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Established 1882

Vol. XIX—No. IV.

OTTAWA, APRIL 30th, 1900.

Vol. XIX—No. IV.

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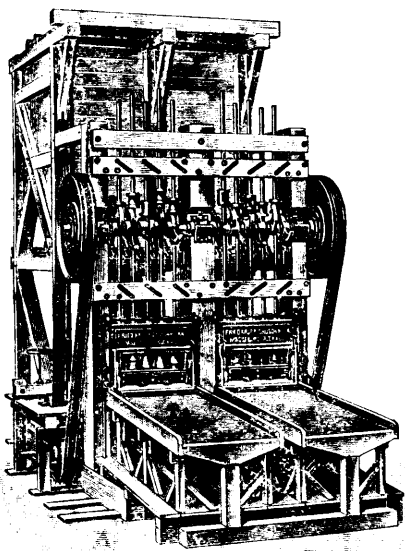
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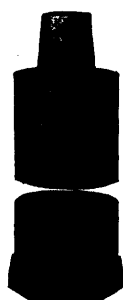


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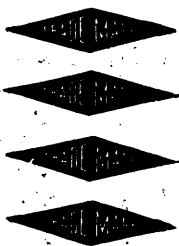
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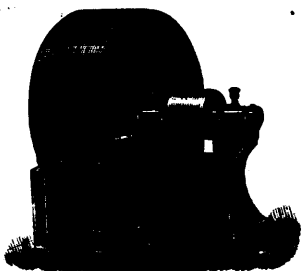
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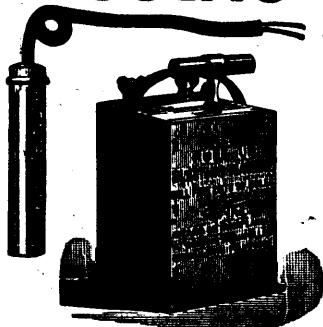
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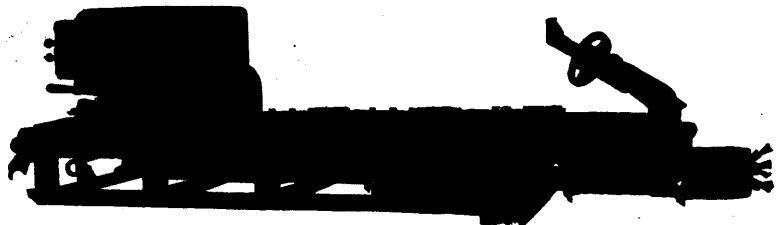
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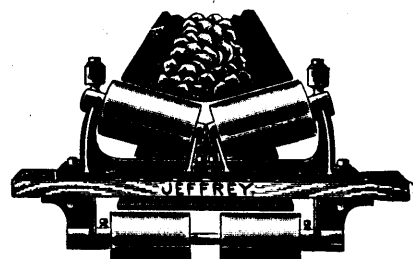
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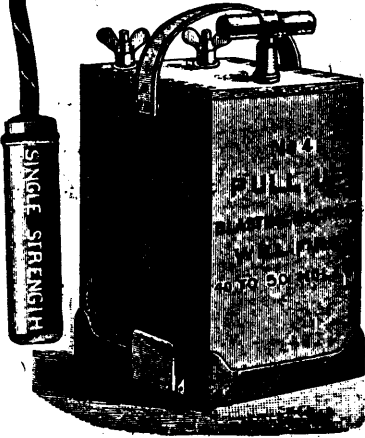
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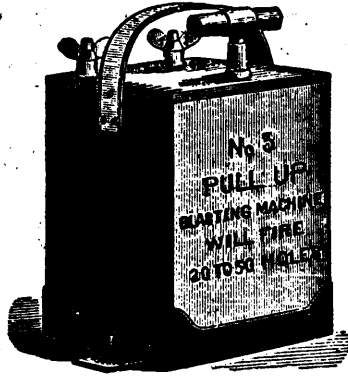
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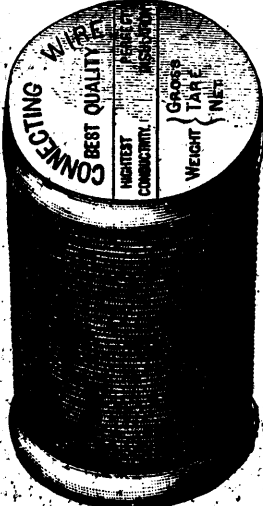
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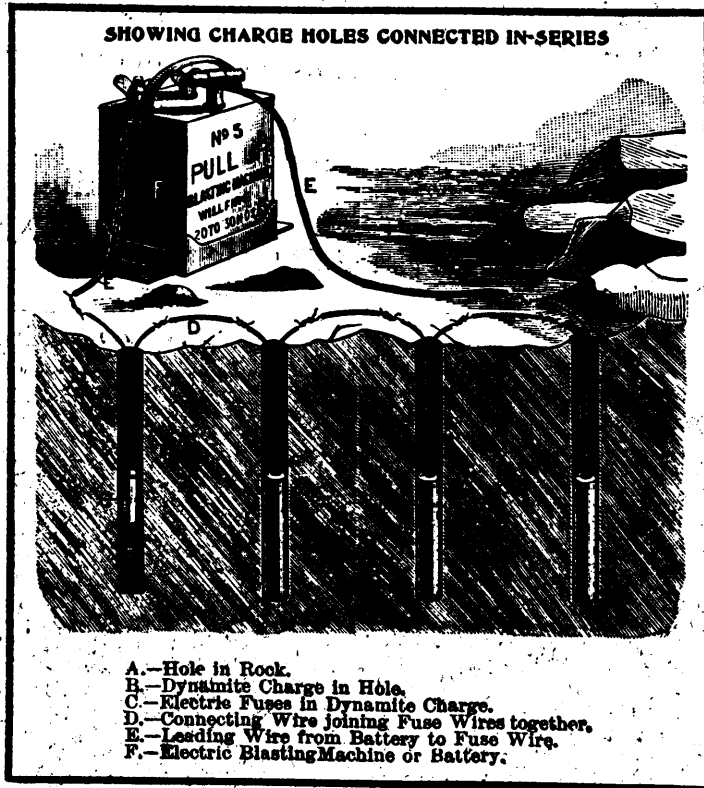
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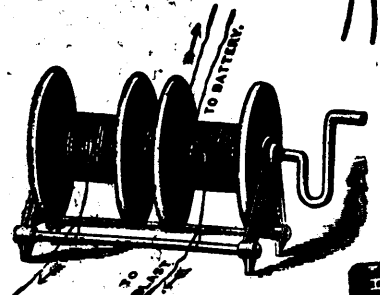
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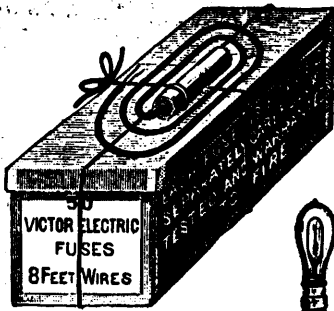
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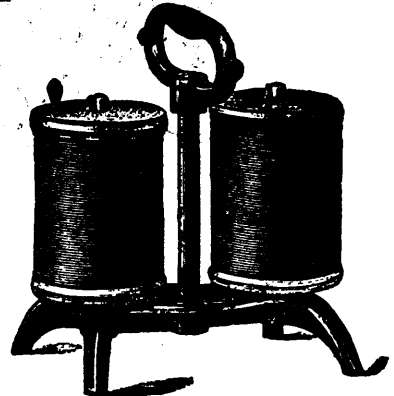
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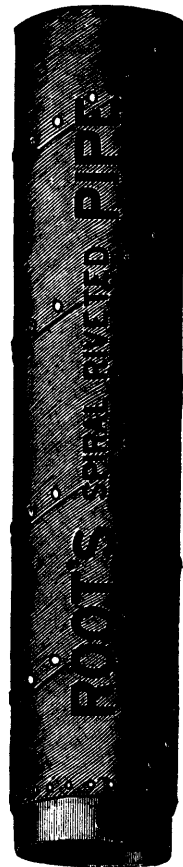
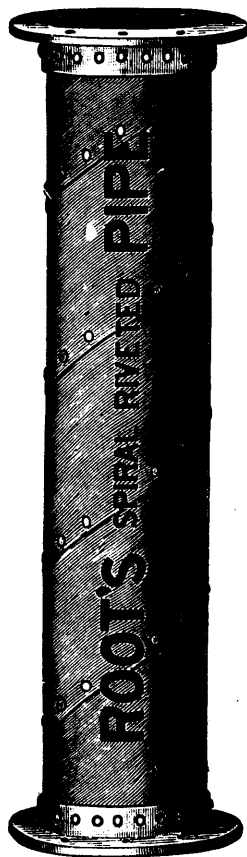
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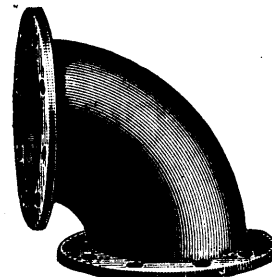
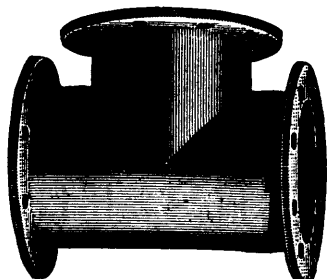
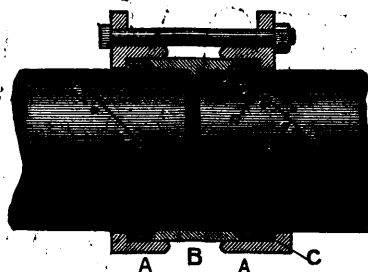
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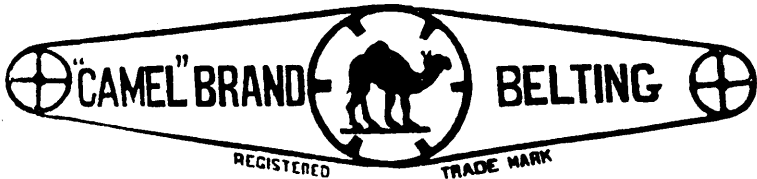
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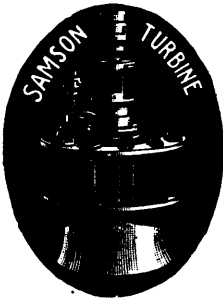
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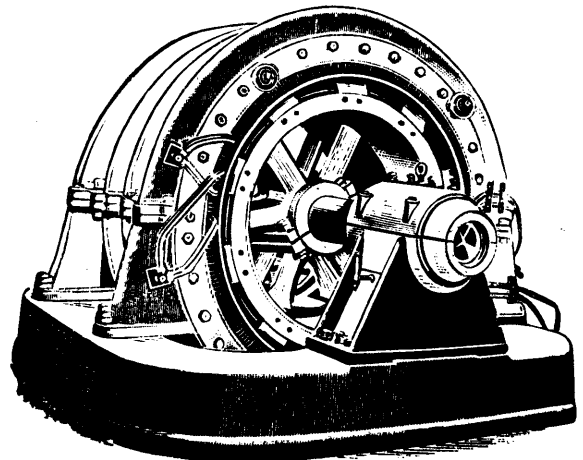
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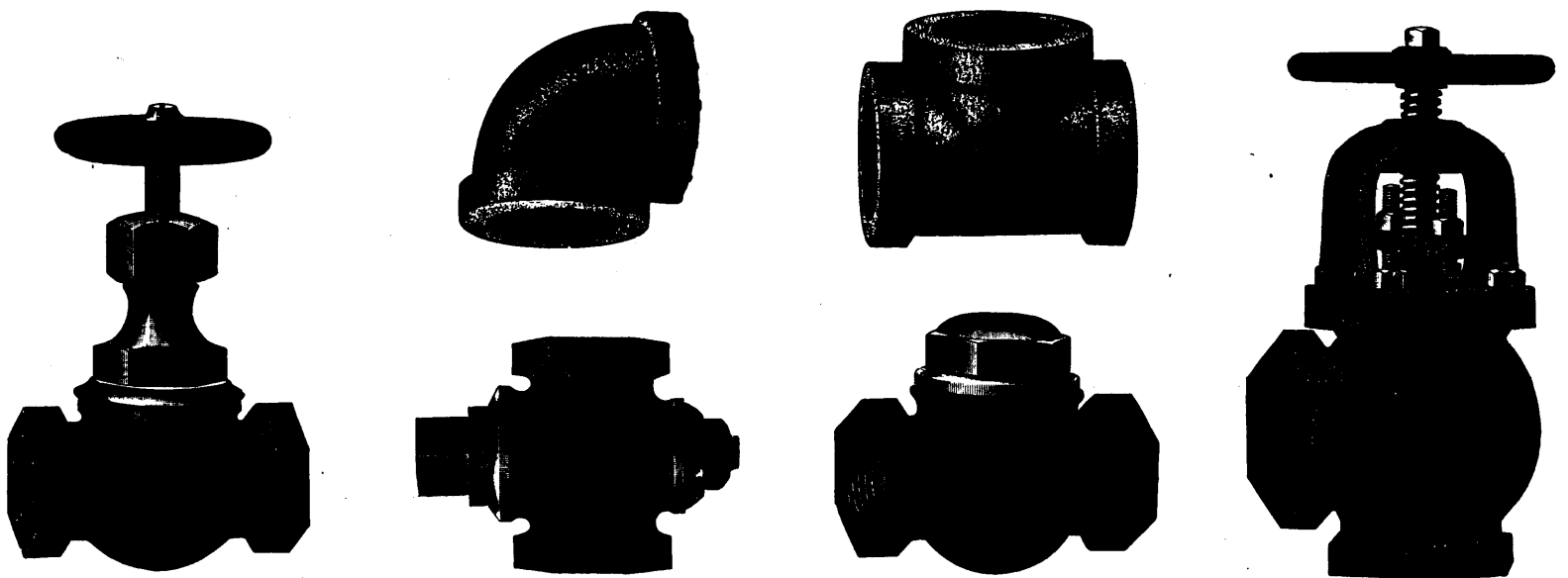
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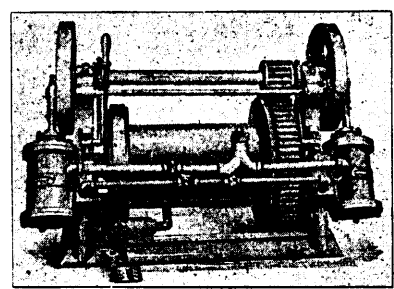
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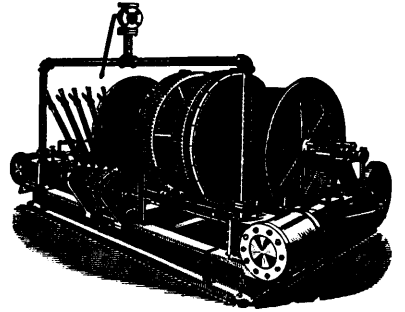
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VOL. XIX., No. 4.

APRIL, 1900.

VOL. XIX., No. 4.

## The New Ontario Mining Act.

The Honorable E. J. Davis, Commissioner of Crown Lands for the Province of Ontario, has introduced into the Provincial Legislative Assembly a Bill to amend the Mines Act at present in force in the Province of Ontario.

The Bill is a radical one—radically wrong, and if passed and not disallowed by the Dominion Government will deal a tremendous blow to the promising mining industry of the Province of Ontario. It is based on vicious economical principles, it violates the fundamental principles of justice and to the lay mind appears to be a flagrant violation of the Canadian constitution.

The first section of the proposed Bill appears innocent enough. It reads: "Sections 3, 4, 5 and 6 of The Mines Act are hereby repealed" but when one examines Section 3 it is found that its repeal is made the basis of confiscation.

Section 3 of The Mines Act provides "all royalties, taxes or duties which by any patent or patents issued prior to the 4th day of May, 1891, have been reserved, imposed or made payable upon or in respect of any ores or minerals extracted from the lands granted by such patents and lying within this Province, are hereby repealed and abandoned; and such lands, ores and minerals shall henceforth be free and exempt from every such royalty, tax or duty; and all reservations of gold and silver mines contained in any patent issued prior to the date aforesaid, granting in free simple lands situate within this Province, are hereby rescinded and made void, and all such mines in or upon such lands shall be deemed to have been granted in fee simple as part of such lands and to have passed with such lands to the subsequent and present proprietors or owners thereof in fee simple; but the provisions of this section shall not be construed to apply to lands patented under The Free Grants and Homesteads Act."

The words in this section that "such lands, ores and minerals shall be free and exempt from every such royalty, tax or duty" are historically derived from the Act of 1892, 55 Vict. Chap. 9. The words there used being that "such ores and minerals shall henceforth be free and exempt from every such royalty tax or duty."

The Government of the Province of Ontario have from time to time issued statements of The Ontario Mining Laws containing these words. They have armed the owners of lands with unconditional patents on the faith of which and on the faith of immunity from "every such royalty, tax or duty" large investments have been made. It would savour very much of confiscation for the legislature now to re-

peal these words, unless provision is made for compensating all who had such unconditional patents prior to 1891 or who made investments on the faith of the assurance of the legislature that the lands covered by patents issued prior to the 4th day of May, 1891, should be free from "every such royalty, tax or duty."

The *Toronto Globe* in its article on the 11th April in the following words correctly states a well recognized principle. The *Globe* says "Had the minerals and mining lands been alienated unconditionally, the Province could not now impose necessary obligations and taxes, for the mine-owners would be in a position to claim immunity or compensation."

All patents of mining lands issued in Ontario prior to the 4th day of May, 1891, did alienate the minerals and mining lands unconditionally and the mine-owners who had acquired such patents are, to use the *Globe's* words, in a position to claim immunity from what are described as the necessary obligations or taxes or compensation.

The repeal of the other three sections, namely sections 4, 5 and 6 which embody the provisions for the imposition of royalties is a movement in the right direction and in itself would constitute wise legislation. The royalties so abolished were first introduced in 1891 by 54 Vict. Ch. 8, but the royalties thereby imposed were expressly limited to "all ores and minerals, mined, wrought or taken from lands located, sold, granted or leased by the Crown after the passing of this Act "that is after the 4th day of May 1891: These royalties have never produced any revenue to the Province so that their abolition will cause a loss of no immediately available revenue. On the other hand the existence of these clauses and of the royalty conditions in the patents have proved a source of constant annoyance and a distinct hindrance to mining investment and development.

The second section of the Bill enacts "that all the royalties, etc., are declared to be abandoned."

By section 3 the reservations of mines, ores and minerals contained in patents before Confederation that is prior to the first day of July, 1867, are rescinded.

The next three sections of the Act provide a system of licenses without which no mining can be carried on under a penalty subsequently fixed at \$10 per day. Such a system of licenses is only justifiable as a means of producing urgently needed revenue and it would seem of all times that this is the most inopportune one for singling out the mining industry for special taxation. The fee apparently provided for (\$10 per year) does not appear large, but the sting of the provisions as to licences is contained in sub-section 2 of section 6 which provides that before a second or subsequent license is issued all sums



owing for taxes in respect of the properties proposed to be covered by such licenses must be paid and such taxes are added to the licensee fee for any second or subsequent license in respect of such properties.

Section 7 is an extraordinary section and the very words must be used in order to convey an adequate impression of its monstrosity. It reads "Every person carrying on the business of mining for any of the said ores in this Province shall pay a tax upon the gross quantity of the ores or minerals mined, raised or won during the preceding year from any mine worked by him to be paid to the Treasurer of the Province for the use of the Province at the following rates, or such less rates as may be substituted by proclamation of the Lieutenant Governor, namely:

- (a) For ores of iron, fifty cents per ton;
- (b) For ores of zinc \$5 per ton, or \$15 per ton of metal contents if partly treated or reduced;
- (c) For ores of copper, \$2 per ton, or \$25 per ton of metal contents if partly treated or reduced;
- (d) For ores of nickel, \$10 per ton, or \$60 per ton of metal contents if partly treated or reduced;
- (e) For ores of copper and nickel, \$7 per ton, or \$20 and \$50 respectively per ton of metal contents of copper and nickel if partly treated or reduced;
- (f) For all other ores or minerals, such rates as may be from time to time imposed by Order-in-Council, but so as not to exceed five per cent. of the selling prices thereof in a free market."

It is needless to point out to anyone having any knowledge of the mining industry that these rates are absolutely ruinous and prohibitive. The very menace of them if embodied in a statute would be sufficient to destroy confidence and prevent investment in Ontario mining enterprises. It must be borne in mind, however, that on reading the subsequent part of the Act this section does not mean and is not intended to mean what it says. The part of the Act including this section may from time to time in whole or in part be brought into force and effect by a proclamation of the Lieutenant-Governor in Council who has power to modify it at any time by substituting a less rate and also to direct that in certain cases the tax shall be remitted or refunded, in other words subject to certain restrictions.

The Government would if this Bill is allowed to become law have absolute control, within certain apparent limits, over the taxation of all mining enterprises in the Province of Ontario. This condition of affairs would be simply intolerable. There is no precedent in any civilized country for such a state of affairs. It does away with the traditional British principles that taxes can only be imposed by Parliament itself, in fact, does not impose taxation at all in the proper sense. The taxation is not equitable or fair. It is generally supposed that exclusive jurisdiction to make laws relating to trade and commerce is given to the Dominion Parliament, and one cannot see how such a law as is proposed in this Bill to amend the Mines Act can have any other object than to interfere with trade and commerce.

Section 14 introduces a novel feature and provides that all patents or leases of mining lands shall contain the express condition that all ores of nickel or copper won, raised or taken from such lands shall be smelted or otherwise treated within the Dominion of Canada, so as to produce fine nickel or copper or any form of product of such ores suitable for direct use in the arts without further treatment, and if this is not done the patents are forfeited and the lands revert to and become vested in Her Majesty freed and discharged from any interest or claim of any other person or persons whatsoever, and this clause is made retrospective and declared to have been in force since the 24th day of November, 1899, the date on which the Ontario Order-in-Council, which is not expressly mentioned in the Act, was passed.

The objections to Section 14 are:

- (1) That it is unwise.
- (2) That it is impracticable.
- (3) That it is unconstitutional.
- (4) That it amounts to repudiation of contracts by the Crown.
- (5) That it is confiscation without compensation.

Quite inconsistently with the other features of the Act the iron bounties are extended for a further period of five years. Why the development of iron mining should be promoted by a bounty in one part of an Act and hampered by a tax in another is a mystery which an ordinary individual cannot be expected to fathom, and why iron mining should be encouraged while every other class of mining should be discouraged by exorbitant and oppressive taxation, threatened though not immediately imposed, is not discoverable on the face of the Bill.

This Bill introduces new regulations as to the forfeitures of mining claims, as to the filing of plans of mines, as to the payment of wages, and also general rules as to ventilation, explosives, hoisting and other matters pertaining to the practical working of mines. These we shall discuss at a future time.

Should the objectionable features of the Bill be passed by the Ontario Legislature, namely, the delegation of authority by Order-in-Council to impose ruinous and discriminatory taxation upon mining enterprises, not for Provincial Revenue but for ulterior purposes wisely entrusted to the exclusive jurisdiction of the Dominion authorities and the confiscation or private vested rights without compensation, then vigorous steps should immediately be taken to secure the prompt disallowance of the Act by the Dominion Government. This was the course effectively taken by the Quebec mining men when a much less objectionable Act was passed in 1890, by the Quebec Legislature, imposing a tax or royalty in favor of the Crown upon every mine sold, or alienated whether before or after the Act. The tax proposed in Quebec was except in special cases "three per cent. of the merchantable value of the products of all mines and minerals."

The result was that the Quebec Act of 1890 was repealed in 1892, and was then made clear that when the lands and minerals had been unconditionally alienated there should be no tax or royalty.

The case of the Ontario mine owners under Patents issued prior to the 4th May, 1891, is much stronger because they have not only unconditional Patents from the Crown but also the express and repeated guarantee of the Legislature that such lands, ores and minerals "shall be free and exempt from every such royalty tax or duty."

### Canals and Our Metallurgical Industry.

Metallurgical industries, next to agriculture, are most vitally related to a properly conceived and properly administered canal system. Canada is peculiarly situated with regard to waterways. Few countries in the world enjoy such advantages as are here presented, with the immense length of our southern boundary line, which is the most richly endowed portion of the country, accessible to deep-water navigation, and traversed by two rivers which have required comparatively insignificant canalization works to open them to vessels of fairly deep draught. This work has in part been done, and some yet remains to be done. The principle that waterways determine the direction of commercial movement and the development of industrial activity, has been quite fully recognized, and, what is still more remarkable, the railroads themselves have not stood in opposition to the government's plans of canal extension. Sir William Van Horne is on record as favoring the Montreal, Ottawa and Georgian Bay Canal, affirming that the country would be benefitted by it, and that it would be of great assistance, and certainly no injury to the Canadian Pacific Railway. In this he takes higher ground than most railroad men in other parts of the world, although the advantage of canals to the railroads was clearly pointed out thirty-five years ago by Dean Richmond, then president of the New York Central Railroad, who refused to

co-operate in a raid on the Erie Canal, and even went so far as to urge that the canal should be deepened to accommodate larger barges. Since that time there have been improvements in railroad construction and equipment rendering it possible to haul longer, heavier trains at vastly reduced fuel consumption and cost of handling, so that the assertion is often heard that the railroads can compete with canals. But the fact remains, which anyone can ascertain by comparison of figures obtainable in Poor's Manual, that the increased gross income due to larger shipments of low class, heavy freights, has not shown a corresponding gain in the net income. Hence it appears that with a larger invested capital there has followed a decrease in its earning power. Moreover, it is precisely these railroads operated through zones tributary to water routes, conspicuously observable both in the United States and in Germany, that the railroads have proven the most profitable. They can afford to relegate to vessels the heavy, bulky freights, the staple raw materials on which industry primarily depends, because the result is such an increase of manufactured products, such a growth of population with all its demands for foods and articles of manufacture, that the railroads are remuneratively employed in the transportation of those classes of goods which can afford the higher charges, and which for obvious reasons must follow the more rapid route. We have taken pains to briefly restate the main argument for canals, because it involves another point not so clearly perceived as it should be by our law-makers and by a large portion of the public, viz., that, as a means for raising revenue for the Government (speaking locally, for both the Provincial and Dominion Governments), the canals without exception should be absolutely free. The apparent paradox becomes rationalized when we point out that just as the railroads profit by the increased population and wealth producing activity of the country, so the Government, by contributing to this result through free canals, will collect in the normal way by regular taxation a vastly increased revenue, out of all proportion to the cost of construction and maintenance of the waterways. The policy of Germany in this particular is worthy of careful study, and a most brilliant example of the same policy, which antedated its inauguration in Germany, is that of the United States towards the Sault Ste. Marie Canal. Since the Canadian Government, in accordance with treaty, has pursued the same policy at the "Soo," it may be asked why a corresponding advantage has not accrued to Canada? Well, Canada has profited largely by it, and is preparing to profit still more, but she has provided a stimulant at one end only to neutralize it in large part at the other. A free canal at the "Soo" with a toll canal between Lakes Erie and Ontario is giving no more than the peel of the orange. The bulk of population in Canada lies east of the meridian of Niagara. Connection with Europe determines the great distributing centre of the Dominion at the head of tide-water on the St. Lawrence. The availability of agricultural products and of water-power in Eastern Ontario and in Quebec invites industrial development in this region, near to the country's financial and commercial centre. But there lies the Welland Canal, with only 14 feet of water, demanding tolls on every ton of cargo passing through it. On iron ore the toll is 5 cents per ton, and on coal and coke 20 cents. To these must be added an additional  $1\frac{1}{2}$  cents per ton on the registered tonnage of steam vessels, and  $2\frac{1}{4}$  cents on sailing craft. These are the fundamental raw materials on which any large industrial development of a country depends. The charge on iron ores is rather insignificant, and might be construed as an evidence of doubt as to the availability of Canadian ores. But the toll on coal and coke is inexplicable. Nova Scotia coal and coke never moves, nor will it move, in large bulk, as far west as Lake Ontario. For these commodities the lake and upper St. Lawrence region is, and will remain, dependent upon the United

States. Various circumstances combine to make the Ontario lake district the natural home for a metallurgical industry, but the effect of the toll on the Welland Canal is to give the Reynoldsville district of Pennsylvania a monopoly of the coal and coke trade for this lake and the St. Lawrence as far east as Montreal, which has been a barrier to development for years. With free competition from Lake Erie the coal fields of the Pittsburgh region, Pennsylvania, and those of West Virginia and Ohio could ship to the lower lake. There would at once be a slump in prices, and what is more, the superior blast furnace cokes of the Connellsville basin and of New River could be brought in as cheaply as the inferior Reynoldsville coke under existing conditions. The Hamilton blast furnace is using Connellsville coke in spite of the disability attendant upon transshipment at Buffalo. Efforts are making to establish a new blast furnace at Kingston, one of the best situated places in Ontario for such an enterprise, and the bug-bear of the tolls rises at once in the way. It is hinted that the projectors of this movement are petitioning for immunity from Welland Canal tolls on its coke. While they are about it they should demand free passage for coal and iron ore as well, for one industry depends upon another, and coal is the power that determines manufacturing, which will consume the pig iron from the blast furnace. It is the basis on which the utilization of our clays and cement marls depends. It is one of the chief items of expense at our mines, and for so vital a necessity we should not be tied to one railroad, and to one group of mines in Pennsylvania.

With a 21-foot canal between Lakes Erie and Ontario, maintained absolutely free of toll, the largest lake steamers could come through from Superior ports to Lake Ontario, and lay down the ores of the Mesabi range at a cost of but a few cents more than to Cleveland, while the cost of fuels would certainly fall 25 cents or more per ton. Even without this increased depth, a remission of tolls on the Welland Canal would induce an enormous expansion of business on Lake Ontario and the St. Lawrence, which would react beneficially upon the whole Dominion.

#### Sampling in Mill Work.

The subject of sampling is of perennial interest. In spite of all that has been written upon it by men of the largest experience, there is no system regularly acknowledged in practice as a standard, and there are very few establishments indeed, where the metallic product obtained agrees with the difference between the values of original ore going to mill, and that of the tailings leaving it, as determined by the routine sampling and assaying. The art of the assayer is, relatively, so accurate in its results to-day, that errors on the part of well-trained men are rare, but sampling is a matter of more difficulty, and leads to constant and vexatious discrepancies. In this connection it may not be amiss to revert to the absurdity of the average promoter of new mining companies in heralding the high reputation of the assayers who have tested his samples, while he tells nothing about the skill and reputation of the man who took the samples, upon whom devolved the larger responsibility. It is to be hoped that the public will one of these days, be educated to the point of understanding that a specimen is not a sample, and that the taking of a sample requires a sort of knowledge which comes only from long and intelligent experience.

A recent paper read before the Chemical and Metallurgical Society of South Africa, by S. H. Pearce, brings out some interesting points in sampling. Discussing the sampling of ore sent to mill, he fairly states the difficulties of the three systems, viz.: 1. Sampling each car load of ore; 2. Sampling from the chutes after passing the rock-breaker; 3. Sampling from the feeders to the fine crushers (stamps or rolls): In the first case the tendency is to obtain an undue proportion

of fine material, commonly resulting in excessive values. Moreover, the bulk of such a sample is necessarily very large. In sampling from the chutes the difficulty consists in getting a proper proportion of the fines, which settle to the bottom of the chute. Concerning the third method, Mr. Pearce says, "There are two ways in which it may be taken, *i.e.*, by small shovel fulls from the disk (or tray) of the feeder, or by holding a tray made to fit the edge or the disk under it, to catch that which falls from it. In either case the sample will generally be found too high as, owing to the amount of vibration in the mill, there is always a certain amount of concentration on the disk, which affects the sample." He says further, "speaking generally of all these rock samples, it would appear that they will give too high a result, and I may say further, that the smaller the sample taken, the more erratic will the results come out daily. . . . It has also been my experience that the larger the mill the more steady will be the daily assays; in this case I do not think that this is due so much to the quantity taken, as that it is taken from more places, and has a better chance of being mixed."

In other words, the law of averages rules here as elsewhere, and the principle must be borne in mind that frequency of sampling, resulting in a large number of contributions of small samples to the main one, will give the best results. It is also conducive to greater accuracy to divide the daily mill-ore sample into four parts, corresponding to each successive six hours out of the twenty-four, grinding and sampling down each six-hour lot separately, and then taking the average of the four assays as representing the whole day's run. At best the mill-ore sample is not absolutely trustworthy, and is apt to lead the the superintendent into difficulties with his board of directors who will usually accept with reluctance and disbelief, his explanations of the difficulties of the case. Unless an ore contains its metalliferous contents very uniformly disseminated, the mine manager will often find it wiser to make no report of assays on such samples, except with the understanding that he is not to be held accountable for apparent discrepancies. Strenuous efforts, however, should be made to secure accurate samples of mill-ore, since they serve to give warning of losses other than the normal loss in tailings, which may occur in the process of milling. If mine samples are conscientiously and carefully taken, their monthly averages will more correctly represent the values going to mill than the mill-ore samples, in cases where the entire output of the mine is milled, without sorting, but when sorting is practised, it is very difficult to obtain any perfectly reliable check on the value of the ore, beyond that derived from the metallic product recovered and the loss in tailings.

The battery sample, in the case of gold milling, is an important one. Regarding this Mr. Pearce says, "I certainly consider this as being the nearest daily check upon the value of the rock milled. It has the disadvantage of being minus the gold caught in the mortars, which has to be remedied by adding that amount, divided by tonnage, to the assay at the end of the month, which will then include die sands, screen tanks, and lip sands." Mr. Pearce uses a metal sample pan with a flat side, so that it may be pressed tightly against the overflow lip, preventing anything from running down the side and escaping. A sample should also be taken by an automatic sampler from the pulp stream, between the batteries and the concentrators, and in like manner, from the tailings launder. The sampling of settled sands is unadvisable. They are, as Mr. Pearce says, "deposited unevenly in value, either horizontally or vertically, or in any other direction." Arrangements should always be made to sample pulp and sands while in a state of suspension in a flowing stream, by some automatic contrivance which will divert to the sample box at regular intervals the whole stream. Samples which split the stream, or which take a mere

dip from it, are never reliable. Very successful automatic samplers can be had which take the whole stream for a brief moment at regular intervals, and which require only a six-inch drop in the pulp stream, but if a four foot fall can be conveniently obtained, superior samplers can be used, which will give consistent results at all times. What has been said as to sampling settled sands applies with considerable force to the sands in cyanide tanks, whether filled by dumping and spreading, or by the Butters' distributor. The tube sample is not safe, and where the sands are flushed out after leaching, as they always should be when water is sufficiently abundant, they should be sampled automatically from the tailings-launder.

It is almost superfluous to point out the need of a suitably constructed and adequately equipped sampling room, with cement, or better still, with steel-plate floors, so arranged, that the last particle of dust may be recovered. Perhaps the best crusher that can be used in the sampling works is the roll-jaw crusher, made by the Sturtevant Mill Co., of Boston, Mass.; otherwise, an ordinary jaw crusher, followed by rolls, will do. There should also be a sample grinder (the ordinary cone-grinder type) which should invariably have both liners and cone of manganese steel. Mr. Pearce gives a table of maximum sizes of ore particles in the residues after each quartering, as follows:

	2	inch diam. to	1200	lbs.
1	"	"	300	"
1/2	"	"	80	"
1/4	"	"	20	"
1/8	"	"	5	"
1/16	"	"	2	"

This is a very safe guide, but we do not commend his endorsement of the old practice of spreading out thin for quartering. The method by shoveling ore, if properly done, is far more accurate. In this, each shovelful should be as nearly as possible alike as to bulk, and the contents of the shovel dropped upon (not thrown at) the exact centre of the pile. Thus a very perfect cone of very uniformly distributed material is built up. When complete, the pile is shovelled away by forcing in the shovel on the floor line in a direction tangent to an imaginary circle, a few inches within the circle formed by the outer edge of the pile, proceeding in this manner continuously round and round the pile, saving for subsequent reduction and sampling every third shovelful, or in difficult cases, every other shovelful. This may be continued safely until the sample has been reduced to 20 lbs. Material as small as 1/8 inch and smaller should be mixed by shaking several times through screens of appropriate mesh, upon a rubber mixing cloth. This gives more accurate results than rolling. When thoroughly mixed, it should be rounded up on the cloth by drawing the corners successively over the center, and then split by a quartering frame, consisting of two vertical planes a foot high, intersecting each other in the middle at right angles. It should be made of sheet iron or steel, about No. 13 Birmingham gauge, the joint at the intersection securely riveted and dressed smooth, so as to afford no crevice for lodgment of dust, and the lower edges should be bevelled so as to cut readily to the bottom of the pile. Opposite quarters are then shovelled and brushed out clean.

We heartily endorse Mr. Pearce's closing remarks, among which he says, "One of the most important things to remember is care and regularity and cleanliness above all things. I have known it said, 'what is the use of all this bother? It doesn't give us any more gold.' Those who have said this, and still think it, never made a bigger mistake in their lives. I say to all of you who are interested in sampling, from manager to shaftsman, those of you who do not use all your endeavors to obtain the best results you can, are neglecting one of the most important of your duties toward your employers."

### The Nickel Agitation.

For several miles around the little town of Sudbury in Ontario large deposits of nickel and copper ore have from time to time been uncovered, and during the last fourteen years a steadily increasing number of men have found profitable employment in mining these ores and smelting them to a crude product, which is sent to New York for further refining.

It has been urged by certain persons in Canada, that the Government should place an export duty on this raw material, to prevent its passage to the States, and thereby to force the owners of the nickel mines to bring this metal to an entirely finished condition in Ontario.

This would at first seem to be a fair business proposition; and it would appear cheaper to manufacture a finished metal at the mines than to transport a crude product one thousand miles to a refinery.

The nickel matte, the product which is obtained by smelting the nickel ores of Sudbury, contains about 350 lbs. copper and 350 lbs. nickel in a ton. The remaining 1,300 lbs. consist mainly of sulphur and iron, which must be roasted or slagged out in order to refine the nickel and copper. This 1,300 lbs. iron and sulphur is lost in refining, and therefore the cost of freight on a ton of matte, amounting to \$5.50 from Sudbury to New York, must be borne by the 700 lbs. metal contained in the matte. If this could be refined to metal in Sudbury, the freight on this metal would be about \$1.92, while at present it costs \$5.50 to carry the same metals in the form of mattes.

In 1899, the Canadian Copper Co. shipped 18,000 tons matte to New York. This contained about 12,000 tons of waste matter, sulphur and iron, on which there was paid about \$66,150 freight, a loss to the Canadian Copper Company of nearly 3 per cent. on their capital stock.

It is evident that there is some very cogent reason why the Canadian Copper Company submit to this loss instead of producing a finished metal at Sudbury. Let us examine carefully the motive for this extraordinary and apparently unbusinesslike conduct.

When nickel ore was discovered in Ontario, a number of companies were organized to mine this ore and refine it to a metal. The Canadian Copper Company, The Dominion Mineral Company, The H. H. Vivian Company, The Chicago Nickel Mining Company, The Algoma Mining Company, and others went into this business. They opened mines, erected furnaces, smelted their ores, concentrated the metals into a matte, and offered the matte for sale. This much was simple; to find a purchaser was another matter. There was at that time but one nickel refinery in America, Mr. Wharton's, of Camden, N. J. He had a small works, which offered a limited market only. His process was very complicated and expensive, so Mr. Wharton was unable to become a large purchaser of Canadian matte. The Vivian Company of Wales, were refining nickel by a secret process, but they were fully supplied by the product of their furnaces at the Murray Mine near Sudbury. The French and German refineries were supplied with ore and matte from the New Caledonian and Norwegian mines, and so the market was exceedingly limited. Owing to lack of a market, most of the smaller companies were forced to close their mines, and at one time about 6,000 tons of unsold matte were piled up on the Canadian Copper Company's yard at Copper Cliff.

At this juncture, the Orford Copper Company, a large refiner of copper ores and mattes near New York, secured patents on a process for refining nickel matte by smelting it with certain alkali chemicals so as to slag off a portion of the copper. This smelting, repeated some six or eight times, finally slagged off all the copper and iron, and left the nickel combined with sulphur alone, which could easily be removed. This process was covered by patents in Canada, England and the United States, so as to effectually prevent its use by any persons except the Orford Copper Company. An arrangement was then

made with the Canadian Copper Company, whereby this Company sold to the Orford Copper Company the crude matte produced in Canada, and the Orford Copper Company refined this matte in New York to a finished product.

This arrangement gave a great stimulus to the nickel industry in Canada. The Canadian Copper Company was at that time working three mines and two furnaces, while at present, eight mines and six furnaces are in operation. Under this agreement, whereby the Canadian Copper Company secures a market for its matte, over a thousand men find employment directly and indirectly in its works at Sudbury. There are 688 men employed in the various mines and smelters; there are scores of other laborers employed in cutting and hauling wood on contract and delivering it to the roast yard; there are numerous shops and stores in Copper Cliff and Sudbury which are dependent on the Company's employees for their trade.

In 1899 about one million dollars was expended by the Canadian Copper Company at Sudbury for labor, freight, supplies, and other necessary expenses in connection with its work there.

The Canadian Copper Company has taken the copper and nickel ores of Sudbury and has caused those stones to become bread. It employs more labor and pays more for freight than any other concern between Montreal and Winnipeg.

This Company has for many years been seeking to obtain a process whereby they could refine their matte in Canada and save the enormous freight charges now paid on waste material. They have not yet found any commercial process except the Orford process. This process is the absolute property of the Orford Copper Company, and is not in any way owned or controlled by the Canadian Copper Company; neither is any officer, director, or stockholder of either of the two companies pecuniarily interested in the other. The two companies stand to one another simply in the relation of seller and buyer. The Canadian Copper Company cannot, therefore, coerce or compel the Orford Company to refine the matte in any specified manner or place.

In the Orford process of refining it is necessary to smelt the matte a number of times with a crude alkali, which is cheaply obtained as a waste product in New York, but which is not produced in Canada, except as a refined product and at a prohibitive price. The numerous smeltings demand large quantities of coal. This costs \$2.60 per ton in New York and \$4.90 per ton at Sudbury. Furthermore, the Orford Copper Company is a large refiner of pure copper ores, and is enabled therefore to distribute the copper slags which come from the refining of Sudbury matte, among its other furnaces, and so save the copper in this slag. The copper received by the Orford Copper Company from Sudbury matte is only about one-tenth of its output of copper.

If the Orford Copper Company were to establish a refinery in Canada, they would be handicapped, 1st, by the cost of coal, which is much greater in Sudbury than in New York; 2nd, by the lack of crude alkali, which is not produced in Canada; 3rd, by the lack of copper ores, and 4th, by the United States tariff of \$120 a ton on refined nickel.

Under these circumstances, the Orford process is a commercial impossibility in Canada, and the Canadian Copper Company has been forced to take their matte to the refiners in New York, as the refiners could not bring their process to Ontario. The loss of \$66,150 per year by freight on waste material is therefore unavoidable, and is part of the expense necessitated by the geography and climate of Canada.

So serious a matter does this question of freight become, that some years ago the H. H. Vivian Company, the old nickel refiners of Swansea, were forced to issue a circular to their stockholders, explaining that it was not profitable for them to mine ores and smelt them in Sudbury, and ship the matte to Wales for treatment. The Murray mine and furnaces, owned by the Vivian Company, were therefore

closed down. Had it been feasible for this company to refine their matte in Canada, the Vivian Company would not have abandoned their large investments in Sudbury. Their retirement from the smelting of nickel in Canada was a confession that the refining of this metal in Canada was not commercially feasible.

In order to establish the manufacture of iron in Canada, bounties have been offered, both by the Dominion and the Ontario Governments, on pig iron smelted in this province. Here is one of the oldest and best known industries, an art whose metallurgical problems have long been solved, a process hampered by no patents, and handicapped by no trade secrets, helped by a double bounty, while the refining of nickel, struggling with a host of unsolved problems, is menaced with an export tax which threatens its very existence. Why is one industry rewarded and the other punished? The two cases are parallel.

The Canadian Copper Company has never sought governmental bounties. It has won for Canada over a third of the world's nickel market, it has employed thousands of men, it has never engaged in strikes or labor warfare, it has paid its debt and its taxes, and it asks what it gives—fair treatment.

For the last ten years the Canadian Copper Company has been seeking a process which was practicable, economical, and capable of being worked in Ontario. To this end they have purchased a large water power at Nickel City, with the intention to use this power in the refining of nickel.

In 1891, this Company brought from France, M. Jules Garnier, the eminent metallurgist who had established the nickel industry of France. M. Garnier assured the Company that he could refine this metal. He was given *carte blanche* in the matter of expense. He erected a large refinery at Copper Cliff to remove the iron from the matte, and a corresponding refinery in Cleveland to remove the sulphur, and make a saleable metal. He and his assistants worked for two years and the Canadian Copper Company spent over \$150,000 on this problem, but without success. M. Garnier could treat the nickel ores of New Caledonia, which contained simply a silicate of nickel uncontaminated with any deleterious ingredients, but he could not eliminate the copper, sulphur, and iron, which render the Sudbury ores one of the most difficult smelting problems of modern times.

In 1893, Dr. Hoepfner, the well-known German inventor, represented to the Canadian Copper Company that he had solved this riddle. He also came to Cleveland. For his process the Company built a refinery where he and his assistants worked during a part of the years 1893 and 1894, and spent about \$15,000 of the Company's money, and at last retired baffled.

In 1896, Dr. Mond, of London, endeavoured to reach an agreement with the Canadian Copper Company for the use of the Mond process for refining nickel. The Company's representative went, in 1896, to examine this process, and in order to make a thorough test, returned to England in 1897 with 60 tons of matte, which was treated in Mond's plant in Birmingham during the year 1897-98. This process proved more satisfactory than any other yet tried, but the fact that the sum of \$2,000,000 would be required to purchase the patents and erect a refinery on this plan, as well as the point that this process could not economically be worked in Ontario, caused the Canadian Copper Company to break off negotiations with Dr. Mond. The Mond process calculates to use coal costing \$1.50 and acid costing \$6.50 per ton in England. These items would cost \$4.90 and \$35.00 per ton, respectively, at Sudbury. Further, the Mond process makes all the copper into copper sulphate, which has a very limited market in Canada, and on which there is a duty of one-half cent per pound on going into the United States.

Doctor Mond has since purchased nickel land at Sudbury and is preparing to erect furnaces to produce matte for shipment to England.

He is very strongly opposed to the imposition of an export duty, since he cannot use his process in Canada, and an export tax would prohibit the use of Canadian matte in England.

Notwithstanding the fact that the Canadian Copper Company has expended at least \$200,000 in unsuccessful attempts to acquire a refining process, it does not propose to give up the struggle unless its investment at Sudbury be destroyed by legislation. It will never discontinue its efforts in this line until it reaches its goal, a process for refining the Sudbury matte which can be successfully and economically worked in Canada. To this end it is now erecting a fourth experimental plant in Cleveland, at a cost of about \$25,000, to test another process on a commercial scale. The location of this experimental plant at Cleveland was necessary in order that its erection and trial should be under the constant personal supervision of the officers of the Company. It is the intention of the Canadian Copper Company, when it shall have found a suitable process, to refine in the United States only that portion of its matte which is necessary to supply the American market, and to refine in Canada the rest of its matte for the European trade.

It is a common opinion that Ontario has a natural monopoly of nickel, that the Sudbury ores are inexhaustible, and that no matter what restrictions be placed upon this industry, the world must come to Canada for its supply of nickel. As a matter of fact, during the five years 1893 to 1897 inclusive, out of the world's total of 23,652 tons, Ontario produced only 9,151 tons of nickel. At no time has Canada produced even one-half of the world's supply. The French nickel mines of New Caledonia are producing a constantly increasing amount. The Society Le Nickel produced 3,000 tons of metal from New Caledonia ores in 1898. Mr. Higginson has opened new mines on this same island, and a third company, the Nickel Corporation, Ltd., has been organised to work these rich and easily-smelted ores. The New Caledonia ore carries 6 per cent. of nickel against 3 per cent. in the Canadian ores. The nickel deposits in the Island of Osterø, near Bergen, in Norway, are being developed, and within a year it is expected they will be producing 300 tons of ore a day, or nearly one half of the world's consumption. It is only by constant vigilance and a careful application of the most economic principles of mining and smelting that the Canadian Copper Company is able to hold its market for Canadian nickel. The New Caledonia ores are richer than those of Sudbury. They are much more easily refined, and the freight by water from New Caledonia to the refineries in Europe and the United States is so low that the Orford Copper Company can import, and has already imported, 8,000 tons of this product for use in its refinery.

Owing to the present tariff law of the United States, nickel ore or matte comes in duty free, while refined nickel pays a duty of \$120 per ton. It is also provided that any article, upon which an export tax is placed in a foreign country, shall, on its importation into the United States, pay an import duty equal to the amount of the export duty. If the Canadian Government applies an export duty of five cents on nickel in matte, such nickel must pay a total tax of ten cents in order to reach the New York refinery, while the French matte, upon which no export duty is placed, will as now be admitted free.

An export tax or royalty levied by the Province of Ontario will have precisely the same effect as a duty levied by the Dominion. Such a tax can not diminish the cost of refining in Ontario, nor increase the market abroad. Its only effect, therefore, would be to increase the cost of the production of matte in Ontario, and to lessen the wages paid to men engaged in this industry.

It is very evident that under these conditions the Canadian Copper Company could not bring its matte to New York, the Orford Copper Company could not afford to purchase Canadian matte carrying this duty when it can import French matte free.



With no process suitable for Canadian conditions, and with the American market cut off, the Canadian Copper Company can not do otherwise than go out of the nickel business. What other option is open? It can not use the Orford process; the Orford Company can not work their process in Canada. Mond's process demands coal and acid at prices which Canada can not meet. Hoepfner has proved a blind guide. Garnier can offer no solution from his experience. The export tax will not mend matters. The Canadian Parliament can suggest no process which is available. Will the export duty modify the climate of Canada? Will it place coal under Ontario forests? Will it lower the price of acids or of chemicals or lessen the rate of freight? Will it remove the United States tariff of \$120 per ton on Canadian refined nickel? It can do none of these things.

The export tax on nickel in matte can do much. It can throw the American market open to French miners. It can force one of the largest institutions in Canada to close its doors. It can throw a thousand Canadians out of their honest employment. It can silence the noise of the drill and put out the furnace fire. It can deter the investment of capital in a land where legislation attempts to ignore climatic and geological conditions. It can do all this. It will do it, at the bidding of men who have not a dollar invested in Canadian mines, and who have nothing to lose by this legislation.

It will do this against the advice of men who have spent millions in building up one of Canada's greatest industries, and who have given years of patient study and investigation of the problems involved. The export tax will do all this. Why?

## COAL MINING AND TRADE.

The subject of a possible considerable increase in the output of Canadian coal by seeking an entrance into new markets has naturally attracted much attention, since the present inflation of trade commenced. At first sight it seems an anomaly that with over estimated tonnage, according to the best authorities, approximating to 20,000,000,000 tons of coal, our contribution to the world's output of 627,000,000 tons last year should only reach the insignificant figure of 4,565,993; but the reasons are obvious. The first is a lack of manufacturing industries in our own borders, which would give that permanent and reliable demand for fuel which has developed coal mining to such imposing proportions in other countries. The second reason is that our natural and hitherto only accessible foreign market, the United States, has been practically closed against us by a prohibitive tariff. It is only where our geographical position enables us to monopolize the Pacific trade that we are able to send any considerable quantity of coal south of the line; San Francisco has for over a quarter of a century been the mainstay of the British Columbia coal trade, but on the Atlantic where from eight to ten million tons of soft coal are consumed every year in the New England States, we are practically excluded by tariff regulations in the interests of the American producer.

The only notable exception to this is in the case of the New England Gas and Coke Company, which is now drawing its large supplies from Cape Breton under a special contract with the Dominion Coal Company, but this is for culm, sold at low prices, for gas making and the transaction is not a factor in the general trade with the Eastern States. The third reason is that for lack of the necessary transportation facilities Canadian coal has not yet sought for foreign market which may possibly be within reach; and whilst the first difficulty is being solved, especially for Cape Breton, in the erection of the extensive Iron and Steel Works of the Dominion Company, even the most sanguine do not expect such a development in this direction

as would give the Dominion anything approaching an adequate market for its coal for many years to come

As to the possibilities of any relaxation in the tariff regulations with the United States, past experience and the tenacity with which our wide awake neighbors secure and hold their markets would not lead one to be at all optimistic, there is therefore, all the more reason why the possibilities of overcoming the third difficulty should be carefully considered. Let us ask what foreign markets are fairly accessible to Eastern Canadian coal, and what are the chief difficulties to be overcome in entering those markets? The question is brought to the front largely in consequence of a general scarcity of coal throughout the world, and consequent high prices now ruling. The first observation to be made is that such a condition is abnormal and transient. Even if the capacity of coal production in the British Isles has been almost reached, with the enormous tonnage of 220,000,000 last year, from an area no larger than the Province of Nova Scotia, there are undeveloped areas in Russia and Germany, in the Old World, and of course in the United States, which are capable under pressure of overtaking the demand in a very short time.

As a matter of fact there have only been three periods of inflection in prices during the last thirty years, and singularly enough, at intervals of about ten years. The high prices then reached have continued in each instance for less than two years and have then subsided to about the previous figure; it is certain that only during such periods could Canadian coal have been sold in competition with European. A comparison of the prices ruling to-day, compared with normal rates will be sufficient to establish this fact, and at the same time to show that if the transportation difficulty could be solved, it would be practicable to place a large tonnage of Canadian coal at the higher figures; but it is not yet certain that except in a few favoured markets, such a trade could be continuous; especially as the determining factor must be that the back freights into the Mother Country, owing to the marvellous ramification of her commercial interests, give her an unrivalled advantage.

	Prices to-day, f.o.b.	Average prices, f.o.b.
Cardiff .....	\$5 00	\$3 00
Glasgow .....	4 00	2 50
London .....	5 50	3 50
Dublin .....	6 50	4 00
Belfast .....	5 50	3 50
Odessa .....	7 50	5 00
Madrid .....	7 00	5 00

A glance at these figures will show that with specially designed boats to carry not less than 5,000, and possibly as much as 7,000 tons, carrying back freight if such a thing were possible, Nova Scotia coal, ranking in comparison with English and Scotch, as second class could be delivered at all these points at present figures. Such conditions would not imply a freightage of more than \$1.25 to British ports and \$1.50 to the Mediterranean, and as a matter of fact an offer at as high a figure as \$4.00 a ton, was recently made to a Nova Scotia firm for 50,000 tons f.o.b., the coal being intended for Cardiff, but freights are so disorganized at present, owing to the war and the general activity, and the demand of the ordinary markets is at the moment so far in excess of the supply that the offer could not be entertained. It is certain, however, that when the present boom is over and prices fall, as they will to the usual average, nothing but the most favourable conditions of transportation and back freight, would enable us to send coal to British ports and whether or not we could send to other European points would depend entirely upon return freights. The possibilities of a market in the West Indies and in South America are probably more favorable and will pay for consideration in a future article, meanwhile it is interesting to note that Canadian manufacturers

are especially fortunate in being free from the extreme fluctuations which prevail in the price of fuel, both in the old country and in the United States, in the former a bound from \$2.00 to \$6.00, upsets all calculations, and yet that is just what has happened, at the same time Canadian coal owners are to be congratulated in maintaining an even and a higher price at the mine, than almost any other commercial country. For instance the average price of Canadian coal for last year was \$2.00 per metric ton, in New South Wales \$1.30, the United States \$1.15, and Great Britain \$1.60.

If there is in England any institution that will compare with *McGill University* it is the *Mason Science College, Birmingham*, which was founded by the generosity of Sir Joshua Mason, and has since developed its operations through the benefactions of prosperous citizens very much after the manner of our own University, until it is easily at the head of British schools of that class. In spite, however, of its great advantages of wealth and position, it has been generally recognized that whilst excellent on the scientific side it was not equally strong on the practical, and for years its supporters have been looking for some means of remedying the defect.

The way has been opened up by the princely gift of \$500,000 by Mr. Andrew Carnegie to found a Birmingham University, and to this end Mr. Chamberlain, the Colonial Secretary is lending his influence.

It is interesting to note that "Mining" is to form a special feature, and especially that in this most important branch, a new departure is to be made in the appointment of a "practical" Mining Engineer to a chair, in order to supplement the theoretical and scientific instruction of the Professors by the practical experience of one, who has been "through the mill" and who is able to teach the best methods of applying scientific knowledge to actual work. This is a branch which has been neglected and the weakness of which has been the reproach of the leading Mining Schools in the past, until the title "A.R.S.M." has in many instances tended to bring more disrepute than credit to a venerable institution. It is a departure which may well be studied by Canadian Boards of Governors, especially those who have increased funds at their disposal.

A measure was recently introduced in the Nova Scotia Legislature proposing to deal with the subject of sub-marine coal areas in a somewhat drastic manner. Briefly stated it provided, that lessees of such areas who had not within a given time developed them, should be compelled to surrender their lease and the areas so forfeited be available for re-letting.

At the present stage of coal mining in the Province such legislation is altogether uncalled for even by the exigencies of trade, apart altogether from the principle of equity involved. A high authority has computed the available coal in Nova Scotia at 2,000,000,000 tons, of which one half is in land areas. With an outfit of 2,800,000 tons it is surely a little premature to cry out for the release of sub-marine areas in the public interest. If there had been any specific breach of covenant by existing lessees the situation would be different, and even then the means of relief obviously in another direction, but no such condition is alleged, and to moot a project which would have for its ultimate object, the confiscation of legally constituted rights, is alien to the spirit of just legislation, and calculated to check the development of our chief industry by creating a feeling of distrust.

The business situation in British Columbia is at present greatly complicated by the political, and it is evident that work will be very intermittent until after the elections in June. There are, however, not lacking evidences that the public are aroused to a sense of the importance of settling down once more to business, and are prepared to give

their quietus to the agitators, who in order to make political capital have succeeded in plunging the industry of the Province into a state of chaos and are doing their best to force an issue on party lines. The result is that men of all shades of opinion are rallying to the support of the non-party standard, and we shall probably have a government prepared to attend to the business of the Province on strictly business lines.

The vagaries of those so called leaders who practically caused the loss of a year's development in the mines, and the engendering of much bitterness and strife by passing the eight hours bill, and who would lessen the output of coal by excluding Chinese labor have sealed their fate as public administrators.

There is not a coal-field in Canada, to-day, that is not short of miners—work is waiting for thousands. With phenomenal activity in the States, it is impossible to draw them from thence; and apart from the Imperial policy involved in the treatment of a friendly State, it is a short sighted policy in any event to shut out the only labor which is available for the development of our mineral resources.

A careful investigation by the Directeur General of the Belgian Mines goes to disprove the theory that there is any connection between seismic disturbances and escapes of fire damp. On the 19th of July last, a serious earthquake developed in Rome, and twenty minutes afterwards affected the whole of the Belgian coal field. The Directeur at once instituted a series of enquiries from upwards of forty mines including nine especially fiery ones, and in no instance was there any unusual escape of gas.

In view of the possible exportation of Canadian coal to foreign markets, especially in Southern climes, the subject of briquettes becomes one of paramount importance, as this is the only form in which coal is taken for domestic purposes and often for steam generation. The Germans have so far become competitors in this branch with South Wales, which has hitherto held a monopoly of the markets, that they are now making briquettes of all sizes to suit the requirements of the customer.

Nova Scotia coal is specially adapted for this trade, but the difficulty hitherto has been to obtain cheap pitch.

The development of cokeing on the bi-product system should help to solve this difficulty, and there is no industry that would yield a more satisfactory return, if properly established on the Eastern coast than that of briquette making.

Mr. W. A. Hickman, Government Commissioner from New Brunswick, read a paper on the "Mineral resources of the Province," at the Imperial Institute, London, on the 19th ult.

In view of the scarcity of coal in England, even for naval purposes, the usual scare has been started in official quarters. A commission is to be appointed similar to the one organized in 1870 to report on the coal resources of the Kingdom, and meanwhile some cranks have rushed to the front with the proposal to tax exported coal. Such a suggestion is as little likely to find favor as any other proposal that England should depart from her free-trade principles. Even in times of great commercial depression the "fair trade party" cannot obtain a hearing.

The first importation of American coal in Austria is chronicled in a recent exchange. Three steamers carrying Pocahontas coal arrived at Trieste having secured a contract at \$1.25 less than quoted by Welsh firms. As illustrating the enormous cost of transportation without the assistance of back freight, it is pointed out that the freightage paid on those cargoes was \$5 per ton.

### Notes on Atlin Gold Fields.

By J. C. GWILLIM, Ottawa.

The present paper is intended to be of a general nature, concerning chiefly the present conditions of mining in the Atlin district, in advance of the more specific information contained in the annual summary of the Geological Survey.

This district, more correctly defined as the Atlin Mining Division, was discovered to be a productive placer field in the summer of 1898, and is practically, at present, the only productive result within British territory of the great Klondike rush of the past few years, as far as new placer camps are concerned.

The Klondike area has not expanded to any great extent, as far as poor man's diggings are concerned, and after these four or five years of active prospecting, the men are passing on to Cape Nome. In the first days of Atlin both the extent and richness of this camp appear to have been over-estimated, and of the many who assembled there early last summer but a small portion remained to do bona fide prospecting, and the actual productive work became concentrated about a comparatively small area, already located before the spring crowd came in.

Various causes, including the Alien Act of the B.C. Legislature, suspended opening of the season; and claim jumping, with consequent inaction until decisions were given, contributed towards the discontent of the new comers. Most of these departed to follow new rumours of strikes before the summer had passed, and carried with them but small recommendation of the place they had left. During June of the past year, however, prospecting of hurried nature was carried on up to the heads of the known gold bearing creeks of the Pine Creek basin, and over towards Teslin Lake, with the result that very little ground remained unstaked on the creeks eastwards of Atlin Lake, for twenty or thirty miles back.

It was not until August and September that we spent much time on these creeks themselves, and by that time the stakes alone, together with a few shallow trenches and holes, remained to represent the ground, that is, the new ground, of that season's discovery. Nearly all the work had become concentrated on seven short streams, at certain points where bed rock was not at all deep, the total producing length of these seven creeks being some 12 or 14 miles, out of their fifty or sixty miles in all.

As far as can be said at present the gold bearing area consists of a tract of country immediately east of Atlin lake and city, some ten miles wide by 15 to 20 miles back from the lake, the greater part of which all lies in the basin of Pine Creek and Surprise Lake, with their tributaries, Boulder, Birch, Spruce, Otter, and Wright Creeks.

McKee Creek runs parallel to Pine Creek, and is some seven miles south of it. It has a length of about eight miles, and contains some good ground. There appears to be a relation between the productive ground and the nature of the rocks in the Placer district, which may be useful in defining the gold bearing areas. At the present time, however, it cannot be said that the creeks outside of the boundaries indicated have had a fair trial. In fact there are many possibilities for this district, which suffers under no disadvantage of frozen ground. Provided plenty of water is available, the extent of pay gravel may be largely increased by hydraulic mining on a more economical scale than the costly methods employed by the individual miner on his 100-foot claim.

During last summer, somewhere between 1,500 and 2,000 men were working on these seven productive creeks. It has been estimated their output is about \$1,000,000. The official returns show much less than this figure. Probably \$750,000 is a fair estimate.

The gold is usually coarse, often as flat little flakes about the size of the seed, up to nuggets of half an ounce. Nuggets, usually well rounded, of several ounces, are not uncommon. The largest I have

heard of so far is one of 38 ounces from No. 6 below Discovery, Wright Creek. Others, larger, with more quartz attached, have been found on Spruce Creek.

As a rule the gold is not much associated with black sand or other heavy minerals, excepting on Wright Creek. Here the amount of black sand, pyrites, and bits of native copper, is large. The usual method of working is adapted to the short claims. The creeks or portions of them turned through sluice boxes, which pass beside the excavations made to bed rock. Into these sluice boxes the pay dirt is shovelled, while the boulders and barren stuff are thrown back on the washed out ground as the excavation proceeds.

The pay gravel is commonly found at or near bed rock, and sometimes a few inches of the softer bed rock carries gold. The whole process of getting down to this pay ground and disposing of the muck and boulders on a 100-foot claim is expensive, and it can also be seen that a single season spent on this small area often leaves it pretty well worked out. On the larger streams, such as Pine and Spruce Creeks, the water is diverted by wing dams, while the bed and banks are shovelled up into the sluices as before. Water wheels work Chinese pumps, and so keep the excavations from flooding.

The gold is by no means confined to the present stream beds, but these afford the most accessible concentrations wherever bed rock is shallow. Good pay was said to be taken from several of the low, rocky benches adjacent to the streams by reducers, and in other places drifting into the banks has exposed pay gravels, probably of an earlier period.

It is likely that much of the ground partially worked out by the individual miner will fall into the hands of hydraulicising companies, either by purchase or abandonment, since richer ground reported at Nome has already attracted many from this district.

#### QUARTZ MINING.

Concerning the Quartz discoveries, a good deal of exaggeration has been made. Specimens containing free gold are common from the Golden Gate locality of Taku arm, and also some from the Pine Creek basin.

There are strong veins of distinct fissure origin, usually containing quartz as vein matter, found throughout the same series of rocks as those containing the gold creeks. Sometimes gold and silver sulphides (Argentite) are visible, but usually there is a presence of the common sulphides of lead and iron, at times forming solid ore of a smelting character, the values of which are not well determined, in most cases. Some of these veins are from three to eight feet wide, and very well defined.

Copper pyrites and pyrrhotite occur, but are not as common as galena and iron pyrites.

These showings are of course little developed owing to cost of mine material and labour, together with the present remoteness of a market.

The milling quartz veins are not very much in evidence as yet, though many discoveries of such are reported from Golden Gate and Otter Creek district on Southern Taku arm. A deposit of a somewhat peculiar character occurs in the Anaconda group of claims, now under operation of an English syndicate, after extensive examination and sampling by Mr. A. H. Bromly, a London mining engineer. This consists of a zone or band of much altered rock, at times over 1,000 feet wide. It appears to be chiefly composed of magnesian carbonate, but is full of quartz stringers, and much impregnated with pyrites, and at times some galena and traces of nickel carbonate. Sampling by drill holes across the outcrop gave results in gold values which induced the bonding parties to make a payment and carry on further investigation during this winter.

In the February number of the *B.C. Mining Record*, it is stated that this rock runs about \$1.00 or less in gold per ton.



"Of two prospecting tunnels now being driven (under charge of Mr. Featherstone,) one has no higher values than \$2.20, and the other averages \$4.00 and is improving in grade."

This appears a small value, but the extent of possible ore body is very great. Very likely the better grades may run in courses. The work now being done will determine this, and the extent to which the ore is free milling. The presence of the nickel carbonate and also a green chromiferous mica in these prevalent magnesium rocks caused them to be often mistaken for copper bearing bodies, and as such it is not improbable they were first started, but copper, as a commercial quantity, appears absent in all the showings seen east of Atlin Lake.

On some of the islands of Southern Atlin Lake, native copper has been found, occurring as slabs and flakes along a dyke or vein which appears to cut the prevailing sandstones and conglomerates of that vicinity. Not much has been done with these showings so far, I believe. They are interesting and indicate great possibilities for the district.

Concerning the topographical features it may be called easy of access both by land and water. There is a fair approach for a railway from Tagish via Little Atlin Lake, some 60 miles. In summer there is all rail and steamboat service from Vancouver to Atlin City, excepting the Taku Portage of  $1\frac{1}{2}$  miles, over which a tramway runs. To the creeks trails and waggon roads can be made without much expense, as the valleys are often wide and easy.

Packing or transport rates from Atlin to the various creeks are from 1 to 3 cents per lb.

The cost of passage from Vancouver is about \$50. Food supplies are nearly double the outside prices. Wages were \$5.00 a day last summer, and may range somewhat under that figure in future.

The timber is chiefly spruce and jack pine, sufficient for mining purposes, but not found far up the creeks in quantity. Milling timber is found in the valleys and when sawn sells at \$100.00 to \$150.00 per thousand feet.

Mine materials, powder and steel, &c., are costly, and not much used at present.

The climate is moderately cold, in winter usually rather dry, with a snowfall probably somewhat less than Kootenay.

At the present time it is reported things are looking well for a busy season next summer. The development will probably be chiefly in the hands of syndicates formed to operate stretches of the creeks, and it may be hoped that successful results from the quartz development will increase operations in that field.

### Natural Gas in Ontario.

By EUGENE COSTE, M.E., Toronto.

[Paper read before the Canadian Mining Institute.]

**DISCOVERY.**—Prior to January, 1889, we had, commercially speaking, no natural gas in Ontario. Small quantities of it had been found in wells drilled for oil or for water, or were known to be coming out in natural springs from the ground—notably at Petrolia and Oil Springs (where in the old days large quantities were struck but not utilized), near Ridgetown, at Port Colborne and Niagara Falls, near Hamilton, at and near Collingwood, at Mimico near Toronto, and at the Caledonia Springs. But nowhere then was the quantity of gas obtained sufficiently large to more than partially heat or light one house or two. In the summer of 1888 I persuaded my father, Mr. N. A. Coste, of Amherstburg, Ont., to form a company (The Ontario Natural Gas Company, of which he was president) to drill for natural gas in the county of Essex, between the towns of Leamington and Kingsville. On my advice the first well of this company was located near Ruthven, Ontario. This well, which was afterwards solemnly baptised by the members of the company before a great concourse of people as "the

Coste Well No. 1," struck a large quantity of gas on the 23rd of January, 1889, in a very porous, sub-crystalline, bluish white dolomitic limestone forming the upper bed of the Guelph formation, at the depth of 1020 feet, or at the absolute depth of 362 feet below tide, as the elevation of the mouth of the well is 658 feet A.T. This was the first natural gas gusher in Ontario, and it was certainly a very large well, its production being, when I first measured it, the day after the gas had been struck, a little more than 10 million cubic feet per day of gas flowing freely at the mouth of the well. After the well was tubed and the gas was shut in, it registered a rock pressure of 460 lbs. to the square inch. This well opened up the Essex County gas field now supplying natural gas to the cities of Windsor, Detroit and Toledo. The second large natural gas well in Ontario also opened up an entirely new field, and was drilled a few months later, in August of the same year, in the county of Welland, at a location which I also selected 7 miles east of Port Colborne on lot 35 of the 3rd Concession from Lake Erie of Bertie Township. This well was drilled by the Provincial Natural Gas and Fuel Company of Ontario, Limited, which was formed by myself with a view of developing this new natural gas field to supply the city of Buffalo, only 14 miles away from the centre of the field. I was then, when the first well was drilled, and afterwards for several years the manager and engineer of the company. The gas was struck in a white sandstone of the Medina formation at 836 feet, or at an absolute depth of 218 feet below tide. The flow from the well at its mouth measured 1,700,000 cubic feet of gas per day, and the rock pressure of its confined gas was 525 lbs. 142 Wells have now been drilled in this field by the Provincial Natural Gas Company at a total expense of \$703,000. the gas being supplied since January, 1891, to Fort Erie, Bridgeburg and Buffalo.

**GEOLOGY OF THE ONTARIO GAS FIELDS.**—As we have stated above, in the Essex County gas field between Leamington and Kingsville the gas is found in the upper bed of the Guelph dolomite. This could not be positively determined until early last year when we drilled a well on the Woodbridge farm in the Township of Colchester South down to the depth of 2,420 feet. This well found the Trenton limestone at 2,150 feet, and gave us the first good log of the complete series of the measures underlying that county, and we can now judge exactly of the correct relative position of the gas rock, which is the upper part of the Guelph dolomite.

The following logs of some of the wells we drilled in different parts of the Essex County reveal many new features of the underground geology of that district:—

Coste Well No. 1., N.W. corner lot 7 in 1st Con. of the Township of Gosfield. Elevation of derrick floor, 658 feet; drilled December, 1888, and January, 1889:—

Formation.	Strata.	Thickness.	Depth.	Remarks.
	Soil .....	5 feet to	5 ft.	
	Drift, grey sand .....	115 feet to	120 ft.	With a little clay at 60 and 85 feet.
Onondaga ..	Brown and grey dolomitic limestones, with gypsum and with white and black flint.....	380 feet to	500 ft.	
do ..	Grey blue and shaly dolomites and drab brown dolomites with a good deal of gypsum .....	360 feet to	860 ft.	
		of shaly group		
do ..	Dark brown dolomites and gypsum (with gypsum bed from 970 to 985) ..	160 feet to	1020 ft.	A little gas at 910 feet and 930 feet.
Guelph .....	Grey blue crystalline vesicular dolomite.	11 feet to	1031 ft.	Large quantity of gas at 1020ft. or at 362ft. below tide.

Well No. 3 of the Ontario Natural Gas Company, Limited, on lot 8 in the 2nd Concession of Gosfield Township. Elevation 663 feet:—

Formation.	Strata.	Thickness.	Depth.	Remarks.
Onondaga ..	Drift, mostly sand... Grey, drab, brown and blue dolomites with gypsum (shaly group from 585 ft. to 930 ft.) (gypsum bed from 1055 ft. to 1070 ft) .....	141 feet to	141 ft.	
		960 feet to	1101 ft.	Salt water at 1095 ft., bottom of well at 1101 ft.

Well No. 1, Union Gas Co., in N.W. corner of lot 17 in 7th Concession of the Township of Colchester North. Elevation 598 feet:—

Formation.	Strata.	Thickness.	Depth.	Remarks.
Corniferous and Onondaga .....	Drift, mostly clay... White grey limestones and brown dolomitic limestones with gypsum below 260 feet .....	65 feet to	65 ft.	
Onondaga ..	Grey blue dolomitic shales and shaly dolomites and drab brown dolomites with a good deal of gypsum, gypsum bed 680 to 690 ft ..	610 feet to	675 ft.	Sulphur water at 582 and 613 ft., probably the upper 100 ft. represents the Corniferous.
do ..	Dark grey and brown dolomites with gypsum, gypsum bed from 1,125 to 1140 .....	300 feet to of shaly group	975 ft.	
		200 feet to	1175 ft.	Salt water at 1172 ft.

Well on I. Desjardin's farm, lot 7 in 3rd Concession of Tilbury West Township. Elevation 603 feet:—

Formation.	Strata.	Thickness.	Depth.	Remarks.
Corniferous.	Drift, boulder clay..	120 feet to	120 ft.	
Oriskany ...	White and yellow brown limestones..	130 feet to	250 ft.	
Onondaga ..	White yellowish fine sandstone .....	50 feet to	300 ft.	
Shaly Group Onondaga	Yellow, white and brown dolomites (with gypsum from 450 to 550 ft.; with flint from 550 to 650 ft.; darker brown with gypsum from 650 to 800 ft.) .....	500 feet to	800 ft.	
Onondaga ..	Blue and brown (mostly quite shaly) dolomites with a good deal of gypsum .....	330 feet to	1130 ft.	
Onondaga ..	Dark grey and brown dolomites with gypsum - gypsum bed from 1275 to 1295 ft. ....	185 feet to	1315 ft.	Altogether 1015 ft. of Onondaga.
Guelph .....	White grey crystalline limestone .....	18 feet to	1333 ft.	Salt water at 1315 ft.

In two wells drilled on Joseph Lalonde's farm, about one mile south-west of the Desjardin's farm well, some oil and gas were obtained at 1213 feet and at 1240 feet, (53 brls. being shipped from there to Petrolia), from rocks of the lower part of the Onondaga; quite a little gas and oil were also found on that farm at the bottom of the drift at 114 feet.

Well on the Woodbridge farm, lot 64 in the 1st Concession of the Township of Colchester South. Elevation, 648 feet:—

Formation.	Strata.	Thickness.	Depth.	Remarks.
Drift .....	Sand .....	20 feet to	20 ft.	
	Quicksand .....	90 feet to	110 ft.	
Onondaga ..	Grey and brown dolomitic limestone with flint and gypsum .....	67 feet to	177 ft.	
do ..	White fine sharp sand ..	10 feet to	187 ft.	
do ..	White, grey & brown dolomites with white & black flint and with gypsum..	203 feet to	390 ft.	
do ..	Grey, blue and brown dolomites (mostly shaly with a good deal of gypsum—shaly group.....	370 feet to	760 ft.	
do ..	Dark grey and brown dolomite with gypsum (gypsum bed 865 to 875 ft.) .....	150 feet to	910 ft.	
Guelph and Niagara 215 feet...	Blue, white, grey and brown dolomites, quite crystalline and very porous...	215 feet to	1125 ft.	Salt black sulphur water at 910 feet, and again at 1010 feet.
Clinton 155 feet .....	White and white blue limestones .....	155 feet to	1280 ft.	More salt water at 1232 feet.
Medina 285 feet .....	Grey blue shale .....	7 feet to	1287 ft.	
do ..	Grey blue limestone.	5 feet to	1292 ft.	
do ..	Green shales .....	8 feet to	1300 ft.	
do ..	Red pink shales .....	5 feet to	1305 ft.	
do ..	Grey blue unctuous shales .....	88 feet to	1393 ft.	
do ..	Grey blue and white sandy limestone...	62 feet to	1455 ft.	
do ..	Red pink shales .....	110 feet to	1565 ft.	
Hudson River .....	Grey blue lime shales with shells of lime.	350 feet to	1915 ft.	
Utica .....	Brown and black shales .....	235 feet to	2150 ft.	
Trenton .....	White and dark grey limestones .....	270 feet to	2420 ft.	A little gas and oil at 2150 feet.

In a well drilled about half a mile east of Amherstburg 50 feet of the Oriskany sandstone were found between the depths of 252 to 302 feet.

In wells drilled in lot 12 in 2nd Concession of Maidstone township some gas was found in the bottom of the drift on top of the rock at 82 feet, and also in stratas of the Onondaga at 700 and 1040 feet. The Oriskany sandstone in the first of these wells was reported to have been struck between 275 and 300 feet.

Another well drilled on Lot 1 in Concession 1 of Maidstone struck some oil in the upper part of the Corniferous limestone at 115 feet.

The principal features revealed by these logs which we might point out are:—

1st.—In the south and south-east part of the county of Essex along Lake Erie, the first strata met with under a heavy sand drift is the Onondaga, and not the Corniferous, as it was supposed, and as shown on the geological maps.

2nd.—Between the Coste well, No. 1, and well No. 3, of the Ontario Natural Gas Co., in a distance of three-quarters of a mile, there is a dip of 80 feet. This, as shown by the logs of other wells between these two, is due to a fault in the stratas running in a direction W.N.W. and E.S.E., and passing only a little to the north of Coste Well No. 1. The logs of other wells to the west of Coste well No. 1 have also revealed another fault running a short distance west of that well in a direction at right angle to the fault above mentioned.

This faulty or fractured structure of the stratas is a pronounced feature of many oil and gas fields, and this feature was recognised by

the late Professor Orton as very well marked in the oil and gas field of North-western Ohio. (Geology of Ohio, Vol. 6, P.P. 53, 95 and 96, or page 46 1st An. Rep 3rd Organisation 1890). To us, this is one more direct proof to add to those we will enumerate below in support of the volcanic theory of natural gas and petroleum.

3rd.—An extensive bed of gypsum, 10 to 20 feet thick, has been regularly found in the lower part of the Onondaga formation. This bed underlies the greater part of the County of Essex.

4th.—Oil and gas, though the first has not yet been found in paying quantity in the county and the second only in one field, are already known to exist in many parts of the county and in a number of different stratas.

5th.—Large quantities of salt water are always found in Essex county in the Guelph and Niagara and in the Clinton.

6th.—The Oriskany sandstone is well developed under the western and northern parts of the county, but is missing in some parts of it, as shown by the record of well No. 1 of the Union Gas Co., given above.

7th.—Only one well, the Woodbridge well mentioned above, has yet been drilled down to the Trenton limestone in the county, and thus well struck a little gas and some oil in the upper part of this formation.

The following logs of four of the wells of the Provincial Natural Gas Co. will illustrate fully the underground geology of the Welland county field :—

No. 1 Well, Lot 35, Concession 3, from Lake Erie, of the Township of Bertie. Elevation 618 feet.

Formation.	Strata.	Thickness.	Depth.	Remarks.
Corniferous.	Soil .....	2 feet to	2 ft.	
	Dark grey limestone	23 feet to	25 ft.	
Onondaga ..	Grey and drab dolomites & black shales with gypsum	390 feet to	415 ft.	Fresh water cased off at 284 .....
Guelph and Niagara...	Grey Dolomites.....	240 feet to	655 ft.	Salt water at 548ft., cased off at 596ft.
Niagara Shales.....	Blue shales.....	50 feet to	705 ft.	
Clinton.....	White Crystalline Limestones, grey and shaly towards bottom	50 feet to	735 ft.	A little salt water.
Medina.....	Red sandstone.....	55 feet to	790 ft.	
do ..	Red shale .....	10 feet to	800 ft.	
do ..	Blue shale.....	8 feet to	808 ft.	
do ..	White sandstone.....	5 feet to	813 ft.	
do ..	Blue shale.....	20 feet to	833 ft.	Total thickness, 98 feet.....
do ..	White sandstone.....	13 feet to	846 ft.	Gas at 836 feet.....

Well No. 14 on Lot 6 in the 15th Con. from Nigara River of Bertie Township. Elevation 605 feet.

Formation.	Strata.	Thickness.	Depth.	Remarks.
Drift .....	Clay .....	38 feet to	38 ft.	
Onondaga ..	Dolomites, gray and drab, black shale, and gypsum.....	300 feet to	338 ft.	
Guelph and Niagara...	Grey dolomites.....	230 feet to	568 ft.	Salt water at 470 ft.
Niagara Shales.....	Blue shales .....	60 feet to	628 ft.	
Clinton.....	White and grey limestones .....	32 feet to	650 ft.	
Medina.....	Red sandstone .....	83 feet to	743 ft.	A little gas.....
do ..	Blue shale .....	15 feet to	758 ft.	
do ..	White sandstone.....	16 feet to	774 ft.	
do ..	Red shales.....	850 feet to	1624 ft.	
Hudson River .....	Blue shales with lime shells .....	730 feet to	2354 ft.	
Utica.....	Black shales .....	171 feet to	2525 ft.	
Trenton.....	White and grey limestones .....	685 feet to	3210 ft.	
CalCIFerous ..	Yellowish sandstone	45 feet to	3255 ft.	A little salt water..
Archaeon.....	Micaschist .....	2 feet to	3257 ft.	

Well No. 22.—Point Albino, Bertie Township, Elevation 580 feet..

Formation.	Strata.	Thickness.	Depth.	Remarks.
Drift .....	Sand.....	10 feet to	10 ft.	
Corniferous.	Gray limestones with flint.....	82 feet to	92 ft.	
Onondaga ..	Grey and drab dolomites, blue shales, and gypsum.....	388 feet to	480 ft.	
Guelph and Niagara ..	Grey dolomites.....	235 feet to	715 ft.	Gas in large quantity at 500, 530, & 580. Salt water at 600 to 630 feet.
Niagara Shales....	Blue shales .....	55 feet to	770 ft.	
Clinton.....	White limestones.....	30 feet to	800 ft.	
Medina.....	Red sandstone.....	80 feet to	880 ft.	
	Blue shale .....	13 feet to	893 ft.	
	White sandstone.....	17 feet to	910 ft.	Gas at 902 feet .

Well No. 61, Lot 2, in 4th. Con. Willoughby Township. Elevation 610 ft

Formation.	Strata.	Thickness.	Depth.	Remarks.
Drift .....	Clay.....	18 feet to	18 ft.	
Onondaga ..	Dolomites and shales with gypsum.....	202 feet to	220 ft.	
Guelph and Niagara...	Grey dolomites .....	220 feet to	440 ft.	Salt water at 330ft.
Niagara Shales.....	Blue shales .....	50 feet to	490 ft.	
Clinton.....	White limestones .....	30 feet to	520 ft.	A little gas at 495 feet and a little salt water.....
Medina.....	Red sandstone and shales .....	73 feet to	593 ft.	
	White sandstone.....	10 feet to	603 ft.	
	Blue shale.....	12 feet to	615 ft.	
	White sandstone.....	18 feet to	633 ft.	
	Red shales.....	830 feet to	1463 ft.	
Hudson River .....	Blue shales .....	717 feet to	2180 ft.	
Utica.....	Black shales .....	160 feet to	2340 ft.	
Trenton.....	White and grey limestones.....	670 feet to	3010 ft.	Gas at 2940 feet. 1000 lbs. rock pressure.....
CalCIFerous ..	Grey coarse sandstone.....	19 feet to	3029 ft.	
Archaeon.....	White quartz.....	1 foot to	3030 ft.	

These four wells are almost on a north and south line across the field in the following order from north to south : No. 61, No. 14, No. 1, and No. 22, and the distance between the two extreme wells north and south is ten miles. We may point out from the above logs and from the records of the other wells now drilled in the field, to the number of 142, the following features :—

1st.—The stratas dip to the south and south-east uniformly at the rate of about 35 feet to the mile except for a small synclinal (about one mile wide and 30 feet deep) the axis of which is about one mile north of No. 22 well at Point Albino.

2nd.—Salt water was struck in every well in large quantities towards the middle of the Guelph and Niagara formation. A little salt water is also found in the Clinton, in the White Medina Gas rock and in the CalCIFerous at No. 14, but in none of these formations below the Guelph and Niagara is there anything like a continuous body of salt water, which on the contrary lies there in disconnected small bodies of water.

3rd.—Besides being found in the stratas indicated in the above logs gas was also found in some other wells in large quantity 5 feet in the Clinton limestone, 10 feet in the red Medina sandstone and in the upper white sandstone of the Medina. Some amber-green color of a gravity of 42½ degrees Baumé was also found in the last few feet of the lower white Medina sandstone at wells Nos. 20, 28 and 62. The gas in that sandstone is generally found 3 feet in from the top of it, but often also another vein is found 9 to 10 feet in.

HOW LOCATED—ORIGIN.—In the opening remarks of this paper I

referred briefly to the discovery of the only two gas fields yet found in Ontario and I may add in Canada, not so much as a matter of record or history, but more as an introduction to the discussion of the much more interesting and important point scientifically and economically which led me to make these discoveries and which is no less than the question of origin of the natural gas and petroleum.

Had I not entertained the firm conviction, against the generally accepted theory in this country, in the United States and in England, that the origin of natural gas, of petroleum and of bitumens in general, is volcanic instead of organic, I would have been unable to point out as likely to become natural gas fields these two localities in Essex and in Welland Counties 200 miles apart one from the other and each about 100 miles from any other oil or gas field known at that time. It is indeed quite clear that one believing in the organic theory of origin of natural gas and petroleum would naturally consider that there might be natural gas or petroleum deposits under any parts of the peninsula of south-western Ontario between the Georgian Bay, Lake Huron and Lake St Clair to the north-west and Lake Erie and Lake Ontario to the south-east, as the whole of that large section of the country is underlaid with Devonian and Silurian sedimentary stratas more or less fossiliferous; and it would be and has been impossible to any one following that organic origin theory to localize any particular district of that vast peninsula where these hydrocarbon products should be found by drilling. In fact, according to that theory, if found in one place, these products should be found in almost any other part of the peninsula. On the other hand, for one accepting as I did the volcanic origin of these products as gaseous emanations from the interior of the earth along certain fissured and fractured zones of the crust of the earth, it was possible to select in south-western Ontario several likely new gas fields by mapping out the probable continuation in Canada of these fissured and fractured zones from other gas and oil fields already located and developed on the same zones in the United States. This was done by me, as stated above, with the result that our only two gas fields in Ontario were at once discovered and this result is in itself a strong proof of the soundness of the theory I accepted of the volcanic origin of natural gas. Especially so when it is considered that in each of these two Ontario new fields the natural gas was found in formations not before known anywhere to contain natural gas in large quantities, viz, as before stated, the white Medina sandstone just above the thick body of the Medina red shales in Welland County and the upper bed of the Guelph dolomitic limestone in Essex County. Thus the volcanic theory allowed me not only to localize with precision two new and entirely unsuspected gas fields, but also to find the gas in entirely new horizons, showing conclusively that when these new fields were selected it was not simply to try and reach by drilling certain formations known elsewhere to be rich in oil and gas, but, on the contrary, that they were selected with the conviction imparted by the volcanic theory of origin that wherever found, natural gas and petroleum are simply emanations from below into a porous rock or into a drift sand or gravel, and that that rock, drift sand or gravel plays only the role of a tank or reservoir and therefore that natural gas or oil, or both, might be found in any or all of the porous rocks or stratas drilled through no matter what their geological name or age might be or whether they had or not a past record as producers of oil or gas.

This is exactly what was found to be the case in the drilling of the 12 wells we have now drilled in Welland County, as we have to-day there, and have had for years, wells connected on the lines getting their gas from each of the following different stratas:

- 3. From three different horizons in the upper beds of the Guelph dolomite. } At depths of 500, 530 and 580 feet.
- 4. From one horizon in the first 10 feet of the Clinton limestone. } Which is about 200 feet deeper than the lower gas horizon just mentioned in the Guelph.

- 5. From one horizon in the upper part of the red Medina sandstone. } About 40 feet below the preceding horizon in the Clinton.
- 6. From one horizon in the upper white Medina sandstone. } About 70 feet below the preceding horizon in the Medina.
- 8. From two horizons in the lower white Medina sandstone. } About 20 and 30 feet below the preceding horizon in the upper white Medina.
- 9. From one horizon in the Trenton limestone 600 feet below the top of it, at a depth of 2940 ft. } About 2,220 feet below the preceding horizon in the lower white Medina sandstone.

To these nine different "sands" (this term means any gas or oil rock in the parlance of a driller whether it is a sandstone, a limestone or any other rock) producing gas in Welland County several others could be added, in which smaller quantities of gas were found, especially in the big interval of shales 1,700 feet thick, between the lower Medina white sandstone and the Trenton limestone where gas was encountered several times in "shells" or small shaly limestone layers.

At a well at St. Catharines, about 20 miles north-west from our wells in Welland County, yet another and lower "sand" was found to contain gas, and some large wells have been obtained in this same "sand" at different localities in Oswego and Onondaga Counties, New York State. This "sand" is a white yellowish sandstone under the Trenton limestone and immediately above the Archæan formation.

Here, then, is a series of Silurian sedimentary rocks in Welland County some 3,000 feet thick resting directly on the Archæan rocks, and containing gas in every one of its porous portion or strata from the one immediately above the Archæan to the surface. Is not that a proof that the source of the gas is still lower and below the Archæan? But let us now look over the results of the thousands upon thousands of oil and gas wells drilled in the States of West Virginia, Ohio, Indiana, Pennsylvania and New York. There we have altogether a series of sedimentary stratas, some 10,000 feet thick, ranging from the Archæan to the Upper Barren Coal Measures of the Carboniferous, and here also every sandstone or porous limestone or other rock of that thick series of rocks has in one locality or another in these states or in Ontario produced either oil or gas or both in commercial quantities. Starting from the most southern of the oil and gas fields in West Virginia where the newer rocks of the Carboniferous outcrop, and going northwest to Indiana and south-western Ontario and north-eastward across Pennsylvania and New York States as far as the Adirondack region where the Archæan rocks outcrop, the oil and the gas are found geologically deeper and deeper as the measures raise to the surface in the following principal "sands" in descending order:—

Pittsburg sandstone....	Just above the Pittsburg coal.....	Lower Carboniferous & Sub-Carboniferous
50 foot Macksburg Sandstone.....	160 ft. below the Pittsburg coal.	"
1st Cow Run or Joy Sand	240 "	"
Mahoning Sandstone... 300	" "	"
Middle Cow Run or Freeport Sandstone	410 "	"
Upper Second Cow Run Sandstone.....	600 "	"
Lower Ditto.....	650 "	"
Tionesta, Homewood, or 700 ft. Macksburg Sandstone.....	810 "	"
Upper Connoquenessing or 800 ft. Macksburg Sandstone.....	910 "	"
Lower Connoquenessing or upper Salt Sand.	1000 "	"
Lower Salt Sand or Sharon Conglomerate, or Olean Conglomerate or Maxon Sand.....	1050 "	"
Keener Sandstone.....	1200 "	"
Big Injun Sand.....	1280 "	"
Squaw Sand.....	1350 "	"
Berea Grit.....	1700 "	"
1st Sand or Butler 2nd Sand or Gantz	.....	Upper Devonian White Sands.
100 foot Rock.....	.....	"
50 foot Rock.....	.....	"
2nd Sand or 30 foot Rock.....	.....	"
Blue Monday Sand or Gordon.....	.....	"

Boulder Sand or Hickory.....	Upper Devonian White Sands.	
Stray 3rd Sand.....	"	"
3rd Sand.....	"	"
4th Sand.....	"	"
5th Sand.....	"	"
Elizabeth Sand.....	"	"
Warren Slush Oil Sand.....	Middle Devonian.	
Warren 3rd Sand.....	"	"
Clarendon 3rd Sand.....	"	"
Speechley Sand.....	"	"
Cherry Grove and Sheffield.....	"	"
Cooper Oil Sand.....	"	"
Bradford Oil Sand.....	"	"
Lower Waugh and Porter Sand.....	"	"
Elk County Group of Sands 2 or 3 in number.....	"	"
Hamilton Limestone.....	The Petrolia and Oil Springs, Ontario, upper show.....	Lower Devonian
Corniferous Limestone.....	Oil Springs & Petrolia fields.....	"
Oriskany Sandstone.....	Euphemia field, Ontario.....	Silurian
Guelph Limestone.....	At least 3 different horizons in Essex & Welland Counties.....	"
Niagara Limestone.....	Seneca Falls and Alden, N.Y. State, and in Indiana.....	"
Clinton Limestone.....	At Lancaster, Ohio and Welland Co., Ontario.....	"
Medina Red Sandstone.....	2 different horizons in Welland County and in New York State.....	"
Medina Upper White Sand )	Welland County, Buffalo,	"
Medina Lower White Sand )	Alden, Oswego, and Onondaga Counties.....	"
Trenton Limestone (upper part).....	Several horizons in Ohio and Indiana.....	"
Trenton Limestone (lower part).....	Several horizons in Welland County, Oswego, and Onondaga Counties, N.Y.....	"
Calcliferous Sandstone.....	St. Catharines, Ont., Oswego, & Onondaga Counties, N.Y.....	"

To this list of about 50 different porous rocks, rich in oil and gas, quite a number of other horizons could be added by a more careful study of the subject, and the Cambrian rocks of the Quebec group now furnishing oil in Newfoundland, can also be added. This fact, that so many porous rocks, one upon the top of the other and all through the 10,000 feet of sedimentary measures from the Archaean floor to the surface of this region are in places filled with oil or gas, should serve not only as a strong evidence, but in our opinion, as a convincing proof that these hydrocarbon products are not indigenous, but adventitious to every one of these "sands" and therefore that they came through fissures in the Archaean below and have penetrated and imbibed every porous rock they encountered in their ascent. We cannot indeed admit a different and new organic source under each one of these formations, especially when we come down to rocks of the lower Silurian and Cambrian ages, during which time the development of vegetable or animal life was most certainly entirely inadequate to explain by some decomposition of organic remains the enormous quantities of petroleum and natural gas found for instance in the Trenton or Lower Silurian limestone of Ohio and Indiana. This ancient formation, we might here remark, has been the most prolific one on the North American Continent in hydrocarbon products.

But we have still a more direct proof that these hydrocarbon products are due to gaseous emanations from below: this proof is the rock pressure of natural gas. As is well known, when first tapped in any of the wells the natural gas rushes out of the hole impelled by a great force which, when the gas is closed in and confined records on a gauge in some fields up to 1,500 lbs. to the square inch, but is generally between 200 and 1,000 lbs.; and here comes the most important point in this relation: in every field when gas is found in several stratas, the highest pressure is always recorded in the lowest or deepest strata. For instance, in the Welland County field the rock pressure of the gas was 300 lbs. in the Guelph dolomite; 400 lbs. in the Clinton; 525 lbs. in the Medina white sand; and, 1,000 lbs. in the Trenton Limestone. These enormous pressures decreasing as the gas travels up from below by friction through the small fissures and the small pores of the

"sands," we submit, cannot be explained any other way than by a volcanic source from below.

It certainly is not to be argued that the expansive nature of the resulting gas from the decomposition or distillation of organic remains will show 1,000 or 1,500 lbs. pressure, as it sometimes does in a certain rock, while in another rock, or in the same rock nearer the surface the pressure resulting from a similar expansion due to an organic decomposition or distillation will only be a few pounds.

Neither is it to be argued seriously that the weight of the superincumbent rocks is the cause of the high pressure of natural gas in its reservoir, and of the increase of that pressure in depth, for the gas is in the pores of firm cohesive rocks, with no more weight on it than the walls of a cavern would on the water in that cavern.

Neither is the theory of hydrostatic or artesian water pressure, advanced and strongly advocated by Professor I. C. White, of West Virginia, and by the late Professor Orton, of Ohio, in their interesting papers and reports on natural gas and petroleum able to explain how organic made gas came to its rock pressure, for the simple reason that the oil and gas rocks of North America are not permeable or pervious rocks, though they are porous in places, as every one who has made a study of these rocks will admit. But, if for the sake of argument, we admit that they are pervious rocks, then this hydrostatic theory is at once condemned again absolutely by the well-known fact, so often strongly illustrated by Professor Orton himself, that the rock pressure of all gas fields constantly diminishes as the gas is taken out and used from the field, and the similar fact that an oil field furnishes flowing wells only for a short time when first discovered. Indeed an artesian water pressure communicated through a pervious rock from the outcrops of it would, of course, furnish a constant hydrostatic head, and consequently the last cubic foot of gas from a gas field would come out of it with the same pressure as the first cubic foot, and flowing oil wells impelled by this constant force would continue to flow and would not have to be pumped. Especially so if it is admitted as Professor Orton did (Bulletin of the Geol. Society of America, vol. 1: pp. 91, 92 and 93, March 1, 1890; also Geol. of Ohio, vol. 1st.—3rd. Organization, pp. 102.) that the porosity is so perfect in the gas rock between the outcrops of it and the gas field that the water pressure suffers absolutely no loss by friction, then surely, with such a free communication, the imparted pressure to the gas or to the oil by this water head should be absolutely constant. Instead of that, the rock pressure of the gas in the North Findlay field is now only a few pounds at many points instead of 450 as at first, and thousands of flowing oil wells in north-western Ohio have had to be pumped for years, and this has been the case in every field. If it is held that the porosity through which the communication of the gas field with the outcrop of the rock is maintained is so small and defective that only the help of long geological time has allowed the water from the outcrops to slowly penetrate and to finally give to the gas its high rock pressure, while on the other hand now that the gas is being used so rapidly from the field, it is impossible for the long and tortuous water column to reach promptly enough to prevent the well-known, rapid and great recorded diminution of the gas pressure. Then to those presenting this argument, it is only necessary to answer that this great want of porosity would of necessity wear off the pressure, and therefore that in such a case the rock pressure of the natural gas would be very small, as it is with natural gas found in shales (so called shale gas) where a good example is at hand to show how the minuteness of the pores of the shales and the want of porosity has destroyed the original strong rock pressure of the gas permeating through these shales from below.

To show by a direct example that the artesian water pressure theory is inadmissible, we will consider the original rock pressure of the Medina lower white "sand" in the Welland County field, which at

No. 1 well was 525 lbs.; there the gas was found in that sandstone at 218 below tide, and as this sandstone outcrops (some 15 miles north at Queenston and Lewiston, below Niagara Falls) at an altitude of 400 ft. A.T., the hydrostatic head would be 618 ft. Therefore such a column of salt water weighing 0.476 lb. per square inch for every foot in height, would exert a pressure of 294 lbs. (that is supposing a perfectly free and easy communication and no loss of pressure) as against 525 lbs., the actual rock pressure recorded. If we now consider the minuteness of the pores of that white Medina sandstone and the necessary loss by friction, which water entering the outcrops of it at Queenston would suffer in its long travel to No. 1 well, we can readily see that water entering the outcrops there never would get to No. 1 well, and therefore, that not a single pound of that supposed waterhead would be available in the gas field to impart pressure to the gas. We see then that it is impossible to explain through an organic origin of the gas, its rock pressure and especially the increase in depth of that pressure, while the volcanic theory, on the contrary, accounts for these facts at once. We now propose to show that through the volcanic theory all the other conditions of the oil and gas fields are most readily explained. Firstly: we will recall the well-known geological fact that volcanic action is, and has been during all geological ages, shifting and intermittent along the fractured zones of the earth crust, that is to say, that while a volcanic activity manifests itself intermittently in a certain region during a certain geological age, in subsequent ages it dies out and becomes entirely quiescent in that particular region to break out anew in other portions of the earth, and this explains why we find that natural gas and oil, though volcanic products, are also stored products, and why their rock pressure and quantity gradually decrease as we take these products out of their deposit: the volcanic action which brought them there was active (as it always is) only for a time, and is now dead and unable to refill the reservoirs, just as it is in most mining regions of the earth where a similar volcanic activity once was filling with quartz and other veinstones, more or less mineralized, fissures, veins and lodes, now long ago solidified.

Secondly—Though many new oil and gas fields and new districts remain yet to be discovered, still enough is known to-day of the distribution of these products in certain regions to show how localised and accidental their deposits are: for instance, in the State of Ohio where so many wells have been drilled all over the State, it is only from a very limited area in the North-western part of the State that two hundred million barrels of oil and enormous quantities of gas have been produced in the last twelve years, yet in many other counties of the State we have the same fossiliferous and porous stratas presenting also numerous anticlinal and other folds, but they nevertheless have been proven to be barren of hydro-carbon products. Similarly the oil region of Pennsylvania is altogether confined to a belt in the western part of the State from Greene County to McKean Connty, and all the central part and north-eastern part of the State, alto underlaid with porous and sedimentary stratas are barren of hydro-carbon; and, the disturbed condition and the high inclination of the stratas cannot be advanced to explain it as other oil and gas regions produce from much more disturbed and inclined stratas, as for instance California. The same localisation can be pointed at in Ontario and in New York State, where the oil and gas fields cover an exceedingly small percentage of the porous and fossiliferous areas—though there is no doubt that further discoveries will somewhat increase this small percentage in both Ontario and New York State. But where this localisation is most striking is in the famous oil fields of the volcanic peninsula of Apcheron, near Baku in Russia, where, from a small area of not over 8 square miles, a production of oil of over 700,000,000 brls. has now been obtained. We could give a much fuller illustration of this local distribution of the oil and gas deposits in small

fields along the fissured and fractured zones of the crust of the earth in connection with the big orogenic movements of that crust, but we will have to leave this to a further occasion. We have however, referred to this point here to show how this local and accidental distribution is unlike what would be expected from deposits of organic origin, who like the coal beds would naturally spread out uninterrupted over wide regions. On the other hand, a volcanic product is "a priori" found localised along the lines of volcanic activity and there in large quantities, while the neighboring localities or districts not subjected to this volcanic action are barren.

Thirdly—In all the oil and gas fields, either above or below or in the producing sands themselves a bitter strong salt water, very often sulphurous, is found. Sulphur is also found in some of the oils as in the Ontario and Lima oils, and often in the natural gas under the form of hydrogen sulphide. In the Welland County field of Ontario, the upper gas in the Guelph Dolomite has a very pronounced odor due to the hydrogen sulphide it contains, and so has the gas from North-Western Ohio, Indiana and Essex County, Ontario. An analysis by Professor Francis C. Phillips, of Allegheny University, of the Guelph Dolomite gas of Point Abino, Welland County, gave the following composition:

Hydrogen sulphide .....	0 74
Nitrogen .....	2 69
Hydrocarbons of the paraffin series .....	96.57
	100.00

Another analysis gave 0.82 of hydrogen sulphide. Now why is this water so strongly saturated with chlorides of sodium, calcium and magnesium, and where is this hydrogen sulphide and nitrogen coming from? While the late Professor Orton who was a firm exponent of the organic theory of origin of natural gas and oil, has to our knowledge, never explained how rain water entering the outcrops of the Trenton in Lake Huron, and travelling so freely through this rock as to loose no head by friction in the long transit to Ohio and Indiana, ever became such a bitter sulphurous brine in the oil and gas fields of these States, we, on the contrary, have in the theory of volcanic emanations a ready answer to the above questions, and a most simple and direct explanation of the presence of these other elements in the oil and gas fields such as water, chlorides, nitrogen and hydrogen sulphide. Indeed, besides the emission of lavas the volcanic activity in all the numerous volcanic regions of the earth where it is now active, or only lately quiescent, or even at many places where it has long been dormant, is also the cause of the escape of large quantities of steam vapours and of gaseous emanations forming the well known "fumaroles," "solfataras," "suffionis," "salzes" and "moffettes" of the volcanic districts. The careful study of these gaseous emanations made by many reputed scientists, has proven beyond a doubt, that they are largely composed of alkaline and other chlorides including ammonium chloride, hydrogen sulphide and hydrocarbons. Here is a direct indisputable analogy between the products of the present volcanic activity, so widely distributed over the entire globe, and between the products we find in the different oil and gas fields. Surely this is a much stronger analogy to compare to the products of the oil and gas fields than the fact often advanced that marsh gas is produced in the swamps and marshy grounds of to-day by the decay of vegetation. If that be taken as analogous, then where is the coal or other carbonized residue in the Devonian and Silurian gas and oil rocks of North America?—for, to follow this supposed analogy, the decaying vegetation of the swamps must continue to decompose into peat or lignite and finally into coal. If it is claimed that the process of decomposition or destructive distillation has been so complete as to leave no residue, then how can there be such large undisturbed coal fields associated with the upper gas and oil rocks of Pennsylvania, West Virginia and South Eastern Ohio? This association of course, would on that supposition be impossible



and all these coal fields would also be distilled into liquid and gaseous bitumens. Therefore, from every point of view, it can certainly be said that the organic theory of origin does not account for the facts, phenomena and conditions of our oil and gas fields; and, if this theory is held by so many, it appears to us that it is simply because they consider it as an axiom that everything constituted with carbon must be an organism, or result from an organism forgetting not only that they should not use "axioms" in geology, but also that to exist and to subsist an organism must first derive carbon from the mineral world, where it must therefore be in large quantities under many forms, and the hydrocarbons of the oil and gas fields are only a few of these mineral forms of carbon brought into their present deposits as most minerals have been under the influence of the volcanic agency, influence which has left so many marks and impress on the constitution of so many parts of this globe from the oldest geological age to this day.

### Recent Advances in Electro-Chemistry and Electro-Metallurgy.

By DR. W. L. GOODWIN, Kingston, Ont.

[Paper read before the Canadian Mining Institute.]

The year 1900 is the centenary of electro-chemistry, for in the year 1800, Nicholson and Carlisle decomposed water by an electric current generated by Volta's battery. This was the first electrolytic decomposition, and in it lay the germ of the numerous chemical and metallurgical processes in which the electric current is at present used. These may be divided into (1) Analytical Processes, (2) Chemical Manufactures, and (3) Metallurgical Processes. In each division the number of applications of electricity has increased with great rapidity, particularly during the last fifteen years.

A short review of the history of current electricity will show that the rapid advance began with the perfecting of machines for converting into electricity the forms of energy ordinarily used in industrial operations. This history may be separated into three periods:

- (1) That of the Voltaic Battery ..... 1800-1842
- (2) " " Magneto Electric Machines ..... 1842-1867
- (3) " " Dynamo Electric Machines . . . . 1867-1900

During the first period, as the production of the current depended on the consumption of metals like zinc, its uses were comparatively limited. In Faraday's discoveries of the influence of a magnetic field on a metallic body in motion, the first step was taken towards a cheap source of electricity. Faraday, himself, constructed in 1831 a magneto-electric machine, but was not successful in applying it to industrial purposes; and it was not till 1842 that we find the first magneto-electric machine patented, by Woolrich. Even this was not much of a success. In machines of this type the current was generated by the revolution of a metal disc or coil between the poles of a permanent magnet, or a magnet excited by a galvanic battery. The current obtained depended, in the latter case, on the constancy of the battery, a somewhat uncertain quantity in those days. Still these machines were used successfully in the large electro-plating industries growing up in Great Britain and on the continent.

The first dynamo electric machine was made by Pacinotti in 1864, but it is from the year 1867, when Siemens and Wheatstone simultaneously published the description of their machines, that the era of cheap electricity must be dated. The improvement consisted in exciting the magnet by part of the current produced by the revolution of the armature, so that the intensity of the magnetic field increases with the speed of revolution.

The perfecting of the dynamo-electric machine gave the world cheap electricity, but this did not take place until the stimulus of a

demand for the electric light was applied. This demand dates back rather more than twenty years, and the rapid growth of electro chemistry and electro-metallurgy began a few years later.

I shall have to dismiss its applications to chemical analysis with a reference to the publication of numerous books on *chemical analysis by electrolysis*. Their number and size show how important the subject has become.

The second division merits however a more extended notice. A recent writer on the subject (Mr. R. W. Wallace) has declared that "in a few years electrical energy will be, if not predominant in the production of chemicals, at least enormously extended" My own notes on the subject during the past fifteen years entirely confirm this view. The rate is an accelerated one. Not only are older methods being replaced by electrolytic processes, but new products are being discovered and manufactured, both discovery and manufacture being due to the use of the electric current. In the review of the Progress of Chemical Technology for 1898 by Professor Ferdinand Fischer (Jahresbericht uber die Leistungen der Chemischen Technologie) the author describes improvements for one year in the electrolytic manufacture of caustic soda, chlorine (for bleaching powder), sodium, potassium, caustic potash, potassium chlorate and perchlorate; other chlorates and perchlorates, cadmium sulphide (used as a yellow pigment), white lead, saltpetre from atmospheric nitrogen, phosphorus, carborundum and other carbides, alums, acetic acid, various dyestuffs, etc.; also the use of the current for reducing indigo in the indigo dye vats, for bleaching in a solution of common salt, for generating ozone, and for "ageing" spirits. To this list may be added the manufacture of calcium carbide and acetylene, graphite, persulphates, etc.

To illustrate the progress in these applications of electricity, the alkali and connected manufactures may be selected.

The history of the alkali manufacture is tinged with romance. The story of the Phœnician sailors is well known. Returning with a load of *natron* or soda, and cooking their dinner on the sandy banks of the Belus, they used blocks of natron in place of stones as supports for their pot. They thus discovered glass. Soda was for a long time made by the crofters of the western isles from the ashes of kelp cast upon their shores by the frequent storms. But near the close of last century the exigencies of France led to the invention of Le Blanc's process for making soda from salt. The crofter's kelp industry languished, and there arose the crofter problem of twenty years ago. But the LeBlanc process has been largely displaced by the ammonia soda process, and this in its turn must now compete with the electrolytic method, which gives at once caustic soda and chlorine, the latter being available for the manufacture of bleaching powder.

Mr. George E. Davis, of Manchester, in a recent "Chairman's Address" at a meeting of the Society of Chemical Industry, compares the various methods for generating chlorine for the manufacture of bleaching powder. He refers to the fact that Charles Watt patented in 1851, a process for decomposing saline and other substances and for separating their component parts from each other by means of partitions of porous material. His source of electricity was a Daniell's constant battery. It has taken half a century to overcome two difficulties which met this inventor; viz, the expense of the electrical power, and the difficulty of securing durable porous partitions. I have already alluded to the solution of the first and shall later go on to the relative cost of the electric current as produced by water power and by steam. The second difficulty has been met in two ways: first by the perfected diaphragms used in the Hargreaves-Bird and the Le Sueur processes, and secondly by the ingenious use of a three compartment rocking cell with mercury cathode in the Castner-Kellner process. In the last review of these industries which I have been able to consult

it is asserted that 'the electrolytic processes are gaining steadily.' This is not remarkable when it is remembered that they produce at one operation the two most valuable products of the alkali manufacture, viz., chlorine and caustic soda (or sodium carbonate in the Hargreaves-Bird process). In 1897 the English alkali makers, using the Le Blanc process, were producing salt cake at a cost of 36 shillings a ton, and selling part of it at 18 shillings a ton. They made their profit on the chlorine from the hydrochloric acid. Such a process can hardly compete with the electrolytic, although the use of the latter is limited by the comparatively small demand for one of the products, viz., chlorine. Mr. Davis also points out that the electrolysis of potassium chloride (with chlorine, caustic potash and potassium chlorate as products) is of increasing importance. I note that at present at least half the world's product of potassium chlorate is made by this process.

The manufacture of calcium carbide for the generation of acetylene gas is an instance of special interest to Canadians, as the process was first used on a large scale by a native of Ontario, Mr. T. L. Willson, in 1894. It is now being made not only in Ontario but also in France and Germany. The demand for the substance is now so great that the price has recently gone up from \$100 a ton to \$125 and \$150 a ton. Two villages in France are reported as now being lighted by the beautiful illuminant acetylene, made by the action of water on calcium carbide. The safety of this gas with ordinary care has been put beyond dispute.

In metallurgical manufactures electricity has become at least equally important. Gold, silver, nickel and copper are now separated from their ores and refined by electricity. A process for the electro-deposition of zinc has given promising results. The direct manufacture of nickel and iron from the Sudbury ore by an electric furnace method is being tried with encouraging results, so it is stated.

The history of the manufacture of aluminium affords a striking instance of the superiority of electrical methods in metallurgy. Deville made aluminium in 1854 by electrolyzing the chloride; but in looking for an industrial process for obtaining this beautiful metal, he was obliged to exclude electrolysis on account of the cost of the current. He then devised the decomposition of aluminium chloride by the metal sodium; but this made the price of aluminium depend on that of sodium, so that up to 1886 the former metal cost \$5,000 a ton. The sodium process was then replaced by the electrolytic processes of Hall and Héroult. The price soon (1894) ran down to \$900 a ton, and by 1897 had fallen to \$700. It now stands at between \$600 and \$700 a ton; the total annual production having in the meantime increased from 5 tons in 1886, to 2,500 in 1897. At the present prices aluminium is cheaper, bulk for bulk, than copper or tin.

The manufacture of both calcium carbide and aluminium depends on the use of water power for generating the electrical current. The current can in this way be generated at about one-half or one-third (variously stated) the cost when generated by coal and steam. This is the statement for Great Britain and Europe. A short description (borrowed from Wallace's paper already cited) of the operations of the British Aluminium Company at Foyers, near Loch Ness, Scotland, will illustrate. They have acquired 100 square miles of land in that neighborhood, and have constructed dams and tunnels to utilise the water of several small lakes. The current is generated by seven turbines and seven dynamos of 700 H. P. each. The Héroult electric furnace is used, practically a carbon lined iron box, acting as the cathode. Bundles of carbon rods act as anode. The furnace is charged with cryolite (from Greenland), and with alumina made from the mineral bauxite mined and prepared in Ireland (mines at Glenravel and works at Larne). The temperature of the bath is 750° C. to 850° C. The voltage is from 3 to 5. The alumina dissolves in the

molten cryolite and is decomposed by the current. The metal gathers on the iron box. A voltage of 2.8 is sufficient to decompose the alumina when dissolved in cryolite. The constituents of the cryolite are not decomposed till the voltage reaches 4 to 5. Thus by using a current of sufficiently low intensity the aluminium is deposited pure. The alumina is fed in as fast as necessary. Each cell requires a current of about 8,000 ampères (700 ampères per square ft. of cathode), and the yield is 1 lb. aluminium per 12 E. H. P. hours. The cost of the electrical current is less than 1/3rd the cost when generated by coal and steam, and this with coal at 3 shillings per ton. This includes all costs and interest on capital. The cost of one E. H. P. year is stated by Liebetanz (Europe) to be \$12.50 when generated by water falls, and \$27.00 when generated by steam. The cost at Foyers is stated to be \$7.50, exclusive of interest on capital. I am informed that the cost at the Willson carbide works is \$15.00.

To indicate the magnitude of the electro-chemical industry, I quote Borchers' statement that the total annual production is now worth \$150,000,000. This is produced by 423,000 H. P., of which 96 per cent. is generated by water power.

Let us now examine the outlook in Canada for the development of such industries.

Of all the forms of energy used to effect those chemical changes upon which these industries depend, the chief are the chemical energy of carbon (as coal, carbon, and wood), and the mechanical energy of water power. The amount of the former is limited, and sooner or later, coal in particular, will become so scarce as to affect the cost of energy available for manufactures. Even as it is there are large areas of Canada in which coal is not found, and which must depend for their supply upon mines at long distances. The freight becomes thus a serious, sometimes a prohibitive, item of cost. But it is in just these areas that water powers are abundant; and water powers are enduring. Canada is unique in the amount and wide distribution of her water-powers. With her Niagara, her Sault Ste. Marie, and her St. Lawrence Rapids alone, she might be considered rich in this respect, as compared with other countries. But when the sum total of Canada's waterpower is found, it will add up to something enormous. I have gathered a few data for Ontario. The Board of Trade of Ottawa last June issued a map showing in detail the water powers within a radius of 40 or 50 miles around Ottawa. The total for low water is 917,403 H.P.; for high water, 3,347,630 H.P. Of course only the minimum can be calculated on unless some system of storage is used. This would doubtless be practicable in the case of some of the smaller powers.

Another district for which I have obtained some data is that of which the town of Mattawa is the centre. The falls of the Ottawa and its branches in that neighborhood are capable of giving something like 150,000 H.P.

Even in the comparatively level district which includes Kingston, Trenton and Smith's Falls, the water power available is large, totalling at low water about 100,000 H.P.

That our opportunities are great is becoming sufficiently evident to those interested in chemical industries. The Ottawa Carbide Company are arranging to use 4,000 H.P. in the manufacture of carbide, and are building so as to be able to double this capacity at a further date.

I am informed that the manufacture of phosphorus by an electrical method is now being carried on at Buckingham, Que.

At Sault Ste. Marie, large works are being projected, including the electrical decomposition of nickel ores, and also, I am given to understand, an electrolytic alkali works.



The Shawinigan Company have a large power at their command on the St. Maurice River, the minimum theoretical value of which is stated to be 250,000 H.P. Of this they propose to use in the near future 100,000 H.P., which will be divided about as follows:— Aluminium, 15,000; paper, 35,000; calcium carbide, 30,000; other electro chemical processes, 5,000. The company is prepared to sell power at Shawinigan Falls at \$12.00 upward for 24 hour horse power. The amount proposed to be used for the manufacture of calcium carbide is very large.

The competition between water power and steam power is extending, and perhaps at no very distant date, Canada, with her unlimited water power, and her great variety of raw materials, will take her place as the chief manufacturing country of the world.

In conclusion I have to thank Mr. T. C. Keefer, C.E., of Ottawa; Mr. McLeod Stewart, of Ottawa; Mr. John Galt, City Engineer of Ottawa; The Ottawa Carbide Company; The Willson Carbide Company; Dr. A. S. Drummond, of Kingston; Mr. D. A. Dunlap, of Mattawa; Mr. Andrew Bell, C.E., of Almonte, and Mr. R. W. Douglas, secretary of the Shawinigan Water and Power Co., for valuable information used in the preparation of this paper.

### Notes on Increased Facilities at Wabana Iron Mine.

By R. E. CHAMBERS, New Glasgow, N.S.

[Paper read before the Canadian Mining Institute.]

[The situation and character of the Wabana ore deposits having been described in the Journal of The Federated Canadian Mining Institute is not here referred to, but some notes on the equipment may be of interest to some of the members.]

The equipment at Wabana is the result of three installations:—

1st. The original plant was erected in 1895 with the idea of supplying ore to the Ferrona Furnace of the Nova Scotia Steel Company. This called for an output of only 200 tons per day, with a possible increase to 500 tons.

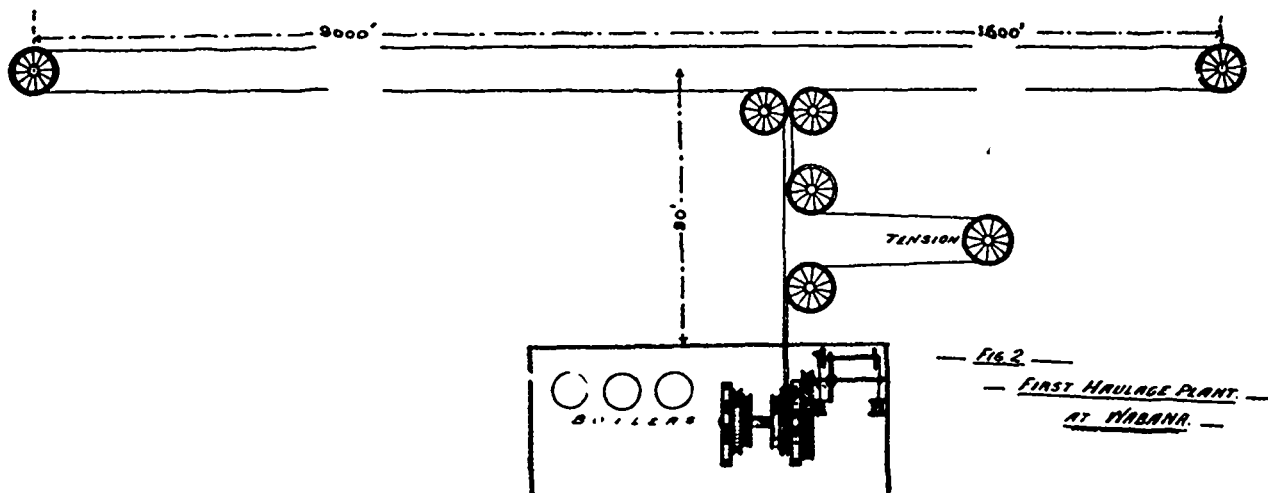
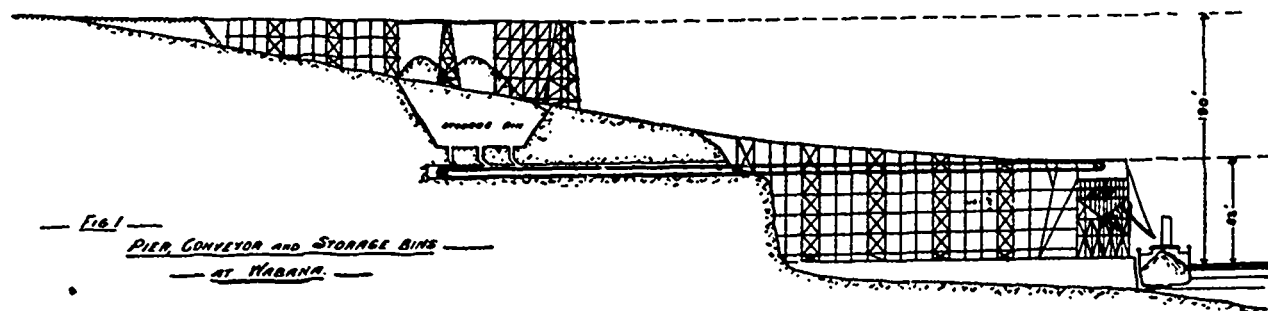
This plant consisted of a hopper pier of 2,000 tons storage capacity, shown at the right hand of Fig. 1, and an endless rope tramway

connecting the pier with the mine, Fig. 2. The haulage engine was at the mine. The mining, being simply quarry work, did not require an elaborate outfit.

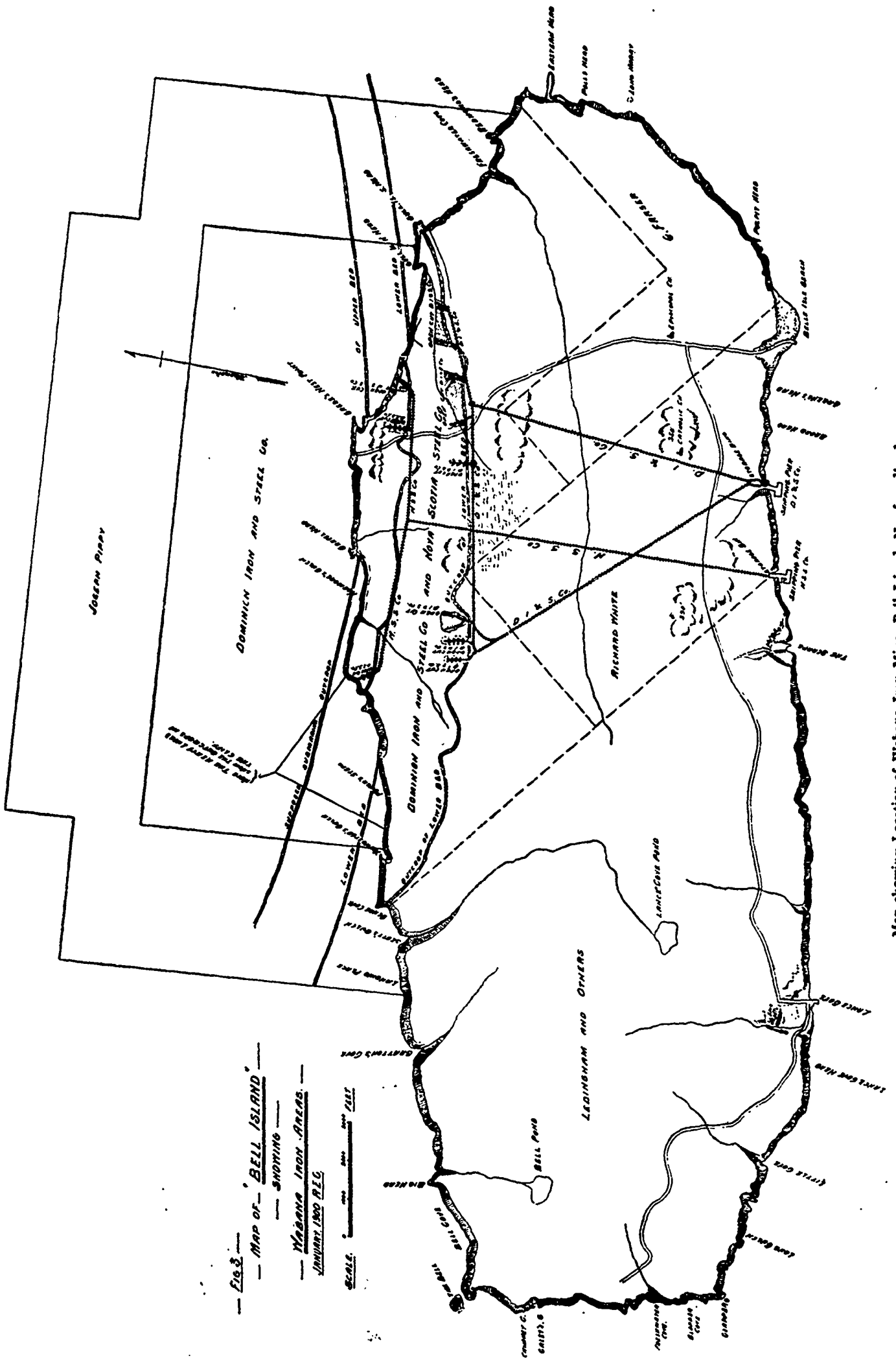
2nd. All demands for ore were easily met by this arrangement until the summer of 1898, when the possibility of shipping ore to the European markets called for an increase. The experience of the previous two years had shown the necessity of increased storage capacity at the pier in order to give quicker despatch to steamers. It was estimated that an extension of the system of pier hoppers would cost over \$100,000 for an increased capacity of 10,000 tons, whereas the excavation of pockets in the rock ashore would give a capacity of 20,000 tons for an outlay of \$40,000.00. The latter plan was adopted, the contemplated output being 2,000 tons per day. To carry the ore from bins to steamer, a distance of 550 feet, a horizontal conveyer was put in. This was designed and made by The Nova Scotia Steel Company, and contemplated a capacity of 600 tons per hour at a speed of 100 feet per minute. In operation, however, by increasing the speed, it has easily hauled 1,100 tons per hour, including stops for shifting the ship, so that the actual working capacity has probably reached 1,400 tons per hour.

To supply the additional ore for this output tramways were built along the crop of the Lower Bed of ore 2,600 feet east and 6,500 feet west, as shown on plan Fig. 3. Quarries were opened at the end of each line. These branch lines were operated by endless cables driven by bull wheels at the Central Station, which received their motion from a shaft driven by a bull wheel on the main cable. To minimize the handling of coal, a new haulage engine was placed at the pier. It is a compound condensing engine with cylinders 13" and 26" diameter, by four feet stroke, and receives steam from three vertical tubular boilers.

During the season of 1899, this plant easily met the requirements. There were sixty-nine steamers loaded, of an average carrying capacity of 4,500 tons each; the total shipments for the year being 302,000 tons. The record for quickest loading was on Sept. 28th when the "Claudius" was loaded with 6,000 tons in five hours and fifty minutes, or over 1,000 tons per hour.



Haulage Plant at Wabana Iron Mine.



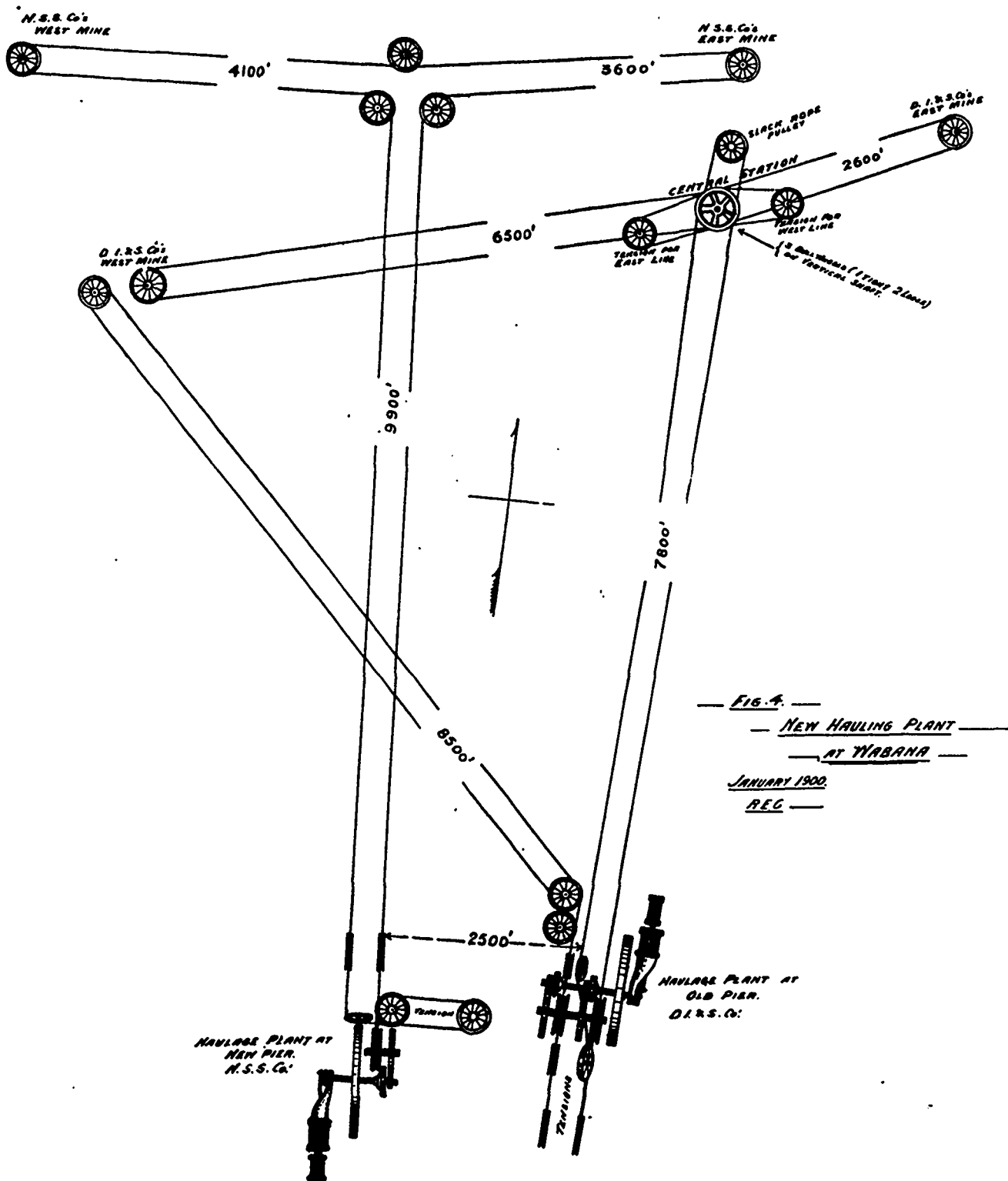
Map showing Location of Wabana Iron Mine, Bell Island, Newfoundland.

3rd. The sale of a part of these ore deposits to the Dominion Iron and Steel Company took place in the summer of 1899 and comprised the lower of two parallel beds of ore, together with the equipment. This company contemplates a consumption of 800,000 tons of ore per year in its furnaces at Sydney. This, taking into account the length of the working season at Wabana, means an output of 5,000 tons per day. To meet this increase, a tramway has been built direct to the west mine from the pier, and additional haulage machinery installed to operate it.

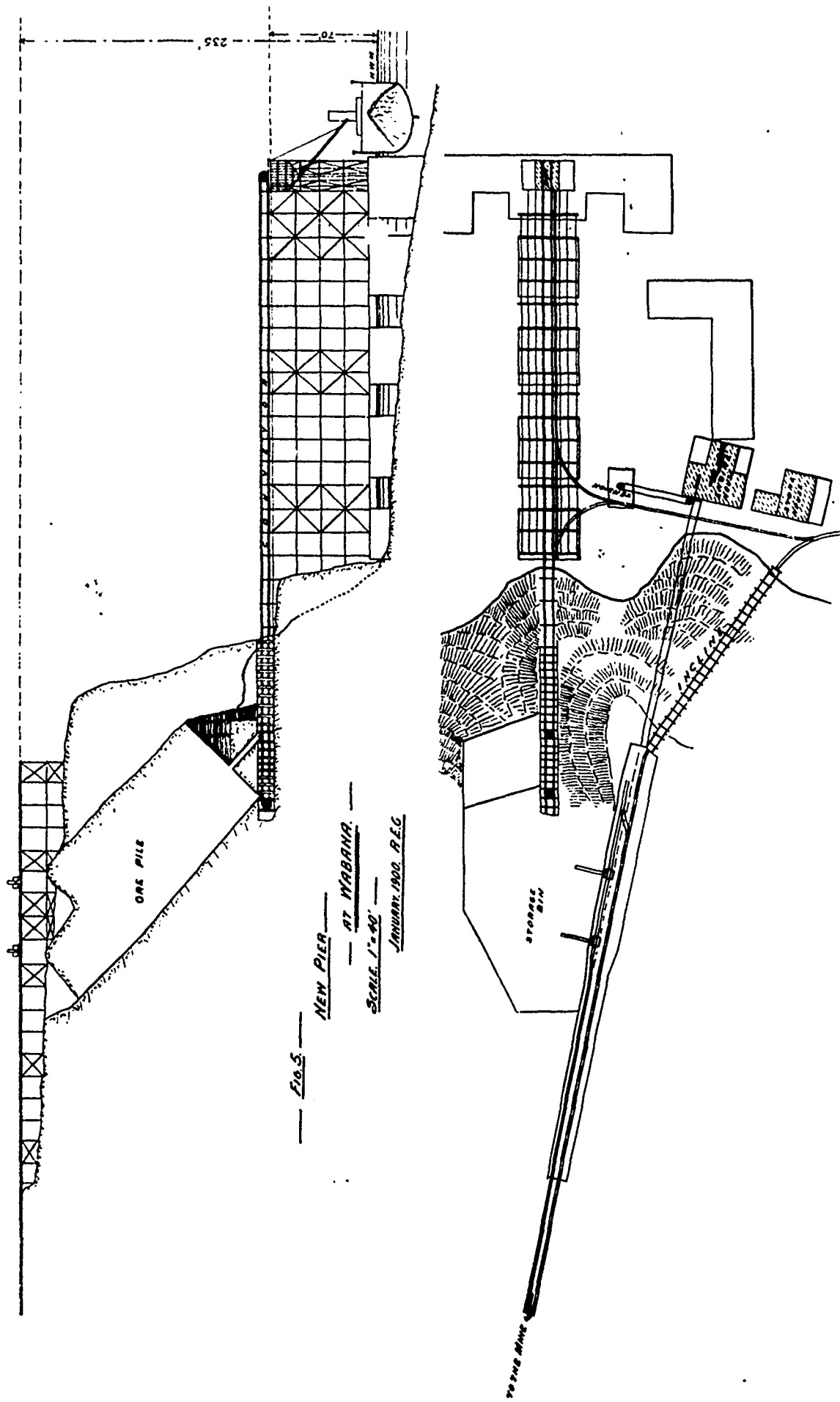
Several new openings along the tramways running east and west from the old Central Station have been made. These will deliver their ore over the old system, while all the ore from the West Mine, where the facilities for working are unusually good, will come over the tramway just built. These lines can be operated separately and independently of each other.

To the west of West Mine is an outcrop on the lower bed of one and a half miles, along which, it is the intention to construct a tramway operated by cable. On completion of this line every part of the outcrop of both beds will be reached.

To meet their sales for 1900, the Nova Scotia Steel Company have constructed a new pier half a mile to the west of the old one, and fitted up a tramway connecting with their new mines on the upper seam of ore. The water at the pier has a depth of over twenty-seven feet at low tide. A conveyer is erected, similar in type to the first one, but with larger buckets, which should give it a somewhat larger capacity. This conveyer will bring ore from pockets in the rock having a capacity of 40,000 tons. To construct these pockets, advantage was taken of a natural gulch on the shore, giving a large capacity without an excessive amount of excavation.

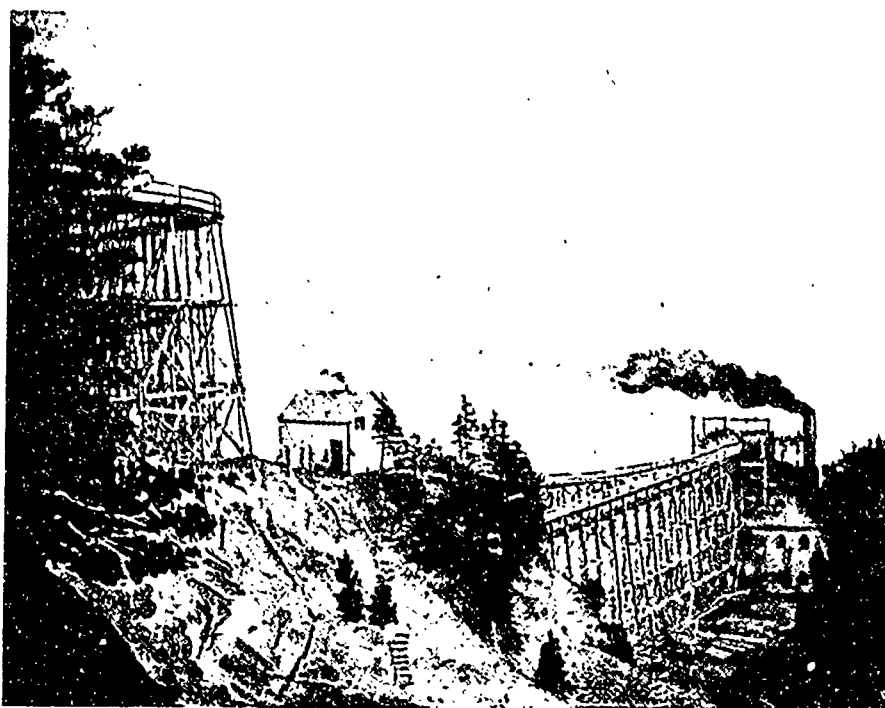


Haulage Plant at Wabana Mine, Bell Island, Newfoundland.

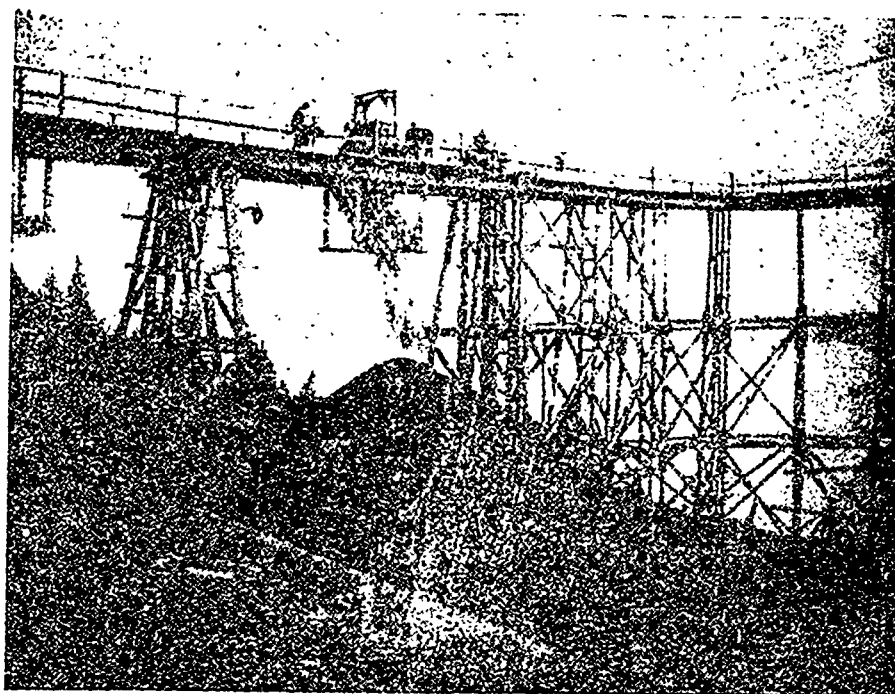


Haulage Plant at Wabana Iron Mine, Bell Island, Newfoundland.

## WABANA IRON MINE, BELL ISLAND, NEWFOUNDLAND.

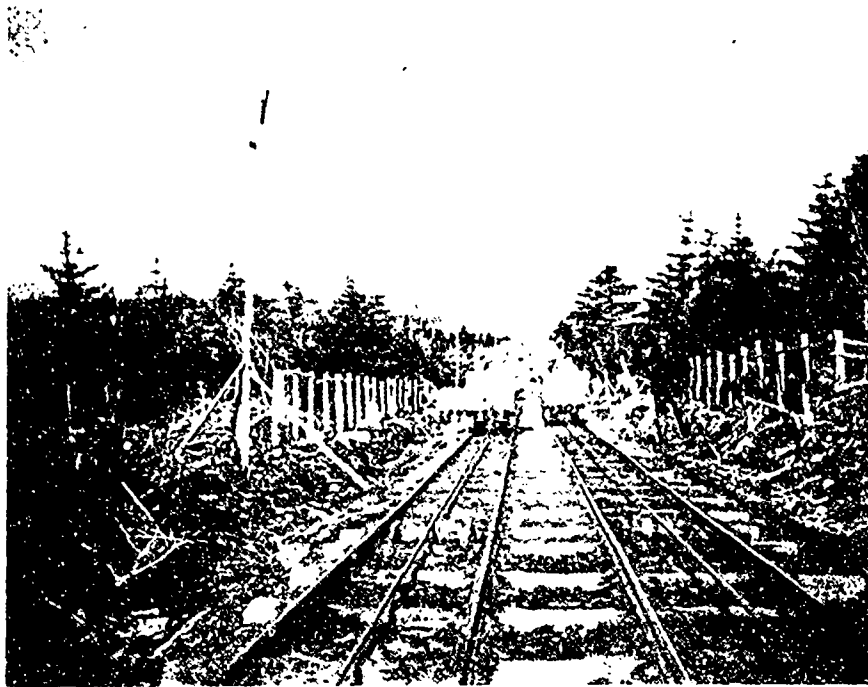


Pier showing Conveyor near top of Trestle, Wabana Mine.

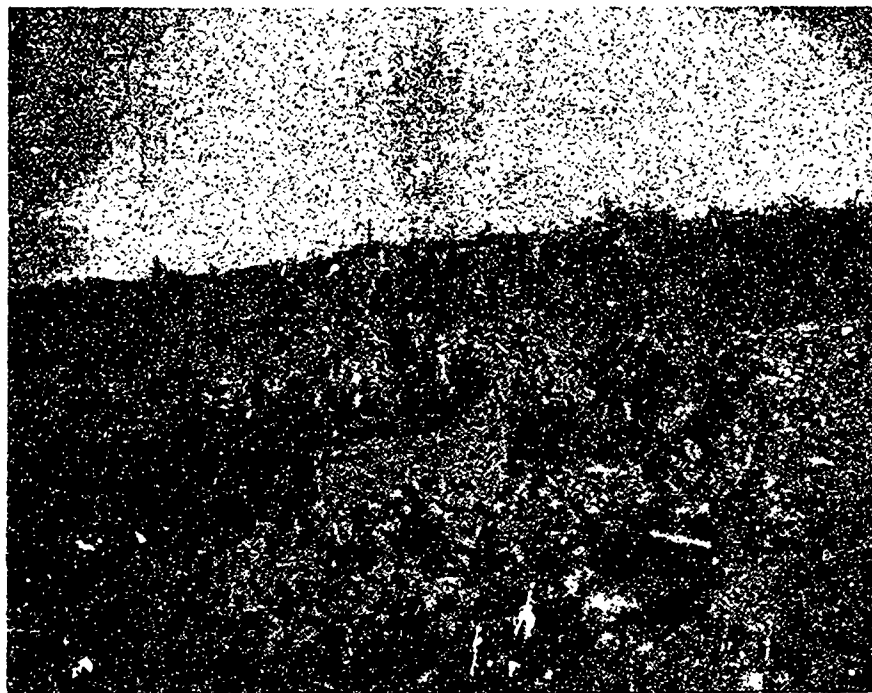


Ore Bin and Tipple, Wabana Mine

WABANA IRON MINE, BELL ISLAND, NEWFOUNDLAND.



Ore Cars in Transit, Wabana Mine.



Mining by Open Cut, Wabana Mine.

## WABANA IRON MINE, BELL ISLAND, NEWFOUNDLAND.



*Ore Cars in Transit being attached to Cable*



*New Ore-bin under construction at Wabana*



The tramway has branches extending east 3,600 feet, and west 4,100 feet along the crop of the upper bed.

Instead of separate cables for the side lines, in this system one rope operates the main line and branches. It is six and three-quarter miles long of one inch diameter plough steel Lang's lay. Travelling at a speed of 240 feet a minute with cars spaced eighty feet apart, it should haul 360 tons an hour, or with a very large deduction for stops, should easily handle 2,500 tons per day.

The mining from the upper bed, as from the lower, consists simply of quarry work. There are in it from 1,500,000 to 2,000,000 tons which can be won by open cut.

Underground mining has not yet been commenced in the district. The situation of the beds, however, is unusually favorable for its prosecution. The character of the ore in the two beds is very similar, with one or two per cent. of metallic iron in favor of the contents of the upper bed.

Fig. 2 shows the original haulage plant installed in 1895, and Fig. 4, that as on the ground ready for the season of 1900.

Fig. 1 is the old pier and bins, and Fig. 5 the new ones.

The photographic views show different parts of the mines and plant of the Dominion Iron and Steel Company, as well as the pier and bins of the Nova Scotia Steel Company under construction. These have since been about completed.



## ANNUAL MEETINGS AT MONTREAL

### Spirited Discussion on the Proposed Taxation of Nickel Ores—The Yukon Royalty, Etc.

(Report of Proceedings continued from the March issue of the Review.)

#### WEDNESDAY AFTERNOON SESSION.

The members re-assembled at 3 p.m., Mr. Archibald Blue, Director of Mines for Ontario, presiding in the absence of the President.

#### ELECTION OF SCRUTINEERS.

On motion, Mr. A. Marshall Hay, of Rat Portage, and Mr. Eugene Coste, of Toronto, were appointed scrutineers for the election of officers.

#### AMENDMENTS TO CONSTITUTION.

On motion of the Secretary, Messrs. Hay (convener), Coste, Blakemore, Blue, Goodwin and the Secretary were appointed a committee to consider and report at a later session upon certain proposed amendments to the Constitution and By-laws.

#### IRON ORES OF HUDSON'S BAY.

Mr. A. P. Low presented a valuable paper describing the iron ore deposits of Hudson's Bay.

Mr. A. BLUE—I would like to ask Dr. Barlow if he found similar iron-bearing rocks at Lake Temagami?

Dr. BARLOW—There are similar rocks there, but there is a good deal of doubt whether they are Huronian or Cambrian, and there are those rocks there much as Mr. Low has described them.

Mr. A. BLUE—I was in the Lake Temagami region last fall with Dr. Coleman, and we noticed many float boulders of Jasper conglomerate, a rock often found associated with iron ore. The same formation occurs at Batchawana Bay, on Lake Superior, and also in the Michipicoton mining division. Iron ore was discovered at a number of points in the Michipicoton division during the past year, and Dr. Coleman and Prof. Wilnot were instructed to make an exploration of the country. An iron bearing band extends for a distance of nearly 60 miles from Little Gros Cap on Michipicoton Bay, trending first in a north-easterly and then north-westerly and westerly across the head waters of the Dog River. Iron ore was found at a number of points along this range, and iron colors are also found at frequent intervals. On Lake Boyer, 12 miles from Michipicoton Bay, exploration work has been carried on for some time with a diamond drill. There it is brown hematite at the surface, and

rises 100 feet above the lake. Exploration with the drill shows that the ore body reaches to at least 188 feet below the level of the lake, and surface work shows an area of 600 by 800 feet. This would indicate an ore deposit of some twelve millions of tons, and proves it to be an enormous deposit. The lower part of the formation is found to be red hematite, although for a distance of 70 feet below the water level it is brown hematite. Deposits of red hematite have also been discovered along the range several miles to the north-east of this one. The formation there, as well as the Batchawana Bay one further south on Lake Superior, appears to be much the same as Mr. Low has described, and there is a probability that the Jasper band extends across the whole country from Lake Superior to Lake Temiscamingue. I think it is a matter of the first importance that we should have that country explored. It is certainly very much nearer to us than Ungava Land at the present time.

Prof. MILLER—I was very much interested in the paper. In addition to the large area northeast from Michipicoton, I might refer to the belt which runs from the Minnesota boundary to the north-eastward in that part of Ontario. This belt has been pretty well located at different points. I think there is no doubt but that it extends continuously from the Minnesota boundary to the C. P. R. and to the east of Shebandowan Lake and on into the interior or northeast. I think that belt is as large if not larger than the one Mr. Blue has referred to, and there is a likelihood of its being opened up in the near future now that the Rainy River Railway is being constructed across part of it.

Mr. BELL (to Mr. Low)—I understand these deposits at Hudson's Bay are on tide water?

Mr. LOW—Yes.

The CHAIRMAN—For what part of the year is Hudson's Bay navigable?

Mr. LOW—For ordinary navigation from the middle of June to November. The Hudson's Straits are not open before the middle of July at the earliest.

The CHAIRMAN—And are the deposits on these islands workable?

Mr. LOW—Yes. There are quite large deposits on these islands for over 60 miles, and they form a good quality of ore. There is probably ten millions of tons in sight there now. If a railway was run down from Ottawa as a continuation of the Gatineau Valley Railway the haulage by rail would be about 400 or 500 miles from Montreal to the south end of James' Bay, and the ore could be brought down by water to there—could be brought down by lighters.

The CHAIRMAN—What is the distance from the ore deposits to the mouth of the Moose River?

Mr. LOW—About 500 miles.

The CHAIRMAN—Could not the peat deposits be used?

Mr. LOW—I question it. It is very bad fuel for iron ore.

#### ON THE WABANA IRON MINE, NEWFOUNDLAND.

Mr. BLAKEMORE, in the absence of the writer, presented a paper by Mr. R. E. CHAMBERS, New Glasgow (reproduced in this issue of the REVIEW), describing the haulage plant at the Wabana Iron Mine, Bell Island, Newfoundland. In discussing the paper Mr. Blakemore gave some interesting facts respecting the character and high value of the ore found on the property, and to the extensive iron and steel works under construction at Sydney, Cape Breton, for the Dominion Iron and Steel Company.

Mr. J. BURLEY SMITH—The ores worked are, I believe, a high-grade hematite? Mr. BLAKEMORE—Yes, of the very best quality. Authorities who have examined it pronounce it one of the best ores.

The CHAIRMAN—What does it run?

Mr. BLAKEMORE—About 54 or 55. You may rely with every confidence upon this ore becoming a very important factor in the iron and steel industries of Canada. Very satisfactory results have been obtained. The capital invested in such an industry with ore of such a high quality and which can be so economically worked should do more for the legitimate advertising of this Dominion than anything else that can possibly occur.

The CHAIRMAN—What is the amount of capital invested?

Mr. BLAKEMORE—The Dominion Steel Co. has a capital of \$20,000,000.

#### IRON INDUSTRY AT SAULT STE. MARIE.

Mr. BLUE—In the Michipicoton country a company has been organized to work a property with a capital of between four and five million dollars, the whole of which has been subscribed by Philadelphia capitalists. The intention of the company is to erect blast furnaces at Sault Ste. Marie. They have already purchased four iron steamships in England, which will be sent up the lakes at the opening of navigation and will be employed in bringing the ore from the Michipicoton harbor to the Sault, and probably also to the furnaces at Hamilton, Deseronto and Midland. A large iron ore dock is in process of construction at Michipicoton harbor, which I am told will be one of the most serviceable on the lakes. The intention is to construct at Sault Ste. Marie a steel plant and a nickel steel plant and to manufacture nickel steel rails. The nickel ores of the Sudbury country will be used in the production of nickel, and it is claimed that by the process which is being adopted the iron and sulphur in the ore, as well as the nickel and copper will be recovered. If the iron and nickel are obtained as ferro-nickel—and this is part of the scheme—it is not improbable that nickel steel can be produced at almost as cheap a rate as Bessemer steel, and there is little doubt that rails made from it will as far surpass Bessemer rails as Bessemer rails surpassed the old iron rails. If this enterprise is carried out as projected it will form an extensive and important addition to the industries of the Province and of the Dominion.

Dr. PORTER—What is their plan in the matter of fuel, largely electric I suppose?

The CHAIRMAN—Yes.

Dr. PORTER—They will bring it up from Pennsylvania?

The CHAIRMAN—Yes, coke.

Mr. BELL—There can be no doubt of the great progress being made in the development of our iron and steel industries, and while doubtless much of this progress is due to Government encouragement, it is a matter of doubt whether the policy of bonussing foreign ores is not open to objection. I am told that the bounty on Newfoundland ores, for instance, has affected the interest in the development of the iron deposits of Nova Scotia. If the bounty on pig iron made from foreign ores was removed, would not it hasten the development of our known deposits in Ontario?

The CHAIRMAN—A number of blast furnaces have been constructed in Ontario that were not being supplied with ores from our mines, because our mines were not opened up.

Mr. J. BURLEY SMITH—Do I understand that the Government bonused the ores brought in from Newfoundland?

Mr. BELL—To a certain extent. Yes.

Mr. SMITH—Do the promoters give any idea of what it is going to cost to make these steel rails at Sault Ste. Marie?

Mr. BELL—Mr. Clergue says he will turn them out for thirty dollars a ton.

#### RESULTS IN THE USE OF A ROTARY PUMP.

Mr. CHARLES FERGIE presented a brief paper, describing results in the use of a Rotary Pump, as against that of the Straight line type (reproduced in our March issue).

Mr. BELL—Mr. Fergie has set an excellent example in coming forward with a class of paper, which one would wish to see more frequently in the proceedings of the Institute. If other members were to contribute more frequently from their own experiences in practical mining work, these discussions would be more interesting.

#### ARE THERE DIAMONDS IN ONTARIO?

Mr. ARCHIBALD BLUE presented an exhaustive discussion of the question "Are there Diamonds in Ontario?"

Dr. ADAMS—I regret that I was unable to be present to hear Mr. Blue's paper, but I have read with much interest the paper by Prof. Hobbs on the presence of diamonds in the Drift of Wisconsin, which directed Mr. Blue's attention to the possible occurrence of this gem in Canada. So far as I am aware the only place in which diamonds have been found as original constituents in a rock, is in the greatest diamond field of the world—in the Peridotite of Kimberley. In all occurrences they are found as pebbles in clastic rocks, or in some other position where they are clearly not original, but to which they have been transported from some unknown source.

While therefore, by no means desiring to go so far as to state that diamonds cannot be formed except through the agency of carbonaceous rocks, and that it is useless to look for them except in the neighbourhood of such strata, I believe that following along the path of experience rather than that of conjecture, the prospector would have the best chance of finding diamonds in the Dominion, at localities where heavy masses of basic igneous rock are intruded through highly carbonaceous shale, or some other such rock rich in carbon.

I hope that some prospector may succeed in discovering the source of the drift diamonds of Michigan in Canada, and thus establish a second Kimberley in the Dominion.

Dr. A. E. BARLOW—Of course, all through the Huronian there are a great many bases of what we may call volcanoes, or what might possibly be ranges of volcanoes, because I believe with Prof. Carver Lewis that the diamond is really one of the bases of these Plutonic rocks. It is very well known that all through the north we have quite a few masses of peridotites and other igneous rocks. The country is very large and uninhabited, and we have not had very much time to look close enough to find diamonds developed. We have masses of larger minerals, such, for instance, as corundum. The lines of the corundum were sticking out right on the portages and yet it was never noticed. Dr. Lawson pointed out years ago that diamonds would be found north of Lake Superior, and I think myself, with more detailed examination, that we will eventually find the diamonds there.

Mr. A. P. LOW—Down in James' Bay there are a series of gneiss rocks that are largely composed of garnet, and they have also basic materials like pyroxene. They might be the source of diamonds, because they resemble the sort of rock found at Kimberley.

Mr. COSTE—I quite agree with Dr. Barlow that it is not necessary to look for carbonaceous shales so as to find the diamonds. I think with him and many others that carbon in the form of graphite and diamond is often a basis of plutonic rocks just as apatite, magnetite, etc., are. The diamonds found in the States have been discovered in the drift and this drift cannot come from any other place than northern Ontario. I do not think it is necessary to look in the shales at all. There is a much better place to find them and that is where the plutonic rocks are largely exposed and show their inner parts as there the conditions are similar to the volcanic rock of the Kimberley mines. I think that is a more likely place to find the diamonds than where the shales are. There is no doubt that carbon must exist in the mineral world for the organic world could not take it from any other place than the mineral world.

Dr. GOODWIN—I am inclined to agree with Mr. Coste with regard to the origin of diamonds. I think it was Sir William Crookes who pointed out that the diamonds as they occur naturally show signs of having been formed under great pressure. They tend to fly into fragments, to explode, as it were. Now it is well known that the artificial diamonds have so far only been made under conditions of that sort, viz., by the sudden cooling of masses of iron highly impregnated with carbon, by plunging molten iron in some cool liquid. Part of the carbon then crystallises as diamonds. Chilled steel often contains minute diamonds. Mr. Coste has pointed out, and justly so, I think, that we must depart from the idea of organisms (plants and animals) as a source of carbon. We need not assume that at all. It is interesting to note that the great Russian chemist Mendeleff has deduced, from the composition of meteorites and the mean specific gravity of the earth, that the interior of the earth is composed of a metallic mass, probably iron; (La Place's theory) so that we have in the presence of carbon under very high pressure a condition for the formation of diamonds. How the diamonds get out afterwards is another question, of course. I do not know whether it has come to the notice of the members of this Institute that certain artificial products have been lately obtained that are harder than the diamond, and that these can be made from materials that are very plentiful and quite easily crystallized. In particular I should like to name carbide of titanium, which has a hardness considerably greater than that of the diamond; so that, even if we do find diamonds in Ontario, this new compound might take the place of them for all abrasive purposes.

Dr. ADAMS—When these volcanic rocks are broken up, the shales are incorporated with them. If there is 30 per cent. of carbon in the shale, and it eats up the carbon, it will form these diamonds. That was the old idea put forward by different authorities.

#### INVITATION TO VISIT MCGILL.

Dr. PORTER, on behalf of his faculty in McGill University, extended a cordial invitation to all the members of the Institute to visit the University buildings and the mining laboratory on Saturday morning, or at any other time which would suit their convenience.

The meeting adjourned at six o'clock.

#### WEDNESDAY EVENING SESSION.

The members re-assembled in the club room at eight o'clock, Mr. Archibald Blue again presiding.

#### MINE PUMPS.

Mr. C. E. MORGAN presented a brief paper describing certain features of Mine Pumps (reproduced in our March issue).

Mr. FERGIE—What is your opinion of the rotary pump compared with the straight line type?

Mr. MORGAN—There is no question in the economy of steam. You can use your steam or your air expander. I think he has already tried to combine compressed air, and I think that has been very successful. The rotary pump engine is far better; the only objection I see is that it takes up too much space in the mine. Of course, they are used very largely in England. I should certainly be in favour of a crank and fly-wheel pump, and I should have to recommend that type.

Col. HAY—What about freezing?

Mr. FERGIE—We have no trouble with freezing. If you have the slightest trouble a little glycerine will overcome that. There is not a firm in the United States today that makes a specialty of an air pump. A little live air in the exhaust will overcome the freezing.

Mr. HANSON—A little stream of water as thick as a pin will stop the freezing in the exhaust.

Mr. MORGAN—What about combined air on the fly wheel pump?

Mr. FERGIE—I certainly failed in combined air myself. We had a combined direct acting steam pump, and before making any change I tried combining, and I failed. I find it better to work your expansion, which we do now. But I would not like to say that the combining was a failure, because where you reheat I think you would be able to make a success of it.

Mr. HANSON—The crank and fly-wheel pumps have been run in the States very successfully in the large coal mines in Pennsylvania.

Mr. FERGIE—There is not a pump on the market today built specially for air by any makers. If you write to the compressor people they know nothing about it. You can build the air pump just as economically as a steam pump.

#### WEST KOOTENAY NOTES.

Mr. R. W. BROCK presented his paper, "West Kootenay Notes" (reproduced in our last issue).

Mr. J. BURLEY SMITH—The interesting paper just read, being generally descriptive, does not leave much room for discussion. With regard, however, to the somewhat severe criticism of prospectors as a class I would like to say something in their behalf. Prospectors, like all other sorts and conditions of men, are to be found good, bad, and indifferent. The class is recruited from all kinds of men. Those who are the most successful as prospectors are generally those who have at some time or other followed the occupation of mining, and who from natural bent and habits of patient observation find themselves adapted to the life. The unsuccessful, viz., those who mislead themselves and involve others in their misconceptions, are often wasters who take to the life because they have nothing better to do, and because the free, gypsy, indolent kind of occupation offers strong attractions. Again, very often men who are neither miners nor prospectors take up locations as a mere speculation, and being unable to pay for the services of a skilled prospector attempt to do the prospecting themselves, from economy and from the fact that this work may be counted by the Government as part of the obligatory assessment labour. The mistakes often made are not discovered until the mining engineer has opened the mine, and are not to be wondered at considering the comparatively slight surface indications the prospector often has to guide him.

I am sure the author of the paper just read will agree with me, that it would take an experienced geologist to trace and follow up mineral deposits from such slight clues. Had the very excellent cross sections illustrating his paper and showing so definitely and clearly the position of the lodes, been available to the prospector, in this particular instance, he would doubtless not have made the error referred to. These diagrams were however, unfortunately not made until the mine was opened and the exact positions of the lodes located, therefore, it seems hardly fair to blame the prospector for errors which only became known afterwards. All this goes to show that too much is expected from the prospector. It is the province of the prospector to find and follow up surface indications, and that of the mining engineer to follow up and complete the prospecting with his knowledge of geology and practical experience of mining, and the latter is alone responsible for not striking or tapping the deposit to the best economic advantage.

The world is much indebted to the prospector and though there have been many failures, thousands of mines of incredible value have been found through his labours and the whole universe enormously enriched thereby.

In solitude and often in face of terrible hardship and danger he pursues his lonely calling. Without the results of his patient observations economic geology would still lack much, and the treasures of the earth's crust still lie hidden below.

Mr. COSTE—I think it is a very good suggestion of Mr. Brock when he says that the assay expenses of the different ores might be included in the assessment work. I know by experience, that a good many good things are passed by for the want of assaying often enough. One will take one sample of ore and think he has something when really he has a poor sample, while if he took four, five, six or seven samples he might find very different results; so that I think it is a good suggestion to incorporate the assaying expenses in the expenses of the assessment work.

Mr. W. BLAKEMORE—With two years' experience more or less in British Columbia I have been most impressed with this—the vast amount of money that has been spent in superficial work without any attempt to thoroughly prove the properties dealt with, the vast amount of money spent to bring worthless properties into the market and the self evident fact in many cases that there was no desire to improve and work the property, but simply to do sufficient to enable them to put it on the market and sell it for a large sum of money. Even take the list of the mines in the West Kootenay; if you take the number of mines or mineral properties at any rate that have been started there as mining enterprises within the last three or four years, and then take the shipments for the last year for instance (1899) and you will see that there are only three mines in the Rossland camp that have shipped any tonnage worth mentioning, and a few others that have shipped a few hundred tons. I will not name them, but I have several in my mind upon which large sums of money have been spent to thoroughly prove the properties, but it has been wasted in such a way as to show, for a short time at any rate, that it is worth a large sum of money, and the same property has been treated this way two or three times. I cannot think that this way of dealing with it is the best thing for this Province or for the Dominion. A tithe of the money that has been so wasted, if properly expended in an honest endeavour to improve the properties, would give us to-day far more shipping mines. I think, that is obvious to a casual observer, but at any rate that is the one thing that impressed me more than anything else while out in the West.

## ONTARIO'S CORUNDUM DEPOSITS.

The CHAIRMAN—I will now ask Professor W. G. Miller, of Kingston, to deliver a short address upon the subject of corundum, and I may say that he has had very little notice that he would be called upon at this meeting. The subject is one to which he has given a good deal of attention during the past three years. It is one of considerable promise in Ontario and for the whole Dominion, and as there are two or three other gentlemen here, Dr. Adams, Professor De Kalb and Dr. Barlow, who have given a good deal of attention to the subject, I have no doubt that the rest of the evening will be profitably spent in the consideration of the subject.

Prof. W. G. MILLER—As you have stated, Mr. Chairman, I had no intention of bringing this subject before the Institute at this meeting. Yesterday morning, when I received your note to bring some specimens, I thought probably you wished to show them to some capitalists or to make use of them for some other purpose. One reason was that I thought some people were tired of hearing about corundum, as there has been so much about it in the daily papers during the past year or so, and I thought it would be better to have these properties developed before much more was said upon it. The corundum rock in Ontario is rather an interesting one, and covers a large extent of territory. Almost everyone knows that this subject was first brought to the notice of the public by Mr. Ferrier, who reported the occurrence of a deposit in the township of Carlow in 1896. The rock in which corundum occurs varies in different parts of Eastern Ontario. It occurs sometimes in syenite—in nepheline syenite and amongst ordinary pink syenite—while in other parts of the district the rock is anorthosite. This occurrence of the mineral is interesting, when we consider the occurrence of it in India and in Russia. The extent of territory in which it occurs is now proved to be very large. Dr. Barlow referred to the fact this afternoon that it was strange that as corundum covers such a large extent of territory in Ontario it had never been discovered before. I traced one belt a distance of 75 miles. Two other belts are somewhat parallel, but are of smaller extent. The largest belt runs through the counties of Haliburton, Hastings, and Renfrew; one of the smaller belts lies in the county of Peterborough, and another belt which gives considerable promise, lies about 30 miles north of Kingston. When the mineral was first discovered in Canada owners of mines in the United States and elsewhere tried to decry it as to its quality; in fact, the "Mineral Industry," published in New York in 1898, stated that the quality was reported to be poor and not up to that of North Carolina. During last year we proved pretty conclusively that the quality of the Ontario corundum is not surpassed by the corundum of any other district. In fact, I think we have proved that the Ontario corundum is superior to that of any other region. In the report of the Bureau of Mines for 1898 we have a statement from a number of manufacturers who have tested this mineral. We sent it out in 100 lb. lots to different manufacturers for the purpose of having it tested as to its binding qualities, as to the action of the different cements upon it and as to its hardness, &c. It is hardly necessary for me to quote these opinions. A day or two ago I received information from a firm in Massachusetts as to the high quality of this Ontario corundum. This firm, large manufacturers of corundum and emery wheels, stated that the wheel made from our Ontario corundum was the best wheel they have ever tested. They now keep it in their shop as a standard, and if they wish to try a new wheel they try its abrasive qualities by this Ontario wheel. They say this Ontario wheel cuts very freely and leaves a smooth, velvety surface. It does not rub, but cuts clear. The uses of corundum and other abrasives are being constantly extended. One of the great uses to which manufacturers put corundum is to bring up the quality of the emery. Certain highly tempered metals are not attacked by ordinary emery, but by mixing some corundum with the emery they can grind down these metals. The corundum is much more valuable than emery. In many cases it is used in sharpening circular saws. It cuts so freely that it does not heat the saw, and therefore does not destroy its temper. If the temper is taken out of the saw, it tends to crack or fly to pieces. At first, when this corundum was discovered in Ontario, a great many thought that the carborundum would be a very strong competitor. It was thought to be very much harder than corundum, and therefore it was believed the latter could not stand in competition with it. It seems very difficult to get a binding that will hold the carborundum together in the wheel. Moreover, another use has been found for carborundum in steel manufacture, so they are not quite so anxious to use it as an abrasive as at first. As to the prices, corundum ordinarily sells for about double the price of emery. At present there is practically no corundum in the market. A gentleman told me the other day that he had asked a certain party if he could give him a certain quantity at 12 cents a lb., and was told that he could not give it to him at even \$1.00 per lb., as the material is not obtainable in quantity at present. When this mineral was discovered in Ontario in 1898 they spoke of millions of tons in North Carolina and other States, but that does not seem to be the truth, as we do not find it being sold in quantity. I think we have nothing to fear as regards quantity, and it is now proved conclusively that we have nothing to fear under the head of quality. The mode of occurrence in North Carolina is somewhat similar to the occurrence here, but the rocks are somewhat more basic in the south. I would not be surprised, however, if some of our rocks were found there. Some of their rocks look as if they were of the nepheline variety. I do not know that I have much more to say. Professor DeKalb can speak of the concentration of the mineral. A great many of the Americans thought we would have great difficulty in extracting this corundum from the rock, but Prof. DeKalb has proved that it can be extracted without any great cost. I may say that the corundum in North Carolina is much more difficult to treat in many cases than ours. The Ontario corundum makes up into a lighter colored wheel than the ordinary emery. Prof. Miller concluded by exhibiting some samples of pink syenite which came from 30 miles north of Kingston and also wheels, and some specimens from the Robillard property in Raglan.

Dr. ADAMS—I do not think that I can add anything to what Prof. Miller has said concerning the very important deposits of corundum in Ontario. He has devoted more time and study to the economic aspects of the subject than anyone, and is better able to speak upon it. I have, however, taken a very direct interest in this district, as several years ago, when on the staff of the Dominion Geological Survey, I was sent out by the Director to examine a series of pyrites deposits in the district to the west of that in which the corundum occurs, which were attracting a good deal of attention at the time, and was instructed to return across country through what is now known as the corundum district, and to make a report on the general character of the country and the probability of the occurrence in that region of mineral deposits of value. As a result of this report Dr. Selwyn decided to have a regular survey of this district made, and consequently what is now known as Sheet 118 was outlined and work was commenced upon it. One of the first fruits of our work was the discovery by Mr. Ferrier of corundum in a peculiar syenitic rock of this district. This rock appears in many phases as Prof. Miller has stated, and corundum occurs in it in many places. It has been traced across almost the whole width of the district, as the map

now nearly ready for publication will show. I think that Prof. Miller has ample grounds for stating that the corundum deposits of this area are very extensive, and his excellent work in connection with the Ontario Bureau of Mines has served to make known their value and the fine quality of the corundum which they yield. I can further bear witness, from personal knowledge of the wilds of this district, that the times which both Prof. Miller and my co-workers of the Geological Survey experienced there were frequently as hard as is the corundum which our labors served to unearth.

The CHAIRMAN (Mr. BLUE)—I may add to what has been said, what perhaps most of you already know, that a company has recently been formed to develop some of the properties which have been discovered in the counties of Hastings and Renfrew. When first organized it had a capital of a quarter of a million of dollars, but when they began to investigate the deposits and to inquire into the nature of the industry they were so well encouraged that they forthwith proceeded to increase the capital to \$1,500,000. That company is now taking steps to erect works in the County of Renfrew, and it is hoped that in a short time they will be able to put the mineral on the market. One of the principal men in the company informed me only two days ago that they had received an offer from one of the large emery wheel manufacturers of the United States to take the whole of the first year's production, about 1,500 tons of milled corundum suitable for the manufacture of emery wheels, and in the second year 3,000 tons, if they were given the monopoly of the market in the United States. Correspondence has been received from manufacturers in Germany, Great Britain and the United States which shows that there is a promising market waiting for this mineral when the works are in operation. There is one possible use of corundum to which Prof. Miller has not referred, and that is its use as an ore for aluminium. I am not sure that it can be used for this purpose yet, but I have confidence in human ingenuity to overcome difficulties and I feel certain that some skillful man—I hope some of the young gentlemen who are here pursuing their studies in the schools, if not some of you older gentlemen—may succeed in finding a way to use corundum in the production of aluminium. If that time should come and if an economic process should be discovered it will add immensely to the value of the ore in this country. Both Prof. Miller and Prof. DeKalb have done much to prepare the way for the utilization of our corundum deposits, and I am sure the Government of Ontario is eminently satisfied with the services they have rendered.

Prof. DE KALB—I desire to touch upon one matter which Prof. Miller has mentioned, viz., the superior abrasive power of Canadian corundum. It had been said by corundum specialists that the prismatic form of grains conducted to higher abrasive efficiency. There is no doubt that such a form, presenting sharp corners to the metal, would, at first, cut more deeply and more rapidly than the rounded form of grain. But it would result in a rapid breaking down of these sharp corners, soon exposing a relatively large area of binding material on the surface of the wheel, after which the abrasive efficiency of that wheel must necessarily be lowered. That is to say, its superiority is only temporary, and it may further be pointed out that the surface of the abraded metal would, with such a wheel, be less dense and less free from injury, than in the case of a wheel which did not cut so deeply.

The Canadian corundum shares with the North Carolina product the advantage of yielding grains whose average shape more nearly approaches that of a sphere than a prism. Such particles grind by the attrition of a single point in contact with the surface to be abraded, just as you may have seen a glass plate cut by a glass ball as if the ball had been a diamond.

Referring to Mr. Blue's expressions of hope that the Canadian corundum may be employed as an ore of aluminium, I may direct your attention to the fact that I succeeded in producing, by ordinary methods of concentration, a product which comes almost within the present limits of purity demanded by the aluminium manufacturers for purified bauxite. The difference is so slight as to probably represent no serious obstacle to the utilization of the corundum. I still believe that I could, in doing this work again, produce an even purer grade of concentrates, employing none but mechanical means to effect this. But the next problem, and the one that offers more material difficulties, is that of comminution of this purified product, for it must be reduced to a state of subdivision as fine as flour to admit of its economical solution in the bath in the reduction pots. In the course of my experiments on corundum I prepared plans for carrying out this purpose, for which test, however, the necessary funds have not been forthcoming. I personally entertain little doubt that this whole question can be successfully solved, at a very small outlay, comparatively speaking, for the experiments required.

The concentration of corundum presents no greater difficulties than the dressing of ordinary ores. Its specific gravity is nearly the same as sphalerite, so I treated it precisely as I would have treated a zinc ore, obtaining corresponding results. The cleaning up of the finer sizes, that is, of the material finer than No. 40 mesh, in the case of this Canadian corundum, presents one peculiarity resulting from the association with it of large quantities of white mica in the form of minute scales. The separation of this from the corundum by the usual wet methods of concentration has not proven successful. It is difficult to obtain a higher enrichment than 70 per cent. with these fine grades. I have been hoping to be able to try pneumatic concentration on this material, which I have reason to believe will effectually eliminate the mica.

The meeting adjourned at eleven o'clock.

## THURSDAY AFTERNOON SESSION.

The members re-assembled in the Club Room on Thursday afternoon at three o'clock, Mr. A. Blue presiding.

## THE MINING LAWS OF ONTARIO.

Mr. J. M. CLARK, Q.C., presented a brief paper describing the salient features of the Mining Laws of Ontario (reproduced in our March issue).

Mr. COSTE—Of course, though the Ontario mining laws are not perfect—laws generally are not—yet I think Ontario must be congratulated on having, at least, a mining law, and not being governed by orders-in-council, the way the Yukon territory has been governed from Ottawa. It is very remarkable that the Dominion Parliament has as yet passed no mining law. On my return from the Yukon last year I met a member of Parliament in Ottawa, and one remark I made to him was this: What we complain of is that we have no mining law at all, and that we are governed by mining regulations made out by the Department of the Interior and simply approved by the ministers, so that they are often changed, sometimes every week or two. That has been the great trouble in the Yukon. Even Mr. Fawcett, the gold commissioner, did not know where he was at with all these changes in the regulations. One time a mining claim would be 500 ft. long; at another time 250 ft.; and still, at another time, 100 ft.; they extended to the rim rock at first, then to the base of the hill—both very uncertain boundaries, really impossible to determine with decision. Briefly, there were so many changes that not even the Gold Commissioner could keep track of them. Why don't you pass a law in Parliament instead of allowing us to be governed by regulations made one day to be changed the next? The Minister of the

Interior may decide this and may decide that; that is the way the mining regulations are; it is always left to the Minister of the Interior, instead of being a law which the Ministers themselves could not change. This has been the greatest trouble in the Yukon country; and Ontario is to be congratulated on having a mining law that cannot be changed every day.

Mr. A. W. FRASER—I think Mr. Clark's paper has dealt with the mining laws of Ontario in a very clear and comprehensive manner. Among a body of men such as are present at this meeting, familiar with the practical application of the mining laws and their operation, there should be a full discussion in order to show from their standpoint whether the law as it exists meets the requirements of the mining interests. I think the Legislature ought to be prepared to consider recommendations which this Institute may make. It is a matter of importance in mining legislation not only that the laws should be clear and definite but that they should be of as permanent a nature as possible. Many of the men in mining districts—prospectors and mining men—are not familiar with the changes from time to time made, and for this reason repeated changes from year to year should be avoided. There is also another important branch of the law in which every mining man is interested, namely, Company law. I have had occasion in connection with a number of companies to consider the manner in which these companies were organized and the capital stock issued. In some cases I found that stock had been issued purporting to be fully paid up, but which I am convinced in the winding up proceedings would be held not to be fully paid up. In the organization of companies, therefore, the law relating to companies should be very carefully considered and followed, especially as to the manner in which the stock is issued. I am glad to follow Mr. Coste in bearing testimony to the good character of the laws passed by the Province of Ontario. They are a credit to the Province, and there has been an evident desire on the part of those who have charge of this legislation to pass such laws as would meet the requirements of the Province. It is not pretended that the laws are yet perfect, but they indicate an intention to make them as nearly so as possible. I hope Mr. Clark's paper will be carefully considered and printed in the records of the Institute.

#### NOTES ON THE ATLIN GOLD DISTRICT.

Mr. J. C. GWILLIM presented his paper on the Atlin Gold District.

Mr. COSTE—I had the good fortune or bad fortune, I don't know which yet, to go there last Spring before the ice broke up, and I spent a month in the Atlin district. I may say that I came out of the district with a good impression of it, though of course it is not to be compared in richness to the Klondyke. A good many of the creeks contain quite rich gravels up to \$1 and \$1.50 to the pan. I have panned myself \$1.33 to the pan in a grey gravel on Spruce Creek on top of the bed rock. I visited several other creeks, such as Pine and Boulder, which, with Wright and McKee creeks are the most important, and I saw almost everywhere that the bed rock was very uniform, as Mr. Gwillim has stated, and it is no doubt a basic igneous rock except on the outside of the area he has spoken of. You get outside of this igneous mass, and you find the black slates he speaks of. One of the great troubles there is the size of the boulders, which are of enormous dimensions, especially when compared with the boulders of the Yukon. Another great difficulty in the Atlin district is the way the claims are cramped; they are limited to 100 feet up and down the creek; this is the limit fixed by the British Columbia Government. The miners are so cramped for room on account of these small claims that they are obliged to put tailings and otherwise encroach on their neighbours; then they are called before the Gold Commissioner, and often before they get back there is another row, especially as back of the small creek claim there is a bench claim of 100 feet, and back of that again a hill claim. Naturally the miners all try to get down to the creek to get water to wash their gravel, and they find they have not even room to breathe. And this in a country which was a wilderness a year ago and almost unknown to the world, where today hundreds of rich creeks are yet untouched and waiting for miners to deliver to them their gold; this being the case why should bad laws pile up thousands of men on one creek? One man can take up more than one claim; the Government had to recognise that, and you can have as many powers of attorney from your sisters, wives, daughters, and aunts as you like, and you can take as many claims as you please. It would be much better, however, to make the claim a proper size by law, so that one would not have to turn around the law and act as if he was stealing a little more ground in that vast unoccupied region. This district was, as I have said, very much hampered by the small size of the claims. I do not think that a claim should be less than 500 feet up and down the creek, and it should go from the top of the hill on one side to the top of the hill on the other side. One must often turn the creek, and this cannot be done on 100 feet; you must have at least 500 or 600 feet. Besides, the man on the hill side has to get water, and he forcibly dumps on the creek claim, and then there is trouble. I do not understand why the property should be parcelled out in that diminutive way, especially, as I say, where there is so much room, it is bad for everybody and good for nobody. I think the Atlin District has made a good record for this last year under the circumstances, because there was also another great trouble, and that was the alien labour law. By this law the Hon. Joe Martin tried to exclude aliens. These were mostly Americans, but they were bringing brains and capital into an absolutely new section of our country, and it was therefore very absurd to try to exclude them; but at least you should not exclude your own people in trying to exclude others. What I mean is this:—That on account of this alien labour law it was decided by the British Columbia Government not to grant a miner's license to any company whatever. We were a company incorporated at Ottawa, and when we got to Victoria we were told, "You cannot register your company in British Columbia; you must get a new charter." Well, we put our hands in our pockets to the tune of \$200 or \$300 for a new British Columbia charter of incorporation, but after taking our money the Government quietly said we could not get a miner's license. "What do you mean?" we asked. "Well, you might sell your stock to Americans," was what the Hon. the Attorney General, Mr. Joe Martin, and also the Hon. the Minister of Mines answered. Strange as it may appear, our attorney has been trying to get a miner's license for this company ever since, and he has not succeeded yet, and the only explanation of the Government is that "we might sell our stock to Americans." What is to be thought of a Government who dares to prevent its own people from working their own country?

The CHAIRMAN—Can an individual licensee sell it?

Mr. COSTE—He is not supposed to. The idea of a Government trying to prevent a mining company of their own forming getting a mining license there. How can they expect to develop their province under such management. I think it is shameful. Nevertheless there is a great deal of good gravel there. We found we could save \$3.00 or \$4.00 to the cubic yard, and losing perhaps 50 per cent. on account of its cemented nature. The large valleys there seem to be choked up with gravel.

The CHAIRMAN—Are they river gravels?

Mr. COSTE—All river gravels, and filled up with those big boulders. The conditions for labour there are a good deal better than in the Klondyke. There is more water in the creeks, and a bigger fall for hydraulic purposes, and the transportation very much better. You can leave the Pacific coast in the evening and be there the next morning. It is a very fine country with a fine climate.

#### NATURAL GAS IN ONTARIO.

Mr. EUGENE COSTE presented an able monograph on the Natural Gas and Oil Fields of Ontario.

Mr. BLUE—This paper possesses great scientific value. It is also a paper which presents many points upon which scientists will differ. I want to say this of it, that in my judgment it presents the most interesting and valuable records that have been given to us since the days of Sterry Hunt and Smith in Western Ontario, and it is by long odds the most informing that has ever been given to the public on the subject with which it deals. I am glad to know that a paper of this character has been presented to this Institute, and that the Institute will have the honor of publishing it. I am not going to take up the time of the Institute in the discussion of any of the features of the paper. This may be more profitably done by gentlemen who are experts, the geologists and chemists of our Institute. I am not quite sure that we can devote a great deal of time to the discussion of it this evening. If it is thought advisable we might adjourn it until to-morrow.

Dr. GOODWIN—I would like to ask one or two questions in connection with Mr. Coste's paper. First I will, however, express the great pleasure I have had in listening to Mr. Coste's very able paper, and hope that the discussion will bring out points on which Mr. Coste will be able to give us more information. Is there any evidence at all of the formation of hydro-carbons in situations where the organic origin would be out of the question? Now that is largely a question for the mineralogists, and I hope there are men here who can answer that question. It seems to me that it has been stated that hydro-carbons have been found in quartz crystals, and that these quartz crystals have been found in the plutonic rocks; that might be considered a piece of evidence. There is another point to which I alluded slightly in speaking on another paper. It is a well known fact that iron and other metals containing carbon, when treated at a high temperature with water or acids, yield hydro-carbons; in fact, in some cases the mixture of hydro-carbons is identical with petroleum. It is also a well known fact that meteorites have been found containing free carbon. The Mendeleeff theory is, if I remember rightly, that in the interior of the earth there are present masses of metallic matter charged with carbon and that the water penetrating through fissures comes in contact with this metal at a high temperature, and that the action of the water resembles its action as we can bring it about on a small scale in a furnace, viz., produces hydro-carbons. As an evidence in favor of this theory he has adduced the high specific gravity of the earth as a whole in comparison with the specific gravity of the crust of the earth, pointing out that the specific gravity of the whole globe is something like twice that of the specific gravity of the crust of the earth. That all confirms the chemical theory of the origin of petroleum and natural gas, a theory which is very attractive to the chemist.

Mr. J. M. CLARK—There is one matter which may be of interest to members of the Institute. In connection with one of these wells to which Mr. Coste referred in the township of Gosfield, the matter was strenuously fought out in the courts to decide upon the question of the proper classification of natural gas, and as a result of the discussion the highest court in our Province, following certain of the American courts decided that natural gas was a mineral.

Mr. BELL—That was decided by Order-in-Council of the Dominion Government.

Mr. COSTE—Since that it was also decided by the Supreme Court of the United States. The United States Government charged us duty on natural gas going into Buffalo and Detroit. We fought the matter six years in the courts, and last January the Supreme Court also agreed and decided that it was a raw mineral and therefore free of duty.

#### MOTION RE LIBRARY.

The CHAIRMAN—There was a report to be made by a committee which the Institute appointed last evening, and as Mr. Hay, the chairman of that committee, is present, he might make his report. There was also a notice of motion on the question by Mr. Blakemore.

Mr. BLAKEMORE—I would suggest that this motion should not be discussed at all this afternoon. I wish to give notice of it in order that no member of the Institute will think that it has been sprung on the meeting. If you refer to our constitution and by-laws you will find on the first page, under the objects of the Institute, in clause B, there is the following sentence: "The establishment of a central reference library and a headquarters for the purpose of this organization." By some oversight we have never complied with the provisions of that clause. As a matter of fact, we have located our library in this building, but still there has been no resolution passed with reference to that matter. In connection with that compliance the suggestion has been made that the headquarters of the Institute should be in Ottawa and not, as at present, in Montreal. It is in pursuance of that provision, therefore, that I wish to give this notice of motion.

#### REPORT OF COMMITTEE RE AMENDMENTS TO CONSTITUTION AND BY-LAWS.

Mr. A. M. HAY—The Committee which you appointed yesterday to look into the proposed amendments to the constitution of the Institute had a meeting this morning. I expected that we should have made a report to the Institute to-morrow morning, but after a very exhaustive discussion of the amendments that were proposed by the Secretary, we came to the conclusion that the question ought to be a very much bigger one than was brought forward by these amendments. The whole constitution appears to have been drawn at a time when the objects of the Institute were not so clearly defined as it is now evidently the intention of the members of the Institute they should be. The consequence was that after discussing them very fully, it was resolved by the committee that the whole matter should be referred by the Institute to a committee to be elected at this general meeting to look into the whole question of the constitution and by-laws and to report at the next annual general meeting, with the suggestions of alterations in the constitution.

The report was received, and the appointment of the committee left over till Friday.

The meeting then adjourned until the evening.

#### THURSDAY EVENING SESSION.

The members re-assembled at eight o'clock.



## EXHIBITION OF LANTERN PROJECTIONS.

Dr. J. B. PORTER exhibited a large number of excellent and interesting slides showing surface and underground works of prominent British, American and Canadian mines.

## GRAVEL BENCHES OF THE KLONDIKE.

Mr. R. G. MCCONNELL presented a paper describing the gravel benches of the Klondike (reproduced in our March issue).

Mr. COSTE—I had the pleasure of examining these very same quartz drifts, as Mr. McConnell has called them. The first thing that struck me when I looked at them was the quartz. It is nothing but quartz pebbles. They are pretty well rounded and very regular in size as a rule, none of them being very large, from the size of your fist to the size of your head or a little bigger. It is very striking that the pebbles should be all quartz, white quartz; and the matrix is a sort of white kaolinized clay. I saw what appeared to me the same thing exactly as this quartz drift of the benches in the lower part of Sulphur Creek, in the creek bottom. In the dumps from the shafts that have been dug down to the bedrock there, nothing but quartz pebbles, with the same white material for the matrix, can be seen.

Mr. MCCONNELL—Entirely decomposed granite.

Mr. COSTE—When you go further up the creek you do not see any more of this white quartz drift, but in the lower part of the creek it struck me that it was the very same white quartz gravel as on the benches of the Bonanza and Eldorado. My idea is that it is simply river gravel slowly deposited in a country of not very much precipitation—so slowly deposited that gradually all the schistose and other material except the quartz has washed away. Slow precipitation as a rule, with at times rapid washing, would, I think, account for this quartz drift of Eldorado and Bonanza benches and of the lower part of Sulphur Creek. On Dominion and Australia Creeks there seems to be none of that quartz drift at all. I spent a great deal of time on Australia Creek and we struck none of that quartz drift there. Its deposit, therefore, is limited, but I am satisfied that on the lower part of Sulphur Creek it is to be found in the creek bottom.

The CHAIRMAN—What is the extent of these deposits?

Mr. COSTE—They are quite extensive in the creeks where they are found. They have worked the Bonanza deposits for 12 or 15 miles now.

Major LECKIE—How wide?

Mr. COSTE—Very wide;—back from the creek for half a mile and more in places. The valleys there are very wide and gently sloping valleys, especially on the high levels; it is that way all the way down the Bonanza Creek for 12 or 15 miles, and these extensive deposits are quite rich also.

The CHAIRMAN—Are they workable to the source of the streams?

Mr. COSTE—Not quite. The upper part has not proved rich so far. Three or four miles down is where you commence to get the best results. In the upper part it seems to be all washed away.

The CHAIRMAN—What would they yield per ton?

Mr. COSTE—All the way from 5 cts. to \$500.00 to the pan. Our friend, Mr. Tyrrell, can tell you of a \$525.00 pan, and I can speak of another of \$200.00 odd; but while this is exceptional, it is quite rich in many places, and one ounce to the pan is not uncommon; though, of course, in very many places \$4.00 to \$6.00 a cubic yard is all that can be had.

The CHAIRMAN—What is the lowest yield that would pay?

Mr. COSTE—That is another question, and one that cannot be properly answered at the present. Everything is so expensive now: labor \$8.00 and \$10.00 a day, board \$3.00 a day, and transportation from Dawson to the claims 1 cent per lb. per mile. Our Government at Ottawa had not spent one cent in making roads out of Dawson when I left there in September last. The transportation facilities are pretty good up to Dawson now. There is a railroad over the White Pass and good steamers all the way down except at the White Horse Rapids, where you have to portage four miles. Where the trouble commences is at Dawson—one cent. per lb. per mile from there to the creeks. If you have a ton to carry a mile it simply ruins a man. It is shameful that a Government which charges 10 per cent. royalty on the gross output of the mines of that country should not even provide in four years time one mile or one inch of road, to get from the only town there to the rich diggings from which they exact such onerous royalty. When you start out from Dawson you are right in the swamps, and you have got to know the country and the terror of these muskegs to know how bad they are. It is as much as your life is worth to go a few miles there on horseback. If you come back alive you are lucky. To the poor fellows who travel with packs and to the animals it is positive cruelty. The Government at Ottawa, and the Hon. Mr. Sifton especially, should be brought before the tribunals of the country for the way they have allowed this thing to go on for years; and after making money out of the country too. I remember very well, in one of the speeches Mr. Sifton made in Manitoba, during the last elections, that he said he had made the Yukon pay for the Yukon—and more, that he had made \$679,000.00 out of the Yukon. It is a shame to make this money out of the poor fellows who went up to that frozen land, a complete blank and wilderness four years ago, and who at great risks and under great hardships, opened up that new country; and not even to make roads there to travel on.

The CHAIRMAN—Is it favorable for the building of roads there?

Mr. COSTE—Most easy. The country is gently sloping. With roads easy to build you could go right over the hills without getting off your horse. They do not seem to know enough to start at it, that's all.

The CHAIRMAN—Only sometimes the muskegs are very deep?

Mr. COSTE—Yes. All the more necessity to make roads!

The CHAIRMAN—How would you get a road?

Mr. COSTE—With corduroy and blue clay on top.

The CHAIRMAN—Is there abundance of timber?

Mr. COSTE—Yes, and rock and clay to make good roads galore, along gentle slopes and wide valleys, and lots of money and everything necessary. There is no excuse whatever, especially after making \$679,000.00 profit on the first few years of the opening of the country there. It is a shame! and that alone clearly shows how badly managed the Yukon Territory has been.

Major LECKIE—There might be some analogy between those quartz of the Yukon and those of the Transvaal. In the Transvaal the gold is not contained in the quartz, but in the cemented material. It is the cemented material which forms the conglomerates, and they are probably older in the Transvaal, somewhere in the Upper Huronian, because the coal is not far from the quartz drifts. The gold does not occur in the quartz but in the cemented material, just like the copper on the south shore of Lake Superior.

Mr. COSTE—Most of the gold in that country is got out of the bed rock. In some places they take four feet out of the bed rock, the coarse gold being found between the shales of the schists.

The CHAIRMAN—It is not found in the bed rock itself?

Mr. COSTE—Yes, really most of the gold is got from the bed rock or the gravel just above it, a foot or two, or three feet above the bed rock, that is the rich part of the deposits, but of course the gold has been washed there and is alluvial gold.

Major LECKIE—The bed rock and right in it?

Mr. COSTE—Four feet in it. There are a great many places where they take four feet out of the bed rock.

Major LECKIE—Are there any quartz then in these schists?

Mr. COSTE—Yes, some perfect quartz and very rich, too. I have seen schists run three and four oz. to the ton.

The CHAIRMAN—On the lower level?

Mr. COSTE—Right on the Yukon, right on the river. There are large ledges of quartz running across the country. You can trace them for miles and in a great many of the gulches and towards the head of the streams. The gold that you see in the sluice box is full of quartz. In some of the gulches every part is quartz. In Victoria gulch and Upper Bonanza there is any amount of quartz in the gold.

Dr. GOODWIN—It is not free?

Mr. COSTE—Not free at all, not like in Atlin.

Major LECKIE—You look forward to quartz mining there, then?

Mr. COSTE—No doubt of it.

The CHAIRMAN—You think quartz mining more profitable there than gravel mining.

Mr. COSTE—In the long run there will be more investment, but not so quick a return. There is a great deal to be done there in placer mining, but the ten per cent. royalty and the heavy expenses were so great, that only the very richest claims count. It has got to be the Klondike to pay.

Major LECKIE—Perhaps the Government wished to shut up the mines there the same as the Ontario Government.

Mr. COSTE—They tried to keep you out of Atlin.

The CHAIRMAN—Is there any coal in that country?

Mr. COSTE—Yes, there are some layers of cretaceous.

Dr. GOODWIN—What is the quality of the coal?

Mr. MCCONNELL—The ordinary lignite. There is one seam that they worked about 75 miles below Dawson, a seam about four or five feet thick.

Major LECKIE—How much moisture?

Mr. MCCONNELL—Quite high.

Major LECKIE—Fifteen per cent.?

Mr. MCCONNELL—More than that.

The CHAIRMAN—What is pay gravel?

Mr. MCCONNELL—The bench gravels require to carry \$14, and the creek gravels \$7.00 or \$8.00. In the creeks \$4.00 or \$5.00 will not pay under present conditions, but of course the conditions are improving from year to year.

Mr. COSTE—The ten per cent. royalty is not improving; it is still there. There is no industry that will stand a 10 per cent. royalty. There was a chance for Canada to open up that frozen land there a few years ago. All at once rich discoveries were made there, and the Government through their greediness—I cannot call it anything else—just went in and killed the country.

The CHAIRMAN—The prospectors got excited.

Mr. COSTE—If the transportation companies got excited that is no reason why the Government should get excited, too.

Mr. STEVENSON—If the Government built these roads there, would the mining men not still object?

The CHAIRMAN—They would want a bonus.

Mr. COSTE—If the miners could see some benefit to be derived from the 10 per cent. royalty,—but still I think they would have the right to kick. There is no country in the world where a 10 per cent. royalty is exacted. The only way I can explain it is that the Government got excited because it was so rich.

A MEMBER—But the salaries of officials have got to be paid.

Mr. COSTE—They have not only paid salaries, but they made a large profit. That was the statement made by Mr. Sifton before the last election in Manitoba. It was the chance for Canada to build up the country and make it the centre of population. The Government ought to have been exceedingly liberal as the British Columbia Government was at the time of the Cariboo excitement. They limited the royalties to two or three years, and gave facilities for opening up the Cariboo district right along the Fraser River, which cost them a million dollars. That is the way to do, not put the screws on.

Major LECKIE—If you have a bounty on the iron ore from Michigan, why not have a bounty on the gold. You treat the foreigner better than your own.

Mr. BELL—I am quite sure that if the Government had in the first instance obtained the advice of a competent mining engineer, no such foolish legislation would ever have been enacted. With all due respect to Mr. Ogilvie, he is only a surveyor, and knows absolutely nothing about practical mining conditions. The Ontario Government has done the same thing in bucking up against the nickel industry.

The CHAIRMAN—What about Dr. Dawson of the Geological Survey?

Mr. BELL—Dr. Dawson is not a mining engineer. They are both exceedingly good men in their own profession, but neither is a practical mining engineer competent to advise on practical mining legislation. The much abused Government of Quebec has shown a better example by not only taking off the royalty but by exempting its mines from municipal taxation.

Major LECKIE—The Dominion and Ontario Governments have not yet learned the lesson which the Government of Quebec taught them by their action.

Mr. BELL—They evidently want to kill the goose that lays the golden egg.

Mr. MCCONNELL—Mr. Bell spoke about Mr. Ogilvie's estimate of \$50,000,000 in sight. Thirty millions have come out in two and a half years, and the very last calculation is something like ninety millions in the creeks, and you can add the bench claims to that about one-fourth or one-third more, say \$120,000,000.

Dr. PORTER—I would like to ask about the estimate of \$120,000,000. Is that the gross or the net?

Mr. MCCONNELL—Gross.

Dr. PORTER—You gave an estimate of how many dollars per yard to get it out?

Mr. MCCONNELL—It costs from \$5 to \$7 a yard.

Dr. PORTER—Have you any idea from the gross estimate. You say the creeks would have something like \$90,000,000, and the benches \$30,000,000. What would the net value be? Have you any figures at all?

Mr. MCCONNELL—So far as the rate is concerned, some of the ground they are working would stand any rate. Ground that will give \$2,000 to the foot will stand anything in the way of expenses, but it is not all like that. In another season or two, if you had a royalty and the working expenses continued as heavy it will not pay at all.

Dr. GOODWIN—What proportion of the gold remains in Canada?

Mr. COSTE—It is all sold to the mints at Seattle and San Francisco. There is a statement that I got from Seattle, a return from the mints, and it shows that for the fifteen months ending in September last year they got \$15,400,000 from the Klondyke.

The CHAIRMAN—How many men are employed in that industry, in the placer diggings?

Mr. COSTE—Thousands of men, but I could not tell you the number. There have never been any statistics, but it is up in the thousands.

Mr. COSTE—There has certainly been more money spent than has been taken out. We could find out a little more about it if we only had a little system about it.

The CHAIRMAN—Would you suggest a Government mint?

Mr. COSTE—I do not know. I would certainly suggest that they keep track of it and know how much they get. That would be very easy, because it is exported along the Yukon. They manage to allow no whiskey to come in. Instead of a return of eight or nine millions last year there would probably be a return of eighteen or twenty millions. It makes a great deal of difference when it comes before the capitalist in England whether it is eight or nine or nineteen or twenty millions—a tremendous difference, and it is certainly easy to get at.

Mr. BELL—I would like to hear, and I am sure all the members of the Institute will agree with me, from Mr. J. B. Tyrell, one of our members now a resident of the Yukon, who I see has just come in.

Mr. TYRELL—I am very sorry indeed that I was not able to be here at the beginning of this discussion. However, on the matter of the royalty in that country there can be no question whatever that a 10 per cent. royalty on the gross output of the mines is a very serious drawback to investments where people believe that the profits may be close. If a man is always confronted, no matter what the output may be, with a ten per cent royalty to the Government and practically a ten per cent. royalty to the banks—for the banks charge 3 per cent. for assay and 2 per cent. for drafts—that means 15 per cent. on the total output of the mines.

Mr. BELL—To say nothing on customs.

Mr. TYRELL—Of course the people of the Klondyke pay that the same as the people of the rest of the Dominion—duty and excise—and everything else that is paid by the rest of the people. And each man in the Klondyke has to pay to work, and he has to see that every man that he employs has a miner's license. A man who employs ten men has to pay for ten miners' licenses to the Government or forfeit his claim, and all that means a heavy set back to the country and the gold-mining industry there. I believe the people would be perfectly satisfied to pay the heavy dues which the Gold Commissioners' office collects. I believe that last year the amount of dues actually collected from the people for gold commissioners' fees, recording fees, miners' licenses, &c., was something like \$700,000. This was outside the royalty altogether. That royalty is of course more or less in the discretion of the man who takes out the gold, to pay or to avoid it to some extent. The honest people pay their royalty; the rogues to a large extent go free.

The CHAIRMAN—Are there exemptions?

Mr. TYRELL—A man, to avoid the payment of that royalty, must make a false affidavit. That means that the man in the country who is honest pays the larger portion of the royalty, and the man who has no hesitation in making a false affidavit and avoid it in every possible way can go to a large extent free. It is a distinct premium on dishonesty and roguery.

The CHAIRMAN—Was it not proposed at one time to exempt a certain production of gold?

Mr. TYRELL—There was \$5,000 exemption on each claim. That allows dishonesty a greater opportunity, because if a man takes out \$50,000 he swears that he has only taken out \$5,000, and they are not able to prove that he has taken out more, so he goes free on that \$5,000 exemption. It does far more harm than it does good. It seems to me that if any revenue is needed further than that collected from the Gold Commissioners' Office—and I think that abundantly sufficient revenue can be collected in that way, in the way of record fees, &c., and throw off the royalty—if, however, it is necessary to raise revenue from the royalty, most decidedly the simplest way is for the Government to buy our gold. By having an assaying office and a buying office, the Government buying our gold and issuing certificates therefor, that gold would be good anywhere. That would leave the banks in precisely the same condition as in any other part of the country, as banking firms, and they would not get the amount that is now paid them for buying the gold.

The CHAIRMAN—Could not gold be smuggled out of the country under that arrangement as well as at present?

Mr. TYRELL—No. A man cannot carry away gold. If a man has a thousand dollars' worth of gold in his pockets he is pretty well loaded. A man could not carry away two thousand dollars' worth of gold without their knowing it.

The CHAIRMAN—Would the banks be implicated in smuggling it.

Mr. TYRELL—No. The moment you make your affidavit that that much gold has been taken out the gold is free, but the claim is liable to forfeiture; but they cannot follow the gold. They put the stain on the title to the claim and let the gold go free. If the gold was held and the title to the claim left perfect men would invest far more readily and nothing like as much need be collected, because 3 per cent. from \$16,000,000 would give \$480,000, and 5 per cent. would give \$800,000 or more than the royalty this year, which was \$730,000. Now we pay 15 per cent., 5 per cent. to the banks and 10 per cent. to the Government. The banks get all theirs, but the Government only get part of theirs. It is all shipped out by the banks, the North American Trading and Transportation Co. and the Alaska Transportation Co. They do a banking business to that extent. I feel with Mr. Coste quite strongly on this question of the royalty, but I am glad to see that the Government has been doing something this winter. They have been amending the principle of the laws, and amending them in the right direction. I feel confident that the Government will do something; at any rate I hope that they will take this matter of the royalty up thoroughly and that they will reduce it or abolish it, or put it on an entirely different basis from what it is at the present time. They have established the titles to the claims, making them of a definite size, and by giving us a longer tenure of mining leases, making them five years instead of one. They have also given us a cash payment of \$200.00 instead of continuous representation. All these are laws in the right direction and will assist us very materially. I sincerely hope that the question of the royalty will be taken up in earnest, and that it will be put in such a shape that the people will not feel that they have the grievance that they do at the present time, and that that the capitalists will not find the bugbear that they find at the present staring them in the face in any commercial enterprise they want to bring into that country. If that is done I feel that we will have in the Yukon country as law abiding and as loyal citizens as there are in any other part of the Dominion of Canada.

The CHAIRMAN—I am sure the members would like to hear Mr. Tyrell's views as to the occurrence of gold in the quartz deposits.

Mr. TYRELL—Well, unfortunately, I do not know Mr. McConnell's ideas or

conclusions on the character and region of the gold there so that I cannot criticize his paper. My idea with regard to those higher level gravels is that previous to decomposition of those gravels the country was reduced to a very gentle slope, that the country was almost reduced to a base level as far as the erosive agencies were able to reduce them. The whole country was reduced to very wide gently sloping valleys. Then it was at a slight elevation. Then it was depressed, and as it depressed the sea approached nearer and nearer to the edge of the Klondike country and the rainfall became greater. There was more of the decayed material on the hillsides washed down in the valleys. The streams were torrential and rounded gravel in the bottoms of those wide sloping valleys. Then the decomposition went still further and over those rounded gravels as the sea encroached on the valleys, and the Klondike country became in fact on the shore of the sea, and the stream gravels in the higher valleys were covered over by a very considerable thickness of delta. The upper portions of what are now the higher benches seem to me as quite distinctly delta deposits formed at the mouths of the originally gently sloping valleys where those valleys go into the ocean. Then the country was receding on the ocean and the present valleys were cut down in the bottoms of the pre-existing valleys, but not their whole width, only in part. Then the bottoms of the old valleys were left on one side or other as terrace gravels at considerable heights of two, three, four, five or six hundred feet above the bottoms of the present valleys, and the gold in the present valleys is to some extent derived from the washing down of the gold from where it was collected earlier in the gravels of the higher levels. That is my idea of the formation of these upper gravels, and I have not the most remote idea whether it agrees or strongly disagrees with Mr. McConnell's ideas.

#### VIEWS OF LABRADOR.

Mr. A. P. Low, of the Geological Survey, exhibited a large number of interesting lantern slides illustrating some of the features of the country and the inhabitants of Labrador.

The meeting adjourned at half past eleven.

#### FRIDAY AFTERNOON SESSION.

The members re-assembled in the Club Room at three o'clock.

#### ELECTION OF OFFICERS AND COUNCIL.

Mr. A. MARSHALL HAY, on behalf of the Scrutineers, presented the following as the result of the elections to fill the vacancies in Officers and Council during the ensuing year:—

##### PRESIDENT.

Mr. S. S. Fowler, (London & B. C. Gold Fields, Ltd.) Nelson, B. C.

##### VICE-PRESIDENTS.

Mr. Charles Fergie, M.E., (Intercolonial Coal Co.) Westville, N.S.  
Mr. James McArthur, (General Manager Canadian Copper Co.) Copper Cliff, Ont.

##### SECRETARY.

Mr. B. T. A. Bell, (Editor Canadian Mining Review) Ottawa.

##### TREASURER.

Mr. John Stevenson Brown, Montreal.

##### COUNCIL.

Mr. E. B. Kirby, M.E., (War Eagle Con. M. & Dev. Co.) Rossland.  
Mr. Bernard Macdonald, M.E., (British America Corporation) Rossland.  
Mr. R. G. McConnell, (Geological Survey) Ottawa.  
Major R. G. Leckie, (Canada Mining & Metallurgical Co.) Sudbury.  
Mr. Henry S. Poole, M.A., A.R.S.M., (Acadia Coal Co.) Stellarton, N.S.  
Mr. G. F. McNaughton, (Modstock Gold Mining Co.) Forest Hill, N.S.  
Mr. J. Burley Smith, Mining Engineer, Montreal.  
Mr. James F. Lewis, Mechanical Engineer, Sherbrooke.

On motion the Report of the Scrutineers was adopted.

The CHAIRMAN—As you have a new President, it is proper that he should be introduced and installed into office, and if that meets your views, I would ask Mr. Fowler to come forward and take the President's chair.

Mr. S. S. FOWLER, the newly elected President, then stepped forward amid the hearty applause of the members, and Mr. Blue, addressing him, said:—I have not until to-day had the pleasure of your acquaintance, but I am credibly informed that you are a man of excellent reputation as a practical mining engineer, and if you have not had experience in presiding over meetings of this sort you will gain it, and you will find this meeting a very easy one to manage. I have occupied the place now yours in an ex-officio capacity, and I am bound to say I have found the members of the Institute to be exceedingly amenable to reason.

Mr. BELL—Before you leave the chair, Mr. Blue, I should like, as the sponsor for the new President, to offer a word of explanation. While I am naturally gratified at the complete success of my ticket it is only fair and proper to Dr. Goodwin to explain that this election was not run on personal grounds. The growth of our membership in the West, and the importance of British Columbia as a mining constituency was warrant for our belief that it would be to the best interests of our organization to give the presidency of the Institute this year to that province. In Mr. Fowler we have elected a gentleman of reputation in the mining profession, a gentleman who represents one of the largest and most important mining undertakings in Canada, and a gentleman who may be depended on to use his influence to promote our interests in British Columbia.

Mr. S. S. FOWLER, upon assuming the chair, said—I wish to thank you for the honour you have done me, not only for my own part, but also for my colleagues and friends in the mining business in British Columbia. I think they will appreciate the good the association has done in affirming the fact that British Columbia is doing its full share, although comparatively a new Province, in promoting the great mining industry, as compared with the older and eastern provinces. Our output is comparatively small as compared to many of the States to the south of us, but still we feel that we are an important part of the community. Our output, which is rapidly increasing, would have grown more rapidly had it not been handicapped by adverse legislation, and the labour element has only taken advantage of the difficulties which have arisen under that legislation. For these reasons we will perhaps not make so good a showing for 1899 or 1900 as we otherwise would have done, but still the

actual result of the mining industry in British Columbia is full of promise for the future. I cannot help thinking, after seeing Dr. Porter's lantern slides last evening, that we still have a great deal to learn and to do before we arrive at such a stage of development. We have, as Mr. Bell says, some good mills in British Columbia. They are large and we are producing cheaply, but still at the same time we are a long way from arriving at that status which will put us in the front rank of mining communities. I am not good at speech-making at all, but I cannot sufficiently thank you for the honor you have placed in me. I do not know what I have done to merit the confidence you have placed in me. I think the newspapers are somewhat at fault, and you know you cannot always believe everything you see in the newspapers. This reminds me of an incident which occurred to Senator Chauncey Depew, while on a political tour through the western part of New York State. In visiting a country town where there was to be a meeting he met the editor of the country paper in the afternoon and asked him how the campaign was progressing. The editor said that the campaign had a very encouraging outlook and that the Republican party was sure to be elected. "Well, what makes you think so, asked Mr. Depew. "Well, all the papers say so," replied the editor. "Mr. Smith, you cannot always believe everything in the newspapers," retorted Mr. Depew. After the meeting Mr. Smith happened to meet Mr. Depew, when he said, "Mr. Depew, are you the famous orator and after dinner speaker?" "Well, I have done some after dinner speaking," replied the Senator. "Are you the famous Mr. Depew that we read about in the papers as the famous after dinner speaker?" again asked Mr. Smith. "Well," replied Mr. Depew, "Why, why do you ask—" "Well, I don't know," said Mr. Smith, "that you can always believe what you see in the papers." (Laughter.) I have always borne that in mind when reading articles about myself. However, I shall go home with the satisfaction of feeling that I am kindly regarded by my fellow members of the Canadian Mining Institute, and I shall endeavour to carry out the work of the Institute to the best of my ability. (Applause.) The field for the work of the Institute is a very large one. At our distance from headquarters we are more or less handicapped in doing favourable work for the Institute. The great trouble there is that we are a very busy community. We have a great deal to contend against, still this Institute must be made useful to British Columbia members as well as others. The work of the Institute must be made to depend upon the individual effort. Every man must put forth his efforts to make the Institute a success. It does not do to sit by at the meetings, but we must do all we can to advance the mining interests of the country, and exercise ourselves largely as we did in British Columbia last summer. That is the particular aim of the Institute. We want more men who will go to work and prepare papers, not only of technical but of commercial importance, papers of sufficient interest to everybody to show that in the Dominion of Canada we have great mineral resources, and that we want those resources developed. We want the fact advertised that the laws are not so bad as they are made out to be. We want to get in foreign capital and we must get it in. For instance, Montreal has been the great monetary centre, yet we want capital from many sources, and we have got to show to the investing community that the mining industry is a generous one, and that they will get good returns from it. We have a number of men in British Columbia today, as in all mining communities, who are not over given to views founded on experience, but we must have men who are good, hard, earnest, pushing, active workers in the field, men who can be trusted individually in anything they take up. We want a superior morale in connection with the execution of any mining work. The prime lever of all legitimate success is honesty in the first instance, and that we must maintain. (Applause.) I must confess that I have become more or less of a confirmed cynic in British Columbia. I am not ashamed to say that I am an American, but I have seen more rascality in western mining towns than I have ever seen anywhere else. Some of that element has cropped up in the western part of Canada, and we should make it our business to put down that element and keep it down. (Applause.) I hope to do my share in carrying on the work of the Institute; I know it will be upheld in every possible way by my colleagues in British Columbia. (Applause.)

#### COMMITTEE TO REVISE CONSTITUTION.

Mr. BELL moved, seconded by Mr. Stevenson, that the following be a Committee to revise the Constitution and By-laws, and to report to the next annual meeting: Messrs. Coste, Blue, Hardman, Goodwin, Hopper, Blakemore, Hay and Stevenson.

The motion was carried.

#### NEXT PLACE OF MEETING.

Mr. BELL—Negotiations are pending to hold our next meeting in conjunction with the American Institute of Mining Engineers at Sydney, Cape Breton, but as the arrangements are not yet complete, it would be well to leave the matter in the hands of the Council.

This was agreed to.

#### VOTE OF THANKS TO RETIRING OFFICERS.

Mr. BELL—I am quite sure we are all agreed that it is only fit and proper that we place on record our appreciation of the services rendered to the Institute by our retiring President, Mr. Hardman. (Applause.) As the chief executive officer, Mr. Hardman and myself have naturally been brought into close contact in the carrying out the work of the Institute during the past two years, and while we have agreed to disagree upon many things, I can vouch for the zeal and interest he has always taken in our work. It is also a matter of regret that Mr. A. W. Stevenson, who has acted so efficiently as our Treasurer, should have decided not to offer himself for re-election. (Applause.) It will be hard to replace him. I would move, therefore, that our best thanks be tendered to these gentlemen and to the retiring members of Council. (Applause.)

Mr. J. STEVENSON BROWN—In seconding the motion, said that in Mr. Stevenson the Institute could congratulate itself on having as its Treasurer, one of the most straightforward, honest and upright men in Montreal. (Applause.)

The PRESIDENT—I am only too pleased to add my word of appreciation of the services rendered by Mr. Hardman and Mr. Stevenson. We all respect Mr. Hardman very highly. As to Mr. Stevenson, his services are too well known to you all to require any further encomiums from me. (Applause.)

The motion was carried unanimously.

#### MOTION RE LIBRARY.

Mr. W. BLAKEMORE—With reference to my notice of motion, I do not regret having brought it forward, because it has led to very general discussion. However, I do not think it wise to press it at this time and I will ask leave to withdraw it.

#### THE YUKON ROYALTY.

Mr. J. B. TYRELL—Yesterday I spoke for a few minutes on the question of the Yukon royalty. It seems to me that if this Institute would give us their support in petitioning the Government, asking that the royalty which they all recognize as too onerous, should be reduced, it would assist us very materially, and especially at this time because I have no doubt that the Government is considering amendments to the mining laws of that country. I would therefore move:

"That the Canadian Mining Institute petition the Minister of the Interior, that the present onerous royalty of 10 per cent. on the gross quantity of the gold extracted from the placer mining claims in the Yukon district be reduced to 2 per cent., and that this royalty should be collected off the gold as it is taken out of the district, and at the same time that correct statistics of the production of the country should be recorded."

I think that 2 per cent. on the present year's output would have given about \$320,000, and next year if the probable output of twenty millions is anywhere near correct, and I think it will be quite under the mark, it would give us a revenue of \$400,000. That would be outside of the revenue received from the Gold Commissioner's office. Last year, as has been stated and I think correctly, the Government collected \$730,000 royalty and had a large surplus from the Yukon district. It appears to me to be quite unfair that a new district of that kind should be asked to pay such a surplus, and I would therefore, ask the support of this Institute in petitioning the Government that this royalty should be reduced.

Mr. COSTE—I am very much pleased to second this motion. Mr. Tyrrell live<sup>9</sup> in Dawson and is perfectly acquainted with the subject and know the whole question. I am interested a little in the Yukon also, and I was there last summer, and I have also felt both while there and in talking it over with those who are especially interested in the English market, that 10 per cent. of the gross output is certainly a very onerous royalty and prevents the development of a new, vast and important part of the country which is very rich in gold and other minerals. It is certainly of the very greatest importance that we, as a body interested in the development of the mining resources of the whole country should petition the Government, and I hope that it will be the last straw that will break the camel's back so as to bring the desired change. One objection that is made by a few people that I have heard speak about this royalty is this: "Well, it is only placer gold there; it will only be taken out in a few years and there will be nothing left, and the Government may just as well make as much as it can out of the country." That shows how little they know about the country and what little confidence they have in its future. We all know that in California—and the geological conditions in the Yukon are very similar—placer mining is going on there still after fifty years. There has been an average production of \$26,000,000.00 a year—one year it went up to \$81,000,000.00, and it is to-day \$18,000,000.00 a year. Last year it was \$2,000,000.00 more than the year before, and the gold production is now going up again with the opening up of the quartz mines. This shows that the Yukon gold product is not going to peter out in a few days. It will last, I will not say for half a century, but for several centuries, if not killed now by a 10 per cent. royalty; for there also, many rich quartz mines will be developed if you give a good chance to capital instead of driving it out. The Government is not posted. They heard the stories of the first prospectors and those stories were so wild that they got wild themselves. We propose to inform them that the mining community of this country, who are the best qualified men to speak of this matter, are opposed to the imposition of this royalty, or at any rate, are in favor of having it very materially reduced. This is decidedly a mining matter, and who is better qualified to give an opinion but the Canadian Mining Institute.

The PRESIDENT—Suggest a committee.

Mr. TYRELL—The President, Secretary, Mr. Coste and myself.

Mr. ARCHIBALD BLUE—I think we had better proceed more cautiously in this matter. It appears to me that for some years past this Institute has been too forward in interposing its opinions on political questions. Every industrial question is more or less political. I have not sufficient information upon this question to vote upon it yet, and even if I had the facts before me I would first consider whether it is good policy to interpose in a matter which the Government is dealing with. If it was an open question I might go so far as to say that I would agree to a reduction of the royalty from 10 to 5 or 1 per cent., or to take it away altogether. But what I say is that we ought to be in possession of the facts before we proceed to express an opinion. I remember very well three or four years ago, when the discovery of gold was first made known to us by the prospectors of the Yukon, that the most extravagant statements were made. People came down to Ontario and Quebec with gold nuggets in their pockets and proclaimed that a man could go into that country and pick them up like pebbles on a lake beach. If the country was so enormously rich—and the Government had the reports of prospectors and its own officers—I am not surprised at the decision that the people of this country who owned the Yukon territory should have a little of its wealth. If it is the case that the country is not so wealthy as it is represented to be, that is another matter. But we should have the facts laid before us, and we have not got the facts. Neither Mr. Coste nor any one who has spoken on the question can even tell us how many men are engaged in the industry, and estimates of gold production differ by millions of dollars.

Major LECKIE—Yes; Mr. Coste gave us the facts last night.

Mr. BLUE—Mr. Coste and everyone who has spoken on the question cannot even tell us how many men are engaged in that industry.

Mr. COSTE—That is the duty of the Government.

Mr. BLUE—I think we should approach the Government in a reasonable way. Governments are made up of reasonable men, and if we place well-founded information before them they listen to us, but you cannot expect them to pay much attention if you go before them with a bald and unsupported resolution such as this.

Major LECKIE—Mr. Blue was chairman of our meeting last night and heard the statements made by Mr. Coste and Mr. Tyrrell, men who are better known than any others. Mr. Coste stated distinctly that the expenditure by the mining men in the Yukon was a great deal more than all the gold that had been produced. Then why put on a royalty of 10 per cent. to make the loss greater? Mr. Coste stated also that Mr. Sifton, in his late campaign in Manitoba, said that he had made a profit of \$679,000 out of the Yukon, out of the men who are imperilling their lives there to open up a new country.

Mr. COSTE—The Government is not posted. They heard the stories of the prospectors, and these stories were so wild that they got wild themselves. We propose to inform them that the mining community of this country, who are the best qualified men to speak of this matter, are opposed to the imposition of this royalty, or at any rate are in favor of having it materially reduced. This is decidedly a mining matter, and who is better qualified to give an opinion thereon than an organization of mining engineers and mining men.

Mr. BLUE—Inform us before you ask us to express an opinion.

The PRESIDENT—I do not see that we are wrong in going before the Government



and stating that certain facts warrant us in asking for a reduction of this royalty. It is hard enough to get the men and supplies in there without having to pay this extra tax on the gold taken out. And then this royalty really puts a premium on scarcity. I know this of my own personal knowledge, that the chances were 999 in 1,000 that it did. If we can put an end to this and at the same time foster the mining industry of the Yukon, I think it is our duty to do it. (Applause.)

The motion was carried.

### THE NICKEL QUESTION.

Major R. G. LECKIE—To Dr. T. Sterry Hunt is due the credit of having first detected the presence of nickel in the ores and rocks of Canada. Fully fifty years ago, he described minutely the character of the copper-nickel ore of the Wallace Mine, situated west of Whitensh river, north shore of Lake Huron. In dressing the copper ore the niccolite had been thrown away in the waste dump, but he showed that it really was a niccolite, carrying about 14 per cent. nickel. He also described arsenurets of nickel found and the veins of Michipicoten Island, and his many analyses proved the existence of nickel ores more or less valuable, in the magnesium rocks of the Quebec group. I like to recall the name of my old friend, Dr. Sterry Hunt. His work, recorded in the volumes of the Geological Survey, speak of his untiring industry and original research. He was undoubtedly one of the foremost scientific men of his day, besides being a scholarly and accomplished gentleman. In 1878 the Orford Copper Company acquired the mining location near Brompton Lake, in the township of Orford. Dr. Hunt describes the ore as follows:—"With the chrome garnet of Orford, the sulphuret of nickel (millerite) occurs in small grains and prismatic crystals, disseminated through the mixture of garnet and calcite in quantities which may become available." About 100 tons of ore were raised and an experimental furnace built, but the ore was found on the average low grade, and the gangue too refractory to make operations remunerative. At that time metallic nickel was worth \$3 a pound in Philadelphia, but the discoveries of great deposits of nickel ore in New Caledonia and their successful reduction by M. Garnier, sent down the price quickly to about one fourth of that figure. In view of this depreciation on value of product, it was considered imprudent to continue operations, but this was the first attempt to mine and smelt nickel ore in Canada.

During the construction of the Canadian Pacific Railway several outcrops of pyrrhotite were discovered in the neighbourhood of Sudbury, and in 1886 the Copper Cliff mine was opened as a copper mine by the Canadian Copper Co. Samples from the surface assayed well, and a considerable shipment of ore was made to the Orford Copper Co. The yield in copper was disappointing, as it did not average much over 6 per cent. A full analysis of the ore was made in the laboratory of the Orford Copper Company, when it was discovered that the ore carried fully 4 per cent. nickel. This fact was communicated at once to the Canadian Copper Company, which afterwards proceeded to erect a smelting plant at Copper Cliff. This was done from the plans and under the direction of Dr. Peters, the well known metallurgist, and Mr. James McArthur, the present general manager, both of whom had been for some years on the metallurgical staff of the Orford Copper Company.

Only a comparatively small quantity of the matte produced could be marketed, as the methods then in use for the separation and refining of the combined metals were slow and costly. The result was an accumulation of matte amounting to about 7000 tons, as shown by photograph in Dr. Bell's report for 1890. In order to solve the problem the Orford Copper Company, under the direction of the President, and a very talented metallurgical staff, conducted a series of costly experiments, which resulted in the development of an entirely new method of separating and refining the metals contained in Copper Cliff mattes. This is now known as the Orford Process, and so far it has proved the most successful method yet operated on a commercial scale.

The Dominion Mineral Company in 1889 commenced operations on their property on the township of Blezard. The mass of ore had a width of fully 80 feet at one point, but like the other lens shaped masses of the district, it gradually decreased in width and length as greater depth was reached. The ore, as reported by their manager, averaged 4 per cent nickel and 2 per cent. copper. The Warrington mine, belonging to the same company, has produced some rich ore, running as high as 20 per cent. of the combined metals, but the output has been comparatively small. The deposit is of a different character from the others, being a breccia or conglomerate, the ore forming the cementing material, and being composed of the sulphides of iron, copper, and nickel. Smelting works were erected at the Blezard mine which treated a large amount of the ore, but these, with the mines, have been silent for over eight years. About four miles west of Sudbury, the C. P. Railway cuts through a ledge of pyrrhotite, upon which the Murray mine was opened by Messrs. H. H. Vivian and Co. in 1888. The ore-body is large, but the average yield was only 1.5 per cent nickel and 0.75 copper, which being too poor to pay, operations were stopped.

Other attempts at mining and smelting have been made by American companies in townships 30 miles west of Sudbury, but after comparatively short trials work was stopped and has not been resumed. Practically, therefore, the only concern which has kept the nickel copper industry, during the last nine years, alive in the Province of Ontario, has been, and is today, the Canadian Copper Company. Not only has it been denied credit for the enterprise, skill, and courage manifested under very adverse conditions, but its present success has drawn down upon it the hostility of the Ontario Government and a certain class of newspapers, in a manner discreditable to them, and which must result in permanent injury to the mining industry of Canada.

The Province of New Brunswick is likely to be a producer of nickel, unless the threatened fall in the price of nickel should follow from over-production. Near St. Stephen, large masses of pyrrhotite exist, which appear to be more extensive and continuous than those in Nipissing and Algoma, the average in places running fully 3 per cent. copper and nickel. Their location is admirable, being within half a mile of the C. P. Railway and less than a mile from tidewater. Cheap labour, cheap fuel, and ample waterpower all favour economical mining and treatment of ore.

Fort Steele district, British Columbia, has sent good samples of nickel ore; arseniurets, yielding from 3 to 8% nickel; and from Lunenburg County, Nova Scotia, encouraging samples of sulphides have been received. Canada is likely, therefore, to maintain a fair share of the world's markets, provided the development of the nickel and copper industries are properly managed, instead of being suppressed by hostile legislation.

In 1892, the average of the ores smelted at Copper Cliff was reported by the company to have been 4.32 per cent. copper and 3.69 nickel, or 7.84 per cent. of the combined metals, from which loss, in slag should be deducted. Last year the average was quite 3 per cent. less, the yield not exceeding 4.50 per cent. nickel and copper combined. During the intervening period the uncertain character of the ore deposits has been more clearly demonstrated, as the lenses have thinned out at comparatively

shallow depths, say 100 ft. to 300 ft., the only one so far which has continued beyond the higher figure being the original Copper Cliff mine, which carried ore to a depth of over 800 ft. It should not be assumed, however, that the exhaustion of the lease exhausts the ore, as it is quite probable that a systematic and careful exploration in depth would result in the development of other masses equally productive.

Mr. J. M. CLARK—Mr. Chairman, I do not know that what I wish to say upon the nickel question follows as a discussion of the exact words of Major Leckie's address. He based his remarks on the question of hostile legislation and on a particular quarrel in which the Canadian Copper Company's interests are, he says, threatened. With that feature of the case I do not propose in any way to deal, but with the question of the general policy of the Government in regard to the nickel industry.

I wish to deal with the whole question of policy, not with any particular interests whatever. The question, of course, has been the subject of great agitation in the Province of Ontario, where the company Major Leckie refers to has been carrying on its operations. It is undoubted that there has been—to a large extent caused by the peculiar way in which the tariff of the United States is framed—a very strong agitation for an export duty on the nickel matte produced in the Sudbury district, and therefore I desire to say a few words on the whole question of export duties. This question is largely one of commerce and political economy. It is a form of taxation which is almost universally condemned—condemned by every authority on political economy of any standing at all, and as far as the English people are concerned, condemned by the British nation. Then, Mr. Chairman, the whole question arose for discussion at the time of the formation of the American Constitution, and it was wisely provided in that constitution that there should be an absolute prohibition of export duties from any state in the Union. I think that was a wise provision of the American Constitution, and I think the whole question of export duties is one, taken as a form of taxation, open to vital objections of the most serious kind. Therefore, I wish to say here that I am utterly opposed to any such system of taxation or interference with the commerce or trade of this country.

Mr. BLUE—What is the difference in principle between an export and import duty?

Mr. CLARK—The difference in principle is that as a matter of taxation an export duty is the most costly method of taxation, and that it operates much more seriously than import duties as an interference with the laws of trade and commerce. Abundant experience in the old country proved that this was the case, and it was largely for that reason that export duties were abandoned in Great Britain.

Mr. BLUE—And import duties were also abandoned.

Mr. CLARK—They have import duties and excise as a means of raising revenue, not as a matter of interfering with industry, and in that they have gone further in the right direction than the Americans. But I am dealing with export duties, not with import duties, and I am utterly opposed to any system of export duties on anything in this country. The only possible ground upon which export duties could in any way be justified, would be in a case in which a country has an absolute or practical monopoly of the supply of the article upon which the export duty is imposed. That is to a large extent the case with the pine timber of the Province of Ontario, but it is not the case in regard to nickel, as has been abundantly proved. Everyone of us knows that there are large areas of nickel lands in the Sudbury district lying idle. Every effort has been made to induce English capital to go into that district, but it was a matter not of theory but of hard-headed common sense that British capital preferred to invest their money in New Caledonia than in the Sudbury district. Some of the very same men who are largely interested in the Province of British Columbia, when they formed a nickel corporation, as they did within the last few months and succeeded in having it subscribed in London, made their investments in New Caledonia, where they acquired an area of about 60,000 acres, which is, I understand, fully double the whole area controlled by the Canadian Copper Company, the latter being according to popular report about 30,000 acres. This stock was all subscribed by men of the highest standing in the city of London, where they have the most stringent law in regard to statements and prospectuses, and it was claimed by the promoters that the company would produce fully 6,000 tons of nickel a year, which we know is fully two thirds of the world's demand for nickel. Now I say that to propose and to enforce an export duty on nickel matte in the face of such a state of affairs would be a tremendous blow to the whole Nickel industry of Ontario, and would be a step that cannot in any way be justified. Of course the question of export duty is one, not for the Ontario Government, but for the Dominion authorities. The Ontario Government have no jurisdiction whatever to deal with export duties under our constitution. That is a matter to be dealt with by the Dominion Government, and the Dominion Government have not taken any action in the direction of an export duty, and the conclusion that I would draw from the facts to which I have referred would be that it would be extremely inadvisable for the Dominion Government or Parliament to do anything in the direction of imposing export duties upon nickel or copper ores. There has been no legislation by the Ontario Legislature dealing with the matter, and under the law of the Province of Ontario, and under our Constitution, which is modelled on the British Constitution, any change in the law in the Province must (unless it is not worth the paper it is written on), be made or authorized either by the Ontario Legislature or the Dominion Parliament. Of course, the Ontario Government, in the exercise of its executive and administrative functions, can deal according to law with the property which still belongs to the Province of Ontario. They are in the position of any other owner in respect to that, but so far as dealing with the nickel industry, there is no power of the Ontario Government that can hamper or interfere with the nickel industry, and, therefore, I think there is unnecessary alarm at the action which in certain directions has been urged upon the Ontario Government. It is appropriate that this whole question of such importance to mining men should be discussed here.

It should be borne in mind that every recommendation hitherto made by the Canadian Mining Institute to either the Dominion or Ontario Governments had been carried into effect.

Mr. HOLLAND—Mr. Chairman, I have been interested for several years in this nickel industry, and I think I am pretty conversant with it, and I cannot speak in too strong terms of my condemnation of the Ontario Government's policy in passing the late Order-in-Council. I will read you this Order-in-Council, which is as follows:—

Copy of an Order-in-Council approved by His Honor the Lieutenant-Governor the 24th day of November, A.D. 1899.

Upon consideration of the memorandum of the Director of the Bureau of Mines, dated 23rd November, 1899, and upon the recommendation of the Honorable the Commissioner of Crown Lands, the Committee of Council submit for the approval of your Honor the following suggestions respecting copper and nickel mining in the Province of Ontario, namely:

1. That in the interests of our relations with the Empire it is desirable an early opportunity to renew the negotiations opened with the British Government in April, 1891, which had for their object the concession of an interest in nickel ores of the ungranted lands of the Crown for Imperial and National uses, on such terms as may be mutually agreed upon.

2. That having in view a larger scope for the employment of capital and labor in the copper-nickel mines and works, it is desirable to secure the establishment in the Province of refining plants in accordance with the scheme of the charter of the Canadian Copper Company, or otherwise; and, if necessary to the success of this object, to ask that effect be given to the provisions of the Act (chap. 67 of 60-61 Victoria) for imposing export duties on nickel and copper, subject to such modifications in favor of the United Kingdom and the other Colonies of the British Empire as may appear to be in the common interest.

3. That for safe-guarding the public interest in ungranted lands of the Crown it is advisable that all grants of mining lands hereafter issued shall provide in the patent or lease that the copper and nickel ores upon or in such lands shall be treated and refined in the Province so as to produce fine nickel and copper of marketable quality, and that for any violation or evasion of this proviso by the grantee, his heirs or assigns, such lands shall revert to and be vested in Her Majesty, Her Successors and Assigns for the public uses of the Province, freed and discharged of any interest or claim of any other person or persons whatsoever as if they had never been granted."

I have no hesitation in saying that no such absurd legislation was ever passed in a British colony. It is the most ridiculous thing I ever heard tell of. I have also a memorandum here from our worthy director of the Bureau of Mines. He says in his recommendation that: "In the seven years 1892-1898 the quantity of ore smelted and reduced to matte in the Sudbury district was 591,852 tons, and the estimated metallic contents were 29,705,000 lb. nickel and 34,570,500 lb. copper. At the selling price of matte at the furnaces, which is the form in which it is exported to the refineries, the total value of the nickel product for the seven years was \$3,294,060, and of copper \$1,302,805, or a total of \$4,596,865. But at the average selling price of the metals during the seven years the value of the refined metals would be \$10,396,750 for nickel and \$3,975,607 for copper, or a total of \$14,372,357. The total amount paid for wages in Ontario during the seven years was \$1,929,894, and this makes up a large proportion of the expenditure for all purposes in our Province for the production of matte. It is certain that the share of the value of the refined metals distributed outside of Ontario for wages, services and profits has been not less than \$10,000,000, or about two-thirds of the whole."

I have no hesitation in saying that the cost of producing this matte was over three millions of dollars.

Mr. BLUE—You are not reading it correctly.

Mr. HOLLAND—You say that "the total amount paid for wages in Ontario during the seven years was \$1,929,894, and this makes up a large proportion of the expenditure for all purposes in our Province for the production of matte."

Mr. BLUE—What does the term "large proportion" mean?

Mr. HOLLAND—Now, gentlemen, this is a most absurd thing. The man that made that recommendation was absolutely ignorant of the condition of the nickel industry. Now I am acting here as the representative of Dr. Ludwig Mond, and I say that any export duty or any such absurd legislation as recommended in that Order-in-Council is going to kill the nickel industry of Sudbury. I will read something from Dr. Mond, which he wrote on May 6th, 1899, at which time I was in London, and at which time Dr. Mond had not completed some negotiations which he was carrying on for the purchase of nickel properties. The letter is addressed to Lord Strathcona, and is as follows:—

LONDON, N. W., May 6, 1899.

Dear Lord Strathcona,—I am greatly interested in the progress and development of the Canadian Nickel Industry.

I have invented a process for extracting nickel from nickel ores, such as are abundantly found in Canada, which I have worked out on a manufacturing scale at great expense of time and money. This process, a full account of which was given in a paper read by Sir William Roberts-Austen at the Institution of Civil Engineers in November last year, produces from the Bessemer Matte, now made at Sudbury, Ontario, metallic nickel of the highest purity, and sulphate of copper, a product consumed in very large quantities, and until now manufactured from refined copper.

I should have established this process in England on a manufacturing scale long ago if I had not met with insuperable difficulties in procuring the raw material. For a number of years, only one firm of smelters of nickel-copper matte has been at work in Canada, and this firm has been and is still under agreement with an American firm of nickel refiners (working a process greatly inferior to mine), by which they are prohibited from supplying anyone else with matte.

The American nickel refiner just mentioned has an understanding with the largest nickel producers in Europe (the Societe "Le Nickel," who smelt an ore coming from New Caledonia of an entirely different character from the Canadian ore) which limits his output, and consequently limits the production of matte in Canada.

I am confident that my process will put me in a position to drive the smelters of New Caledonian ores out of the market and to thus develop the Canadian nickel industry very largely. I have consequently lately taken an option for acquiring a very important mining property in the township of Denison, near Sudbury, Ontario, which it is my intention to develop with the utmost vigor as soon as it shall have passed into my hands.

I find myself, however, in a serious difficulty about completing this purchase. I am informed that there is a strong agitation going on in Canada to prevail on the Government to place an export duty on nickel ores and mattes with the object of compelling refiners to establish their works in Canada. My process, involving delicate operations, requires highly educated scientific supervision, and well-trained first class workmen, of which a sufficient choice cannot be found in a country so little developed industrially as Canada is at present; it also requires a large supply of sulphuric acid and other chemicals not now manufactured in Canada, and the importing of which would be almost impracticable. The consumption of the pure nickel and sulphate of copper produced is mainly in Europe. The weight of these products is twice the weight of the Bessemer matte from which they are produced, and the rate of freight and insurance to Europe would be so much higher than those for the matte, that the difference in cost of transport, if the matte had to be refined in Canada, would so seriously diminish the advantage my process gives me over the smelters of New Caledonian ores, as to make my chance of driving these competitors out of the market, and consequently increasing the Canadian nickel production, very problematical.

My intention is to produce the Bessemer matte (which contains about 80 per cent. of nickel and copper) near Sudbury, and to take this to England to refine it.

My refining process, while requiring a very large outlay of capital and very complicated and delicate plant, employs only a small number of hands, out of all proportion to the large number of men I should have to employ in mining, roasting, and smelting the ore and converting it into Bessemer matte. From the point of view of giving employment to Canadian workmen, the Dominion would thus gain very little by having the refining done in Canada, while the quantity of ore raised

and matte produced would remain limited by inability to supply Europe from Canada cheaper than the smelters of New Caledonian ores, who have a very abundant supply of these ores at their command.

There are further a considerable number of mines producing ores of similar composition to the Sudbury ores in Europe. It is true that these mines are small as compared with the Sudbury mines, but I have quite a number of these offered to me at the present moment, in Norway, Austria, Germany, and Spain, and if the Government should place an export duty on copper-nickel mattes affecting England, the only consequence would be that it would become profitable to develop these European mines.

I have put this matter so elaborately before you in the hope that you may be able to get me an assurance from the Dominion Government that they do not contemplate putting on an export duty on copper-nickel mattes which would affect the Mother Country.

It would be of great importance to me to receive an early reply, as the option which I have taken on the Denison property will expire in a few months.

Yours very faithfully,

LUDWIG MOND.

I have another letter by Dr. Mond to Lord Strathcona on December 20th, 1899, when I was in London after the passing of this ridiculous Order-in-Council of the Ontario Government. At this time the money market was in a position such as was never known before, and a company for the acquiring of the New Caledonia nickel deposit, with a capital of £750,000, was floated, and the capital subscribed for in two days. The year before it was impossible to interest English capitalists in our Sudbury deposit. Well, Dr. Mond says in his letter to Lord Strathcona on December 20th, 1899:—

Dear Lord Strathcona,—On the 6th of May, 1899, I wrote a letter to you for transmission to the Dominion Government, of which I enclose a copy, wherein I explained to you that it was my intention to acquire nickel and copper mines in the Sudbury district of Ontario for the purpose of supplying myself with Bessemerized copper-nickel mattes, to be refined by my new process in England. I expressed in that letter my difficulty in proceeding with this project because of the uncertainty as to whether the export duty on copper-nickel mattes, under the provisions of the Act, Chapter 67, 60 to 61 V., would be enforced by the Government.

The reply which I received led me to conclude that it was extremely improbable that the Dominion Government would ever put in force this export duty against the Mother Country, and I have in consequence acquired, for considerable sums, large mining territories in the Townships of Garson and Denison in the Sudbury district. I am also about to expend very large sums of money in developing these properties and in erecting the necessary smelting and bessemerizing plant to convert the ores from those mines into bessemerized matte containing about 80 per cent. nickel and copper, and would almost immediately employ several hundred workmen in connection therewith.

My attention has now been called to an "Order-in-Council" signed by the Lieutenant-Governor of Ontario on the 24th of last month, in which there is a recommendation to the Dominion Government to put in force the export duties on copper-nickel ores and mattes. A recommendation of this character from the Ontario Government must undoubtedly carry great weight with the Dominion Government; I have, therefore, thought it necessary to once more appeal to your kindness to lay before the Dominion Government the following facts: which would be of great importance in arriving at any decision in this matter, and which I fear may not be sufficiently known or appreciated in Canada itself.

It appears to be a general opinion in Canada that the Sudbury copper-nickel deposits are the only serious sources of nickel ores in existence, and that such large quantities as exist in New Caledonia—not to mention deposits known to exist in smaller quantities in Norway, Austria, Germany, Spain, etc.—are only of secondary importance. I would point out that the Societe le Nickel, which is controlled by the powerful house of Rothschilds in Paris, has by itself produced up to the present time more nickel than has ever been extracted from the Sudbury ores, and that this company is at the present time manufacturing quite half of the nickel that is produced. Besides this powerful corporation there are other nickel mine owners supplying other European refiners who contribute at least 1,000 tons of nickel a year to the European market, and there appears no difficulty for any European refiner to obtain almost unlimited quantities of New Caledonia ores, in fact, I have had large quantities offered to me personally within quite recent time.

In addition to this, there has been within the last few weeks issued to the public, by one of the largest and most powerful financial companies in London—a company styled "The Nickel Corporation, Limited," with a capital of no less than £750,000, which has all been subscribed by the public. This company has acquired about 60,000 acres of nickel ore property in New Caledonia, and proposes to manufacture 6,000 tons of nickel per annum, out of an estimated world's consumption of 9,000 tons per annum.

You will therefore observe that it is by no means a fact that the Sudbury district is the only one capable of producing large quantities of nickel ore, or that capitalists anxious to enter on the nickel industry have to look to this direction alone for their raw material. As a matter of fact, any person working the Sudbury copper-nickel ores, which are considerably poorer than the New Caledonia ores in their nickel contents, will only be able to compete with the nickel produced from New Caledonia ores when working under the cheapest and most favorable conditions. Those conditions do not exist at present, and are not likely to exist for a considerable time in a country which is so young in its industrial development as the Dominion of Canada.

I have personally had the relative cost of refining by my process in suitable Canadian centers, such as Montreal and Quebec, carefully investigated, and have found that on comparing it with the cost of refining in Swansea in England that there would be a very large difference of increased cost to the refiner established in Canada.

Personally, I would point out that in case the export duty was enforced against this country, it would greatly hamper, if not destroy, the whole of my scheme for smelting in Canada and refining in England, by which I hope to enable the English nickel-steel and armour-plate manufacturers to be independent of foreign sources of supply for their nickel, and also to develop on a large scale the Sudbury nickel fields by driving the nickel refined from New Caledonia ores out of the market.

As I have previously pointed out, the amount of labour employed in refining copper-nickel matte is very trifling compared with the amount of labour employed in mining, smelting and bessemerizing, and it would appear to me to be a very great pity if the promising development of the Sudbury nickel fields was nipped in the bud by the imposition of an export duty which would greatly hamper the refiner and make successful competition with the refiners of New Caledonian ore impossible.

I would also like to point out that the English capitalist is beginning to look more and more on Canada as a country where he can safely invest his money in an English colony, with the assurance of fair and business-like treatment on behalf of the

authorities. I know that you personally have taken the greatest interest and devoted the most unremitting energy to encourage this movement, which would certainly be very much discouraged if, in one of the first attempts which is made by an English capitalist to develop industrially important mineral resources of the Dominion, his efforts were hampered by restrictive legislation of a kind absolutely unknown in the British Empire.

I think it would be of the utmost value if the Dominion Government could see its way to make some definite declaration as to what course it intends to pursue regarding this duty which is at present in suspense. You will readily see that it is practically impossible to ask either private capitalists or the English public to join with me in a scheme which promises to be an industrial enterprise of the very first rank and of the largest kind, when it is impossible to assure them that the undertaking may not any day be rendered unprofitable by this export duty being imposed.

I enclose a copy of the prospectus of "The Nickel Corporation, Limited," to which I have referred herein.

Thanking you in anticipation for your kindness, I remain,

Yours faithfully,

(Signed) LUDWIG MOND.

Now Dr. Mond says that he will spend 88 per cent. of the total cost for labor in mining, roasting, smelting and bessemerizing in this country, and only 12 per cent. will be spent in the refining in England. The very fact that the Dominion Government can at any time throw an industry of this magnitude clear out of its calculations is worse than any legislation they could impose. Even if they had no intention of doing it, still the very fact that they have the power will frighten capitalists. The mere fact that the Dominion Government without bringing the matter up in Parliament, can at any time by proclamation place an export duty on nickel ores and mattes is a most serious drawback. Now, gentlemen, I feel like apologizing to the members for taking up the time of the meeting, but this is a matter that interests me vitally, and I have a few pages here of my own experience. I am not only acting as Dr. Mond's representative, but I am speaking in the interests of the whole industry, in the interests of the Canadian Copper Company, and not only the interests of nickel mining but also of any other mine. In view of the fact that there is an agitation in this country for an export duty on copper-nickel mattes and ores, and that the Ontario Legislature and the Dominion Parliament have both passed measures favoring the imposition of such a duty in order to, as it is expected, compel the refining to be done in Canada, I would like to call your attention to the following:

At present there is only one company operating in Sudbury district. By this I mean actually producing. Several were at one time operating, but only one has survived. Anyone starting in this business must be prepared to meet with strong competition. In order to successfully compete with companies already in the market, one must be able to produce as cheaply or even more cheaply than those companies already established in the market, so as to be able to sell their nickel more cheaply than their competitors; consequently, if it is the wish of the Government to develop this industry, they must encourage capitalists to commence new operations, not embarrass them with restrictive legislation. If there were no other deposits of nickel in the world than those in Canada, we could probably force refining to be done in Canada, for this would only raise the cost to the consumer and probably restrict its use, but everyone would be on the same footing, but, unfortunately for those interested in the Sudbury district there are very serious sources of competition and the sooner the people and Government of Canada realise this the better it will be for all concerned. Let me call your attention to a few figures showing the amount of nickel consumed annually for two periods of five years each and the relative proportion of Sudbury to New Caledonia ores. In the "Mineral Industry" for 1893, which is perhaps the best and most reliable work of its kind, we find the following figures given:—

Year.	World's Consumption in kilograms.	New Caledonia. kilo.	Canada. kilo.	Other Countries. kilo.
1889.....	1,878,414	1,381,482	309,701	187,231
1890.....	2,454,873	1,633,214	651,239	169,420
1891.....	4,705,719	2,449,306	2,098,598	157,815
1892.....	4,822,404	2,800,000	1,888,790	133,614
1893.....	4,712,950	2,800,000	1,811,205	101,745
	18,574,360	11,064,002	6,759,533	749,825

"MINERAL INDUSTRY," 1898.

Year.	Tons.	Tons.	Tons.	Tons.
1893.....	4,424	2,493	1,807	124
1894.....	4,755	2,422	2,226	107
1895.....	4,420	2,548	1,764	108
1896.....	4,624	2,972	1,541	108
1897.....	5,429	3,498	1,813	118
	25,652	13,933	9,151	565

These figures surely prove conclusively the serious nature of New Caledonia competition. I know from personal experience that the sale of nickel by the Societe le Nickel and the combined sales of the Canadian Copper and Orford Copper Cos. are usually nearly equal, the balance generally being in favor of the New Caledonia Company. In addition to this, nearly all the other independent nickel refiners use Caledonia ores. So out of an estimated world's consumption of 9,000 tons, the French and Canadian companies would each provide for about 4,000 tons, and independent refiners the other 1,000 tons, the latter amount very largely from New Caledonia ores. It may be in order to say here that the H. H. Vivian Company of Swansea, Wales, after establishing works in the Sudbury district have closed them down, and I am now informed are smelting New Caledonia ores.

With such competition as this, Canadian producers must be enabled to manufacture as cheaply as possible. If the nickel can be refined in Ontario more cheaply than it can be elsewhere, it will be refined here without any legislation, but this cannot be done, and if you say it must be done, you only handicap your deposits that much more and increase the advantage so long maintained by New Caledonia in the race. If it is going to cost the Canadian producer a few more cents per lb. to refine in Canada than it does elsewhere, as anyone who has looked into the question knows it will, it will be just that much more of a handicap to him, and instead of Canadian ores displacing New Caledonian as we all hope to see, the New Caledonian ores will have just this much advantage. We hear a great deal about the American import duty on refined nickel being a discrimination against Canada. I can hardly see how this is so when Canada has never produced a pound of refined nickel, and moreover, I know that the object of this import duty was to keep our refined New Caledonian nickel, and as the Canadian mattes are admitted duty-free, Canada and the Canadian-American producers have enjoyed the benefits of this protection, which has enabled them to sell

their nickel at a higher price in America than what they could get for it in open competition with the New Caledonia people in the European market where both were on the same footing. This higher price for American nickel has been the strongest sort of an advantage to the Canadian-American producers in competing with their rivals. If anyone wishes to verify this statement let them look at the comparative prices for nickel in America and Europe whenever this duty has been in effect. Nearly all the nickel used in the United States is made from Canadian ores and mattes, whereas if this duty was removed the refined nickel of New Caledonia would come into immediate competition with the Canadian nickel. Parties refining in England even cannot enjoy this American market, and, consequently, have to look to the European, where they come into open competition with the New Caledonian nickel and the surplus American refined nickel. The Mond Nickel Process is peculiarly adapted to the refining of the Canadian ores. The copper contained in these ores makes them difficult to treat, to say nothing about the other metals, but by his process this is turned into an advantage as he is enabled to manufacture copper-sulphate, a highly refined product, and until now usually manufactured from metallic copper. This advantage is however, entirely done away with if he had to refine in Canada, as the weight of this product is four times that of the metallic copper in the matte and the market for it is chiefly European. To make a success of this new refining process the owner must be enabled to refine more cheaply than the companies already established in the market. At present this can only be done in England. This process must have a Bessemer matte to work on, a matte containing about 80 per cent. of metal, which is certainly far from being a raw material, as many of our friends seem to think. To mine an ore, crush and sort it, smelt in a blast furnace, then put it through the converter, bringing it from an ore containing less than 5 per cent. of metal to a matte containing 80 per cent. of metal, a concentration of 16 to 1, employs ten times the number of men that it takes to take this 80 per cent. matte to the pure metallic state, a concentration of 14 to 1. Surely reason would tell us this, even if it was not backed up by the only persons who really know the number of men it takes to do this. Dr. Mond makes the statement over his own signature that he will expend 80 per cent. of the total expenditure for labor in Ontario, and 20 per cent. in England. Shall we lose this 80 per cent. for the sake of the other 20 per cent.? One hundred men would do all the refining of the matte now produced in Canada. Are you going to throw nearly 1,000 men directly employed in this industry and a good many more indirectly employed out of work for the sake of another 100. Why not prohibit the export of the metal altogether? Compel the European Governments to make armor-plate in Canada. Why not put an export duty on all raw products? Why single out the nickel mattes, which are a semi-manufactured and not a raw product.

It is necessary in starting this new refining process to have it under the personal supervision of Dr. Mond and his associates, and their vast interests in England make this impossible if the refining had to be carried on in Canada. After a staff has been sufficiently trained, it would be possible and is the intention of Dr. Mond to erect a refinery in this country for the American market, not the European mind you; for the latter market the refining will always have to be done in Europe on account of the reasons given by Dr. Mond in his letter; the extra freight rates and the greater weight of the sulphate of copper make the refining of the matte and shipping the resultant product to Europe commercially impossible. To manufacture this product large quantities of sulphuric acid are used, a product very much higher in price in Canada and the United States than it is in England. Anthracite coal used in this process is also higher in price in Canada than it is in England. Dr. Mond had his experts visit several places in Canada—Montreal, Quebec and other points—with a view of finding what the relative cost of refining would be in Canada as compared with what it would be if done in England, and the balance against refining in Canada is enough to make the venture commercially out of the question. I may call your attention to the fact that there are only two or at the most three known refining processes capable of refining pure nickel and copper from the Sudbury ores. One of these is that used by the Orford Copper Co., a furnace method, another is the wet or electrolytic process, used by Mr. Wharton and the Balbach Smelting & Refining Co., and finally Dr. Mond's. I know of no others that have produced any refined metals from the Sudbury ores. Only one of these is used on any large scale at present, the Orford, and yet you say the Canadian Copper Company must refine its ores in Canada and it has not got a refining process to do it with. You may compel the Orford Copper Company to refine in Canada if it has to depend on Canadian ores, but they have the option of refining New Caledonian ores, which can be laid down in New York at the same price per pound of metallic contents, yes at even a little less than is now being done by the Canadian producers. Considering this fact I should think the Orford Copper Company would refine New Caledonian ores if an output duty was placed on Canadian mattes, and it might be of interest for you to know that this export duty would cancel all contracts existing between the two companies, this is surely proof of how these companies regard the effects of an export duty. Aside from the others mentioned Dr. Mond's is the only known process for refining the Sudbury ores. His is the only one that has produced nickel in large quantities, which nickel has been marketed and found to be of a very superior quality. Other processes have been tried and proven failures; others are to be tried, but until they are demonstrated successes it would be a pity to spoil an established industry until it was proven that there was a good chance of it being replaced, and even then the wisdom of such a policy is open to discussion. The Ontario Government's policy in this matter is very much like that of the dog in the fable of the "Dog and the Bone," grasping at a shadow and losing what we have already got.

There is also another matter I would like to say a few words about. The new Order-in-Council provides for a clause in all leases and grants to be hereafter issued which says, the ores found on such lands must be refined to metallic nickel and copper in Ontario. I would like to ask the Government if it is business-like or honest of them to issue leases for lands with the understanding that if certain conditions are complied with, a patent will be issued for these leases at any time within a period of ten years, then after issuing such leases, which are virtually contracts, such an Order-in-Council is passed as that referred to, and when the owner of the lease asks for his patent, he is offered one which makes his property valueless; in other words the Government deliberately repudiates its own contracts and imposes new restrictions; such a mining policy as this is worthy of the Government of the Transvaal but not of Ontario.

With only two or three known processes for refining our Sudbury ores, this Order-in-Council is bound to discourage prospecting and the opening up of new mines, for as I have already pointed out a large corporation working in this district for over thirteen years, with vast resources at its command, has been unable to find a refining process up to the present day, although they have spent large sums of money trying to find one. If the Government wish to play into the hands of one or two parties or corporations and give them complete control of operations no better scheme could have been devised. If anyone can show me or tell me of a process which has produced one ton of marketable nickel from Sudbury ores than those I have mentioned, I would be much obliged to him.



We often hear it said that Canada requires capital to develop its resources, yet when an English capitalist comes into Canada with his money, spends it for mining leases given under conditions, you refuse to give him a patent for his lands unless it contains new and impossible conditions, and threaten to spoil all his plans and make what seemed a promising venture and important industry a complete failure. Is such treatment as this likely to induce the English capitalist to invest his money in Canada? People wonder why English capital is so largely invested in the United States. One reason for this is perhaps that they know that the Government of that country will protect industries not hamper them with impossible conditions. Why does not the Government encourage the smelting of nickel ores as it does iron ores? We bonus iron furnaces, yet an industry operating many blast furnaces, which have never been bonused, is threatened with conditions which would close them all down.

I anticipate that some people will ask me why the Orford Copper Company and Dr. Mond refine Canadian ores in preference to New Caledonian. Speaking of the former I know they have made contracts for many years past which do not permit them to buy New Caledonian ores so long as they can get all the Canadian ores they want. After many years of hard work a large industry has been built up, and it is not only in the interests of these two companies to keep matters as they are, but it is in the interest of our Province to do so. So far as Dr. Mond is concerned, his process is more adapted to Canadian ores than any now known, for he is enabled to make the copper in the ore a great source of profit, while by existing methods the presence of this copper has only made the ores and mattes that much more difficult to treat. It is this feature which enables him in no small manner to say he can drive the smelters of New Caledonia ores out of the market. Why not give him a chance to do this. If he can, and Canada can secure the other half of the world's markets, this will be better than having a paltry 100 men employed in refining our present share of it, and we are not sure that we would get that. Dr. Mond was so convinced that if an export duty was put on nickel ores and mattes that it would be rescinded in so short a time that he made the statement to the writer that he would not spend one dollar in Canada until it was rescinded.

This Order-in-Council I referred to expressly states that the copper in the matte must be refined to metallic copper. This will prohibit Dr. Mond from taking advantage of one of the strongest points of his process. This Order also says the nickel in the ore must be refined to metallic nickel. Perhaps it would interest the framers of such an order to know that a very large proportion of the nickel used in the world is used in the form of oxide, a product usually not as pure as metallic nickel, usually containing between 80 and 90 per cent. of metal, or very little more than the bessemer matte we propose to make, so two very important products of the Sudbury ores we are prohibited from manufacturing, unless we first make them into metal and then ship them out of the country and in the case of the nickel oxide at least, take a step backwards. This will be very profitable.

To go back to the question of the New Caledonia competition. It is a fact that in New Caledonia the people there have much the same ideas of the extent of the Sudbury deposits as we have—some people, at least—of theirs, and they have greater reason, for while their area is probably as large or even larger, their ores contain on an average of 7 per cent. of nickel alone. Some people say our ores are the richest because they have copper in addition to the nickel, but a little examination would show us that even if the Sudbury ores contained even 7 per cent. of the combined metals, they would not yet be as valuable as the New Caledonian containing 7 per cent. of nickel alone, as nickel is easily of twice the value of the copper, and as a matter of fact, very few mines in the Sudbury district produce an ore containing 5 per cent. of the combined metals. I have an extract from a prospectus issued by "The Nickel Corporation, Limited," and while a prospectus is a prospectus, still the statements made therein show what some English capitalists at least think of the New Caledonian ores as compared with the Canadian. Here is an entirely new company almost owning 60,000 acres of nickel lands, while the largest company we have operating in Canada have about 30,000 acres I believe, and some people think with good reason that they have the lion's share of our deposits. Seven years ago the Societe le Nickel owned 150,000 acres of nickel lands. The island of New Caledonia is about 200 miles long, and from 30 to 40 miles wide, and the serpentine in which the nickel is found covers about  $\frac{1}{2}$  of the island. Does it need more to prove the extent of these New Caledonian deposits? Yet we often hear it said that they are only of secondary importance.

If the Ontario Government had wanted to cripple the nickel industry they could not have devised a better scheme. And another thing, I do not think it is right to set up one Province against another. We heard a good deal recently against the export duty on pulp in the Province of Quebec, because it said that it must be manufactured in Quebec, and they have altered that now to Canada, while here it says it must be manufactured in Ontario. Dr. Mond's process is particularly adapted to Canadian ores, because it requires copper in ores to make it the success that it is. But he says that he could not spend one dollar in this country until this ridiculous Order-in-Council was rescinded.

Major LECKIE—He made the same statement to me.

Mr. BLUE—Are his works closed down?

Mr. HOLLAND—He got assurances from the Dominion Government that nothing would be done in the way of placing an export duty on nickel ores, as without such assurance he would not have spent a dollar. He has spent \$400,000 or \$500,000 for mines alone. Now gentlemen I have taken up a great deal of the time of the meeting, but I would like to say this: that I believe it is the feeling of the people of Sudbury and of the mining public, that such an Order-in-Council as was lately passed is detrimental to the investment of capital in our country, and I think we should pass a resolution asking for the rescinding of this Order-in-Council, and that in future our mining laws should be stable. We should have stable mining laws, and they should not be liable to change any day. If you want to interest American capitalists or any other capitalists the laws should be in such a position as to always be on the same basis.

Mr. BELL—As an Institute we have already expressed in a very decided manner, by a resolution unanimously adopted three years ago, our disapproval of export duties, be they applied to nickel or any other mineral or commercial product. A policy so wrong in principle, so hostile to the best interests of mineral development, is universally condemned by every intelligent mining engineer and mining man in the country, and I cannot believe that its enactment is seriously entertained at the present time by the Dominion Government. This foolish agitation, inspired and fostered as it is by malevolence and cupidity, has shown conclusively that while Ontario undoubtedly possesses a great and important asset in her valuable deposits of copper-nickel ores, she is very far from possessing a monopoly of these minerals, and that other countries may in the very near future jeopardise her position in the nickel market. As to the proposed legislation, which I believe is at present under consideration by the Ontario Government, it is unwise, if for no other reason that this tinkering with our laws creates a feeling of insecurity in the minds of investors, at a time when capital is being earnestly sought for the development of our mines. The Government of Ontario will

do well to let the nickel industry expand along natural lines. We have had far too much paternal legislation in Canada. Nickel refineries and those allied industries of mining which are so much desired, will develop in due course along natural lines, if the mining industry is left alone.

Now while the members of the Institute have already expressed themselves by resolution as being opposed to an export duty or to the enactment of any legislation likely to interfere with the welfare of the nickel industry, the position this ill-advised agitation has recently assumed fully warrants further action, and I would therefore, beg leave to move the following:—

"Resolved, That the Order-in-Council passed on the 23rd November, 1899, by the Government of the Province of Ontario, prohibiting the export of copper and nickel except in the condition of refined nickel and copper, will prove fatal to the nickel and copper mining industry of Ontario;

"That the imposition of an export duty on nickel matte by the Dominion Government will make it impossible for the Canadian producer to compete with those of foreign countries;

"That a copy of these resolutions, together with a complete reprint of the discussion which has taken place at this meeting, be forwarded to the Premier and Commissioner of Crown Lands for the Province of Ontario, and to the Hon. the Minister of Finance and the Hon. the Minister of Trade and Commerce, at Ottawa."

This agitation to tax the nickel industry was conceived in vindictiveness. It has been fostered by malevolent misrepresentation, and by appealing to false notions of patriotism. It is being promoted to-day by persons who seek to injure the large and important mining and smelting industry of Ontario, in the hope that thereby they may succeed in securing capital and franchises to promote schemes of their own—undertakings which seek to exploit refining processes not yet proved beyond the stage of laboratory experiment, and others which cannot be described as other than extremely, ridiculously, visionary in their character. By all means let us have nickel and lead and zinc refineries established in Ontario, but let us be careful not to force these on the country prematurely by drastic legislation, which cannot fail to seriously cripple if not paralyze the more stable and the much more important industry of the ore producers.

Mr. HOLLAND—I have much pleasure in seconding Mr. Bell's resolution.

Prof. MILLER—My opinion is that the export duty should not be enforced against the Mother Country, at any rate.

Mr. HOLLAND—Why against any country?

Prof. MILLER—There is one point to which I wish to refer. It has been the custom to speak in a pessimistic way of the ore deposits of Sudbury and very highly of the New Caledonia and other foreign deposits. I was very glad to hear Dr. Mond's opinion of these Sudbury deposits, and of his process, which he believes will be a success, and which from his experience I believe will be a success. If that is carried out the Sudbury district has nothing to fear from any country in the world. These deposits have been spoken of in too pessimistic a way. The Canadian Copper Company deserves great credit and I would not like to see them crippled. I just wish to say—and I believe it has been proved—that these deposits have nothing to fear from any deposits in the world.

Major LECKIE—Mr. Blue asked Mr. Clark what was the difference between an import duty and an export duty. There is a very great difference. The import duty—the protective duty—gives the home market to the producer as well as the chance of selling in any other market in the world, but this policy of the export duty confines the producer to the home market, and so far as nickel is concerned there is no home market, and the market for copper is very small indeed, and if the Ontario Government sees fit to put an export duty or prohibit the exportation of nickel and copper in any other shape than that of a metallic condition it will simply kill the industry.

Mr. BLUE—Mr. President, I rise with a great deal of diffidence to say a few words on this subject. I am perhaps the only one in this room—with the exception of my friend Dr. Bell here—who is not a politician and who is supposed to keep a sealed mouth in the discussion of public questions. I will endeavor as far as I can to avoid questions of a political color, and I will endeavor as far as I can to abstain from the personalities that have characterized this discussion as far as it has gone. Reference has been made to myself as having been trained in the Department of Agriculture. Well, I may go a little back of that. I was born in the woods of Canada, and I have lived for a quarter a century on a farm. I know the country perhaps as well as any member of the Institute. I have spent 20 years in the study of its various industries, its farming, its manufacturing and its mining industries, and I may say that whatever positions I have held under Government they came to me from the Government of its own motion and good will. I never pulled wires to advance my own interests, and whatever services I have rendered to the country most of you I dare say know. Mr. Holland, who has shown a great deal of feeling here, has been on the farm a little later than myself. He has been husking corn, digging potatoes and grubbing out stumps a little later in life than myself. This is no detraction from him, but it does not qualify him to speak in a superior way on my fitness or unfitness. Mr. Clark has given a disquisition on political economy, and has endeavored to point out that there is an important distinction between an export duty and an import duty. I have given some attention to economic questions also, and I have never been able to see any difference in principle between an export and an import duty. It is useless to tell us that export duties are discredited by British economists and statesmen, when the fact is patent to everybody that import duties are also discredited in that quarter. I would prefer it if both kinds of duties were imposed as little as possible. I believe largely in a policy of unhampered trade, and while I freely acknowledge that Governments may do much to advance the industrial interests of a country, I am in favor of giving to every trade the greatest possible freedom of action. We have had some experience in the Province of Ontario in the development of the natural resources of the country, and perhaps, you will pardon me if I call attention to two or three of these by way of illustration of the policy the Government is pursuing at the present time. A few years ago—I think it was in 1894—an agreement was entered into with a company having a large capital to establish a pulp industry in the country. The company undertook within two years to expend \$200,000 in capital and to employ 200 men, and within three years to employ an additional \$200,000 capital and an additional 100 men.

The PRESIDENT—I think, Mr. Blue, you should confine yourself more strictly to the question under discussion.

Mr. BLUE—I think I am confining myself to a fair and legitimate discussion of the question before the meeting. We are dealing with a principle in this matter. Now that company has already invested \$2,000,000 in this industry.

Major LECKIE—Is it an American company?

Mr. BLUE—Yes, of Philadelphia capitalists. They employed last year 500 men and they turned out a product valued at \$700,000. This year they will largely increase the number of men, and it is estimated that their output will reach \$1,000,000. There are three other companies with which similar contracts have been made, one of which

has developed its business to a very considerable extent, and as part of that development one of the largest publishing houses in England has agreed to come in and establish paper mills in the Province. Then as regards the saw-log question. I am not dealing with a political question, because there are no party divisions upon this log question. When the Government two years ago put an embargo on logs there was a great outcry, especially from our neighbors across the line. But as a result of the first full year's operation of that policy there has been expended in the Georgian Bay region and along the shores of Lake Huron in labor and in freight \$580,000 more than in the previous year, and the estimates made by the Crown Lands Department show that for the current year there will be an expenditure of \$1,250,000. These are illustrations of the carrying out of the policy of the Government in requiring the raw material of the country to be as far as possible manufactured in the country. As to the question now before us, I think I may go back a few years and refer to the conditions under which the Canadian Copper Company was allowed to operate in this country. But before doing so allow me to say this: It has been stated that the Government and the people of Ontario are hostile to the Canadian Copper Company. As far as I know, there is no sentiment of this sort in Ontario. I know pretty well the correspondence that has gone on between the Government and the Canadian Copper Company, and I know there is not one word in that correspondence that will bear out the statement that we are hostile to the Canadian Copper Company. We recognize the good work it has done. It was organized as an Ohio corporation, and as such it could not hold a foot of land in this country, unless it had a Canadian charter—or, what amounts to the same thing, unless it received recognition and confirmation of its charter from the Canadian Parliament. It was not the Ontario Legislature but the Dominion Parliament that gave the recognition. When the bill was before Parliament in 1886 it was introduced so as to enable the company to mine its ores in this country and to treat them wherever they saw fit. It was discussed in the Private Bills Committee, and Sir John Macdonald, the Prime Minister, was present at the meeting. I have seen three statements regarding what took place. One was written by the late Hon. W. B. Ives, who was chairman of the Committee.

Major LECKIE—They wanted to bring in a Bill to kill the Canadian Copper Co.

Mr. BLUE—The other was written by Mr. Ritchie, who was president of the Canadian Copper Co., and the third was written by Mr. John Bell, of Belleville, who was the solicitor of the company, and who drafted the Bill. They all agreed that when the question of allowing the company to treat its ores outside of Canada came up Sir John Macdonald said "You must smelt and treat your ores in Canada," and the Bill was so amended.

Major LECKIE—Where is your proof of it?

Mr. BLUE—My word.

Mr. HOLLAND—Have you the words of the charter of the Canadian Copper Co.?

Major LECKIE—Your statement is not accurate.

Mr. BLUE—What I say is that the charter given to that Company by the Canadian Parliament intended that it should carry on its smelting and treating operations in this country, and that that policy was laid down by Sir John Macdonald, the leader of the Government. The Ontario Government is asking that the intention of the charter of that company should be carried out, and that the company should manufacture its raw material in our country, so as to give the country which produces the raw material the benefit of the industry. As to the importance of that industry you will perhaps allow me to give you a few figures.

SOME MEMBERS—That is not the point. Discuss the resolution.

Mr. W. BLAKEMORE—I rise to a point of order. Practically the whole of this session has been given up to this question and we have heard only one side of it. Members of this Institute who have no technical knowledge of the subject are asked to vote upon a very important resolution. The subject should be very thoroughly discussed before the vote is taken on it, and I therefore ask that Mr. Blue, who seems to be the only gentleman present to give us the other side, should be heard and that without interruption.

Mr. BLUE—I am discussing the whole question as it has been presented to the Institute this afternoon. I am not simply discussing the resolution which has been moved by Mr. Bell. In any discussion of this sort we have the whole scope of the question before us. I will make my remarks as briefly as I can consistent with an intelligent understanding of them. During the past eight years, from 1892 to 1899, the copper nickel mining works of the Sudbury country have produced matte which carried 35,450,000 lb. of nickel and 40,240,000 lb. of copper. The whole amount expended in the country which has produced the raw material in these eight years, including labor, the cost of explosives and other materials, has been something less than \$5,000,000. The selling price of fine nickel during these years has ranged from 30 to 50 cents per lb., and at an average of 35 cents per lb., the total value would be \$12,407,500. Estimating the value of the copper contents in the same way at 12 cents, the average of refined copper, the value would be \$4,828,800, or a total in the eight years of \$17,236,300. If you deduct the amount that has been expended in Canada you have for wages and profits outside of this country nearly \$13,000,000. Now the question is whether it is more in the interest of this country which produces the raw material to require the ore to be refined in our own country, or permit it to be sent out in an unrefined state to build up large industries elsewhere. It is said that there is no process for refining nickel in this country, that we are dependent on Dr. Mond, on the Orford Copper Company, and perhaps another, and that with all these we can do nothing. The Orford Company's process is not patented in Canada.

Major LECKIE—It is.

Mr. BLUE—I am speaking of what I know. In 1893 the Orford Copper Co. secured a patent for the Thompson process. It is in the patent records at Ottawa, and I have a copy of it. The patent laws of this country provide that if a patent is not brought into use within two years it shall become void. The Orford process was not used within two years; it has not been used up to the present time; and the whole life of the patent in Canada was only for six years. It would have expired in September last year by effluxion of time, but as a matter of fact it expired four years ago, and any person or company has the right to set up works and refine nickel ores by the Orford Company's process. Then there is another, the Hoepfner process, to which some reference has been made. I think I understand Mr. Leckie at Sudbury to say that it had no value, at all events in the experimental stage. As a matter of fact, it has been in use in Germany for a considerable time, and at the present it is refining one ton of fine nickel and one ton of fine copper every day.

Mr. HOLLAND—From what ore?

Mr. BLUE—From nickel copper bearing ores. I have proof of it in my hands.

Mr. HOLLAND—I want to know where it comes from.

Mr. BLUE—I think members of this Institute will take my word. It is a cable-gram which came to the Crown Lands Department on Monday last, and is dated March 5th, 1900. "To Crown Lands, Toronto, from Hamburg. Visited Popenburg. Hoepfner's refining process eminently successful. Output ton each nickel

copper daily. Company resolved establishing Canadian works; negotiations proceeding purchase nickel lands.—(Sgd.) PRESTON."

Mr. HOLLAND—Where did that nickel come from?

Mr. BLUE—I cannot tell. I am informed that they were Canadian ores. I saw a few days ago a series of contracts signed by companies in Hamilton—and there are no better men in Canada than the men in these companies—in which they undertake to employ Dr. Hoepfner's process as in use at the present time. They undertake to erect refining works in Hamilton, and to begin operations in September next, and to refine daily for the next month ten tons of matte, carrying 40 per cent of nickel and copper, and will increase the operations by ten tons daily at the beginning of each month, until at the beginning of the sixth month they will refine 60 tons daily. The contract provides that they may further increase operations by ten tons per month daily for the ensuing six months, so that at the end of twelve months they will be refining 120 tons of nickel and copper matte daily by the Hoepfner process. This, I believe, is quite as much as the total of the Canadian Copper Company's output at the present time, although I know as a matter of fact that the Canadian Copper Company has increased the number of its employees within the last few months and has largely increased its output. A company is also being organized in Hamilton to manufacture nickel steel that will have an investment of \$10,000,000. Another company has been organized at Sault Ste Marie with a total capital of between \$4,000,000 and \$5,000,000, and refining works are being erected there, as well as works for the manufacture of nickel steel rails. And when these works are in operation they will employ Canadian labor to refine Canadian ores.

Mr. BELL—Pardon me, Mr. Blue, but is it not a fact that the labor employed in nickel refining is comparatively insignificant?

Mr. BLUE—The Canadian Copper Company tell us that about 100 men are employed in refining the product of their mines, but they are all outside of Canada. There has been a misunderstanding of the provisions of the Order-in-Council. I am not surprised that they have been misunderstood. Perhaps when the gentleman has read it as often as I have he will not misunderstand it. The Order in Council clearly favours a preference in the export of nickel-copper ores and mattes for refining in the United Kingdom. But I am not discussing the export question. That is a matter for the Dominion Government to decide upon. It is their own law; it was passed by the unanimous consent of Parliament; and both sides, Liberal and Conservative, Ministerial and Opposition, agreed to it; and if the Government sees fit to impose an export duty it is free to do so. If you see fit, in the exercise of your wisdom, to advise them that it would be a mistake, a stupid mistake, you have a right to do so, but if you employ all the terms that have been used so freely by speakers here this afternoon, I have my doubts as to the reception you will get. The Government, I am sure, is always ready to listen to advice and to statements of facts, but I doubt very much whether any Government in Canada will be found in a mood to receive impertinence from the Canadian Mining Institute or any other institution in Canada or out of it.

Mr. BELL—Mr. Chairman, I must take exception to Mr. Blue, when he characterises the opinions of members of this Institute upon a very serious and important public question as an impertinence—I take it that this representative body of mining men is fully competent—

Mr. BLUE—I referred particularly to the address made by Mr. Holland.

Mr. BELL—Your remarks might be taken as an imputation reflecting upon the other members. Our only desire is to discuss this question intelligently and fairly and to elicit facts. We are not politicians, and do not seek to make political capital out of it. All that we mining men say to the Government is "Keep your hands off; leave us alone." As the hour is late I would suggest that further discussion be adjourned. A number of us would also like to hear what Dr. Goodwin has to say on the subject of Electro-Metallurgy. Perhaps we might have his paper now and resume the discussion on the nickel question later.

Dr. GOODWIN—I regret that Mr. Gibbs, who I see is down for a paper on "Electro-Metallurgy in Canada," and Dr. Douglas are not here. I must say, while I am on my feet, that I deprecate very much indeed the tone of this discussion this afternoon, and I recall that at one stage of the development of this Canadian Mining Institute we had the beginning of this discussion, and it was resolved that such discussions should not form part of our proceedings in the future. I must say that I have been surprised that those members who have piloted the affairs of the Institute so far should not have put a period to this kind of discussion. I think it is quite foreign to the objects of this Canadian Mining Institute, and while I realize that the question is one of the very greatest importance, and that it could be discussed in a way that would come within the scope of this Institute, I maintain that the discussion this afternoon, and the tone which has been given to it, has been quite outside of the objects of the Institute; and I foretell the downfall of this Canadian Mining Institute or at least the impairment of its influence in Canada, if this kind of discussion is to form a part of its proceedings.

Mr. BELL—I do not wish Dr. Goodwin's remarks to go on record without correction. I need hardly say that this Institute while aiming to be largely technical in its character, is primarily a protective organisation of mining interests. It has been so since ever I have had anything to do with it—indeed it may be said to have its origin away back in 1890, when the Mercier legislation threatened to paralyse the mining industries of Quebec. It was that legislation which called into existence the Quebec Mining Association, of which the present institution is the evolution. If Dr. Goodwin will refer to his copies of the Journal of our Proceedings he will find that every year we have taken action upon some question of Provincial or Federal legislation affecting the mining industries. The Government of Nova Scotia does not recognise the discussions of the Mining Society of that Province as impertinence. It has long ago realized the value of the operation and advice of a competent body of mining men upon legislation which affects their interests. I remember Mr. Fielding—

It being six o'clock the meeting adjourned.

#### FRIDAY EVENING—NICKEL QUESTION CONTINUED.

The members reassembled at eight o'clock the President in the Chair.

Mr. BELL. When we adjourned I was referring to a conversation with the Hon. Mr. Fielding. Mr. Fielding said: "when you mining men agree among yourselves upon a question, you will always find the Government of Nova Scotia ready to receive you and deal with you reasonably." No later than last year that Government had referred some important amendments to the Mines' Act to a joint commission of members representing the Mining Society and the Government, with the result that a Bill was prepared embodying the views of the mining men and suitable to all parties. That was a proper position to take on a matter upon which mining men were competent to pass an opinion. Just so in this instance. The Ontario Government could not do better than refer the whole of this nickel question to a commission of competent professional mining men, independent of the parties directly interested on both sides, and by whom the facts could be ascertained. I am confident that such a commission

would show that the policy proposed by the Ontario Government is suicidal. The results it hopes to achieve are not commensurate with the injury it will create. It is very unfortunate that this discussion was not brought on earlier; under the circumstances, it would perhaps, be better to withdraw the resolution and refer the whole matter to the Council to take whatever action might be necessary.

Mr. COSTE—I quite agree with Mr. Bell's suggestion.  
Mr. HOLLAND—Your resolution also dealt with the late Order-in-Council of the Ontario Government. However, I am quite willing to withdraw the resolution which I seconded, and would like to see the matter discussed calmly. I am very safe in saying that we have nothing to fear from discussion; we have the facts of the case on our side, and it is not going to lose anything by discussion.

Mr. FRASER—I agree with the suggestion to leave the matter in the hands of the Council to arrive at the best possible settlement of the question. I believe that representations from the leading and representative mining men who form the Canadian Mining Institute will be considered, and the Government will adopt the wisest laws possible in the interest of the mining development of the country. The policy of this Institute, as stated by the Secretary, was laid down several years ago. It would be better to wait on the Ontario Government and also on the Dominion Government, and lay the feeling of the meeting before them. They could have those gentlemen who take one view, and some who take the other view. This strikes me as the best manner of attaining our object. If we can show them that it is in the best interests of the country to take a certain course, I am satisfied they will do so.

Mr. BLAKEMORE—I would very much prefer that this matter went to the Council without any stipulation whatever—to simply refer the whole matter to the Council to deal with and leave them to decide according to their own judgment whether to send a deputation to the Government or not. I move that the whole matter be referred to the Council to deal with as they may see fit.

Mr. COSTE seconded this motion.  
Mr. HOLLAND—I think the gentlemen who are conversant with the nickel industry and who have worked in this industry should be consulted in this matter.

Mr. BELL—I think the Council may be relied upon to get the best advice upon the subject and to act in the interests of the industry.

The motion to refer the whole matter to the Council was carried.  
Mr. BELL moved, seconded by Major Leckie, that the remaining papers on the syllabus be held as read and left in the hands of the Council for publication.—Carried.

**AUDITORS APPOINTED.**

Mr. BELL moved, seconded by Mr. Blakemore, that Mr. W. deCourtenay and Mr. George McDougall be appointed auditors for the ensuing year.—Carried.

**VOTES OF THANKS.**

Mr. BELL moved, seconded by Mr. Coste, that the thanks of the Canadian Mining Institute be tendered to the various Chairmen who have presided at this meeting and to all those who have assisted in any way towards its success, and to those students who assisted in the arduous task of counting the votes for the election of officers.—Carried.

The meeting then closed.

**SMOKING CONCERT.**

The remainder of the evening was spent at an enjoyable Smoking Concert when a very fine programme of vocal and instrumental music, recitations &c., was provided by the Zingari Mandolin Banjo and Glee Club.

**COMPANY NOTES.**

**Canadian Gold Fields Limited.**—The accounts of this company show that after all the liabilities of the company up to the 31st December last, were provided for, there was a cash balance on hand at the time amounting to \$1,623.27. In addition the company held Bills receivable amounting to \$8,616.00. In detail the accounts showed:—

**ASSETS.**

<b>Sunset and Alabama Mine—</b>	
Cost of Mine.....	\$120,000 00
Expenditure on Development, &c.....	215,957 93
Machinery and Buildings.....	13,324 24
Furniture and fixtures .....	963 67
	<u>\$350,245 84</u>
<b>Jennie Mine—</b>	
Cost of Mine.....	\$12,000 00
Cost of working .....	205 45
	<u>12,205 45</u>
<b>Goldhunter Mine—</b>	
Cost of Mine.....	35,125 00
<b>St. Eugene Consolidated Mining Co.—</b>	
640,000 shares of \$1 each, fully paid-up....	\$640,000 00
Inasmuch as the Lake Shore Mines and the development of same up till the date of the Consolidation, cost the Canadian Gold Fields Syndicate the sum of \$116,969.77, these shares are only entered at the value of such expenditure, and are therefore subject to revision as to value when the same is established by the Market.....	116,969 77
<b>Cash—</b>	
On Deposit in Bank of British North America, Montreal .....	\$4,600 70
Petty cash on hand .....	22 57
On hand at Rosslund .....	536 77
	<u>5,160 04</u>
<b>Bills Receivable—on hand.....</b>	<u>8,646 00</u>
	<u>\$528,352 10</u>
<b>LIABILITIES.</b>	
<b>Capital Stock—</b>	
5,283,522 shares issued at 10 cents per share.	<u>\$528,352 10</u>

*Treasurers Cash Statement for the year ended 31st December, 1899.*

**RECEIPTS.**

Received in Cash on account Stock sold.....	\$170,508 25
Interest on Deposits, &c.....	73 50
	<u>\$170,581 75</u>
Add balance on hand 31st December, 1898.....	33 07
	<u>\$170,614 82</u>

**DISBURSEMENTS.**

<b>Office Expenses, Salaries, Rent, Telegrams, &amp;c.—</b>	
Toronto Office, account 1898	\$239 60
“ “ “ 1899	681 54
	<u>921 14</u>
Montreal “ “ 1899.....	424 32
	<u>1,345 46</u>
<b>Directors Fees &amp; Travelling Expenses—</b>	
On 1898 account .....	665 60
On 1899 “ .....	903 87
	<u>1,572 47</u>
<b>Interest and Discount—</b>	
Discount on Cheques and Drafts and Commission on Remittances to Mines .....	281 72
<b>Travelling Expenses—</b>	
President and Vice-President to Sunset properties .....	800 00
Secretary to Toronto .....	55 39
	<u>855 39</u>
<b>Sunset Mine—</b>	
Remitted Managing Director and payments to him on account of Shares.....	39,590 00
W. F. Ferrier, for Special Report ..	350 00
Vote to Managing Director for extra services .....	500 00
J. Cooper Mfg. Co., for Machinery ..	1,584 22
	<u>42,024 22</u>
<b>Lake Shore Mines—</b>	
Remitted Managing-Director and payments to him on account Shares .....	110,000 00
J. Cooper Mfg. Co., Machinery ....	5,200 00
Newsome & Co., Typewriter.....	105 00
C. E. Hope, on account services Moyie Mining Co. deal.....	1,500 00
Telegrams, etc.....	24 57
J. C. Drewry, Special vote for services St. Eugene Consolidation ..	1,000 00
	<u>117,829 57</u>
	<u>\$163,908 83</u>
	<u>\$170,614 82</u>
<b>Bills Receivable—Discounted .....</b>	
	800 00
<b>Guarantee Bond—Premium.....</b>	
	37 50
<b>Mortgage Account—</b>	
Mercantile Trust Co., on Principal.	\$986 00
Interest and Expenses.....	259 22
	<u>1,245 22</u>
	<u>165,991 55</u>
<b>Cash Balance .....</b>	
	\$4,623 27
<b>On Deposit Bank of British North America.....</b>	\$4,600 70
<b>On hand—Petty Cash .....</b>	22 57
	<u>\$4,623 27</u>

E. E. JOHN HYDE, Treasurer.

**LARDEAU DISTRICT.**

There seems no doubt now that the winter is really over and an early summer assured, which will possibly help to balance the very late season of last year and be more productive of new locations than could possibly be made in that short working period. But unfortunately the same great drawback to development seems likely to be very much in evidence, that has existed for so long, namely, the want of sufficient transportation facilities in the shape of properly built roads; for indeed the roads generally in this district have been allowed through the neglect of the authorities, and perhaps through the parsimony of the Government, to fall into a state of uselessness and even of danger to those who are compelled to pass over them. Surely this ought not to continue. The very first need of any country is good roads, and British Columbia is no exception to that rule, although any apology for a rough trail is called a road and is scarcely ever repaired after being once made, with the natural result that after the heavy spring and fall rains the so-called road is practically impossible.

The advent of the long expected branch of the C.P.R. into the Lardeau district will be an immense advantage to the mine-owners, and if, as is probable, low freight rates are made, many properties will be in the list of shippers which now cannot bear the heavy cost of freighting over bad roads. Possibly the new Government that is promised us shortly will be able to find some way to improve the present state of affairs, but it will be very late in

the season apparently before anything of value can be accomplished as the Government can hardly be in working order much before the end of August.

In the immediate vicinity of Revelstoke there is very little doing in the way of mining; it is too early yet, that is, there is still too much snow, to travel far except on snowshoes, and a man loaded with them and a good heavy pack has no easy time of it climbing our celebrated hills.

Nothing fresh so far has transpired with reference to the Standard Basin property, but one of the parties very much interested in the matter stated recently that the whole affair had been entirely reconstructed, and that work would be resumed on the claims as soon as possible, but that in this case also the condition of the roads made access far more difficult than it would be if sufficient attention had been given to them, and much delay caused in consequence. There is no doubt that the claims have an exceedingly fine showing, but (like many more) need capital to prosecute the work in an efficient manner.

The Rosebery group, Carnes Creek, recently issued their annual statement of work done and ore in sight, from which we gather that the company have a very valuable property, and are developing systematically. The ore seems from published accounts to improve distinctly in value as the depth increases, the lower tunnel having gone through patches at least of ore much higher in quality than that found near the surface. Very convenient cabins, etc., have been built, and a small assaying plant established.

It is satisfactory to note that the labor trouble caused by the totally unnecessary enactment of the eight hour law, has not interfered to any appreciable extent with operations in this district, and still more satisfactory to learn that the matter is almost settled in those places that were so badly affected. As a matter of fact, any mine can regulate the conditions of pay and labor for itself: two hours can easily be enough for a shift in one case, while 10 hours would be no hardship in another part of the same mine; hence a cast-iron rule of eight or any other number of hours can only cause trouble between the men and the owners, which is about the worst thing that can happen to a mining camp. Perhaps some more elastic arrangement may be made by the coming new Government; and another thing that is most urgently required is the appointment of several additional mine inspectors, as it is obvious that the one gentleman holding that position at present cannot possibly attend to the countless mines and prospects that need his care. It is not, as a rule, in the large and intelligently managed mines that accidents occur, but in the much smaller and less developed properties worked by the owners, who are too frequently unable from lack of funds to take very necessary precautions, even when they recognize the necessity, which is not always the case. One mining inspector for every mining division is probably as few as could do the work required, and some divisions might need more than one.

The Fish Creek division of the Lardeau district is very busy developing its numerous prospects, and these are so good that a considerable amount of outside capital is being invested quietly in some of the most promising. This is one of the divisions that will be enormously benefitted by the long expected railroad, and no doubt it is owing to the practical certainty of this road being built that so much attention is being paid to the mining claims,

for the general richness of them has been well known for a long time. Lack of decent transportation has hindered both work and capital for long enough, and though money has been spent on roads and trails, yet it has not been always wisely spent; and too often no provision whatever has been made for keeping the roads in order.

The Eya group on Lexington Creek has been steadily developed during the past winter, and the owners report that the good values in gold found at the surface, fully keep up to the mark as depth is gained. This is a very good sign, but there are other instances where the value and quantity of ore has actually considerably increased with depth; the Lardeau Queen being an example.

Further east, at Trout Lake and Ferguson, much attention is being paid to the rich galena ledges which are so well known; the Silver Cup (about the oldest mine in the camp) continuing to ship its produce occasionally to the Trail smelter, as that establishment is by far the most conveniently situated. The Nettie L., often previously mentioned, is doing the same thing, and hopes to ship steadily all the summer—if the roads permit.

Another very promising claim adjoining the Nettie L. is the May Be, on which the work so far done has disclosed some very fine veins of galena and gray copper. This is the property of the Double Eagle Gold Mining Co., which was recently formed to obtain and develop claims, and sell if they prove good. The same company owns prospects more or less developed about Fish Creek, and intends to do a great deal of work this coming season, which so far has every appearance of being one of unexampled activity and prosperity.

A. H. H.

REVELSTOKE, B.C., April 15, 1900.

### LAKE OF THE WOODS.

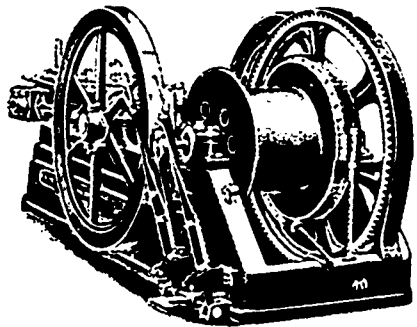
Travel over the ice of the lakes has been suspended for some time, after the sacrifice of several horses drowned. Navigation promises to open earlier than usual—probably by the 1st of May. The winter just passed has been remarkable for its general mildness and the absence of storms, and the spring weather has been correspondingly splendid.

*Mikado.*—A new crusher of the Blake pattern has been delivered at Rat Portage for this mine, ready to go out on the opening of navigation. It is from the Gates Iron Works and has a capacity of 300 tons a day. As it has only 20 stamps to supply it will, of course, run only a fraction of the time. This will secure a great abatement of dust in the mill.

*Bad Mine.*—It will be remembered that this property was acquired by The Bullion Mining Co. during the past winter. Not much sinking has been done since, attention having been directed to outfitting work, such as the erection of a shaft-house, putting in ladder-ways, timbering shaft, etc. About 25 men have been employed. Vigorous development work begins shortly.

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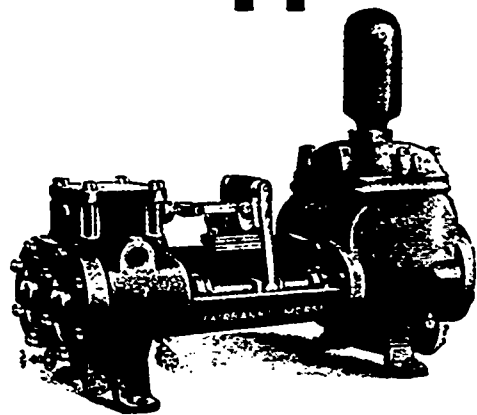
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*The Treasure.*—Work was discontinued when Captain Tennant finished his contract of sinking and drifting a couple of weeks ago, and as Mr. Upton, the optionee, is in Duluth, it is not known what will be done next. There are two shafts, one 100 feet and the other 51 feet, the latter being on a strong rich stringer, 75 feet from the former, which is on the main vein. About 300 feet of drifting and cross-cutting has been done.

*Imperial.*—The shaft is down 115 feet; there is 40 feet of a drift. A cross-cut was run to cut another vein, but stopped at 60 feet without reaching it. The main vein varies from 1 to 3 feet, but at the head of the drift is about 4 feet; the gold values are middling, I believe. Work is suspended while a mill run of the ore is being made.

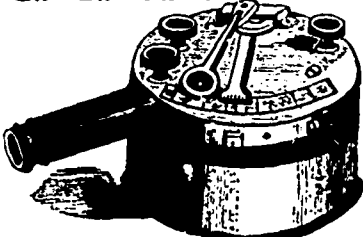
RAT PORTAGE, April 17, 1900.

J. M.

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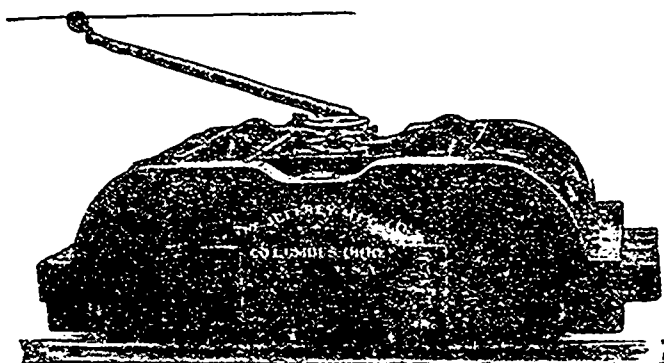
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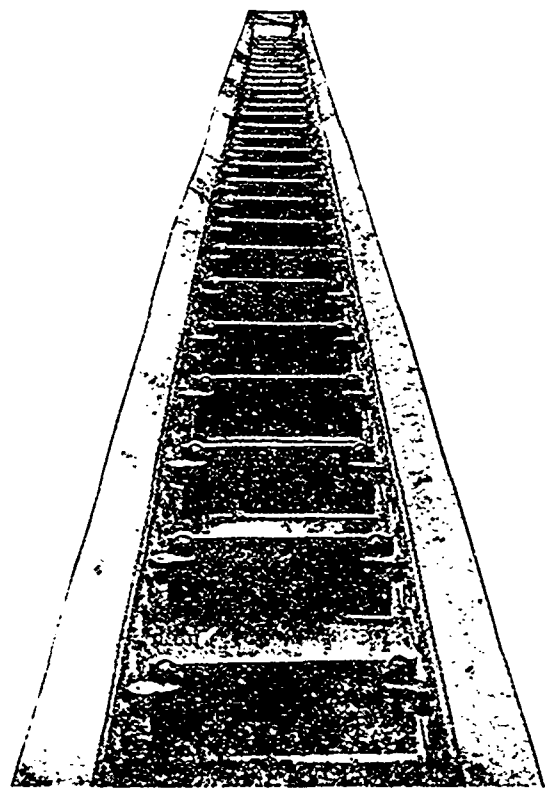
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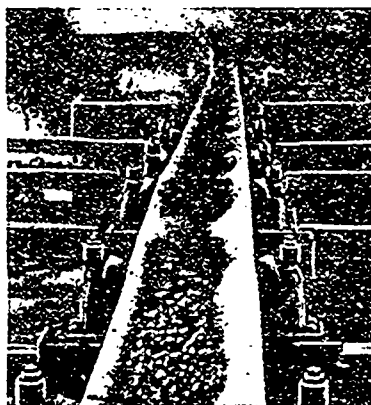
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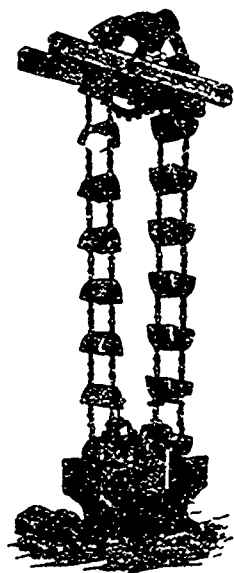
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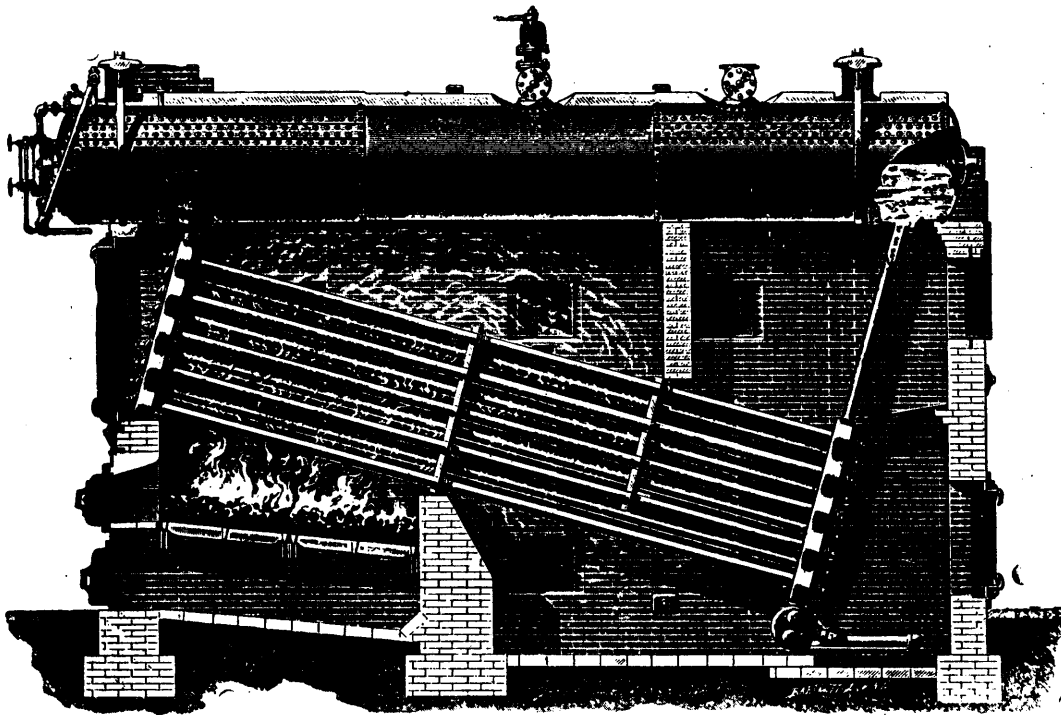
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We are, Dear Sirs, Yours faithfully. (Signed) pro S. PEARSON & SON, E. W. MOIR.

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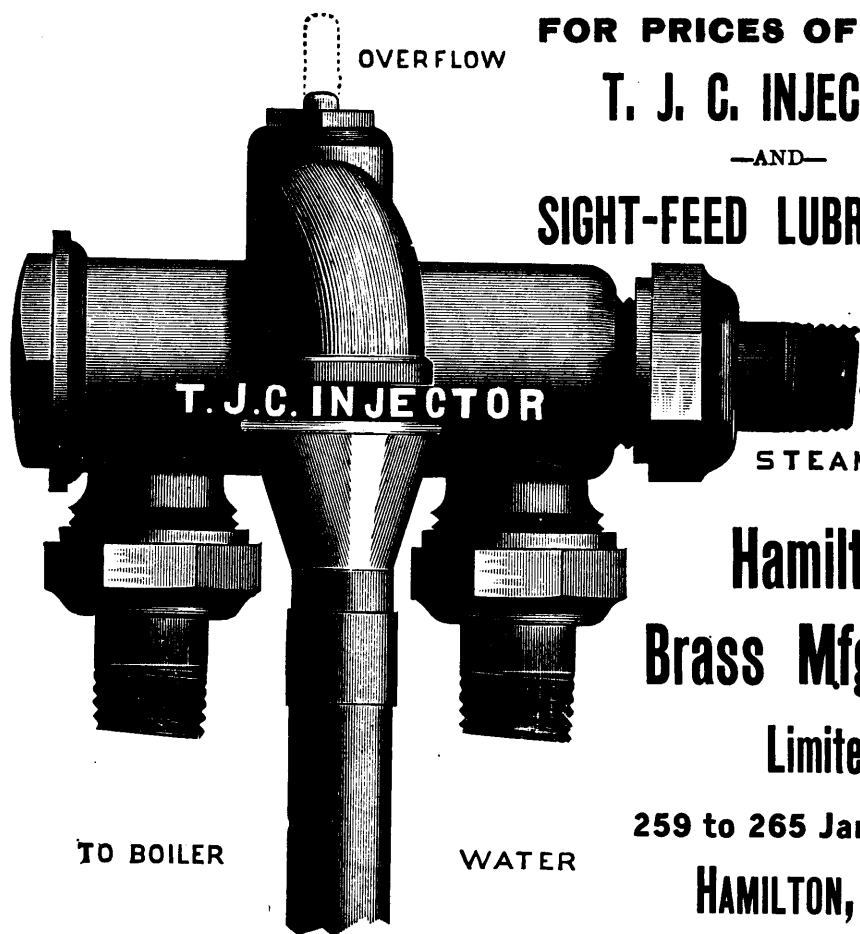
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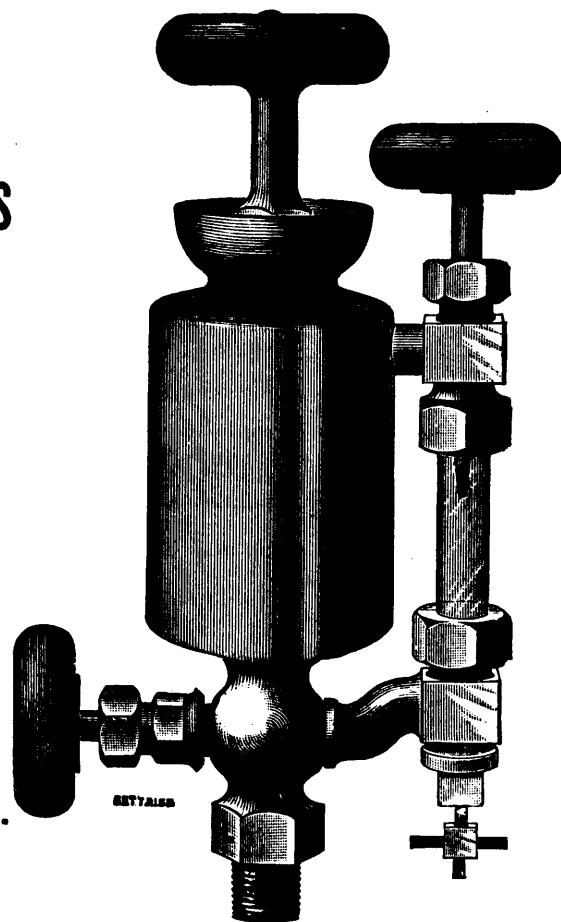


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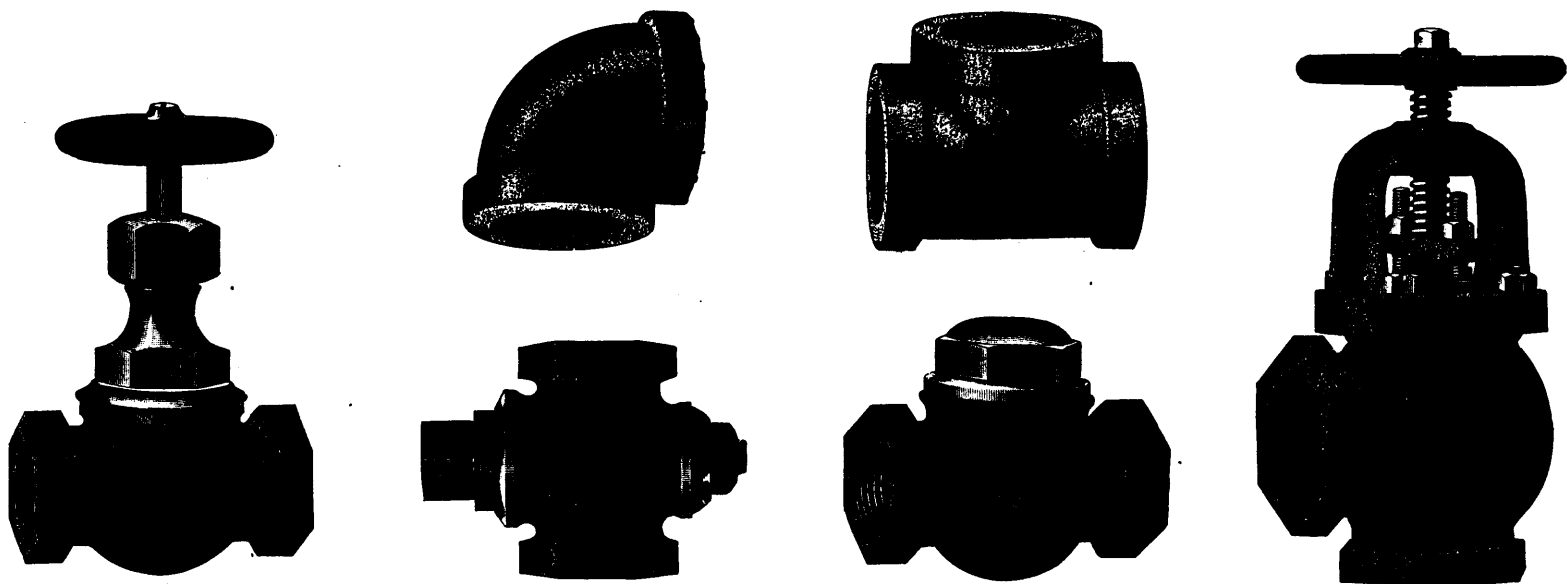
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### GOLD AND SILVER.

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

Licenses are issued to owners of quartz crushing mills who are required to pay

Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at \$19 an ounce, and on smelted gold valued at \$18 an ounce.

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

### MINES OTHER THAN GOLD AND SILVER.

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

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire 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.

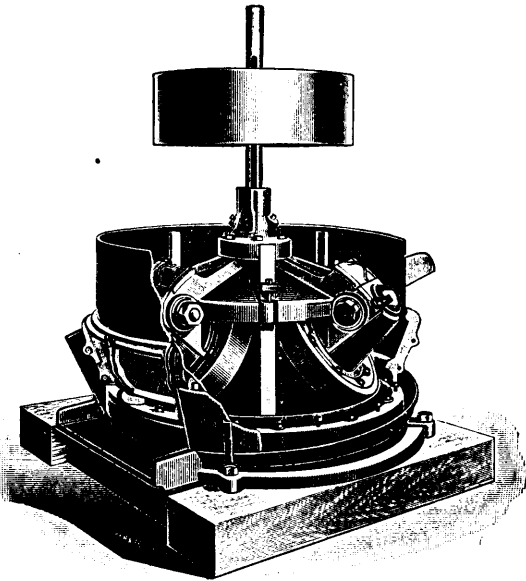
The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou 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.



# THE GRIFFIN

## THREE ROLLER

# ..ORE MILL..

The Griffin Three Roller Ore Mill is a simply constructed Mill, suitable for working all kinds of ores that require uniformly fine crushing by the wet process. This Mill is a modification of the well-known Chilian Mill, but the rollers run upon a crushing ring or die, which is inclined inwardly at an angle of about 30 degrees, the rollers themselves also being inclined to the central shaft of the Mill, thus utilizing the centrifugal force, as well as the weight of the rollers themselves as a crushing agent. The Griffin Three Roller Ore Mill is therefore a Mill of great strength, and has few wearing parts. We construct these Mills, with extreme care, using only the best of raw materials, which are most carefully worked by men who are specialists as mill builders. We sell the Griffin Ore Mill on its determined merits, and will gladly supply full information regarding it to any one.

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The Gates Gyratory Rock and Ore Breaker, a cut of which is presented, is the most perfect machine of its kind that mechanical science has been able to produce. Its crushing product is cubiform, its capacity is greater than that of any similar machine, and it is operated at less cost.



We have manufactured Mining Machinery longer than any other house in business. Our machines are used in every mining district in the world. Our sales during the current year have been unparalled, the increase in business being greater than in any other year of our existence.

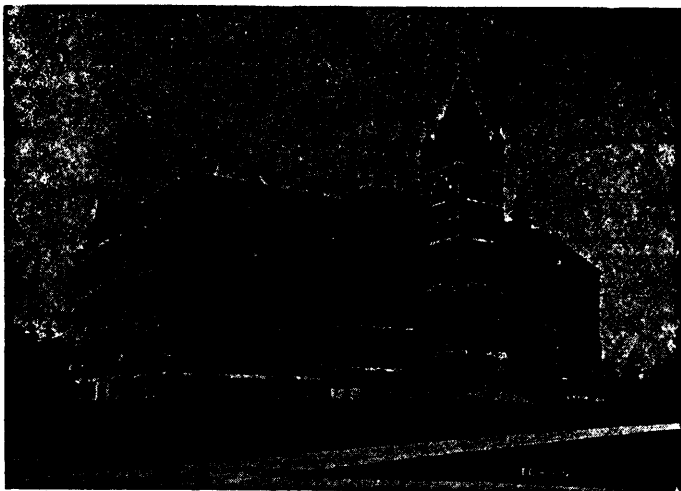
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The School also has good collection of Minerals, Rocks and Fossils. Special Students will be received as well as those taking regular courses.

FOR FULL INFORMATION SEE CALENDAR.

L. B. STEWART, Secretary.

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# **FLEXIBLE METALIC HOSE**

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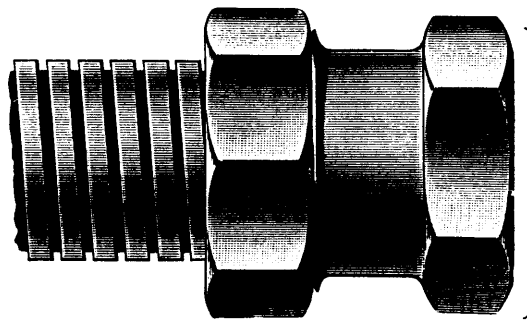
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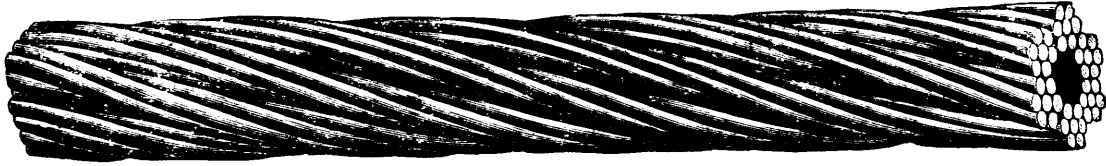
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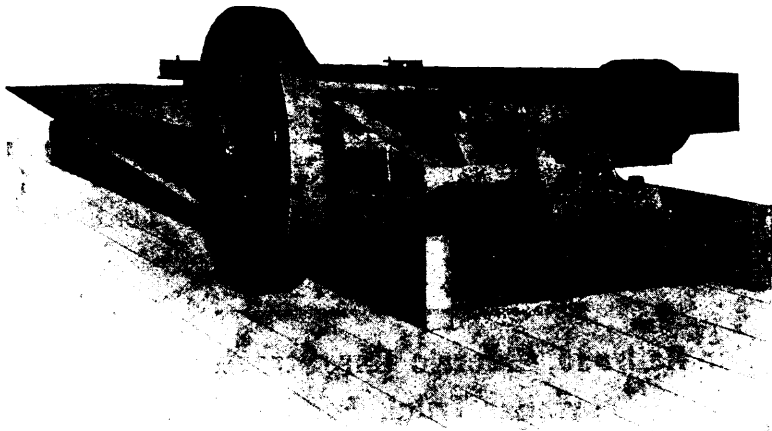


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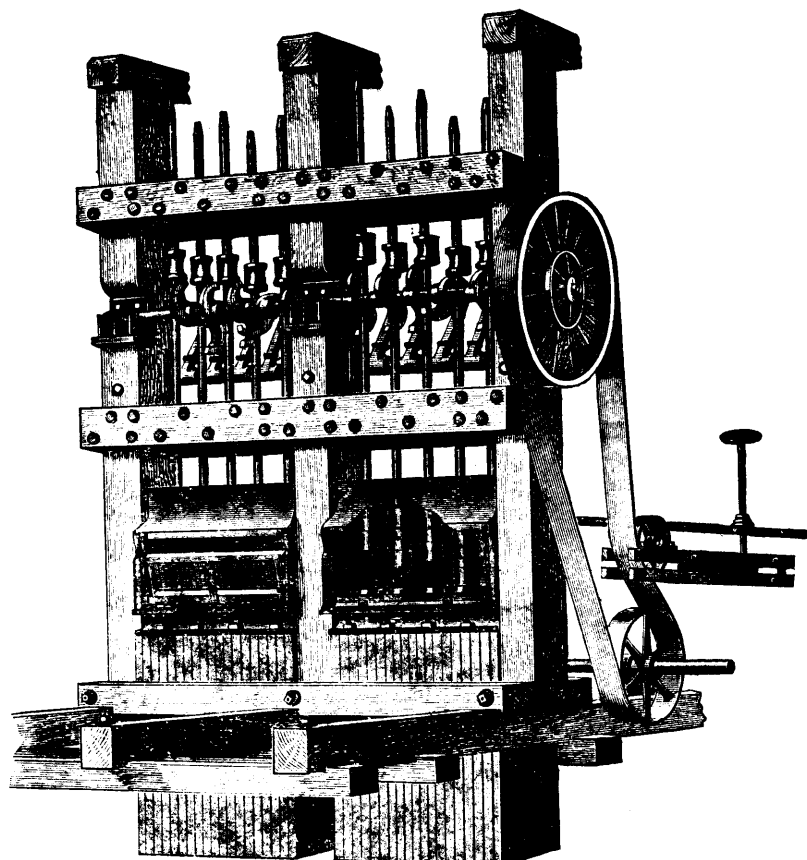
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