and tables would do equally well, if not better, on the claims mentioned, and the working expenses would be practically the same, but the first cost of the screen dredge would be slightly greater.

Dredge tables are generally sub-divided athwartships into three feet sections.

Where there is a probability of nugget gold some of the New Zealand dredges have fitted a nugget catcher, that is to say the stone

shoot behind the screen is fitted with ripples. The "Fourteen Mile" (N.Z.) dredge obtained a two ounce nugget by this means; but it has not been thought worth while to generally adopt it.

Time does not permit the Californian tables as applied to dredges being described in this paper. Briefly they are a combination of the sluice-box and the ordinary dredge tables.

If the claim is one where it is necessary to work into high banks an elevator will have to be provided of suitable length to stack efficiently the material from the face dredged.

Ground stacks differently according to its composition, but for a general approximate it may be assumed that it stacks thirty three per cent. higher when elevated than it did when in the solid Some of the large dredges working into the terraces at Alexandra, New Zealand ("Dunstan Lead," "Glasgow," etc.,) have elevators from eighty to one hundred and twenty feet long, and when loaded with tailings weigh over sixty tons. Large elevators are most expensive to construct and maintain, and entail also the construction of a very large hull to carry the immense weight with its leverage, etc., and extra engine power to drive them.

Mr. Walter Peck, dredging engineer, of Dunedin, however, has come to our assistance with a most ingenious contrivance, which in many instances will completely supersede the ponderous "jib type" elevator we see projecting over the sterns of a number of the modern dredges, besides reducing the size and cost of the hulls about one-half.

The "Ngapara No. 1," a small but very successful privately-owned dredge at Alexandra, in New Zealand, was the first to adopt "Peck's Patent Centrifugal Elevator" which consists of a cast steel drum with its surface shaped so as to act as beaters or impact plates to the tailings falling upon it from the stone shoot. The drum is designed to revolve at a speed of about two hundred and forty revolutions per minute. The diameter of the drum may be anything from three to five or six feet, according as the height to which it is desired to stack the tailings, may vary from twenty-five to eighty or one hundred feet. The beating surfaces of the drum are faced with small renewable strips of manganese steel which are readily renewed and form the only part subject to wear and tear. The "Ngapara No. 1" found the cost of renewing the beaters did not exceed £1 a month, and the elevator could stack ordinary tailings to a height of thirty-five feet, and sand to a height of twenty-five feet, though their elevating drum only measured thirty-eight inches in diameter by twenty inches wide. The "Glasgow" dredge at once discarded its eighty feet elevator and fitted one of Peck's, and their example has been followed by the "Island Block Company," and "Sandy Point" and several others during the last few months.

The credit of applying the elevator to gold dredges rests with Mr. W. H. Cutten, dredging engineer of Dunedin, who designed and fitted to the "Enterprise" dredge, Alexandra, the first serviceable dredge elevator, which turned out a great success. There is not the slightest doubt that Mr. Cutten's idea advanced the dredging industry considerably. Most of the elevators at present in use are modifications of Mr. Cutten's original design.

All the leading points in the details of the construction have now been touched upon, and it only remains to give a general idea of the manipulation of the assembled parts—the "gold dredge" herself and the general principles on which she is worked on her claim.

To commence with, a dredge ought to be built on the lower pegs of her claim whenever it is possible to do so. Sometimes it is impossible to get solid ground at the spot, or it may be that the ground is too irregular; or the only suitable site for building may be on the top of the high banks where it would be an impossibility to launch from; or it may be submerged by floods. A large number of dredges in this State were built under flood mark, and I only know of two that were caught. Building under flood water mark is a very risky undertaking, even with the dry season before you; yet there are claims where it has to be done; for instance, in low lying river banks or flats which the river when in flood submerges, say for several hundred yards back; to build above the flood mark in a case of this kind would mean launching or skidding the dredge several hundred yards, a most expensive operation. It is very often a matter of supreme importance that the dredge should start on a spot where a rich patch of gold is known to exist, whether it be above or below flood water mark, or at the top, middle, or the bottom of the claim.

The reason for building at the lower end of the claim, whether it be a river or flat, is this: A dredge always if possible works up the stream (in the Molyneux she could hardly do anything else), her tailings are then always on the down stream side (that is behind her), and the dredge practically constructs her own dam and brings or banks up the water in front of her with her own tailings as she goes along, if it is found necessary to do so; if she were working down stream, and the ground shallow, it would be necessary to keep building dams ahead of her, a very costly operation. Another point, in rivers like we have in Australia, when working up stream your tailings fall on the down stream side of the dredge, and if a flood comes it washes them further away—you have seen the last of them; but if you are working down stream the tailings are all on the up stream side of the dredge, and the first flood that comes along generally washes them over the top of the dredge and fills up the paddock, and when it subsides you usually find the dredge left high and dry, and almost invariably in a twisted condition.

It might be argued that a flood generally fills up a dredge's paddock in any case; so it does, but when filling it up it might as well fill it up with untreated material as with tailings.

On a flat where you do not depend upon damming a river, (as in the case of the "Ovens Valley Co's" claim in Victoria) it is immaterial where you start, provided it is a point that commands the whole claim on the proposed working scheme.

A gold dredge is manipulated by six steel ropes, which are led on to the particular barrels allotted to them in the winch before mentioned, namely:—Head-line, port bow-line, starboard bow-line, port stern or quarter-line, starboard stern or quarter-line, and ladder-line. All these with the exception of the ladder-line are secured to trees or stones, if they are procurable in the correct position, if not a form of anchor, called in dredging parlance a "backer" or "toggle," is used. These are simply logs of hardwood, eight to ten feet long, and from six to ten inches in diameter. The steel lines are secured round the middle of these logs directly or with a chain sling, or steel rope strop. A T-shaped hole is dug in the ground, in the required position, varying in depth from two to six feet according to the holding capabilities of the ground. The backer is dropped into this hole and buried up; the log forming the head of the T, and the chain sling, steel rope strop (or steel line) the vertical portion of the T. This form of anchor if properly put in in hard ground will hold almost anything; but if submerged by flood water, often washes out. A dredge master always tries, if it can be done at all, to get his head-line round a good solid rock or a strongly rooted tree.

The head-line is the line that holds the dredge up to her cut and resists the back thrust and surge of the dredge as the buckets at their work strike and leave the face. It is the heaviest line on the dredge, and very stiff in construction compared to the other lines.

In the actual working it is advantageous to use as long a head-line as possible, for the head-line is the radius of the arc that is formed hy the dredge when at work on the face of her paddock; and as it is desirable to keep the face as straight as possible, a short head-line puts too much convexity in the face, and also puts a very heavy strain on the side-lines (and the winch generally) when the dredge is in the corners, making it a difficult matter to retain the desired width of face.

Where the distribution of gold is pretty equal over the river or flat to be dredged, the wider the face the better, as taking out the corners occupies considerably more time for the work done than straight dredging, and loss of time means less material treated and a correspondingly less quantity of gold won. A wide face means a long head-line, but in low lying rough country the length of head-line is limited. At Waipori, in New Zealand, where the dredges work with faces several hundred yards wide, a single head-line would require to be so long that it would be practically unworkable. The system adopted there is to have several head-lines and use one for a certain distance, then change on to another; this is found more expeditious though more expensive than using one line and shifting it on to different backers arranged at the required intervals across the face.

Opening out is the term applied to the initial operations of the dredge in cutting out the width of the face and size of paddock required. A paddock dredge generally starts in a square excavation of a size sufficiently large to allow her to turn completely round in it (that is its size is fifteen per cent. or twenty per cent. more in length than the extreme length of the dredge itself), and takes cut after cut across the side of the paddock destined to be the face. On each successive cut she turns at an angle of about forty-five degrees, and cuts directly into the corners of the face, as far as she can, each time thereby widening the face and making her paddock wider until the desired width of face is obtained.

The building site should be selected with a view of allowing the dredge to open out on both corners. The duration of opening out operations is from a fortnight to a month. At the end of these periods it is assumed that the dredge is in a thoroughly efficient position to deal with the ground ahead, and that the owners may expect steady work and regular gold returns. In opening out operations gold getting and saving are only secondary considerations, the first being to get a proper working face and paddock formed.

The side-lines are arranged to either hold the dredge steady or pull her into any required position laterally, and are secured to backers in suitable positions to accomplish this end. The side-lines have to be long enough to at least reach the full width of the paddock; in construction they are much lighter and more flexible than the head-line.

The ladder-line lowers or lifts the ladder as required. In construction it is lighter than the head-line and much more flexible than the side-lines on account of the number of sheaves it has to run over.

In working a gold dredge every effort should be used to keep the ladder on the bottom (that is the gold-carrying bottom) all the time, even when pulling forward on the head-line for a new cut; this cannot, however, always be done, and in very tight ground (like the Macquarie) that will not fall in, the ladder has to be lifted to the surface of the water, or surface of the cut, every time before pulling over the dredge laterally on the cut, to feed the buckets, and the face from the surface (of the water) has to be cut down to the bottom by the buckets themselves; or it has to be worked by a series of light horizontal cuts across the face until the required bottom is reached. The portion standing above water is broken down with a water jet, or jumped down with crow-bars, or a shot is put in to loosen it.

All dredge winches should be so designed that the ladder-line can be manipulated without disengaging the side line clutches. This is a very important point in ground liable to falls, the loss of time in releasing the side-line clutches being a serious consideration in event of a heavy fall of material coming on the ladder. In very rough ground in which the dredge surges about a lot the trailing-lines (*i.e.* paying out lines) should be held perfectly tight with the brakes, and only eased sufficiently to permit the dredge to be pulled across the face, the necessary amount to feed the buckets. It is a most reprehensible practice to allow the dredge to surge about indiscriminately, as some winchmen are in the habit of doing. A dredge should be held as steady as possible to give the buckets, gearing and tables the best chance of performing their respective duties.

Stones up to a ton weight, or more, are lifted by the buckets and grabs of gold dredges. The method of handling the stones is to stop the bucket or grab, as the case may be, on its arrival at the deck-line, and roll off the stone on to the deck or pick it up with a small jib crane provided for the purpose and land it on the deck; it remains there until the side of the paddock is reached and it is then rolled or skidded off on to the side of the paddock, or if the ground is deep it is put at once on a small trolley and run far enough aft on the dredge to prevent it rolling back on to the face again, and dropped over the side into the bottom of the paddock. When a big stone is met with in ground with a soft bottom, the best way of getting rid of it is to dig a hole with the buckets at the side of it and let the stone drop into the hole dug.

Heavy timber is a far more difficult thing to deal with, and it is quite a common occurrence to lose days and days grappling with a big sunken log. Submerged logs have been lifted on the Ovens River, in Victoria, seventy feet long, with a mean diameter of three feet, and when lifted were found to be perfectly sound in every respect. This says a great deal for Australian hardwood, but dredging men would have much preferred, for their part, that Australia had not been so liberally endowed with good timber.

To deal with log handling would occupy more time than is at our disposal. Briefly, the log is loosened along its entire length, if it can be got at by the buckets, one end is freed and lifted up with the assistance of the powerful cranes provided in all dredges equipped for log handling. When the end of the log is raised high enough, a convenient section of it is cut off with a cross-cut saw, or axe, and rolled or dragged by bullock or horse teams out of the way of the dredge, and this proces is repeated along the log until the log is entirely removed. A big log may have to be cut into several lengths before it can be removed.

Before concluding it might not be out of place to mention the name of Mr. Charles McQueen, who undoubtedly is the father of practical and profitable gold dredging. The others before him were in reality only theorists, and their schemes were very crude indeed until Mr. McQueen took up the matter and, at his own expense, went into costly experiments for the benefit of the industry as a whole; with the result that gold dredges are now treating ground in parts of New Zealand at a cost of something under three farthings per cubic yard, and the gold dredge as we see her to-day is to all intents and purposes Mr. McQueen's dredge of twenty years ago. To Mr. Chas. McQueen and a few other enterprising men in New Zealand, and to Mr. C. L. Garland, the pioneer of gold dredging in Australia, the mining industry owes a debt of gratitude, and numbers of abandoned goldfields, both here in Australia, as well as in New Zealand, have been converted into hives of industry by this simple and inexpensive process—dredging.

New Assay Plant of the Canadian Smelting Works.

To replace the assay office which was destroyed by fire in July last, the Canadian Smelting Works has completed at Trail, British Columbia, a new structure, which, in point of modern equipment, equals, if not surpasses, any assay office on the American continent. The purpose of the management is to keep pace with the progress and needs of the rapidly increasing resources of a new country, and to that end the assay office has been constructed and equipped to permit of the running of all classes of work that might be presented, such as coal and coke, iron and nickel ores, gold, silver, copper and lead ores and other mineral deposits, in addition to any experimental work which might be necessary in connection with the smelter and the new electrolytic lead refinery.

In the case of the Canadian Smelting Works, where the ores are so varied, coming as they do from all parts of the Province, containing anything from 200 ounces down in gold, and 5,000 ounces down in silver, from 30 per cent. down in copper and 82 per cent. down in lead, in practically every combination—and such impurities as molybdenite, arsenic, zinc and antimony—the assay office holds even a more important relation to the smelting industry than is generally the case, the great variety of ores making it necessary to analyze nearly every shipment. Such large quantities of zinc and other impurities demand the closest tab on the furnaces, roasters and every part of the works, necessarily increasing the demands on the assay office.

The new structure consists of two large brick buildings; the smaller or furnace building being built into and at right angles with the main structure, yet being entirely separated by brick walls. The main building, which is 70 x 35, contains the office, two balance rooms, an electrolytic and parting room, the chemical laboratory, bucking room, store room and basement. In the basement is the motor. which furnishes power for the mills and crushers.

Two samples of every shipment of ore are sent to the assay office, where they are placed in electrical dryers. On one the moisture is calculated and the other is pulped. The mills and crushers are all on separate foundations to prevent vibration in the building. The sample is divided into four parts, one of which goes to the mine, one is sealed and put aside for use of an umpire, the third is stored for reference and the fourth is assayed. In case of dispute, the umpire sample is sent to some assayer agreed upon by both mine and smelter, and his assay is final. All samples are taken to the pulp room, where there is a cabinet capable of holding 10,000 pulps. All the weighing of pulps for chemical, furnace and electrolytic work is done in this pulp room, which is equipped with glass-top tables, built from the ground, and carrying four chemical balances.

On one side of the pulp room is the chemical laboratory, fitted with every new labor-saving device. The chemical and H_2S draft chambers, for the purpose of carrying off all acid fumes, are brick the full height of the building. The chemical hood has four electric hot plates, each 12 x 18 inches, for chemical work, with separate adjusting apparatus, so that the chemist may have any degree of heat, from 50 degrees centigrade to the melting point of tin, without the slightest inconvenience. The H_2S hood has two similar electrical plates, three sulphuretted hydrogen and one dionide generator. In the laboratory there are two hot water tanks, one of which is connected with a still for distilled water, heated by electric coils and provided with syphons and rubber tubes for washing precipitates. Amongst other useful equipment are the vacuum and pressure pumps and the hot and cold water throughout.

On another side of the pulp room is the entrance to the furnace building, the walls of which are surmounted by large ventilators and skylights. The furnaces, four in number, have 23 x 17½ inch muffles, and are constructed to burn Crow's Nest coal. They have a common 40 ft. stack. The fire room is also open to the roof, and is divided from the furnace room by a brick wall. The floors are concrete, covered with quarter-inch sheet iron.

Two electrolytic plates and a hood for fumes, similar to those in the laboratory, are contained in the electrolytic parting room. The electrical equipment in this department also comprises a set of storage batteries, connected with a dynamo in the basement, which are capable of delivering a continuous current of 20 amperes at 6 volts, the distribution of which is governed by rheostats, capable of cutting the whole down to one-tenth ampere. Larger currents, up to 500 amperes, may be had direct from the dynamo, when required for experimental work.

Not the least interesting, however, is the balance room, which contains three gold balances and one analytical balance. To insure greater accuracy, they are mounted on tables, and are so delicate as to weigh the ten-millionth part of an ounce.

The building, with its arrangement and equipment, was planned by Mr. S. G. Blaylock, assayer for the Canadian Smelting Works.

Notes on the Training of a Colliery Manager.*

By R. A. S. Redmayne.

It is interesting to compare the present status of colliery managers with the position and requirements of those in the early history of the coal trade.

In that quant little volume—perhaps the earliest treatise on colliery management in the English language—"The Compleat Collier; or, the whole Art of Getting and Working Coal Mines, etc, as is now used in the Northern Parts, especially about Sunderland and Newcastle," by J.C., and printed by G. E. Conyers, at the Ring in Little Britain, 1708, the writer says that a "viewer should be well skilled in lining and levelling," as also in the method of "coal working," and should have a knowledge of the "nature of the coal," for, says he, "there is a very great occasion for all these qualities," and adds that "it behoves the viewer and overman to be experienced in guiding the air to good purpose. as also to order well and prudently, for Stythe, which I before spoke of, doth destroy the ignorant and unwary."

The charge of a colliery manager in those days was not an excessive one, seeing that, though he might have a number of mines under his control, in no case would any one of these extend beyond a radius of 200 yards from the shaft. His wage was correspondingly small, being 15s. to 20s. per week, or more "as he has pits to look after." Says the "Compleat Collier," "the viewer well deserves his 15s. or 16s. a week if he has care and parts."

Mr. J. B. Simpson,† writing of the term "viewer" says, "The first mention I can find of the old name is in 1356, in a lease from Bishop Hatfield to Thos. Grey, Knight; one clause of which states that the lessee had to work the mine as far as it could be wrought by five barrowmen, according to the view and oath of the chief forester, and of the viewer (spelt 'veiour')."

Coming down to a much later date, we find, in an "opinion" hitherto unpublished, written by Mr. John Buddle, senior, a viewer of great note in the latter half of the 18th century, the following definition of the duties and salaries of an agent and viewer respectively. Under the date of March 22, 1830, Messrs. Donkin & Stable write to Mr. Buddle to the effect that the owners of a "Seasale colliery, upon the Tyne, of considerable magnitude (the basis of its vend for 1828 being between 22,000 and 25,000 tons)" are about to make a change in the agency of the colliery, and are desirous of having his opinion with regard to the system which he deems most advisable to be pursued in the management of such a colliery, the number of agents he would recommend to be employed, and the duties of each, etc. Mr. Buddle answers that he is of the opinion "that the affairs of the colliery would be best conducted by one principal agent or manager, and one principal viewer, with the aid of subordinate assistants in their respective departments," the agent to have the management of the fittings (sales) and all cash transactions of the concern, purchases, etc. The viewer or manager "to have the sole management and direction of the colliery in all its several departments, embracing the machinery, etc, from

*Abstract of paper read before the South Staffordshire and East Worcestershire Institute of Mining Engineers, on December 5th.

† "Rise and Progress of Coal Mining." An address delivered at Newcastle-on-Tyne before Students of Inst. C.E., 1896.

the hewing of the coals to their delivery into the ships." He adds at a later date—April 5th, 1830—that for an agent "a salary of £250 or £300 a year with house and fire, and a cow kept, would be fair and ample; as to the viewer, if not resident, I think a clear annual salary of £200 a year fair and reasonable, without any perquisites whatever, except his flannels."

Even so late as the year 1854, we find that the largest collieries were comparatively small affairs, the output from the largest amounting only to about some 200 to 300 tons daily, although they were equal to drawing "400 to 500 tons daily at each pit. The number of the workmen at two large pits at this period was 428 and 179 respectively, including boys. It is interesting to compare this with the establishment of a large modern colliery, and the comparison illustrates as much as anything the great extension that has taken place since the middle of the last century.

What are the qualifications demanded of the colliery manager of the present day?

It will be everywhere acknowledged that more scientific knowledge is now requisite to deal with the larger issues at stake at the present time or looming ahead of us. Briefly summarized, the necessity for this increased and increasingly higher education of our mining managers may be stated as being due to the following facts:—

1. The mines are deeper, the more easily worked seams and shallow mineral deposits are rapidly approaching exhaustion, and deeper and more difficult mining, as well as developments in engineering, has led to—

2. The introduction of more elaborate machinery, necessitating a wider knowledge of the principles underlying its construction, application and management—especially noticeable under this category is, of late years, the application of electricity to many mining operations.

3. Foreign competition, which, growing in keenness, necessitates wherever possible the introduction of labor saving appliances, as indeed of anything that tends to cheapen production.

4. Stringent State regulations, imposed in a great measure for the protection of the persons and interests of the miners.

5. The higher educational status of the mine-workers, rendering tact, discrimination, and higher mental attainments, generally necessary in those set in authority over them.

6. The great and increasing development of Colonial mining, opening out as it does, a wide field of profitable employment for highly trained mining engineers.

And under this final category it is significant that in respect to metal mining, the leading positions in South Africa, Western Australia, and other of the Australian Colonies are held not by British or Colonial trained mining men, but in the majority of instances by men trained in America.

In Britain we still produce the best colliery managers, but then our coal mines are more difficult to manage than are those of America, by reason of the greater depths and thinner seams. But even in this department of mining, we would seem to be losing our proud pre-eminence. Up to the year 1899, we held the position of being the largest producers of coal of any country in the world; but in that same year America wrested this position from us. Moreover, we are far behind our trans-atlantic rivals in the matter of cutting coal by machine, as the following figures show:—

In the year 1899 Great Britain produced by coal-cutting machines 3,538,408 tons.

In the year 1900 Great Britain produced by coal-cutting machines 3,312,007 tons.

In the year 1901 Great Britain produced by coal-cutting machines 3,044,340 tons.

Whereas in America:—

In the year 1899, 3,125 machines were in use which mined 43,963,935 short tons.

In the year 1900, 3,907 machines were in use which mined 52,784,523 short tons.

In the year 1901, 4,341 machines were in use which mined 57,843,335 short tons,

and in ten years, from 1891 to 1901, the number of machines has increased from 545 to 4,341.

It may be argued that conditions prevailing in the American coalfields are such as allow of the proportionately larger introduction of coal cutting machinery, but can it be maintained to such a relatively greater extent? It would seem, therefore, that what we might copy from the Americans in matters relating to mining, and indeed in other departments of engineering, is their readiness to adopt wherever possible labour-saving machinery.

It must not be supposed that the writer is for one moment an advocate for the adoption of American methods in their entirety, but he takes the position that we should be willing and anxious to learn what we can from anyone, more especially from our chief competitors.

There is one point in respect to the training of mining engineers in which he believes, we are in advance of the Americans, though they hold otherwise, and that is, in respect to our apprenticeship system. There is no mining apprenticeship in vogue in America, but he would ask at the same time, are we not possibly erring on the side of excess in this matter? For the five years' underground practical experience required by the Coal Mines Regulation Act of 1887, before a mining student can sit for his certificate of competency as a colliery manager, practically precludes the possibility of obtaining the scientific training so necessary at the outset of a mining engineer's career to fit him for the effective management of mines, coal and otherwise, now required.

In a conversation which the writer had with Prof. H. S. Munro, chief of the mining department, at the Columbia University, the latter emphasised three special points for mining students, placing them in the following order:—

1. Thorough ground work in the sciences allied to mining, mathematics, physics, chemistry, and geology.

2. Thorough training in the special department of applied science which the student intends adopting as a career.

3. Competency of the student to commence earning a livelihood at once on his leaving the university.

So much for America. What is of greater importance to us is the question: What is being done in the way of higher education for the mining men of Britain? For, though in pure science we are still pre-eminent, it seems to the writer there is this great difference: The American engineers are submitted to greater thoroughness in technical training than are our men. Better facilities, in this respect, are placed before them, and realizing the paramount importance of such training, they take greater advantage of it than seems to be deemed necessary in this country. Technical education is held in higher regard by the owners of mines and other industrial concerns in America, than is yet the case in Great Britain. Anyone who has read the accounts of what is done and provided in the U.S.A., and contrasts the magnificent educational apparatus of their universities with the scanty system, or want of system in this respect in this country, will no longer be at a loss to understand one reason why the British mining engineer, who seeks employment in our Colonial mining regions, is handicapped in the race for supremacy.

At Birmingham, at any rate, it is hoped that this deficiency will be remedied, and the writer believes that it will be so, with the assistance of the mining m· of the Midlands. Much good work has been

and is being accomplished by the County Council lectures in mining in the Midlands, which will undoubtedly be the means of inducing many of the young men who benefit by this instruction to proceed to the university with the view of further advancement in this department of study.

As it is, courses of study have been arranged, and are already being conducted for practising and consultative mining engineers, colliery managers, and managers of metal mines, teachers of mining, and mine surveyors. The complete course including instructions in the following subjects:—

1. Mathematics (including algebra, trigonometry & geometry).
2. Inorganic chemistry with laboratory practice.
3. Geology and mineralogy.
4. Physics and laboratory practice.
5. Mechanical and electrical engineering.
6. Coal and metal mining.
7. Metallurgy and assaying, in so far as applied to the treatment of ores only, and the analysis of fuel.

Besides the indoor work, there will be frequent visits to the mines of the neighbourhood, and occasional surveying classes are being held out of doors, in which the students practise what they have learned theoretically; and a month or five weeks will be devoted by the students each year in company with the Professor, to the inspection and study of some group of mines in Britain, or it may be abroad, which will constitute the summer mining school.

Mineral Shipments Over the Quebec Central in 1902.

By courtesy of the accountant of the Quebec Central Railway we have been favored with the following returns of the minerals shipped over the Quebec Central Railway in 1902:—Asbestos 25,025 tons (from Coleraine 274,680 lbs., Black Lake 961,020 lbs., Thetford Mines 564,480 lbs.); asbestic 5,445 tons; chromite 900 tons; brick 9,798 tons; lime 9,102 tons; flagstone 1,401 tons; granite 335 tons; cement 20 tons.

Dominion Iron and Steel Company, Limited.

The following official returns of the output of the Dominion Iron and Steel Co. during the year ended 31st December will be of interest:—

	Tons.
Receipts of Ore—	
Iron ore mined by Company in Newfoundland	298,634
Iron ore imported from Spain	27,499
" " United States	24,978
" " Sweden	9,887
" " Cuba	3,102
Pyrites " Newfoundland	279
Limestone quarried by Company	204,040
Products—	
Coke	338,230
Pig iron	191,259
Steel billets and slabs	86,424

Cape Breton Coal Company.

The coal disposals of this company's New Campbellton colliery in 1902 were:—

To Quebec	1,718
Newfoundland	2,134
Nova Scotia	3,719
P. E. Island	504
New Brunswick	126
Other countries	1,554
Colliery consumption and employees	3,083
Total	12,838

Gold Bullion Handled by the New Dominion Assay Office at Vancouver, B.C.

Dr. Haanel in his report to the Minister of the Interior for the year ended 30th June last gives the following returns of the bullion deposited with the Dominion Assay Office at Vancouver, B.C.:—

From	No. of Deposits.	Weights. Oz. dec.	Value. $
Yukon	266	50 578.36	$24,125 89
British Columbia	366	16,469.55	284,401 12
North-West Territories	12	218.04	3,990 71
Ontario	24	2,597.31	39,368.60
Unclassified	3	62.41	1,128 18
Totals	671	69,925.67	1,153,014 50

NEW COMPANIES.

ONTARIO.

Dominion Oil Co., Limited.—Incorporated 11th Dec., 1902. Authorized capital, $850,000; in shares of $1.00 each. Head office: Chatham, Ont.

Saugeen Oil Co., Limited.—Incorporated 11th Dec., 1902. Authorized capital, $10,000; in shares of $10.00 each. Head office: Walkerton, Ont.

Summit Lake Gold Mining Co., of Ontario, Limited.—Incorporated 19th Dec., 1902. Authorized capital, $100,000. A. F. MacLaren, Stratford, Ont., Attorney.

Hutton Mining Co.—Incorporated 13th January, 1903. Authorized capital, $100,000; in shares of $10.00 each. Head office: Sault Ste. Marie, Ont.

Moose Mountain Mining Company.—This company, capitalized at $1,000,000, and the Hutton Mining Company, with the same capital stock, have been organized to develop the iron range north of Sudbury, discovered some time ago by Railroad Commissioner Chase S. Osborn. The incorporaters of both of the companies are Chase S. Osborn and Otto Fowle, of the Soo, Mich., and Messrs. Hearst, McKay and Darling, of the Soo, Ont. The companies control 5 miles of the range along what is known as the Moose Mountains. The iron formation is reported to extend 30 or 40 miles. The principal discoveries of apparent greatest value have been along the west branch of the Vermillion River, prolonging northwest and southwest into the township of Hutton in the District of Nipissing. To the northwest the range runs into an unsurveyed territory of the Algoma District. The ore is a hard magnetite, reported to run from 60 to 67 per cent metallic iron, with much low enough in phosphorus to be of Bessemer grade. The ore is without a trace of titanium. The work done up to the present time has consisted of locating and securing titles to the properties, road building, camp building, diamond drilling, trenching, cross-cutting and test pitting. In this sort of work alone there has been expended over $100,000.

COMPANY NOTES.

Slough Creek.—Cable received from the mine manager, dated Barkerville, B.C., 12th inst.:—"Now working south drift. We are driving 1 ft. per day. Present appearances show considerable signs of improving. Water about the same. Length of No. 1 crosscut to the east is 26 ft.; No. 2 30 ft.; No. 3 20 ft. South drift, 140 ft.—Splendid wash."

Ymir.—Cablegram from the company's representative at Nelson, British Columbia:—"During last month 50 stamps ran 650 hours (27 days) Estimated profit on operating, $7,671 (£1,580). This is after deducting development $2,900 (£600) and repairs $1,550 (£320)."

Mica Boiler Covering Company.—Lien registered January 2, for £15,000 debenture stock. Trustees: Mr. P. A. Makins, 12, Stanford Road, Kensington, and Mr. C. R. Tritton, banker, 1, Pall Mall East, S.W., charged on the undertaking, and all the property and assets, including the uncalled capital.

London and British Columbia Goldfields.—In a circular to the shareholders the directors state that important negotiations for improving the position of the company are now in progress, in connection with which the chairman has recently visited the United States and Montreal. As it would not be in the interests of the company to hold the general meeting until these negotiations have reached a further stage, it has been decided to postpone the holding of the annual general meeting until as early a date as possible.

Whitewater Mines.—The secretary writes that it has been deemed advisable to make up the company's accounts to the end of last year, and to submit them at a general meeting, to be held as soon as possible after that date. Work at the mine continued until September last, when it became necessary to cease all operations owing to the stoping having overtaken the development. Strong efforts are now being made to obtain legislation for the improvement of the local market conditions, which, if successful, will considerably benefit the company's position. The chairman, Mr. H. W. Forster, has resigned on account of his recent Government appointment.

The New Vancouver Coal Mining and Land Co.—will shortly pass out of existence, the property being sold through its agents, Messrs Rosenfeld, of San Francisco. We should not be surprised to hear that the Dunsmuir interests are the real purchasers. The Board was armed with an overwhelming number of proxies at the meeting on Tuesday, which the Chairman

did not scruple to use, but some of the questions of the shareholders—to whom he gave scant courtesy—appeared very pertinent. So anxious are the directors to rid themselves of the property—and receive a solatium of £5,000 for loss of office—that they have agreed to take their agents' promissory notes for £50,000, but the mines are to be handed over without reservation on receipt of £60,000, or a little over half of the purchase price. Some of the more businesslike shareholders suggested that the company should retain some hold on their property until they had been paid in full—a suggestion which the Board refused to consider. The American agents who guarantee the balance of the purchase price are to receive an unnamed sum for guaranteeing this payment, and an additional £2,000 for relieving the company from an investment of £10,000 in the shares of the purchasing company. The superintendent receives £10,000; the secretary, £3,000; his assistant, £1,000, with other bonuses to various officials. The shareholders are promised a return of 20s. per share, with a possible addition of 2s per share. The company, by the way, has accumulated cash assets of £100,000, and its lands and collieries on Vancouver Island are of more value to-day than ever before, so the anxiety which the directors display to get rid of their property is difficult to understand.

Snowshoe Gold and Copper Mines.—The report of the Snowshoe Gold and Copper Mines, from the inception of the company to 30th September last, which was submitted at the meeting on Wednesday last, states that development work has been vigorously prosecuted during the period named, and the mine is rapidly approaching the time when it will be capable of shipping to the local smelters 500 or 600 tons of ore per day. The plant and equipment includes boilers, compressor engines, hoist, pumps, and other machinery necessary to the proper working of the mine. The new main three-compartment shaft has been completed to a depth of over 300 ft. and an electric hoist is being installed. A great deal of underground work has been carried out, and large areas of the surface have been stripped, disclosing very extensive ore bodies. In addition to the old buildings, a number of new ones have been erected, including a new office, boiler and engine house, boarding house, bunk house, and residences for the accomodation of the staff and employees at the mine. During the period covered by the accounts 9,000 tons of ore have been sent to the local smelters. Most of this has been in the nature of experimental shipments from different parts of the mine, in order to prove the value of the large bodies of ore exposed, and the result has been satisfactory. Shipments of from 150 to 200 tons of ore per day are at present being made, which yield a substantial profit, so that earnings are now being put back into the mine. Arrangements have already been made with smelters in the district to take the ore as they can handle it, to the extent of 400 to 500 tons per day. One of the companies is enlarging its smelter capacity, and will then be able to deal with a larger tonnage of this company's ore, as well as with ores from other mines. The profit to be derived from these shipments would be considerably enhanced had the company its own smelter. The main Phœnix branch of the Canadian Pacific Railway crosses the Snowshoe mine, and the railway company has put in additional sidings there in order to provide better facilities for handling our ore. There is good reason to believe that the Great Northern Railway—an American line—will next year cross the company's property, as their engineers have already surveyed a branch to the Snowshoe.

The managing director visited the propetty in 1901, and again in 1902, on each ocassion spending some months there in consultation with the local officials as to the best course to be adopted in carrying on the development of the mine. He has taken every opportunity for discussing with the Government and railway officials and with the owners of neighbuoring properties the numerous questions affecting the company's interests. During this year two of the directors, Mr. Waterlow and Dr. L wis Jones, visited the Snowshoe mine, and spent several weeks there in thoroughly investigating the whole situation on the spot, and were able to form a very favourable opinion of the progress of the mine since the date of their former visit in 1900.

ADVERTISING PAYS.

Montreal, 21st February, 1902.

The Canadian Mining Review,
Ottawa.

We have been advertising in the Canadian Mining Review for some sixteen years, and as extensive manufacturers of mining machinery in Canada we have great pleasure in stating that we consider that the money spent in reaching the public through your columns has paid us an hundred fold. We consider it, without exception, the best medium to reach the mining, engineering and investing public in the Dominion of Canada, not taking into consideration its foreign circulation. Our continued patronage will serve as substantiating the above assertions.

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Yours faithfully,

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PROVINCE of QUEBEC

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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 of 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

THE MINISTER OF LANDS, MINES AND FISHERIES,

PARLIAMENT BUILDINGS, QUEBEC, P. Q.

PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

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 anuually 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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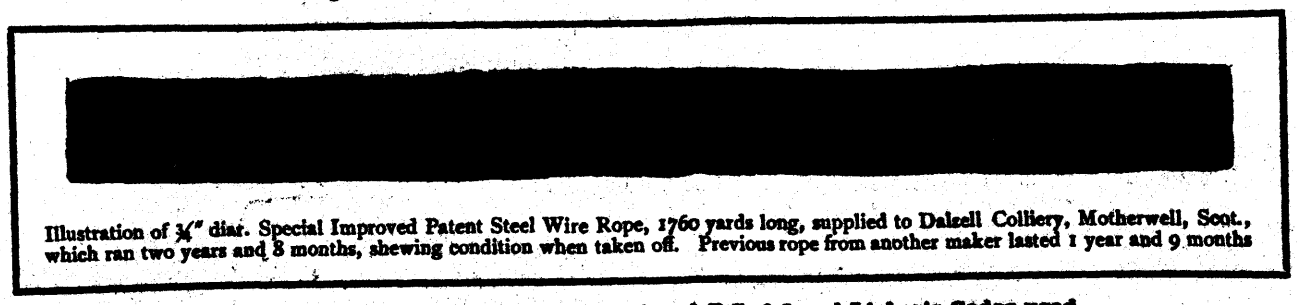

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