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CANADIAN MINING REVIEW

Established 1882

Vol. XXI—No. X. OTTAWA, OCTOBER 31st, 1902. Vol. XXI—No. X.

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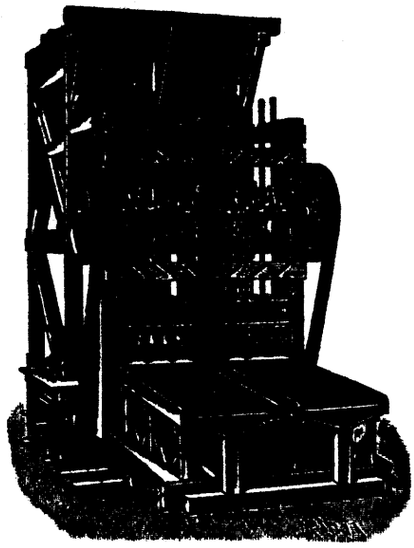

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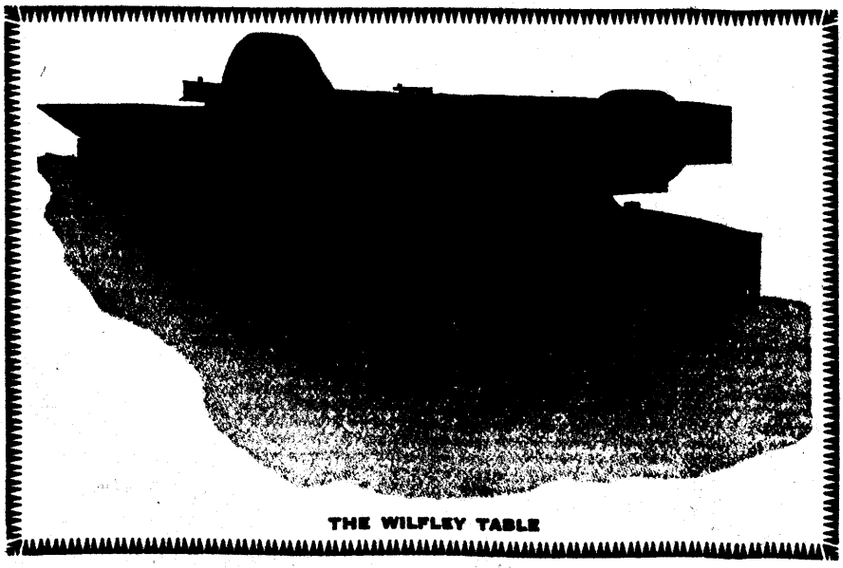

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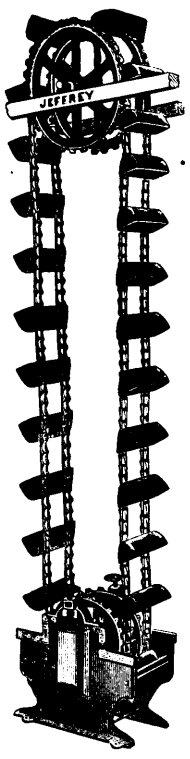

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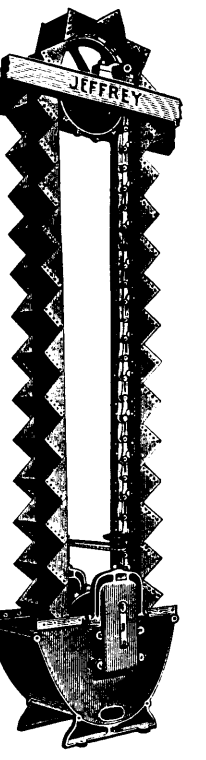

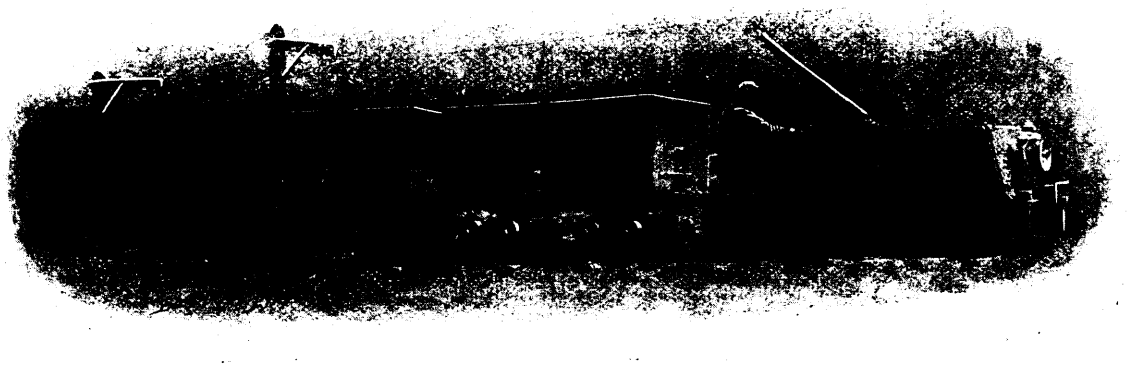

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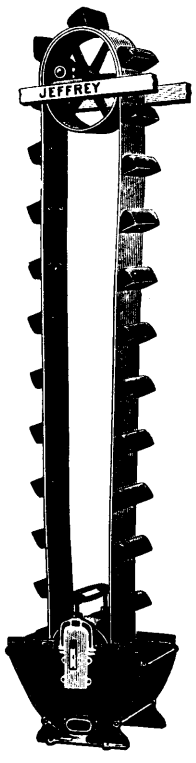

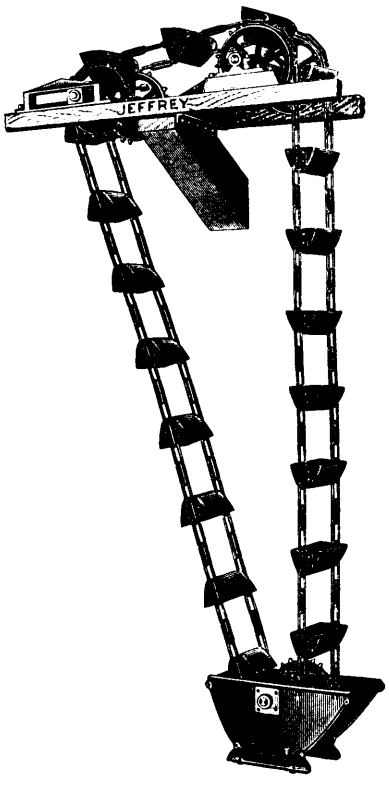

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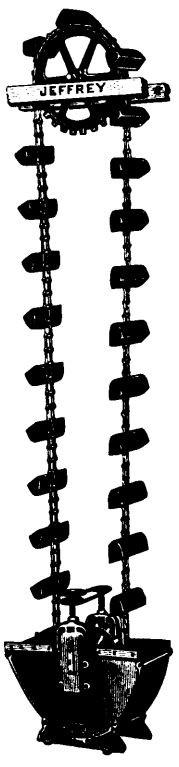

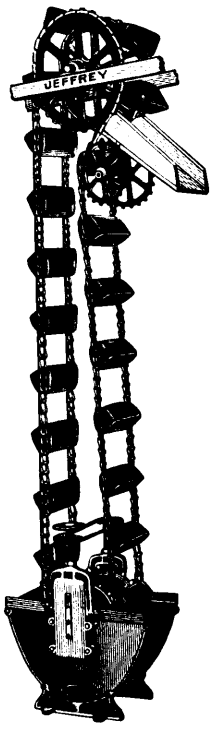

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Published Monthly.

OFFICES { Orme's Building, Ottawa;
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VOL. XXI., No. 10. OCTOBER, 1902. VOL. XXI., No. 10.

The Value of Topographic Maps to Prospectors and Miners.

At the Montreal meetings of the Canadian Mining Institute a feature of the discussion upon the proposed reorganization of the Geological Survey of Canada into a well equipped Department of Mines was the unanimous insistence by the members of greater attention to the production of topographical maps of mining districts. Excellent work has been done by the Geological Survey in this direction, but the long delays in the publication and distribution of the sheets has frequently rendered them valueless to mining men. It is hoped that when Mr. Sifton's plans are completed for the organization of his much needed Department of Mines, special attention will be given to the topographers. New mining districts are constantly being opened opened up in Canada and almost the first requisite of the prospector and miner is a good map. Maps are also urgently required of many of the older districts. Of the value of these maps to the geologist, to the engineering fraternity and to those interested in the general development of a region, Mr. B. H. Chapman contributed an excellent paper to the Butte session of the American Mining Congress. Describing this work of the Geological Survey of the United States, Mr. Chapman said:—

First—The exploration work, which is primitive in the extreme and depends upon rough sketches and notes made while travelling between points distant one from the other, and the compilation of this data.

Second—The standard sheets, which are the product of an actual survey of an area in which the numerical values are completed—the measurements of horizontal distance and the elevations compared.

Third—The "special" maps of areas important to mining men, where development is in progress or to be begun.

The first of these is of more importance to the prospector, often are the only guide that he has in a new region. They are small in scale and usually cover the forest reserves and such regions as Alaska. The second and third are directly of use to the mining man.

The standard sheets are made at a scale usually of one inch to two miles, with contour lines 100, 50 or 25 feet apart, as determined by the ruggedness of the region under survey, which show the relief, the slope and height of the hills and mountains and the grade of streams and configuration of the valleys. Clties, towns, roads, trails and isolated houses outside of towns and the township corners and lines exactly as found are shown. These sheets are the size of a small newspaper page and include an area of about 400 square miles each.

The "special" maps show everything enumerated for the standard maps and in addition the buildings, street railways and alleys in the towns, the section corners, "quarter" corners, all mines and the important prospect holes. The interval between the contour lines ranges between 10 and 50 feet, and the scale between 800 and 2,000 minutes to the inch.

The field work of topographic mapping is of three varieties. First, the primary control, which consists of a few carefully computed points, which are located by triangulation; second, the spirit levelling, upon which depend all the measurements of heights and the contouring, and, third, the drawing, in the field, of the map upon these data, for which the plain table and telescope alidade, in connection with a telemeter rod, is used.

The standard sheets are of such accuracy that with a little experience the mining man can locate his property upon the map with preference to his elevation above sea, its distance from mountain peaks, streams or towns. He can determine approximately the length of a trail or road to his property, together with the necessary grade; the location of a mill or smelter site, the headwork and length of ditch necessary to bring him water, and the feasibility of a railroad connection should the development of the property warrant it.

The special maps may be used to better advantage for all of these purposes, but, as they necessarily cover a smaller area, the relationship of the information to distant points cannot be so well determined. Upon these maps the mining claims may be plotted or measurements made from definitely marked points on the map to croppings, or other geological features, and so the surface position may be determined.

Mining Progress in Ontario.

Mining in Ontario is rapidly developing into one of the most important industries, and, indeed, it may be said with truth that in so far as metalliferous mining is concerned, this Province has jumped into the leading position among the other Provinces of the Dominion. The production of nickel, copper, iron, arsenic, gold and silver for the first three months of the year shows an advance of no less than 52 per cent. over the same period last year. Considerable prospecting is going on and many new mines are being opened up. The greatest of these industries is unquestionably the copper-nickel mining operations in the Sudbury region, mines which for many years now have earned handsome profits to their fortunate owners; and much of the progress reported in Mr. Gibson's last report of the Ontario Bureau of Mines has been due to the extension of the operations of the Canadian Copper Company, the Mond Nickel Company and other operators in that region.

The Report of the Bureau of Mines recently issued is the eleventh since the Bureau was started, and the second since Mr. Gibson succeeded Mr. Blue as Director of the Report. It is a most excellently printed and beautifully illustrated blue book, and has the merit of giving concisely a vast amount of serviceable data concerning the mines and mining industries of the Province. It includes four excellent maps, one of the Michipicoten iron range, one of the Helen iron mine, an outline map of the Eastern Ontario Gold Belt on the scale of four miles to the inch, and also a map of part of the District of Nipissing. The last two are the work of Mr. Willet G. Miller, late of Queen's University, who has been attached permanently to the Bureau as Provincial Geologist. Reviewing the progress of mining in 1901, Mr. Gibson says:

"The year 1901 was productive of substantial progress in many branches of the mineral industry, especially in those concerned with iron, copper and nickel, the three most important products of the metalliferous mines of Ontario. Up to the present time a very large proportion of the mineral output of the Province has consisted of non-metallic substances, including building and structural materials such as stone, brick, lime, etc. The aggregate value of this non metalliferous output is growing from year to year, but much more rapid progress is being made in the production of metals, as will be apparent from the tables of production given below. The present ratio of development if maintained will soon place the value of metallic minerals annually produced in the Province in excess of that of the non-metallic products. The following figures will illustrate this point:

Year.	Total Production of Minerals	Metallic Output.		Non-Metallic Output.	
		Value.	Per cent	Value.	Per cent.
	$	$		$	
1898	7,235,877	1,689,002	23	5,546,875	77
1899	8,416,673	2,055,492	24	6,361,081	76
1900	9,298,624	2,565,286	28	6,733,338	72
1901	11,831,086	5,016,734	42	6,814,352	58

Thus, while the total production in 1901 as compared with that for 1898 showed an increase in value of $4,595,209, or 63 per cent., the metallic products increased by $3,327,732, or 191 per cent., and the proportion of metallic output to the entire value which in 1898 was 23 per cent., rose in 1900 to 28 per cent., and in 1901 to 42 per cent. As compared with 1900 the gain in the production of metals is about 100 per cent.

Of the metalliferous output in 1901, copper contributed 11 per cent., nickel 37 and pig iron 33, a total of 81 per cent. The yield of gold was 5 per cent. of the metallic product, silver 1.6 per cent., iron ore 3.4 per cent., and steel 6 per cent.

Grouping iron ore, pig iron and steel together, and making no deduction for the ore smelted into pig iron, or the pig iron converted into steel, these three products account for about 44 per cent. of the metallic output, or about 19 per cent. of the gross mineral production for the year. In 1896 the first iron ore was raised and the first pig iron made for many years, so that within five years the iron industry—that industry of prime importance—has made good progress.

In the mining of nickel and copper, too, the advance has been marked. The output of both metals in 1901 was the largest yet reached, and owing to the more extended manipulation to which the nickel-copper mattes of the Sudbury district are now subjected previous to exportation, the product had a much larger value than ever before. Some of the mines on the north shore of Lake Huron, where the ore carries copper only as distinguished from the pyrrhotite of eastern Algoma and western Nipissing which contains both copper and nickel, are in a condition promising speedy production on a considerable scale. Indeed, one of them, the Rock Lake mine, where an extensive plant has been installed, has begun the shipment of concentrates to Michigan since the beginning of 1902. There is some prospect of a smelter being erected in the district for treating the product of this and other properties also likely to become producers ere long.

As the business of mining is carried on almost exclusively by means of joint stock companies, the formation of which under the provisions of the laws of Ontario is neither difficult nor expensive, the number of such companies organized in the Province, and of foreign corporations licensed to do business in Ontario, is to some extent an indication of the interest taken by the general public in mining affairs. That this interest has been well sustained in comparison with 1900 is shown by the fact that 47 companies were incorporated under Ontario laws with a nominal capital of $27,716,000, and that 13 companies of foreign origin took out licenses to sell stock and hold real estate in the Province, with a capital of $12,250,000; the total number of companies being 60, and the aggregate nominal capital $39,966,000. In 1900 the number of companies was 57, and the total capital $42,403,999.

But while the formation and introduction of joint stock companies is some evidence of attention being paid to mining by the general public, it is by no means a safe guide to the volume of work actually going on in the mineral industry, or even the amount of capital actually being invested in mines and used in carrying on mining operations. It must be said that the interest manifested by the non-mining public in the mining business is chiefly of a speculative character and has its origin in the hope of quickly making large returns on small investments. Many of the companies formed on the basis of undeveloped mining properties never emerge from the chrysalis state; the formal notice in the *Ontario Gazette* announcing the fact of their coming into existence being the first and last occasion on which their names are mentioned in public. Others advance a stage further and offer their stock for sale, but the rage for mining shares has for the time being passed away, repeated disappointments having brought home the truth that the road to sudden wealth seldom lies through the purchase of stock in a million dollar company the value of whose lands is entirely unknown, even though the stock may be sold at the bargain-day rates of 10 or 15 cents per dollar share.

It is a somewhat remarkable fact that metalliferous mining in this Province is almost wholly carried on by companies whose share capital is in the hands of people living in Great Britain or the United States. In nickel and copper this is true without exception, in gold it is all but true, and so also in iron. There is no objection whatever to English and American capital finding employment in our mining industry; on the contrary, capital is the industry's crying need, and is made heartily welcome from whatever source it comes, neither sentiment nor the laws of the country discriminating between funds of home and funds of foreign origin. But in this, the formative stage of the business, it is matter for regret that the people of Ontario invest so little money in legitimate mining enterprise in their own Province, and are allowing the control of what promises to be one of the most important factors in the country's development to pass into the hands of others."

Preservation of Mine Timber.—A series of experiments were recently carried out at the Altenburg Colliery, near Saarbrucken, with lime, tar and carbolineum, to determine the respective value of these as preservatives of mine timber against rot. Lime was of least value, while coal tar, although ensuring perfect preservation of the surface of the timber, had failed to protect the interior, which in every instance was found to be seriously attacked by rot. Carbolineum, however, gave excellent results, provided the timber coated had been previously barked and well dried.

THE LATE J. RODERICK ROBERTSON, NELSON, B.C.
(From snapshot taken while in his office of the London and B.C. Goldfields.)

MR. R. RANDOLPH BRUCE, M.E., WINDERMERE, B.C.
(From a snapshot taken in his office at the Paradise Mine, East Kootenay, B.C.)

Profits of Gold Dredging in New Zealand.

Mr. C. E. Turner contributes to a recent issue of the *Mining Journal* a short article describing gold dredging on the Matakita River, New Zealand, in which he gives certain figures of costs and profits which are certain to be of interest to Canadians who are now giving greater attention to this promising industry on the Saskatchewan and other rivers in Western Canada. Mr. Turner says:

"That the industry is profitable, if properly conducted, is evident from the following figures:—The nominal capital of a company need not exceed £12,000. This acquires the claim, buys new dredge complete and stores sufficient for six months:

Costs of working:—

	Per week.
Dredge master	£ 6 0 0
Engineer	4 0 0
Two drivers at £3	6 0 0
Three winchmen at £3	9 0 0
One general hand	2 10 0
Labor	£27 10 0
Stores, &c.—	
Firewood or coal per week	£12 0 0
Lighting and lubricants, &c.	1 0 0
Wear and tear	16 0 0
	£29 0 0
Plus labor	27 10 0
Total	£56 10 0

Gold at £4 the ounce=14 ounces 2 dwts. 12 grains.
Say 14 ounces to cover expenses.

Usually the engineer takes either the morning or 4 p.m. shift, so that the machine runs the whole 24 hours.

It will readily be seen that a dredge capable of handling 1200 cubic yards per 24 hours (which is a small amount) of wash that will average only two grains per yard will pay a good dividend, thus 1200 yards at 2 grains=2400 grains=100 pennyweights=5 ounces per day of 24 hours=in one week 30 ounces at £4=£120, less working costs £56 10s., gives £63 10s. profit, which=£3302 per annum. Deducting £302 for secretary and office expenses, there remains the handsome profit of £3000, or 25 per cent. on the nominal capital of the company."

Oil Concentration for Low Grade Ores.

At the moment some attention is being directed in British Columbia to the introduction of the Elmore process of oil concentration whereby it is thought a very large tonnage of low grade ore in the Rossland, Slocan and other camps, now unavailable, may be made marketable. While it is extremely doubtful that this process will achieve for Rossland what the promoters claim for it, experiments with the process in a modified form seem to point to its successful application in some of the other camps. The process is the outcome of experiments at the Glasdir Copper Mines in North Wales extending over a period of some two years. At the outset laboratory tests and tests on a small working scale were tried, and these proving successful a plant was erected capable of treating 100 tons a week, and subsequently this was increased to 250 tons a week. Something over 3,000 tons of various ores have been treated so far and now the owners are branching out and propose to do business on an extensive scale.

Over 52,000 tons of ore treated at the Glasdir mine under the supervision of capable managers and with a modern up-to-date plant—water concentrator—resulted in the average value of recovery of only 14.5 per cent., while under the oil process over 80 per cent. of the metallic values have been obtained after working on a fairly large scale. If the process is commercially successful it means much to the mining camps across the border and will be installed on a number of mining properties during the coming year.

The process is shortly described as follows:—The rock from the mine, after passing through the usual stone-breakers, is crushed on a pair of Cornish rolls and run thence to two Huntingdon mills, where it is reduced to pass through a 30-hole screen and issues therefrom with just sufficient water to make it into a freely flowing pulp. From the Huntington mills the pulp passes directly into the open end of a horizontal rotating drum, inside of which is fixed a helix with crossed blades or buckets, which lift up the pulp to a certain height and drop it again, at the same time propelling it forward to the opposite end of the drum, thus keeping the pulp in constant agitation for the few seconds which are occupied in its progress through a drum. With the pulp is also admitted a small quantity of thick, sticky oil (the residue left in the drills in the refining of paraffine oil).

This oil is, of course, subjected to the same agitation as the pulp and is consequently tumbled about with it and exercises the remarkable property of sticking to and buoying up the particles of mineral that are floating about or suspended in the pulp; but it does not stick to or have any effect whatever upon the particles of rock which are present in much greater number. The oil and pulp automatically discharge from the opposite end of the drum into a pointed box or spitzkasten in which the tailings at once settle down and flow off with the water at the bottom, while the oil, by reason of its buoyancy, floats to the top and carries up with it practically all the values which the ore contained. From the top of the box the oil with its load of mineral flows off continuously to a specially constructed centrifugal machine, where the oil is extracted from the mineral, which is left in the machine, the oil being at once ready for reuse.

Phosphate Output.

While the production of Canadian apatite no longer occupies any prominence in the mineral statistics of the Dominion, the whole output having dwindled to a few thousand tons annually, mainly from the mica mines of certain portions of Ontario and Quebec, figures of the production of phosphate rock across the line are still interesting to many readers of the REVIEW.

The total production of phosphate rock in 1901, as reported by Dr. Joseph Struthers, in "Mineral Resources of the United States, 1901," now in press, United States Geological Survey, was 1,483,723 long tons, valued at $5,316,403, as compared with 1,491,216 long tons, valued at $45,359,248, in 1900, a decrease of 7,493 in tonnage and $442,845 in value.

The industry in Florida, which has been the chief producing State since 1894, continued to show an improvement, the total output and value for the State in 1901 being the largest yet recorded. The production of hard rock and land pebble was greater than in 1900, though the quantity of river pebble was appreciably less than the output of the previous year, and but slightly greater than one-half that in 1889. The increase in the production of hard rock and land pebble more than offset the large decrease in the quantity of river pebble produced, so that the total production of phosphate rock in Florida during 1901 was greater than in 1900, being 751,996 long tons, valued at $3,159,473, as compared with 706,243 long tons, valued at $2,983,231, in 1900. Soft rock has not been produced in Florida since 1893, in which year a small output of 2,800 tons was reported.

In South Carolina there was a slight decrease in the output of long rock, which was nearly offset by the increased output of river rock, the total being 8,000 long tons less than in 1900; the respective

outputs reported are 225,189 long tons of land rock in 1900, as compared with 266,168 long tons of land rock in 1901, and 95,992 long tons of river rock in 1901, as compared with 62,987 long tons in 1900.

The total output of phosphate rock in Tennessee decreased from 434,191 long tons in 1900 to 409,653 long tons in 1901, equivalent to nearly 10 per cent. decrease.

The average price per long ton of Florida hard rock continued practically the same as in 1900, being $5.23; the price of land pebble decreased from $2.77 in 1900 to $2.67 in 1901; and the price of river pebble declined from $2.36 in 1900 to $2.25 in 1901.

The price of South Carolina hard rock in 1901 was $3 18 per long ton, as compared to $3 30 in 1900, and the average price of river rock was $2.56 in 1901, as against $2.61 in 1900.

The Mineral Grants of Nova Scotia.

Owing to the prominence given to gold and coal mining in Nova Scotia it is generally believed that all the minerals are reserved to the Crown. This is far from being the case, and the history of the mineral reservations in the land grants forms a chapter at once useful and important.

Practically speaking the English settlement of Nova Scotia began when Lord Cornwallis founded Halifax. The lands bordering the Bay of Fundy, so long occupied by French settlers, became an early object of attention. The Government, anxious to settle them with British subjects, invited immigrants from Maine, Massachussets, Rhode Island, etc. Coming in companies, township grants were laid out for them. We thus find the townships of Newport, Windsor, Annapolis, Granville, etc. In these, among the earliest grants, we find that sometimes only the royal minerals, gold and silver, were reserved, together with pines for the king's ships; in other grants, copper, lead and coals were reserved. Later grants were issued with the reservations somewhat increased. After 1808 iron was almost invariably reserved.

Much space would be required to give these variations in detail, and now no record remains of their causes.

In the island of Cape Breton, which seems to have been largely governed on the principle that the settlers were best served by leaving them alone, large tracts were occupied by settlers who received no grants. In many cases leases were given of lands subsequently legislated into fee grants.

Finally in 1826 the Crown of England granted to the Duke of York all ungranted minerals in Nova Scotia. So carelessly was this done that for some time doubt remained as to his title to the minerals in Cape Breton.

In the year 1858 this monopoly was terminated. The assigns of the Duke of York, the General Mining Association of London, retaining seven valuable tracts of coal lands, relinquished their rights to the remaining minerals. By an Act passed in the same year the Legislature of Nova Scotia undertook to define the position of the rights so relinquished. In the Act it was stipulated that in all Grants passed between 1826 and 1858, which necessarily did not convey any minerals, the Crown would reserve only gold, silver, lead, copper, tin, iron, coal, and precious stones, and that the grantees should possess all other minerals. Further, it was stipulated in future Grants the reservations would be the same.

This legislation continued in force until 1892 when the reservations were extended to include all minerals except gypsum, limestone and building materials.

As, in addition to coal and gold, the mineral list of the province contains manganese, barytes, gypsum, iron, marbles, dolomites, etc., it will be seen that important sources of revenue have been lightly overlooked.

In many countries where the descent and ownership of land is a matter of interest and importance, the titles under these grants would have given the present proprietors promise of mineral wealth. The early settlers, however, in some cases never occupied their allotments, or after a brief settlement sold or abandoned them. Frequently they were succeeded by squatters or by later grantees.

It thus happens that grants of all ages are mixed together, and are now presented divided and subdivided, so that in too many cases no clear title can be traced either to the land or to the mineral.

These evils excited but a passing notice for many years. Now, however, they meet the prospector at every step. The development of the iron ores of the province, at this moment of great interest in view of the manufacture of steel and iron in Cape Breton. In many grants where the allotments were taken up and remain in possession of the descendants of the original grantees no difficulties are met. This is noticeable in the grants around the Bay of Fundy as in the townships of Londonderry, Truro, Nictaux and Amherstport. In the older settlements, however, in the poorer parts of the province, speaking from a farming point of view, this is seldom the case, and large tracts are met to which a clear title cannot be found.

Judging from opinions given some years ago by the ablest legal authorities, it is questionable if the effect of these grants can be construed to permit any method of escheat. It would be immeasurably to the benefit of the public, as well as to the occupant of the land, if some scheme could be devised by which clear rights of entry and search as well as indefeasible rights of mining could be obtained. This subject is one worthy of the careful consideration of the Government in the interests of all concerned. As it would seem impossible to fix the rights to the minerals clearly to permit in all cases of a good title, it might be necessary for the Legislature to condemn all mineral rights not reserved, and not under form of option or purchase for working.

By this means clear and easily obtainable mining rights would be secured. The occupier of the lands should in such case receive for his rights, such as they may be, a share in any royalty levied by the Government.

Enquiries Respecting Molybdenite.

Messrs. Chas. Hof & Co., 52 Leadenhall Street, London, E.C., write as follows:—

"To-day we would like to enquire whether you can offer us molybdenite, which we understand occurs in large deposits in Canada and British Columbia. Perhaps you are aware of some of these, and if you can make us the offer of regular supply we are prepared to contract for the regular delivery of about 50/60 tons monthly, and at the present time, are ready to pay 10d. per lb. delivered c. i. f. Hamburg, or a proportionate amount for delivery f. o. d. Montreal or other port having steamer connection with Hamburg.

We further beg to say that we make a specialty of rarer minerals, such as Monazite Sand (Thorium), Vanadium, Wolfram, Rutil, etc., and we shall be pleased to receive your offers, which must be accompanied by samples and analyses, if you are in a position to supply."

Mr. S. Dillon-Mills, Toronto, writing upon the same subject, says:

"One great want in connection with our undeveloped mining sections appears to be that of an accurate knowledge of the commercial value of the less common minerals, and even of such as mica, talc, soapstone, marble, graphite, etc. There is a good deal of enquiry for molybdenite, the value of which is stated at various figures ranging from 33c. to $1.25 per lb. for the clean ore; now, with 50 per cent. ferro-

molybdenum quoted at $1.25 per lb., either of these extremes appears absurd If the price was definitely known many small deposits would be worked by the owners, who are now afraid to touch them. Could you not add to the value of your excellent REVIEW by giving prices current or approximate values of these and the rarer ores of which no mention is made in trade journals, *e.g.*, pitchblende, wolframite, etc.?"

Some Reflections Upon the Coal Strike.

Now that the strike is practioally ended, it will be well to study some of its features in relation to Canada. Our country is so intimately associated with the United States in social and economic matters that any great disturbance in the latter is soon reflected into the former. This has been, one may say, strikingly exemplified lately; and the scarcity of fuel in Canada raises the question as to whether our present dependency upon the United States coal operators is a necessity. Is it possible that we may learn to do without Pennsylvania anthracite? Are we even now finding out that we can do without it? Anthracite owes its advantages as a fuel to the facts that it burns without smoke, that it is so hard as to suffer little loss as slack in handling, and that it is compact enough to burn slowly and very regularly. For these reasons it is the favorite fuel of the householder wherever it can be bought at a reasonable price; it is preferred in cities where soft coals, when used, cause the heavy pall of smoke with which Londoners become so familiar in damp weather, when it descends upon and almost suffocates them; and even for generating heat on the large scale it may be more economical than soft coal under certain conditions. But soft coal can be used in such a way as to avoid smoke. It may be converted into coke which can compete with anthracite in most respects. The New England Gas and Coke Company of Boston, formerly a struggling concern, is now reaping large profits from the rapid sale of its coke, and many consumers are finding out for the first time how good a substitute it is for anthracite. In the conversion of bituminous coal into coke, gas, ammonia, and coal tar are obtained as by-products. This well known industry is only in its infancy in the United States and in Canada. The demand for ammonia is sure to grow as intensive farming extends. The time will come sooner or later when both countries will manufacture their own coal tar colors and synthetic medicines. The demand for coal tar will thus increase. The consumption of gas for heating purposes has enormously increased during the strike. Thousands of householders who have become accustomed to this cleanly convenient fuel will stick to it. With all these influences growing in favor of the coking industry is it too much to hope for coke cheap enough to compete with anthracite?

At this point let us take stock of our resources in coal. The only place in the Dominion where anthracite is being mined is from the comparatively small deposit at Anthracite in the West. As anthracite is the rarer form of coal we can hardly hope for any extensive discovery in the future. We are, however, richer in the bituminous varieties of coal. Nova Scotia will be a large producer for an indefinite period. Cape Breton is by no means completely explored; and the recent extensions of the coal areas in the Springhill district by the work of Mr. Hugh Fletcher are significant. In New Brunswick some small deposits of coal are known to exist, and one at Grand Lake on the St. John River is being worked in a small way. But going westward we pass over a hopelessly coalless region until we reach Manitoba. The lignite of the Souris Valley is being extensively used by the railways to which it is easily brought. It is spoken of by railway men as a good locomotive fuel. Other and large deposits of brown coal are known in the Northwest. British Columbia is well provided with bituminous coal. The coal problem is then most difficult in Ontario and Western Quebec, but even here the situation is by no means hopeless. With the completion of our great waterway from the west end of Lake Superior to the Atlantic we may hope to see steamers running between lake points and Atlantic seaports. A demand in Cape Breton for the iron ores of Michipicoten, of Nipissing, and of Eastern Ontario would bring about an exchange for Cape Breton coal and coke which as return freights could penetrate much further inland than they can at present be profitably carried. Another possibility, (one would like to write *probability*), for Ontario is the discovery of coal in the regions about James's Bay, believed by our geologists to be of the right horizon. Should such a discovery be made, the distance of Central Ontario from the nearest Canadian supply of coal would be cut in two.

The strike has also directed increased attention to peat fuel, large quantities of which are made and used as briquettes in Europe. A large number of investigators are working at the problem of converting peat into a hard, compact smokeless fuel, with a maximum of valuable by-products. One ingenious experimenter (Jebsen) has even introduced a retort heated by electricity, so that the temperature can be very exactly controlled. In this way he has succeeded in making a good fuel and in saving by-products much resembling those from coal, but with a larger yield of paraffin wax. Jebsen's process may not be so unpractical as its use of electricity for heating purposes might seem to make it. An easily developed water-power, a handy peat-bog, and a good market for by-products are factors to be considered. Nature has been particularly kind to Ontario and Quebec in regard to peat, although she has neglected their coal interests. In both these provinces, as well as in Nova Scotia, in New Brunswick and in British Columbia, there are extensive peat bogs. They are particularly abundant in Ontario, where the archæan rocks, of varying hardness and resistance to erosion, have been glaciated into numerous comparatively small basins, in many of which having no large outlets water has collected and bogs have formed. The Ontario Bureau of Mines has had in hand for several years an investigation into the extent and character of its peat bogs, and the best methods of making them available. We await with interest the publication of the report. In the meantime, peat is being made into briquettes at Beaverton and sold at $3.25 a ton.

Wherever population is dense enough to make feasible the manufacture and distribution of gas we may hope to see its use extended both for heat and for power, provided it can be made from cheap raw material. In many of our towns and cities immense quantities of waste wood are being burned or in other ways disposed of at an actual expense to the lumberman. Dr. James Douglas of New York has so modified the Allis-Pettibone gas producer as to adapt it to wood; and he expresses the opinion that a further modification will enable us to use it for saw-mill refuse. Gas engines have been so improved that they are now made up to one thousand horse power. This puts cheap power within the reach of manufacturers who are within easy range of a saw-mill.

Another form of power unusually abundant in Ontario and Quebec is that of waterfalls and rapids. It is safe to say that no country upon the face of the earth has been equally favored. Ottawa alone has one million horse power within a radius of forty miles. The transmission of water power by compressed air and by the electric current has been very much improved, and the loss is now quite small. The range of the electrical transmission of power is becoming continually wider. Thus, so far as power is concerned, Ontario and Quebec may become largely independent of the coal operators and of coal strikes, as soon as the manufacturers learn to group their factories around the easily

available water powers. In fact, recent developments at Sault Ste. Marie, Shawinigan Falls and other places show that the lesson has been already learned. We are glad to note, by the way, that the coal strike was dodged at the Cordova mine (the greatest gold mine in Ontario) by the completion just in the nick of time of the compressed air line from Deer Lake Falls.

It is doubtful if the electrical current, even when generated by water power, can ever compete with a cheap fuel for heating purposes. Its use in this way will in all probability remain among the luxuries so long as present conditions prevail. In order to compete with coal the current must be generated at something like seven or eight dollars per electrical horse-power (24 hours). But the solution of a problem which at present seems almost insoluble, would completely change the situation We refer to the direct conversion of the potential energy of coal and charcoal into electricity. As is well known, the best engines convert into power only about twenty per cent. of the heat received, and this does not take into account the loss by way of the chimney. We may consider that the limit of efficiency has been pretty nearly reached. The average loss is very much greater than that mentioned; so that the discovery which awaits some fortunate investigator might reduce the cost of the electric current to about one-sixth of its present cost when generated by a steam engine. Under these circumstances heating by electricity might become economical.

When Does a Miner Start Work?

A case of considerable interest under the Workmen's Compensation Act was recently heard before Judge Gwilym Williams at the Mountain Ash County Court, South Wales, in which John William Matthews, a collier employed by the Penrikyber Colliery Co., sued his employers for nine weeks' compensation, at the rate of 13s. a week, for an accident which had occurred within the colliery yard, but before the applicant had obtained his lamp from the lamp station. Applicant said that on March 6th he was going to his work at the Colliery. He had turned off the main road into the colliery premises. He was going for his lamp along a tramline, in company with another man, and to avoid an escape of steam he turned aside and fell, and broke his arm, and was out of employment until May 8th, and he claimed 13s. a week. The lamp station was a few yards away, and the lamp was then handed him locked and examined. Getting his lamp was his first duty. Mr. Bertram (for the respondent) urged that until the man obtained his lamp his employment had not begun, and he quoted the case of a man being on the railway leading to the colliery. His Honor said that his view was that the deduction from the decisions of the various courts was that the moment the man got on the colliery premises for the legitimate purpose of entering on his duties the company was liable. Judgment was given for the applicant for the amount of claim with costs.

CORRESPONDENCE.

To the Editor of THE REVIEW :—

SIR, The publication in many papers of the text of Mr. E. B. Kirby's paper on "The Influence of Government on Mining," presented at the Nelson meeting of the British Columbia branch of the Canadian Mining Institute, is my warrant for asking you to publish the comments which follow, at the same time I desire to express the hope that the paper will be discussed at a *full* meeting of the Institute before it is permitted to be printed in the Transactions.

Knowing, personally, Mr. Kirby's ability as a mining engineer in Colorado before he was called to British Columbia, and recognizing fully the difficulties, both economical and technical, which he has encountered in the exploitation of the War Eagle and Centre Star properties, the writer has deeply regretted the biassed or uninformed view which Mr. Kirby seems to have taken in dealing with the complex subject of mine taxation.

Mr. Kirby starts his paper with the statement that "Mining is almost everywhere a favored industry," and then proclaims a uniqueness for British Columbia mining because that province not only neglects to further the industry, but imposes "difficulties" which overshadow all the other problems which mining men have to face and meet there, or elsewhere. Further perusal brings out the fact that *all* of these "difficulties" are not originally of *Provincial*, but some are of *Dominion*, origin, and his bald statement that the Government taxation is twenty per cent. of the gross value of the yield is misleading, and is not verified on investigation

In his generalities, Mr Kirby is unguarded, and the writer thinks he assumes what is quite unproved, which is not permissible to a mining engineer of Mr. Kirby's reputation. The "increasing paralysis" of the mines of British Columbia is ascribed solely to two causes, excessive taxation and oppressive legislation. That British Columbia has suffered from constant change of government, and from a general ignorance (on the part of its legislators) on the subject of a reasonable treatment of its mineral resources, can not be denied by any one at all acquainted with the history of government in that province during the last six years. But that the mines are in a condition of increasing paralysis, because of *oppressive taxation* alone, is as untrue as the former statement is true; other factors are patent.

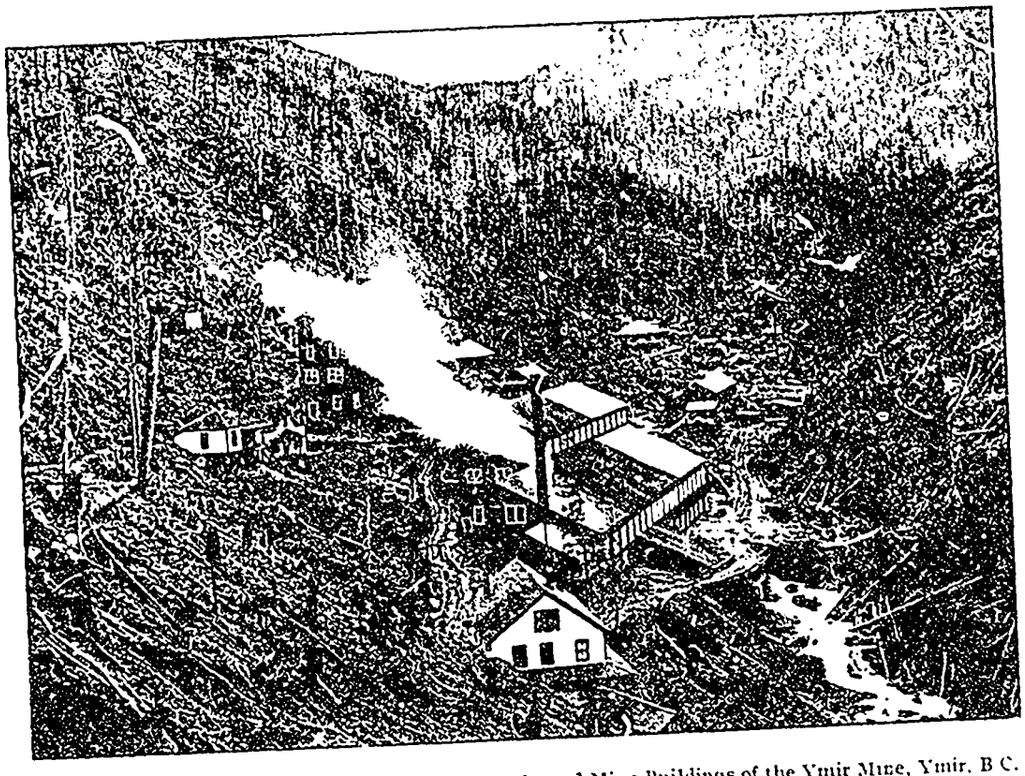
Mr. Kirby gives some figures which need comment. From the year books he finds the total value of all products in British Columbia to be about $27,000,000, of which the metal mine products (figured as Mr. Kirby says "fictitiously" on New York values and not on actual local value) amount to $15,000,000, or 55 per cent. of the whole He then states that the "actual taxes collected amount to $5,350,000," or 20 per cent. of the total value of *all* products, and goes on to say that (by thimble rigging) the actual burden is shifted from some other industries to the mining industry, and that it "*probably*" approaches 30 per cent. of the "fictitious" value of the metallic products.

A little study of official figures and documents which have been published by the British Columbia Government will show Mr. Kirby that the total *taxes* paid to the Government in any one year from mining have never yet reached the sum of $1,000,000, or have never amounted to 7 per cent. of the total "fictitious" values produced; a little learning is a dangerous thing, and special training, if not natural aptitude, is required to make a competent statistician, or critic of statistics. Imposts levied by the Dominion Government, and Provincial taxes, are all lumped together in this paper, as they were in the discussion which followed the paper.

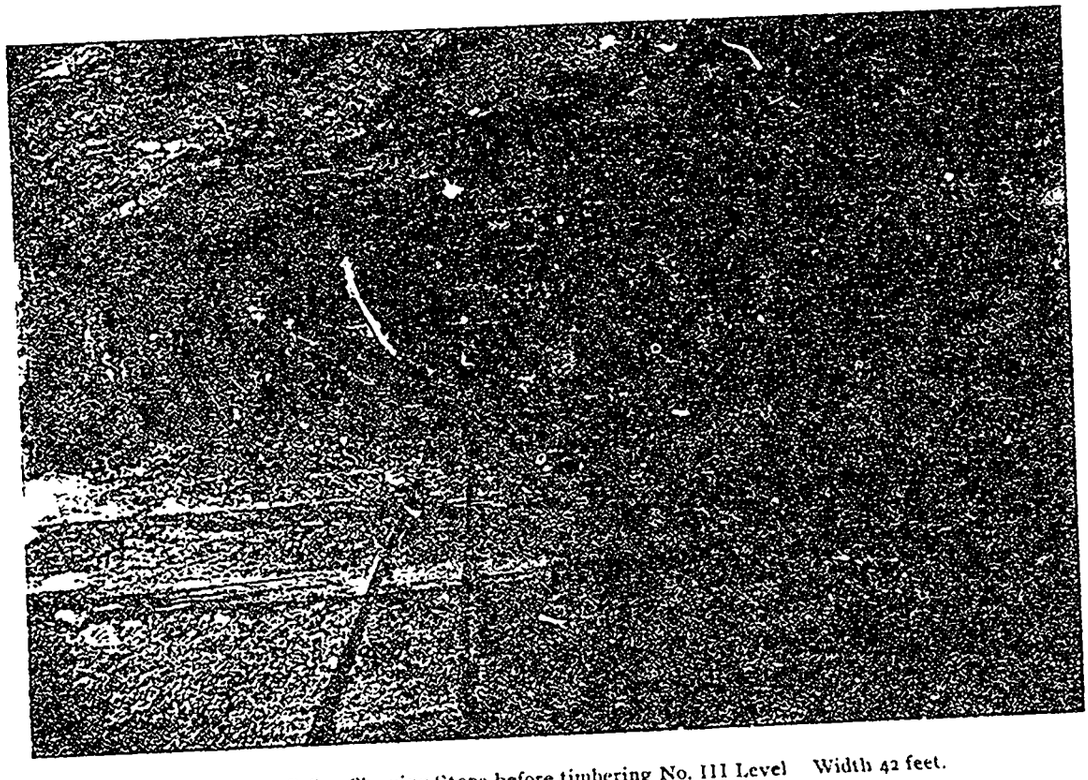
The direct taxes on mining are few; the 2 per cent "mineral" tax on output is the chief one, for "Free Miner's Certificates," licenses, fines, forfeitures, &c., &c., are more of a tax on the individual than on the producing mines, and tariff dues are Dominion and not Provincial.

Taking all indirect taxes as well as direct ones, it may be possible that, of the whole amount of revenue derived from *provincial taxation* by British Columbia the metallic mining industry pays nearly one third, but if this is so (and it would take an expert statistician to correctly obtain the amount) the percentage of the output would only be between 6 and 7 per cent.

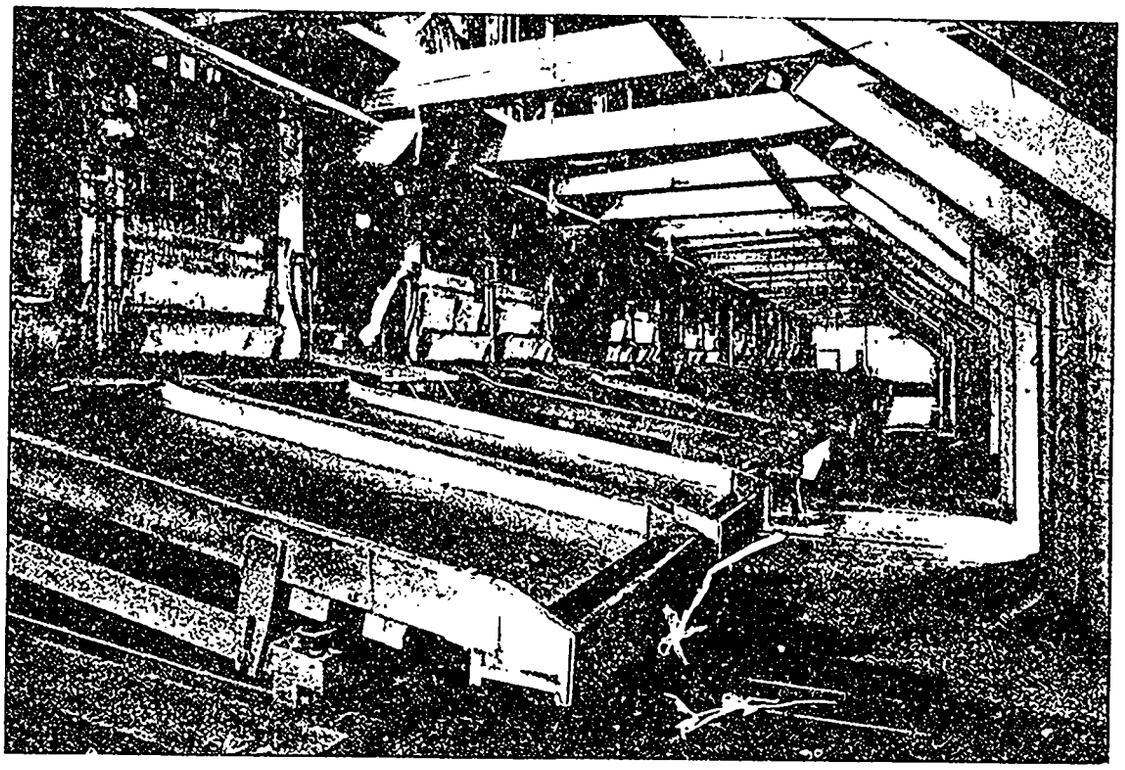
The trouble with this article, Mr. Editor, is two fold. firstly, that Mr. Kirby's justifiable anger against the Provincial Government of British Columbia has led him to make a number of statements which he will undoubtedly be willing to revise, on suggestion, and secondly,



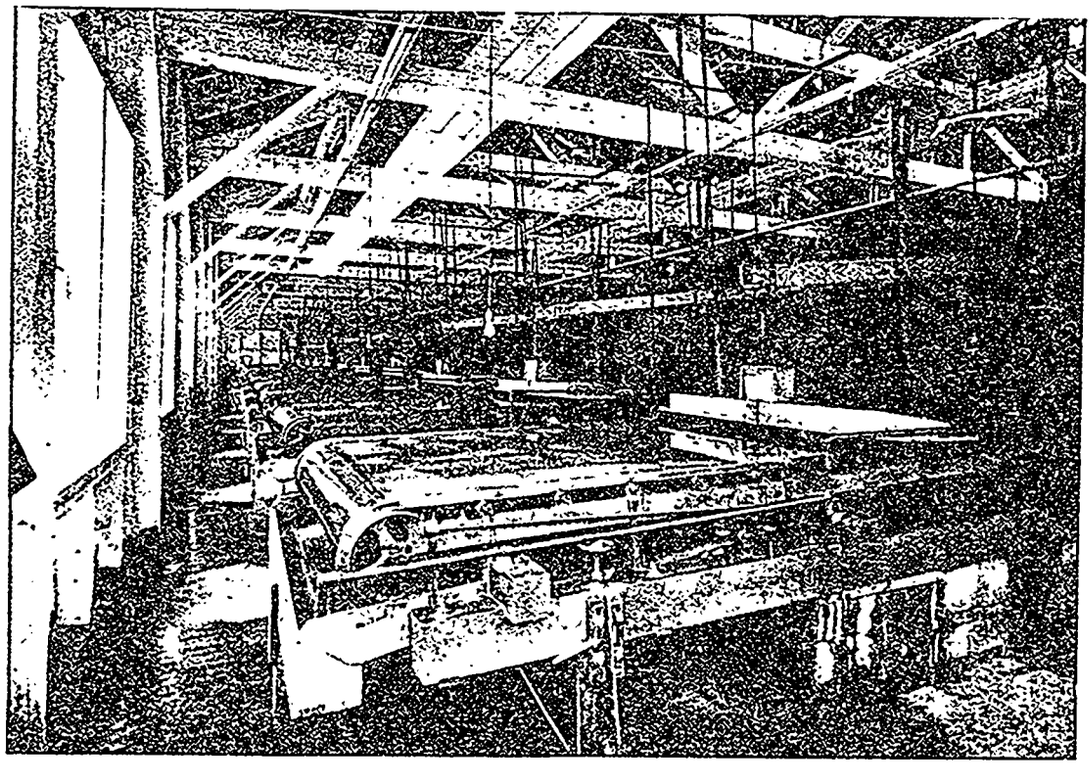
General view of the 80-stamp Battery, Cyanide Works and Mine Buildings of the Ymir Mine, Ymir, B C.



Ymir Mine, B C —Showing Stope before timbering No. III Level Width 42 feet.

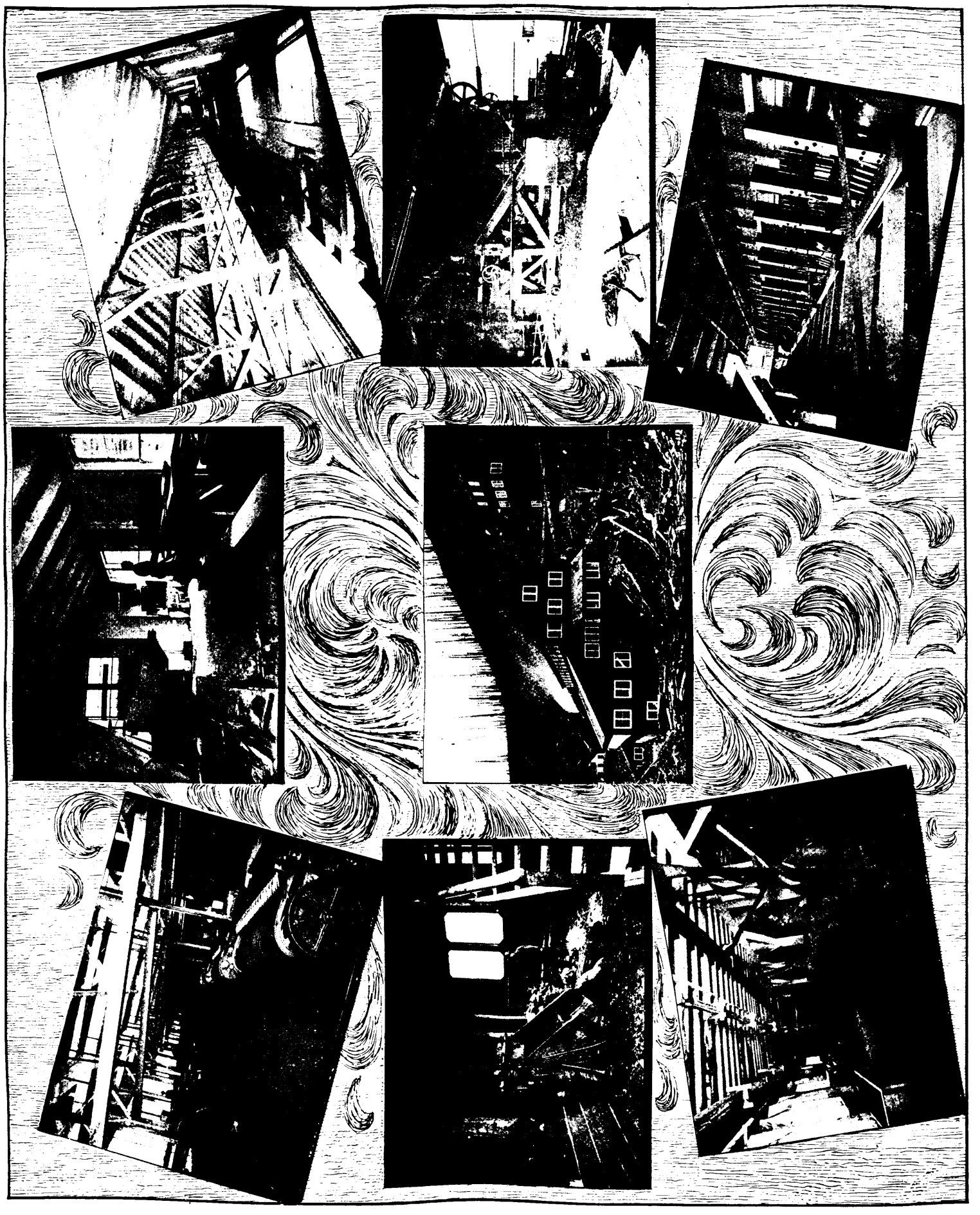


Ymir Mill, shewing Batteries and Plates.

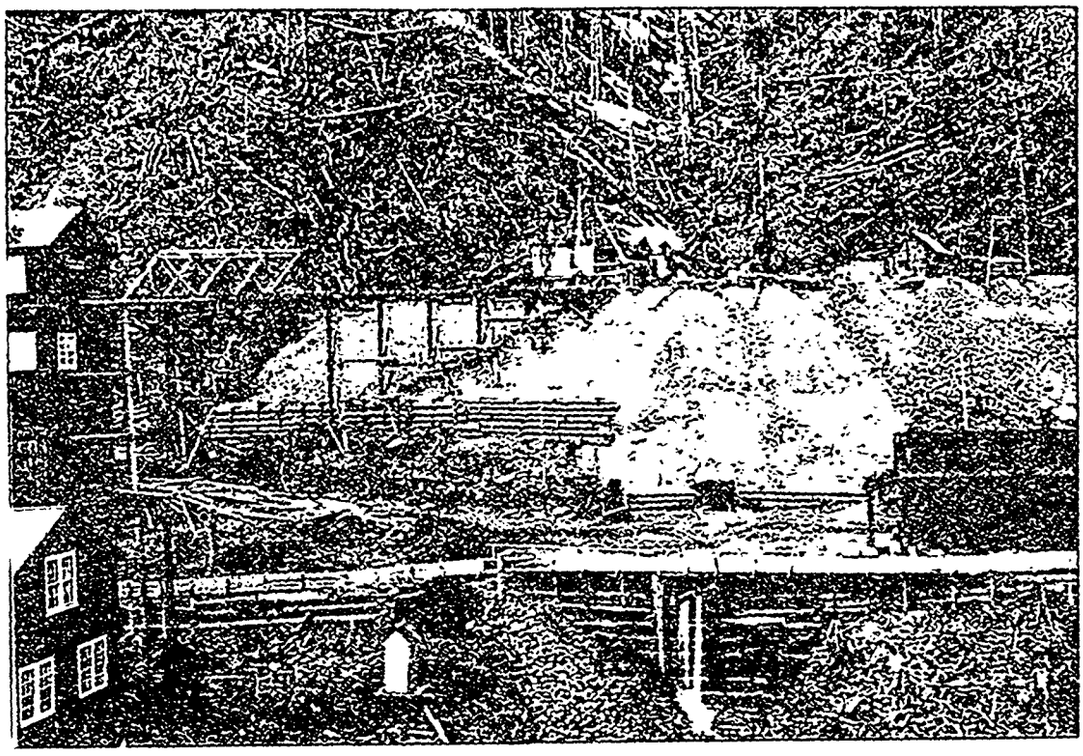


Ymir Mine, B.C —6-ft Frue Vanners.

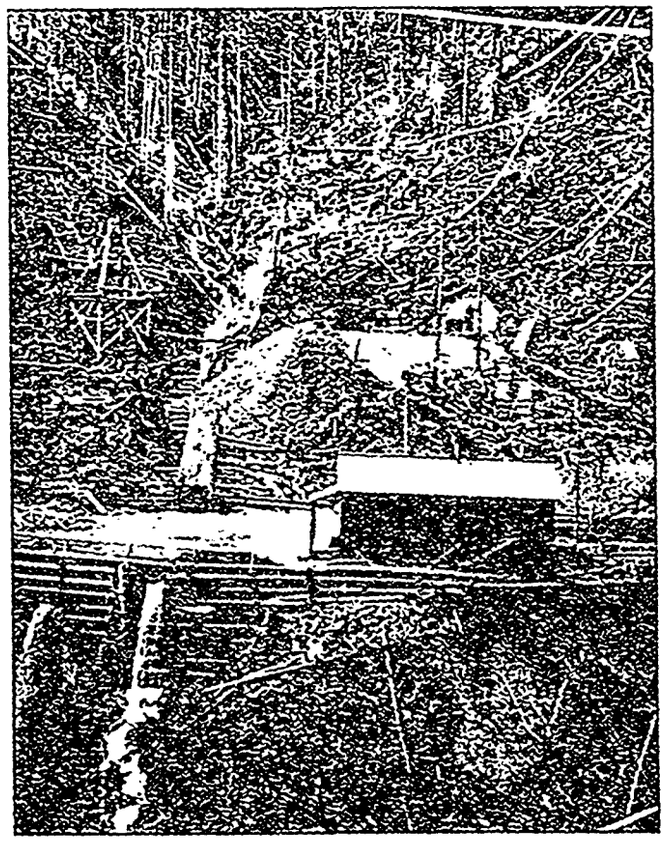
80-STAMP BATTERY AT THE YMIR MINE, B.C.



1—Vanner Room.
2—Gates Crusher at Rock House.
3—Concentrates floor under Vanners, showing method of gathering Concentrates.
4—Retort Floor.
5—Exterior of Mill
6—Bin Floor.
7—Lower Tram terminal at Rock House, 2,200 ft. from mouth of No. III Level to Mine.
8—Cam Floor of Battery.



Ymir Mine—Adit Level, No. 10 Tunnel.



Ymir Mine—Another view of No. 10 Adit. Photo taken at the beginning of operations.

that such an article going forth unamended as the views of the members in the Transactions of the Canadian Mining Institute, will unquestionably deter capital from considering an investment in British Columbia, especially when it has the authority of such a reputation as Mr. Kirby enjoys. It is possible that the production of the detailed figures, which Mr. Kirby supplied to the discussion but which have not yet appeared in print, may afford a means of determining what direct taxation, other than the 2 per cent. mineral tax, is chargeable to the metallic mineral industry; but the Dominion tariff tax, which is common to all Canadian mines, should not be permitted to enter into any statement, or paper, which is supposed to be dealing with *local* or *provincial* burdens.

To remedy an existing evil it is usually better to isolate that evil from any obscuring or attending circumstances, and then attack it unrelentingly; if the ills that British Columbia is at present heir to are of *local* origin, the Dominion should not be brought in. The Canadian Mining Institute is a Dominion association, and the writer is of the opinion that members in other provinces should be given full opportunity for discussing this paper before it is included in the Transactions.

H.

New York, Oct. 20th, 1902.

The Future of the Coal and Coke Supply of British Columbia.

By W. Blakemore, M.E., Fernie, B.C.

The future prosperity of this province depends on an abundant supply of the best quality of fuel at a low price. This controlling factor is determined by two conditions—the general low grade value of our ores, and the fact that the geological formation forbids the existence of coal in proximity to the metalliferous deposits and so involves more or less costly transportation. This governs the conduct of our mining industry absolutely and as I shall be able to show further on is of equal force as applied to other important industries that may be established. The only important consumers of fuel not likely to be handicapped in this respect being the railways, and that because the matter of quality is not so important as in the case of smelting and manufacturing.

Steam Fuel.—As there can be no considerable development without railway transportation it may be well to consider first how our coal deposits will serve existing and prospective railways in British Columbia. The natural surface conditions will probably limit railway construction from east to west to three lines. In the north the Canadian Northern, from the Yellowhead Pass to the Coast. In the centre the Canadian Pacific, from the Kicking Horse Pass to Vancouver, and in the south the Crow's Nest Pass, with some continuation of the same by way of the Similkameen Valley to Vancouver. The difficulties and the cost of building across the mountain ranges of this province are sure to militate against more than these. The natural method of serving the interior will be by means of branch lines running north and south between the mountain ranges. In order that transportation may be as cheap as possible it is necessary that these main lines should pass through or near to large coal deposits of suitable quality for steaming, at any rate this is a present necessity and will remain so until some day, in the possibly not very distant future, when our magnificent water-powers are harnessed to electric locomotion.

The main line of the C.P.R. has hitherto been well served with fuel by the Canmore mines and it is likely that for at least ten years these will continue to furnish all that may be required The unworked area, however, is not large, and already it is time to look further afield. On the eastern slope of the Rockies, eight miles west of Calgary, we have exposures of coal seams running north and south which are probably continuations of the large bituminous coal field lying to the south. Little or no development work has been done at this point but the exposures are consistent with the theory named and I have little doubt that a season's work would shew up a series of seams of good quality. A line can be gotten as to this by examining the coal at Sheep Creek which, though inferior to that at Canmore, is still of fair quality and such as could well be used in the absence of a higher grade. Recent investigations convince me that the coals found in the Blairmore district and as far south as the entrance to North Kootenay Pass continue northwards parallel to the Rockies far beyond the Yellowhead Pass and, if so, although they are on the Alberta side, they are in an ideal position to furnish steam fuel for the main lines at least half way across the province of British Columbia.

As far as the Canadian Northern is concerned, no portion of this system has yet been constructed, but the route has been surveyed from the Yellowhead Pass to the coast and at three points, at least, good steam coal has been located in large quantities. Two hundred miles east of the Pass, upon the Saskatchewan River, a high-class lignitic coal has been discovered yielding on analysis

Fixed carbon	52 per cent.
Volatile combustible matter	35 "
Ash	12 "

This is about the same grade as the Lethbridge coal of which more than 1,000 tons a day is mined in the season for steam and domestic purposes, and which is a far superior coal to that used by the Great Northern south of the International line.

At a point 200 miles west of the Yellowhead Pass outcroppings have been met with by the surveyors and at the moment these are being traced. They, no doubt, represent the northern continuation of the cretaceous measures and, if so, the quality will be that of a high grade bituminous coal, and the only question will be as to the extent.

On the Pacific coast, 400 miles north of Vancouver, there are extensive coal seams near the route of the proposed railway. The measures run north and south, and the average of several samples recently taken by a reliable expert shews

Fixed carbon	54 per cent.
Volatile combustible matter	37 "
Ash	14 "

This coal, although high in ash, compares favorably with the fuel recently used on American lines in the west.

Coming to the Crow's Nest line and prospective continuation to the coast, we have the highest grade of steam coal known on this continent in the Crow's Nest Pass and its extensions, and it is not necessary that I should say anything about it except that its only limitation as a railway fuel is one of distance. It will always control the market for this purpose as far west as the Arrow lakes, but recent discoveries farther west tend to shew that as the Columbia and Kootenay extension is built it will open up new coal fields which, by reason of their shorter haul, will secure this trade.

On the north fork of Kettle River outcroppings of high class bituminous coal have been found and are being traced. My own analysis of a sample taken from a 4-ft. seam gives

Fixed carbon	62.6 per cent.
Volatile combustible matter	29.6 "
Ash	7.8 "

If any considerable quantity of such a fuel as this can be found it will dominate the steam coal trade from the Okanagan lakes east to the Arrow lakes, but it lies nearly 100 miles north of the Boundary district and out of the route of the proposed railway, although it can only be a question of time until a branch is constructed up the Kettle River. Farther west we have two well defined coal fields near

Princeton and Nicola. The former, with Ashnola as its centre, is undoubtedly upon the route of any railway from the Boundary district to the coast, as such a railway must pass up the Similkameen valley at least as far as Princeton, whatever route it may take thence westwards. Here we have a well defined coal basin 8 miles from east to west and 10 or 12 miles from north to south, many seams of lignitic coal outcrop of which a fair average analysis gives

Fixed carbon..... ...	42.0 per cent.
Volatile combustible matter.....	42.7 "
Ash.....	3.0 "

In the absence of a better fuel this would be used by the railway from the Boundary district to the Hope mountains. Only a month ago, however, a 9-ft. seam of good coal was bored through at a depth of 625 feet, which yielded

Fixed carbon.....	54 per cent.
Volatile combustible matter.....	23 "
Ash	8 "

This is full of promise for the future and there are, doubtless, other seams of equal if not superior quality. Thus, the supply of an excellent steam coal for the Columbia and Kootenay is assured.

At Nicola (near which the projected railway will pass if it joins the main line of the C.P.R. at Spence's Bridge) there is an extensive coal field, probably of the same character as the Princeton basin, which would be easily available.

If in connection with these various sources of supply it be borne in mind that we have extensive coal mines in full operation on Vancouver Island, you will see that every part of the province is well furnished with good steam fuel and that the first essential for cheap transportation abounds wherever an important railway is likely to be constructed. I estimate that on the Canadian Northern the maximum haul of steam fuel within the province will not exceed 250 miles; on the main line of the C.P.R., 200; and on the Crow's Nest line, 150. This should give fuel at an actual cost ranging from $2.00 to $3.00 a ton, a figure which would certainly be favorable for the development of the province on the lines of cheap transportation. These figures take no account of other discoveries which will be made in the near future, as there are abundant evidences that there is a continuity in the coal seams of the Rockies, from Mexico to the Yukon; and there are few valleys of British Columbia in which some trace of these does not exist.

Smelting Fuel.—We now have to consider the subject of smelting fuel and probably this will appeal more directly to our members because it "comes home." Without cheap and good smelting fuel the mining industry of British Columbia would come to a standstill. The men who were reviled in 1895 for pronouncing our ores "low grade" have had an ample revenge, and it is now not merely a proven, but an acknowledged fact. Transportation and treatment on Rossland ores have been reduced from $13 to less than $5 a ton, and shipping values from $25 or $30 to $8 or $10. To this result the Crow's Nest coal and coke have contributed not a little, having brought the delivered price of the former down from $12 to $4, and the latter from $17 to $6. During this period we have learnt many things, and some yet remain to be learnt. It must now be admitted that our ores are so low grade that every cent in cost tells and that to develop the industry will require the cheapest fuel that can be obtained. Take for example the great self-fluxing copper district, the Boundary. Is it taking too low an estimate to say that with the exception of a few rich chutes, which may run to $7 or even $8, the vast bodies of ore in that camp will not exceed $4? If this is so and if, as Dr. Ledoux says, fuel represents 65 per cent. of a total smelting cost of $2, then every dollar saved in fuel would mean about 25 cents on the ton of ore treated, a sum which probably represents the difference between profit and loss since it is admitted on all hands, and confirmed by the highest experts, that everything has been done in the way of appliances and economic management to reduce the cost of treatment to the lowest possible figure.

Let us enquire then how the future of smelting in British Columbia is likely to be affected by the fuel question. This practically resolves itself into the enquiry—how can smelting fuel be still further cheapened? There is only one way, by competition. This involves the development of other coal fields and the liberation of some portion of the Goverment coal lands in the Crow's Nest Pass.

First, as to the opening up of other coal fields. At the moment of writing there is, so far as I know, only one place in the interior of British Columbia (outside the Crow's Nest Pass) where coal of a suitable quality for making a first-class smelting coke has been found, viz. on the north fork of the Kettle River. The analysis was given under the heading of "steam fuel." If this deposit should be large enough the quality is all right, and the location being only about 100 miles from the Boundary district, would give it an advantage of at least $1.50 in cost of transportation and would save 40 cents a ton in treating the ore.

The same coal would serve any smelters that might be erected farther west in the event of no coking coal being found in the Similkameen or Nicola valleys, where it is certain there are valuable copper ores and at least three promising camps—Twenty-Mile Creek, Copper Mountain, and Aspen Grove.

For any relief in the cost of fuel in East Kootenay and the eastern camps of West Kootenay, we have to look to the Crow's Nest Pass coal field Leaving for later consideration the Blairmore section of this (because it is in Alberta) we are confined to three sections, viz.: the coal areas owned and operated by the Crow's Nest Pass Coal Co.; those lying to the south beyond the B.C. Southern reserve in the neighborhood of Lodge Pole Creek, Greenhills and Wigwam River; and the 50,000 acres recently selected by the Dominion Government. The former are being developed slowly and having regard to the statement made by the managing director that in addition to the home market the Great Northern company require 10,000 tons a day, it is not likely that this demand will be overcome for many years. In addition, the liability to accidents like the recent deplorable disaster, and to strikes, renders it extremely undesirable that the fuel supply upon which every industry in the Kootenays depends should be in the hands of any one firm, however competent and well-meaning. Then there is the impossibility of getting the lowest possible price from a monopoly. At the moment the charge for coal is $2 and for coke $4 a ton at the ovens As I shall shew, effective competition would reduce these figures to $1.50 and $3 at the ovens, and possibly a little lower. The actual cost of shipping one ton of coal need not exceed $1 and will almost certainly be less after allowing for every item of charge. This would give coke at a cost of $2.25 to $2.50 and leave a margin of 50 cents profit on coal and 75 cents on coke, which is at least double the average rate of profit on coal and coke in the Eastern States or in England over the last twenty years The present British Columbia consumption of Crow's Nest coal is *1000* tons and of coke *300* tons a day, and a reduction such as the above would mean a saving to the industries of the Kootenays (and mainly to the mining industry) of about $1,000 a day or *$300,000* a year. As the country is growing so rapidly this tonnage would be largely increased in the near future. From what areas could fuel be produced at these figures? Possibly from the sections south and east of the B.C. Southern reserve already referred to. That, however, is at present a matter of speculation, because nothing has been done beyond locating the coals and until develop-

ment work has been carried to a much more advanced stage it cannot be stated with certainty whether the measures are sufficiently continuous and regular to yield a large working area. In any case it will take two years to prove this and will involve the building of a branch railway nearly thirty miles up Lodge Pole Creek.

If, however, the Government would liberate say 5,000 acres of their selection adjoining and on the south side of Morrissey, all the conditions exist to bring about the result I have foreshadowed. At this point the coal seams of the basin are exposed and are most accessible. The measures are regular and dip under uniform strata to the east for several miles until they meet the eastern upthrow which terminates the basin. From exploratory workings conducted here last season I got samples yielding the following analysis:—

No. 1—18-ft. Seam.

Fixed carbon	78.7 per cent.
Volatile matter	17.0 "
Ash	4.3 "

No 2—4-ft. Seam.

Fixed carbon	77 3 per cent.
Volatile matter	18.4 "
Ash	2.8 "

These figures shew that the celebrated coals of the Crow's Nest Pass are at their best on Morrissey Creek as a comparison with the following samples taken from two other points in the Pass indicates:

Fernie—6-ft. Seam.

Fixed carbon	69.14 per cent.
Volatile matter	25.45 "
Ash	3.62 "

Michel—14-ft. Seam.

Fixed carbon	62.40 per cent.
Volatile matter	24.10 "
Ash	12.05 "

This is the only point where coal of equal quality to the best Fernie coal has been discovered and explored sufficiently to enable me to speak with certainty of its extent, and in this view I am confirmed by Mr. J. McEvoy, former Government Geologist. In the interests of the Province, and especially of the mining and smelting industry, no effort should be spared to induce the Government to place this area on the market. There is no legal impediment or obligation in the way and I have little doubt that an unanimous request would attain a result so important to the future of the Kootenays in particular.

This brings me to consider another source from which relief may come in any case through the ordinary healthy channels of competition. I refer to the Blairmore coal field. Having done most of the prospecting work that has been done here this year I am able to give you the latest information. Here we have what I believe to be the same series of coal measures as are found in the Pass, only instead of having been uplifted in the form of an elongated basin or trough they are uplifted and fractured in longitudinal lines and exposed in ridges running north and south, or nearly so, parallel with the Rockies. The result is much folding and duplication, but at the same time many more exposures of the same seam, and increased facility of access.

These conditions have been proved in extensive properties owned and controlled by Mr. Leslie Hill, Mr. T. G. Procter, Messrs. McVittie and Leitch, Messrs. Davenport and Paine, and others. The coal seams which correspond in thickness and occurrence with those of Fernie and Morrissey have been traced from the entrance to the north Kootenay Pass where Mr. J. J. Hill has secured 10,000 acres to a point 20 miles north of Blairmore. Messrs. Frank and Geho have developed a successful mine on the east side of Turtle Mountain which has already attained an output of 800 tons a day, the coal being excellent for steam purposes. My own object in taking up certain bonds in this important coal field was to determine its character for coking purposes and to ascertain how it compared with Fernie coal. The result you can best judge from the following analyses taken by me from comparatively shallow workings, the ash is certain to be less at greater depth:

	Fixed Car.	Volatile.	Ash.
No. 1	63.4	29.1	7.4
No. 2	64.5	26.5	9.0
No. 3	67.7	25.5	6 8
No. 4 (20 miles north of Blairmore)	58.9	28.5	11.8
No. 5	60.3	31.3	7.4

Samples Nos. 1, 2 and 3 are all first-class coking coals, Nos. 4 and 5 good steam.

This coal field is so near to the province of B. C. that it will seek its natural market there for coal and coke, especially the latter, and the mode of occurrence of the seams being more favorable for cheap working than in the Pass, there is no reason why the cost of production may not offset the extra transportation, a matter of 30 to 50 miles. At any rate I am convinced that in less than two years from date we shall see coal and coke of satisfactory quality being produced in this district at the figures I have already named to the enormous benefit of the various industries of Southern British Columbia.

Development of Coarse Concentration in the Slocan District, B.C.

By Samuel S. Fowler, S.B., E.M., Nelson B.C.

The silver-lead mining industry of the Slocan has now been alive approximately ten years, a time sufficient for it to have taken on a definite form and to have become of definite importance. This form, although, we think, not yet a perfected one, quite naturally has been attained only by passing through many struggles with nature and with man, and yet these both have done much toward its growth and its perfection. To-day it is just about holding its own in an equal contest; but it needs help to win and to survive.

It is not our purpose to discuss the form or extent of assistance necessary, nor yet to enter into many purely technical details of concentration as now followed: it is rather to consider what has been done toward working the deposits economically and thus doing all that is possible locally to bring about the stability of the industry.

Without considering certain evidences of an earlier knowledge of one or two deposits of ore, the "Slocan" first became known in the late Autumn of 1891. The grade of the ores in silver was found to be so high that, although the price then was considered low (above 90 cents per oz.), the discoveries caused much excitement and the district was the scene of great activity during the year 1892. The activity was well justified, too, for during the year several shipments of ore were made, and these proved that, generally, wherever galena was found, it was of sufficiently good grade in silver to be marketed profitably, containing as it did, say, 150 ounces or more of silver per ton, and 50 per cent. lead.

As is often the case, the region was a wilderness and "transportation" was far away. Kaslo, on the west shore of Kootenay Lake, was the first town to be created because of the discoveries, and it was not long before the energy of its citizens took form in the building of a wagon road up Kaslo Creek, 20 miles to Bear Lake. Many trails also were reaching out to many claims, and shipments were made on a sufficient scale during 1892 to afford a good knowledge of the resources of the region.

But, discouragement was soon to come, as it did in 1893, in the

fall of silver. This, however, was only a shock which served to quicken the senses of the workers in this still new field, and with energy and a realization that expensive mining plant was not an essential, the claim owners kept on with such success in their efforts, that the Canadian Pacific Railway Company had a branch line well under construction during the year for the purpose of entering the field. This was completed in the autumn of 1894 as far as Three Forks, 36.6 miles from Nakusp on the Arrow Lakes. The year 1894 also saw the formation of a company to build a narrow gauge line from Kaslo to Sandon, 28 miles, and this railway was built to the latter point in 1895. Moreover, as Sandon was several miles nearer to the centre of probable production than Three Forks, the Canadian Pacific line was extended from the latter point to Sandon, thus affording competitive transport facilities, the effect of which has been felt favorably ever since.

It is difficult to get accurate statistics of what the output of silver-lead has been up to the end of 1894, and no comparison can therefore well be made with the output of later years; but the effect of the advent of railways can be imagined. Suffice it to say that not only did the volume of shipments increase, but the cost of operation decreased, while development work received a decided impetus.

It should be remarked, here, that what had been accomplished at the time of the completion of the railways, and even in large measure since then, had been without any extraordinary effort, and without the aid of any large amount of outside capital; indeed, many of the shipping properties had paid "from the grass-roots". It was, nevertheless, beginning to be felt that sooner or later an important part of the output must be won by mechanical means, the present importance of which will be shown hereinafter.

The geological and physical features of the Slocan ore deposits are not germane to our subject, but in passing it may be well to give a brief statement of these. For our purposes we would describe the Slocan District as a ruggedly mountainous area lying west and north of Kootenay Lake and its west arm, east of Slocan Lake, and south of a line extended east from the north end of the latter. In the northern part of this area we find about 100 square miles of the "Slocan *slates*,"* from which by far the greater part of the silver-lead output has been derived. The ore bodies usually cut across the slates, are from a few inches to many feet in width, are probably genetically related to a series of porphyry (felsite) and other dykes, and, beside the usually occuring gangue minerals, which are chiefly spathic iron and quartz, in the case of the larger deposits contain many inclusions of the country slate.†

South of the slates we find a large area of coarse *granite*, in which are many veins of value. Those which contain any notable amount of lead and zinc minerals are quite narrow when compared to the deposits found in the slates; but because of the hardness of the granite, the fissures are often much more sharply limited as to their walls, and fewer large inclusions of the country rock are found. The ores are harder and tougher, contain a greater proportion of quartz and spathic iron to valuable mineral, a greater variety of other gangue minerals, and important amounts of the richer silver-bearing minerals, finely disseminated. As in the slates, an important part, and indeed frequently the chief part of the values, is highly concentrated, and is extracted and shipped, with little sorting, as "clean ore".

East of the slates and granite, we find along the west shore of Kootenay Lake, a narrow fringe of very old schists and slates, which, in the vicinity of the town of Ainsworth, carry valuable deposits of good size and apparent permanence. But the ores are of low grade in silver (excepting some which lie near the granite area), and although considerable shipments have been made, they cannot under present conditions yield much, if any, profit.

I have stated above that a large part of the Slocan output has been derived from those portions of the deposits which contained the ore in a concentrated or "clean" state. It will be understood that a vast amount of material has been broken down in this process, which could not be formerly profitably disposed of. This may be somewhat enriched by such small fragments of the clean ore as escaped the miners' vigilence, and was used for filling stopes or placed on dumps, until such times as it could be treated by mechanical means. Such second class ores, together with the parts of the deposits which contained no clean ore, accumulated to an enormous amount, and of late years have formed the basis of operations very important to the district.

The experience of most of the mines has shown that the process of hand-sorting, even of the so-called solid ore, was at best a very expensive one, and very inefficient. The tendency has thus been toward the adoption of means to cut down the cost and improve the quality of the work, whilst at the same time winning such of the values as would otherwise lie dormant. Latterly, therefore, the proportion of hand-sorted ore to total shipments has declined noticeably.

CHARACTER OF PRODUCT.

The material shipped from the region described, is (*a*) silicious oxidized ore from near the surface of the deposits which are in slate. This product was formerly of important quantity, was often high grade in silver, and carried about 20 per cent. to 30 per cent. of lead; but it is no longer of much, if any, importance, the superficial portion of the veins having in most cases been worked out. (*b*) *Galena.*—This forms now the bulk of product, whether as coarse, hand-sorted ore, or as concentrate. The shipments are still high grade in silver, say, 80 to 100 ozs. per ton, and probably average about 40 per cent. lead. It is impossible to give any average analysis of this material as a whole, but besides the lead, about 12 per cent. of zinc may be said to be present, and of the balance the chief constituents are quartz and spathic iron, which, by reason of the imperfections of all processes, cannot well be eliminated efficiently, *i.e.*, without the loss of too much value or at too great expense. (*c*) *Dry Ores.*—Chiefly silicious, silver bearing material, very low in lead. This class is now derived principally from the granite area, and up to the present, is not amenable to efficient concentration. It is therefore shipped direct to smelters, who employ it as a flux, and as a diluent of the heavy lead ores in the furnace "charges." (*d*) *Silver-bearing Zinc.*—This is found of high grade in several properties, and some has been shipped either as hand-sorted or as a middle product from some mills, either by itself to European smelters, who allowed payment for the zinc content, or mixed with the galena concentrate after elimination of gangue minerals. The Slocan is affording a gradually increasing amount of this rich zinc, and a satisfactory solution of the problem of realizing on all the values is at present one of our greatest troubles. Not discouraged, however, several of those in charge of plants appear to be approaching a solution, of which it is yet too early to speak.

PRODUCTION.

It is extremely difficult, if not impossible, at this late day, to get accurate figures of production for the first three years of Slocan output. Those given in the "official reports" are essentially Customs returns, and the metal contents of exports have always been only approximately stated. The figures of output since 1894, however, thanks to the careful work of the Provincial Mineralogists of British Columbia, are dependable.

If we refer to the reports of the Minister of Mines of British Columbia for 1894 and subsequent years, we find the basis of the following table of silver lead production in the "Ainsworth" and Slocan mining divisions, which embrace the area which we call Slocan.

* So named by the Geological Survey of Canada: See Mr. McConnell's Report for the year 1895.

† This latter characteristic might better, in some cases, be expressed as a penetration of the fractured slates by the ores.

Year	Ozs Silver.	Tons Lead (2000 lbs)	1 Unit of Lead (20 lbs) contains.... ozs. Silver.
1892-94*.....	1,050,539	4,783	2.20
1895.....	1,400,070	8,238	1.70
1896.....	2,328,355	10,686	2.18
1897.....	4 165,865	17,126	2.43
1898.....	3,235,795	14,520	2.23
1899	2,159,190	10,125	2.13
1900	2,473,343	11,466	2.16
1901.....	2,601,172	9,407	2.76
Total.....	19,414,329	86,351	Av. 2.25

These figures are of much interest to those immediately concerned, and exhibit the effects of certain causes, but for us the main interest centers in the column of ratios of lead to silver. When we explain that in 1895 the ratio is low because the old Bluebell mine was producing a very large amount of lead of low silver tenure, and that in 1901 there was a heavy output of dry silver ores, with concurrent small lead production, the ratio was high, there is a remarkable uniformity in grade of output. A second point of interest is revealed in the average ratio of two and one quarter ounces of silver to each unit of lead. This implies much richer ore than is produced on a large scale in any other district of the Northwest, and the richness is still more evident when we state that the ratio in East Kootenay is only one-half of one ounce per unit, and in the Coeur D'Alene district of Idaho, it is somewhat less yet. It should be remembered, too, that whatever ore was produced near the town of Ainsworth tended to reduce the average ratio, which is there about one to one, and the comparisons above made are, therefore, all the more remarkable.

The figures given above tend to show not only a very good reason for the rapid advance of the Slocan, but they indicate the important differences between successful concentration in Slocan and in East Kootenay or the Coeur D'Alene, when commercial results are considered. Putting the difference tersely, and assuming that all the silver is contained in lead, a loss of one per cent. of lead in tailings, means in the Slocan four and a half times as much as it does in the other places. The layman will quickly point the moral—"Save your lead"—but just where to stop is the problem for each manager to solve in his own case, and no line or limit can be arbitrarily set, nor can we say that it is not better to save only 70 per cent. in one case than 85 per cent in another. Millmen throughout the Northwest, confronted by conditions of very high wages and expensive supplies, may and do often find it best to sacrifice high efficiencies to the better commercial results attained by rapid operation and large tonnages. In a general way this has been proved desirable in Coeur D'Alene, but in Slocan it is not so much so. Our observations lead us to the statement that in many instances the relations of the commercial and technical factors of concentration have not been sufficiently studied before construction has been started. Indeed, it is within only the last two or three years that there has been any considerable departure from the details of mill design, which have been so long regarded as incapable of improvement. The earlier designs followed the Coeur D'Alene practice very closely, with rapid running and low costs as the chief aim. Latterly the modifications have been in the direction of possibly greater first cost, and increased efficiency, without increasrng the operating cost, especially in the fine end of the mills.

Coming now to an enumeration of the mills which have been built, we believe that even those who are familiar with the Slocan will be surprised at their number. The mills and years of construction are as follows:—

1—Alamo.....	1894
2—Washington	1896
3—Slocan Star.....	.1896
4—Noble Five.....	.1897
5—Whitewater.....	1898
6—Montezuma.....	.1898
7—Comstock.....	.1898
8—Jackson.....	.1899
9—Ruth.....	1899
10—Wakefield.....	.1900
11—Ivanhoe.....	1900
12—Enterprise.....	.1901
13—Payne.....	902
14—Rambler Cariboo.	1902
15—Pilot Bay.....	.1893 (?)
16—No. One.....	(?)
17—Woodbury.....	(?)
18—Highlander.....	.1899
19—Highland.....	1900

Of these the last four are in the vicinity of Ainsworth, and have treated the low grade ores of that camp. The Pilot Bay mill, in 1895, treated the ores of Bluebell mine. The Washington mill was dismantled during 1901, and the plant rebuilt at the Rambler-Cariboo.

The combined capacity of these plants is probably about 2100 tons daily, and their erection has probably involved an outlay of well over $500,000.00. Of the total number only five happen to be in operation at present, while of the remaining thirteen, six were erected, in our opinion, without sufficient justification as to tonnage in sight. The others are not in operation for various reasons which it is hardly necessary to discuss here.

Among so many plants one easily discovers differences of design and operating scheme, and, as might be expected, the technical results obtained probably vary within wide limits. Of the more prominent mills, however, no less than seven were designed and erected under the supervision of one man, who, in outward appearance of his structures at least, has quite naturally followed one general plan, eminently adapted to local conditions; and we may also say that no matter how much we may differ from this designer in detail of scheme, he has been very successful in producing mills which are operated at low costs for labor.

By way of brief description of the process, we would say that the ores are delivered to mill storage bin. From this they pass over only a small Grizzley to Blake crusher, set so that the maximum size of product will be about one and a half inch. With or without an intervening bin, the ore passes through a belt-driven cam feeder to roughing rolls, belt driven, usually not less than 30 in. diameter, nor more than 12 in. faces, running at about 110 revolutions. These rolls discharge to an elevator and thence to trommels, whose screen sizes vary from 21 mm. to 2 mm. Sizes over 2 mm. pass to Hartz jigs, and those under 2 mm. to hydraulic separators, from which, sizes above 1 mm. go to fine Hartz jigs, and those below 1 mm. through spitzkasten to some form of vanner, or other table machine, or formerly to revolving single or double-decked buddles. Middling products from coarse jigs are re-crushed by rolls usually duplicates of the roughing rolls, while middlings from finest jigs and the tables are commonly re-crushed in Huntington mills. The concentrate is conveyed by water through launders to a series of bins where it drains, and is put into jute sacks for shipment to the smelter.

The general course of the ore and products through the mill will thus be seen not to differ in any material way from that of other regions where coarse concentration is practised. When we examine into details and results, however, we are forced to the conclusion that better work can be done, and we therefore venture to offer the following comments on the process as now carried on to any who contemplate the erection of concentration plants in the Slocan.

We have remarked above on the the high ratio of silver to lead in these ores. This ratio is high not only because the galena, when perfectly clean, is usually high grade in silver, but because of the admixture of gray copper and other rich silver-bearing minerals. These, as well as the galena, are not only soft, but very friable, and what with their tendency to breaking very finely in the crushers and rolls, and the results of attrition on the beds of the jigs, a surprising quantity of rich material soon finds its way out of the mill by illegitimate means, and the

* The figures for these three years are for the *entire* British Columbia output, but as this was essentially all from the region we call Slocan, the figures may be regarded, for our purposes, as sufficiently accurate.

vehicle largely responsible is the final overflow of water from concentrate bins and from the spitzkasten, whose settlings feed the vanners or tables. Almost all mills attempt to remedy this evil by means of shallow settling vats placed below the concentrate bins; and in a measure these are useful. Our experience shows, however, that not only is the overflow still valuable, though less in quantity, but that the material saved, on account of the extreme fineness, holds about three times as much water as the normal concentrate, is lower grade in lead and silver and higher in zinc. The same remark as to quality would apply in greater degree to the overflow from spitzkasten. As to the latter, we may say that in order to reduce losses in this direction, we have returned this overflow in one instance, and concurrently reduced the volume of clean wash water on various machines, with some degree of success; but at best the scheme is only a make-shift, and I believe that we are doctoring this difficulty at the wrong end. We should prevent the evil rather than remedy it, by providing a short sorting belt above the coarse crusher. This need not be over, say, six feet long, would cost little and could be handled by the crusher tender, whose functions now are chiefly those of a watchman. The sorting belt is practically unknown to the Slocan mill, and without reverting in more than slight degree to the labor-devouring practice of Europe, I know from experience that in some instances a limited introduction would be a paying one. As indicating the result which may be expected, where the mill feed contains an appreciable quantity of galena in pieces of the size of one's fist, or larger, I may cite an instance at one of the mills of which I am in general charge. In the summer of 1900, our crushermen, under instructions, picked out from the ore stream passing over the grizzley such pieces of coarse galena as they could conveniently, and without any special care. The feed was not sprinkled, and much of the galena which was coarse enough to have been easily sorted on a belt, probably escaped into the crusher. During a period of about four months, 120 tons of galena were thus sorted, equivalent to about 8 per cent. of the total concentrate made in the same period. Comparative average assays of the two products are given; viz:—

	Silver.	Lead.	Zinc.	Ratio.
Sorted Galena.....	101.7 ozs.	40.2	15.4	2.53
Concentrate.....	73.0 "	30.0	21.0	2.43

For this galena we received from the smelter about $670.00, and had it been sent through the mill in the usual way, it is safe to state that fully 10 per cent. would have been lost.

It cost us nothing to save that $670.00. How much more could have been saved by the aid of proper appliances I do not know; but there is no doubt about the accuracy of the data, nor, I think, of what they indicate.

Another notable feature of our mills is the absence of any general attempt at close sizing before jigging. In this respect we follow the common tendency of the Northwest, and more particularly the Coeur D'Alene, unless the practice of that region has changed since I was more familiar with it than I am at present. In many places the low grade of ore demands, or its simplicity permits, good results to be obtained without that close sizing which our German friends formerly thought essential, but about which American authorities have had considerable differences of opinion. There is no doubt in my mind, however, that Slocan mills cannot do efficient separation without close sizing. An extreme instance is often more likely to impress one than a normal case of difficulty. I therefore give the following:—

At the Whitewater mill the feed consists essentially of slate, "talc", zinc blende, copper and iron pyrites, gray copper, quartz, calcite, spathic iron and galena. At our Enterprise mill the slate is replaced by granite, and we find, beside the Whitewater minerals named, important quantities of complex carbonates of iron, lime manganese and magnesia, some undetermined manganese zinc iron compounds, probably silicates and oxides, to say nothing of the rich silver minerals and native silver.

Now were our gangue minerals all simple and of low specific gravity, we would consider our way easy, and have little difficulty in doing respectable work with a simple screening system. The presence of all of the minerals above named is of course troublesome, but these obstacles to success are not insuperable. When we begin a proper study of conditions at Whitewater, we are stunned by the discovery that "galena" is not galena at all, for it is a mixture, I might say a concrete of comminuted slate, galena and zinc, with accluded particles of several of the gangue minerals named, the whole having a gravity of 4.75 to 5.25. This is so typical of the Whitewater mine that shipments of large quantities of well hand-sorted product, before our mill was built, shewed an average content of about 35 per cent. of lead and 16 per cent. of zinc, equivalent to, say, 40 per cent. galena, 24 per cent. zinc blende, and the balance, or 36 per cent. virtually barren gangue. Galena of a gravity of 5.0, and barren pyrites of a gravity of 5.0, mixed with barren blende of a levity of 4.5, form a sort of ore dressing joke whose density is so great that one cannot laugh, with any enjoyment, and hold one's position at the same time. It appears to me that the only satisfactory way of solving such difficulties as are implied above, is through a more extended screen system than we employ. I am not prepared to say that we should go to the extreme limit of some German practice, but I do think that our mills should be designed with what one may call a greater limit of elasticity, one which will permit rapid and convenient alteration or extension of the screening department. The day has gone by when the man who wants a mill should go to a drawer and pull out a stock plan labelled with a specific tonnage capacity. Certain essential features of mill construction must always remain the same, but each new case of installation must have its details considered by themselves. Granting conditions of well sized feed, and a uniform quantity, I think the Slocan jig practice very efficient. The feed above 3 mm. in size usually forms nearly 80 per cent of our tonnage although more nearly 30 per cent of our values reach the fine jigs and tables. Indeed, in one instance the jig tailings were all eventually crushed fine enough to reach a row of seven Wilfley tables, I believe with results which were good. Here, of course, a smaller percentage of product was made on jigs. The usual run of jig tailings seldom contains more than one-third as much silver as the fine end tailings do, and often it happens that the work of the coarsest jigs is practically perfect. This is due in large measure, in some cases at least to the inclusion of coarse slate, quartz and calcite in the ore, all of these being generally barren of silver.

The fine end of our mills certainly affords room for very great improvement. In the mills which were built from 1896 to 1899, the most common machine used on the finer feed were double-decked revolving buddles, and although some are still in evidence, the majority have been replaced by other types. There are several reasons for this change, especially where the very finest pulp was being treated: 1st. the buddle was handicapped by imperfect classification of feed; 2nd. the wooden surface seemed to accumulate some vegetable slime which permitted the metallic minerals to escape too soon, and 3rd. in cases where volume of water was a consideration, it was found very wasteful. The buddle advocate has accused us of ignorance as to how to work that machine. This may be just, but the fact remains that, in one mill, an extended comparison, on feed as nearly indentical as possible, resulted in a saving of 300 lbs. more of a much better product, in 24 hours, with about one-tenth of the volume of wash used, the table used occupying only one half the floor space of the buddle.

The unsatisfactory work of classifiers, of course, operates against any concentrating machine, and we still have troubles to overcome in the fine end, which no number of machines of existing types will bring about. Some one will always get a portion of what the preceding one failed to secure, so we are compelled to set a limit to plant which is governed by questions of dollars and cents. Slocan seems to have

discovered that, on account of the excessive cost of machinery and installation, it does not pay to try to save more in the fine end than can at present be recovered by one passage of pulp finer than half a millimetere over well known machines of proved merit. Attention is, however, being paid to slime treatment, and some very careful experimental work conducted, which is so encouraging as to cause us to say that the close of this year will witness our probable ability to make an efficiency of well over 85 per cent. in silver a paying one.

This brings us naturally to what the present efficiencies are, and the subject is a delicate one. Aside from the fact that there are many millmen who, through false reasoning, would not confess to high losses, I believe there are more who do not know their actual losses, because of the general absence of automatic sampling devices for the tailings, and the too frequent use of the fire assay instead of the wet, in determination of lead. There is too much of a tendency among mill men to assume that, because they cannot see galena, for instance in tailings, the best possible work is being done. This assumption is, I think, a commercially justifiable one in many cases, but it affords no good reason for not knowing instead of guessing at losses. Personally I consider an accurate sampling of tails, and wet lead tests, of the greatest importance, in the Slocan, and especially where much slate is present in the feed.

To illustrate the importance of the wet assay for lead, I may say that a series of important trials of pulps show a loss by fire method of from 70 per cent. to 100 per cent. of the actual lead present, when the wet test shows, say, under 2 per cent. in the sample, and in a recent trial the wet test showed 1.36 per cent. and 1.42 per cent. the fire assay none. The feed from which these tailings were derived contained 4.7 per cent. and 5.2 per cent. lead respectively, and the fire assay therefore perfection in the mill work, while the wet test gave efficiencies of 71 per cent. and 73 per cent. only. These results would be slightly improved, of course, if the tailings losses were worked out per ton of feed, but the figures illustrate our point; viz., not to deceive ourselves through wrong method of determining our efficiency. I do not pretend to know what degree of perfection is attained by others, but our own experience shows an actual recovery of 74 per cent. of silver and 82 per cent. of lead, from a feed of 10 ounces silver and 40 per cent. lead. Those who are not familiar with the shortcomings of existing types of concentrating machinery in use on a large scale, and those who do not care to know how poor a quality of work may be done, will regard these efficiencies as wickedly low. I am confident, however, that thorough investigation would show them to be excellent under the circumstances.

COSTS.

The operating costs in Slocan mills are, as everywhere, very much dependent on the tonnage treated, but the cheapness of our power is an important factor. The ruggedness of the mountains permits convenient installation of small water power plants, working commonly under heads of three or four hundred feet, and while in some instances sufficient, if any, gaugings of flow have not been made before location of plant was decided upon, to determine the dependable volumes, he.. ; snow-fall and even the presence of the glaciers at the head waters, insure sufficient wather throughout the year on lateral creeks, at points very close to many of the mines. It is not necessary to dilate on this phase of the facts; suffice it to say that none of the mills except two on Kootenay lake have any steam power plants. Most of the plants are designed with a view to saving of labor, and are compactly arranged. Their efficiency in this respect may be seen from the table of costs below, being results attained in operating one of the more prominent mills:—

Period, 557 days of 22 hours.
Tons of feed milled, 100,824 (including 7 per cent. moisture).
Tons milled per day, 181.

Costs.	Per Ton.	Per Day.
Crushermen	$.0364	$6.59
Foremen, jigmen and tablemen	.1613	29.19
Miscellaneous labor	.0223	4.04
Operating supplies	.0248	4.49
Maintenance and repairs of all plant; labor and material	.0958	7.34
	$.3406	$61.65

These costs do not provide for depreciation or insurance, the amount of which is of course largely a matter of judgement and conditions. The cost of maintaining the flume was 15/100 of one cent per ton, and thus practically a negligible account. It will be noted that the above figures make no provision for handling and disposal of product. The cost of this in the table would have added $.0557 per ton of ore, but as the figure depends upon the richness of the ore, these costs of sacks and sacking are placed by us under another head, or are stated as so much per ton of product, (in this instance 56 cents). In this plant two hours are allowed every day for the common light repairs, and the practice has proved a good one in preventing many annoying shut-downs. We believe that with the tonnage treated, these costs would be difficult to lower, and they are given as an indication of what has been done on a large scale, without fear of serious adverse criticism.

Copper-Nickel Mining in Ontario

Mr. T. W. Gibson, Director of the Bureau of Mines, has an interesting review of the nickel and copper mining industries of Ontario from which we take pleasure in reproducing the following abstract:—

"Nickel mining occupies the chief place in the list of mineral industries for 1901, the output of nickel exceeding in value that of any other single product, though closely followed by pig iron. The production for the year amounted to 8,882,000 pounds, or 4,441 tons, valued in the matte at $1,859,970, an increase in quantity of 25 per cent., and in value of 145 per cent., as compared with 1900, when the yield was 3,540 tons valued at $756,626. The output in 1901 reached the highest point yet recorded.

It will be observed that the advance in value in comparison with the previous year was much greater in proportion than the advance in production. The reason for this will be made plain by the following explanation. About the middle of the year 1901 the Ontario Smelting Works erected by Col. R. M. Thompson at Copper Cliff for the purpose of re-treating the low-grade mattes made in the furnaces of the Canadian Copper Company, began operations, the effect of the re-treatment being to raise the metallic contents of the matte from say 30 up to about 70 per cent. Additional labor and expense having thus been expended upon the mattes, and the metals contained in them having been brought so much nearer the point of actual refinement and separation, it follows that the contents were worth more per pound in the high-grade than in the low-grade condition. It has been the practice of the Bureau to compute the value of the Sudbury nickel-copper mattes at their selling price at the place of production, and not at the price of the refined metals, consequently the relative as well as the absolute value of the nickel and copper contained in the mattes produced in 1901, was considerably higher than in 1900, when only the low-grade product was made. The average price at which the nickel contents of matte were appraised in 1900 was 10.7 cents per pound, while in 1901 it was 20.9 cents. Only about one-half the product of the Canadian Copper Company's smelters was treated at the Ontario Smelting Works last year, consequently the total increase in value of the nickel is not so great as it would have been had the whole of the product been re-handled.

It is not uncommon for the metals contained in raw or partly treated ores to be valued for statistical purposes at their full selling price in a refined condition. This method is adopted, for instance, by the Geological Survey of Canada, and by the mining departments of one or more of the Provinces, and were it applied to the nickel and copper of the mattes produced in the Sudbury region, the values would have been given as $4,440,000 and $1,450,000, instead of $1,859,970 and $589,080 respectively. The apparent value of the mineral output of the Province would have been increased by upwards of $3,440,000, but the gain would have been in seeming only, not in reality. So long as the product of the mines is exported in an unfinished condition, so long ought it in strictness to be set down for what it really is worth, namely the price at which it would be sold at the place of production. There are advantages, too, in adhering to an established basis of valuation, a departure from which would make it difficult to compare the figures of one year with those of another.

The following table gives the principal features of the nickel-copper industry for the last five years, and clearly shows the substantial growth made during that time:

PROGRESS OF NICKEL-COPPER MINING, 1897-1901.

Schedule.	1897.	1898.	1899.	1900.	1900.
Ore raised.....tons	93.155	123,920	203,118	216,695	326,945
Ore smelted .... "	96,093	121,924	171,230	211,960	270,380
Ordinary matte duced..... "	13,706	21,101	19,109	23,336	29,588
High grade matte produced..... "	328	.....	106	112	15,546
Nickel contents. "	1,999	2,783¾	2,872	3,540	4,441
Copper contents. "	2,750	4,186¾	2,834	3,364	4,197
Value of nickel.. $	359,651	514 220	526,104	756,626	1,859,970
Value of copper. "	200,067	268,080	176,236	319,681	589,080
Wages paid..... "	253,226	315,501	443,879	728,946	1,045,889
Men employed..No.	535	637	839	1,444	2,284

During the ten years beginning with 1892 and ending with 1901, according to the returns made to the Bureau of Mines by the producing companies, there have been raised from the nickel-copper and copper mines of Ontario a total of 1,306,722 tons of ore. Of this quantity 1,245,422 tons have been smelted into matte containing 52,411,000 pounds or 26,606 tons of metallic nickel, and 56,140,500 pounds or 28,070 tons of metallic copper. Computed at the selling prices of the refined metals in the New York market, the nickel was worth $20,500,000, and the copper $7,000,000, a total of $27,500,000, or an average annual output of $2,750,000. The production has been on a growing ratio, and the yield and value during the latter part of the 10-year period were much greater than in the earlier part. For instance, in 1892 there were 72,349 tons of ore raised, and matte containing 2,082 tons nickel and 1,936 tons copper produced; while in 1901 the ore raised amounted to 326,945 tons, and the matte turned out by the furnaces contained 4,441 tons nickel and 4,537 tons copper. In 1892 the mines employed 690 men and paid out $539,821 in wages. In 1901 the number of workmen was 2,284 and the amount paid out in wages $1,045,889. The matte produced in 1892 was valued at $823,037, while in 1901 the product was worth $2,449,050. As stated, the foregoing figures include the copper produced by the non nickeliferous copper mines of the north shores of Lake Huron and elsewhere in the Province, but so far the output from this source has not been large. The prospects are, however, for a considerable increase from the purely copper mines at a not distant date.

The price of nickel remained steady throughout the year, being quoted at about 50 cents per pound in New York. The producing companies in the Sudbury district have been prosecuting their operations vigorously. These comprise the Canadian Copper Company at Copper Cliff, the Mond Nickel Company at Victoria Mines, and the Lake Superior Power Company. Matte is not yet being turned out by the last-named company, but the Gertrude and Elsie mines have been opened up and are yielding considerable ore, part of which is being roasted on the former property, where smelting works are also being erected. Picked ore from the Gertrude containing little or no copper is taken to the company's reduction works at Sault Ste. Marie for treatment. At Victoria Mines the Mond Nickel Company's plant began turning out matte during the year by the Bessemer process. The product is a high grade article carrying about 80 per cent. metallic contents in equal proportions of nickel and copper, the iron in the ore being almost entirely eliminated. The matte is sent to Great Britain, where it is refined near Swansea, Wales, by Dr. Mond's own process.* The smelting establishment at Victoria Mines is well-equipped and modern in its appointments, the offices and other buildings connected with the business are tasteful and substantial. Less than two years ago the site of the village was a swamp, but it now shows a number of comfortable houses with electric lights and other adjuncts of civilization.

The bulk of the nickel and copper is produced by the Canadian Copper Company, whose mines and works have now been operated for a period of about fifteen years. A feature of this company's business in 1901, was the opening of an immense deposit of nickeliferous pyrrhotite and copper pyrites on lot 10 in the first concession of the township of Snider, called the Creighton mine. This remained one of the company's undeveloped properties until the construction of the Manitoulin and North Shore Railway from Sudbury rendered it accessible. The body of ore, which is exposed on the surface in very considerable dimensions, was sunk upon, and so far the work has been carried on as an open cut, shipments to the smelters at Copper Cliff averaging perhaps 500 or 600 tons a day. The ore is said to run higher in both nickel and copper than the average of the district.

A distinct advance in the treatment of the company's ores was made during the year by the commencement of operations at the Ontario Smelting Works, a plant established at Copper Cliff by Col. R. M. Thompson, president of the Orford Copper Company, with the object of re treating the low-grade mattes produced at the Copper Cliff smelters and raising their metallic contents from 30 to about 70 per cent. This is effected by crushing, grinding, calcining and re-smelting the matte, thus getting rid of a great deal of the rock-matter, iron and sulphur, and producing an article so much nearer the point of actual refinement and separation of the metals.

THE NICKEL COMBINATION.

Since the beginning of the present year (1902) there have been many rumors of an impending sale of the Canadian Copper Company's mines to other American capitalists, and a recent publication† contains what appears to be an authentic account of the consummation of the transaction. What appears to have taken place is a consolidation of the Canadian Copper Company and Orford Copper Company, always hitherto closely allied, and the transfer of the properties and stock of these companies and of some other less highly developed Ontario concerns, together with certain nickel interests in New Caledonia and refining works in the United States, to a new company called the International Nickel Company, formed under the laws of the State of New Jersey with $12,000,000 common and $12,000,000 preferred

* Dr. Mond's works have a capacity of about 1,000 tons refined nickel per annum, but provision is made for increasing the output. The copper is recovered as sulphate of copper. Refining operations on a commercial scale began about 1st April, 1902.

† Engineering and Mining Journal, New York, April 5, 1902, p. 474.

stock, and $10,000,000 worth of bonds. Of this amount, $9,000,000 common and $9,000,000 preferred stock is to be issued to acquire the properties taken over. The Anglo American Iron Company, which owns iron lands, mostly undeveloped, in the County of Hastings, and the Vermilion Mining Company, whose nickel property in the Sudbury district was looked upon as valuable in the early days of mining there but on which nothing has been done for many years, are non active Ontario concerns acquired by the new corporation. The companies holding nickel lands in New Caledonia are the Nickel Corporation, Limited, and the Société Minière Calédonienne, neither of which, so far as is known, has yet contributed much to the supply of nickel. The refining works owned by Mr. Joseph Wharton in Camden, N.J., are also taken over.

Actively interested in bringing the transaction to a close are said to have been Mr. Chas. M. Schwab, of the United States Steel Corporation, Col. R. M. Thompson of the Orford Copper Company, and Col. J. R. De La Mar. The officers of the International Nickel Company are: President Ambrose Monnell, formerly assistant to the president of the Carnegie Steel Company; chairman of the board, Col. R. M. Thompson; general counsel, Max Pam, of the United States Steel Corporation; treasurer, Stephen H. P. Bell; secretary, Joseph Claudet. Other directors are E. C. Converse, of the U. S. Steel Corporation, Joseph Wharton, of Philadelphia, Dr. Leslie D. Ward, A. W. Macconochie, J. R. De La Mar, and Millard Hunsiker, of London.

The other great producer of nickel, Société le Nickel, with its extensive properties in New Caledonia and its reduction works in France, which now divides with the Canadian Copper Company the duty of providing the world with this metal, is not included in the combination; but it is stated that a full understanding has been arrived at between the new company and le Nickel, as regards prices, production, and division of markets. Also outside the consolidation are the Mond Nickel Company, whose mines and works at Victoria Mines have been referred to, the Lake Superior Power Company, with mines in Creighton Township, smelters under way at the same place, and reduction works at Sault Ste. Marie. There are also the Nickel Copper Company, whose works at Hamilton to operate the Frasch process of refining have not yet been put into operation; the Dominion Mineral Company, and H. H. Vivian and Company, both of whom own lands and idle smelters in the Sudbury region; the Great Lakes Company, and other companies, firms and individuals.

The combination by no means controls all the nickel ore in the district, and there is plenty of room for independent companies. Locally, it is believed that not more than one-fourth of the known deposits have passed into the possession of the new company.

The formation of the new corporation and the transfer to it of the properties at Sudbury have been accompanied by a partial cessation of work at the mines and smelting plants. This has given rise to apprehension in some quarters that the consolidation will have a prejudicial effect upon the development of the nickel industry in this Province. It is of course too soon to say what the result will prove to be, but the stoppage of work is not likely to be more than temporary, and there is little or no doubt that the new company with the ample capital at its command will operate the mines quite as vigorously as its predecessor in ownership.

A PROMISING COPPER DISTRICT.

West of the nickel region generally spoken of as the Sudbury district which includes parts of the western side of Nipissing district and the eastern side of Algoma, lies a tract of Huronian rocks characterized in many places by deposits of copper sulphides. A typical example is that at Bruce Mines, which upwards of 40 years ago yielded large quantities of ore containing probably more than $3,000,000 worth of copper. Another vein of a similar nature has been opened up and is now being worked at Rock Lake, some twelve miles north of Bruce Mines, where a 200-ton concentrator began work about the beginning of the present year. A railway has been built to the mine from Bruce Mines on the Canadian Pacific Railway, which will be extended to deep water on Lake Huron, so as to afford shipping facilities. At present the concentrates produced at the Rock Lake Mines are being sent to Dollar Bay, Michigan, where they are smelted into copper, but a project is on foot for establishing a smelter either at Rock Lake itself or some other convenient point in the district at which the product from all the mines in the neighborhood could be reduced.

Other bodies of copper ore occur at the McMillan location in Aberdeen township, not far from the Rock Lake mine, at the Stobie mine near Desbarats station on the C P. R., in the townships of Montgomery, Gould, Morin, Haughton, Gladstone, Plummer, Salter, Victoria, in timber berth No. 153 and elsewhere over a district stretching from Massey station on the east to the east shore of Lake Superior on the west, and there is little doubt that if the region were better supplied with railway facilities, further exploration would take place which would bring many more deposits to light. It is well within the range of possibility, even probability, that this portion of Ontario will yet take important rank as a copper field. Other minerals occur, such as gold at the Ophir mine in Galbraith township once regarded as of promise, but not now being worked, and iron, of which there are prospects near Lake Huron and indications along the upper stretches of the Mississaga river and elsewhere. There is a tract of country lying west of the tiers of townships accessible from Sudbury and vicinity, south of the main line and north of the Sault Ste. Marie branch of the Canadian Pacific Railway, whose timber, mineral and agricultural resources are little known. There is reason to believe that extensive white pine forests exist in that region, all the more valuable because tributary to the north shore of Lake Huron. Most of the rivers, too, are marked by good water powers.

Of purely copper ores, mainly derived from the north shore district just spoken of, some 6,800 tons were raised during 1901, having an estimated value of $47,180. The number of workmen employed in the mines and to operate the plants was 432, to whom wages amounting to $142,964 were paid. These statistics are included in those for nickel and copper. Practically none of these mines were in the producing stage during the year, which fact partly explains the size of the wage bill as compared with the value of the output. The Bruce Copper Mines were in operation about four months in 1901, but are now idle. The concentrating plant ran a short time and produced over a hundred tons of concentrates, which were shipped to New York."

The Essentials for Successful Hydraulic Mining.

In his very excellent review of "The Gold Mines of the World," of which another very handsome edition has been issued, and of which we hope to have something more to say later on, Mr. J. H. Curle in discussing the question of hydraulic mining says:—

"Hydraulic mining is a distinct art. To my mind the laying out of an hydraulic mine is a greater test of capacity than the opening of a quartz mine.

In hydraulic mining there are three main essentials: *gold; water power* to force the gravel into the sluices; and *grade* to carry away the tailings. To determine the presence of these on any property, or the being able to bring together these three, often means a series of experiments stretching over several years. An hydraulic property cannot, therefore, be hurried to the producing stage.

But there are *so many other questions*, too. Gold, water, and grade may be there in abundance—all the essentials—but if the questions of ownership of adjoining property, litigation and finance are looked at, the whole fabric may fall to pieces, and the labor of years be of no use.

The owner of an hydraulic property must not only have title to his own ground, but he must be certain that his mining operations will not interfere

with the properties of any one else, either above or below him. This is a rock over which, I suppose, hundreds of otherwise payable mines have come to grief. In California, some years ago, a whole hydraulic industry had to close down because the properties of farmers, many miles away, were being flooded with *debris*; and even in Atlin, at the present moment, there are several bitter law cases because the silting up of tailings from one mine blocks the passage of tailings from another mine.

In bringing in water, too, one property may gain at the expense of another. Then comes litigation—the water is cut off, and the mine—on which perhaps a small fortune has been spent—has to be shut down.

Again, if a mine is to be laid out to the best advantage, there are the years of experiment to be faced. The depth of gravel and nature of the bed-rock have to be tested by innumerable holes, and temporary sluices have to be fitted up for trial runs; surveys have to be made for the bringing in of a head of water, and the volume of water tested the whole year round; the grade for the sluice boxes and the tailings race has to be laid out, or perhaps tunnelled, and the ultimate disposal of the tailings made sure. The Mining Commissioner and the lawyer have to be consulted at every fresh step. All this takes time, and a good deal of money. Directors, who rarely understand technical details, become impatient, and if the shares are weak on the market, the manager will probably have trouble in getting enough money to carry out his original and carefully thought-out programme."

NEW COMPANIES.

BRITISH COLUMBIA.

Vancouver Petroleum Syndicate, Ltd.—Incorporated 22nd Sept., 1902. Authorized capital, $25,000, in shares of $5.00 each.

ONTARIO.

The Hatch Electric Smelting and Refining Co. of Ontario, Ltd.—Incorporated 17th September, 1902. Authorized capital, $500,000, divided into $500,000 shares of $1.00 each. Head office: Parry Sound, Ont.

Gold Reef Mining Co., Ltd.—Incorporated 17th September, 1902. Authorized capital, $700,000.

International Portland Cement Co., Ltd.—Incorporated 24th Sept, 1902. Authorized capital, $1,000,000, in shares of $100 00 each. Head office: Toronto, Ont.

Union Oil Company of Canada, Ltd.—Incorporated 24th Sept., 1902. Authorized capital, $600,000, in shares of $1.00 Head office: Petrolea, Ont.

COMPANY NOTES.

Emma.—The daily output of ore from this mine, at Summit, is 160 tons. This ore is quarried from open workings and goes to the Hall Mining and Smelting Company's works at Nelson.

Granby Consolidated.—The new machinery house for the electrically driven compressor plant is about completed. The building is 60 by 120 ft. There will be two tandem duplex compound air compressors driven by two 750 h.p. induction electric motors, giving a 60-drill capacity. The machinery has been shipped from the factory at Sherbrooke, Que., including the necessary rope drives, seven air receivers, new drills and a 10-ton travelling crane.

A gravity tram from the upper part of the ore quarries to the ore bins and crusher house and a tray to the shipping bins have been in course of erection, and are about ready for the big Farrel crusher, having jaws with an opening 36 by 42 inches, which will be driven by a 100-h.p. electric motor. This crusher is the largest of its kind yet made in Canada.

The open workings at the mines now extend north and south about 1,300 ft., and have a width varying from about 50 ft. to about 100 ft. Besides this an area approximately 800 ft. long by 200 ft. wide has been stripped. Work in the main quarries has been carried on as usual. Large openings have been made from the Knob Hill main tunnel up to the quarries, giving in all twelve chutes.

Common Errors in the Determination of Silica.—In a comprehensive and interesting paper giving a large number of experiments, the author investigates the causes of the common occurrence of error in the determination of silica in silicate analyses, even after repeated evaporations, and draws the conclusion that intermediate filtrations are necessary to ensure the complete removal of the silica. He also recommends the use of the blast to obtain the correct weight of SiO_2.—W. F. Hildebrand, *Journal American Chem. Soc.*, April, 1902.

MISCELLANEOUS.

A Novel Air Compressor.—An interesting air compressor, containing no piston nor any moving part save valves, has recently been described in the *Revue Universelle des Mines et de la Metallurgie*. It is due to Mr. Emile Gobbe, and has been tried with some success at the Monceau Company's blast furnace. The arrangement consists of an explosion chamber, the outlet of which leads to a chimney. A throttle valve which tends to remain open by its own weight is introduced between the chimney and the explosion chamber. Two conduits, one for gas and the other for air, lead to this chamber. At some distance from the points at which they enter the combustion chamber each conduit is provided with an inlet and an outlet valve, the latter communicating respectively with the receivers for compressed air and compressed gas. A draught having in any suitable way been started up the chimney of the plant, charges of air and gas are drawn in and mix in the combustion chamber. The mixture is then fired by an electric spark. The explosion closes the valve to the chimney, and forces a portion of the air and gas back along their respective conduit pipes and through the discharge valves into their receivers. When the pressure falls sufficiently, the valve at the base of the chimney opens automatically again, and a fresh charge is drawn in and the action repeated as before. In the experimental plant erected at Monceau, the explosions followed each other at the rate of twelve to fourteed per minute; but the plant proved to be in need of considerable modifications if satisfactory working was to be obtained. In a laboratory apparatus since constructed and designed to work with town in place of blast-furnace gas, good results have been obtained in the matter of regularity of working, and the inventor claims that with a large plant carefully designed very considerable economy could be relied on, and the capital cost would be extremely small.

Cyanide Practice in the Telluride District, Colorado.—At the Liberty Bell Cyanide Works the method of treatment consists in draining the upper vats under suction, and adding lime at the rate of 4 lbs. per ton of sands. Weak solution (3 lbs. cyanide per ton) is then pumped on to displace the water retained in the sands. This is washed to waste until cyanide is detected and run through the waste solution 2-inch box. At a strength of 1 pound per ton it is diverted into the weak solution box. After several days treatment, the upper vat is drained and lowered to the vats underneath and the sands are washed with strong solution containing 6 pounds of cyanide per ton The treatment here lasts four days and the strong solution is displaced by weak washes and water until the strength falls to .7 lbs. per ton when the vat is ready to sluice out. The strong solutions have a total alkalinity equal to about 5 lbs. lime per ton of which about half is due to cyanide and half to dissolved lime so that the solutions are considered to be virtually a saturated solution of caustic lime. The cost of cyaniding 4,000 tons per month is between 60 and 70 cents per ton and the consumption of cyanide varies between .75 and 1.25 pounds per ton of ore treated. The zinc consumption is .03 or .04 pound per ton. The extraction averages about 67 per cent., the residues containing about 85 cents per ton.—*Mines and Minerals*, Denver, Colorado, April, 1902.

Accidents with Explosives.—Among the accidents reported by H M. Inspectors of Explosives for the year 1901, the following is said with regard to "hang fires," and returning too soon to shot-holes. Under this heading are included those cases where miners have returned to the shot-hole believing that the shot has missed fire or not been ignited or that it has fired. In nearly all such cases a hang-fire has probably occurred. Of these accidents only one was remarkable, in that it occurred with a cartridge of amvis fired electrically. In this case the detonator fired, and ten or fifteen minutes later, when the men had returned, the cartridge itself exploded. This is not an unprecedented occurrence, and information from Germany shows that *similar phenomena have been observed there with ammonium nitrate explosives*. The cause is obscure, and experiments have failed to reproduce the effect.

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. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

PROVINCE of QUEBEC

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

GREAT MINERAL TERRITORY

Open for investment in the Province of Quebec.

Gold, Silver, Copper, Iron, Asbestos, Mica, Plumbago, Phosphate, Chromic Iron, Galena, Etc.

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.

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.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite: copper in sulphide and native form; gold, mostly in free milling quartz; silver, native and sulphides; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc, apply to

HONORABLE E. J. DAVIS,
Commissioner of Crown Lands,

or

THOS. W. GIBSON,
Director Bureau of Mines,
Toronto, Ontario.

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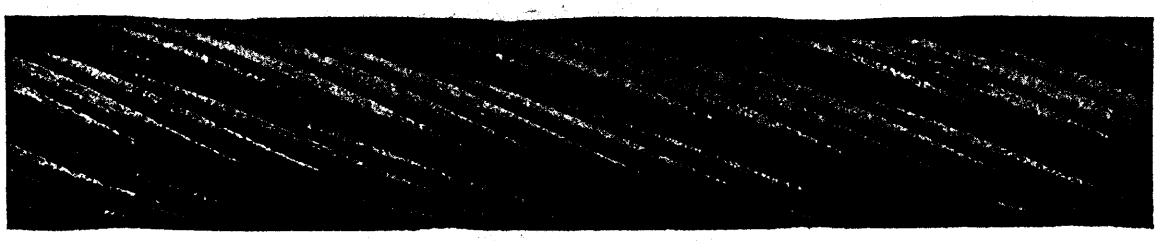

to Kenneil Collieries, Bo'ness, Scot., which gave a record life of 6 years and 2 months. Shewing condition when taken off.

TELEGRAMS—"Ropery Rutherglen." A B C, A I and Lieber's Codes used.

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