MR. S. S. FOWLER, S.B., *Mining Engineer.*
PRESIDENT 1900.

MR. JOHN HARDMAN, S.B., MA.E., *Mining Engineer.*
PRESIDENT 1898–99.

THE LATE H. A. BUDDEN, Montreal.

DIED FEBRUARY, 1900.

THE LATE W. J. NELSON, Montreal.
DIED 20th JULY, 1899.

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OF THE

Canadian Mining Institute

1900

CONTAINING THE

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Held at Rossland and Nelson in 1899

AND THE

ANNUAL GENERAL MEETINGS

At Montreal in March, 1900

VOLUME III.

EDITED BY THE SECRETARY AND
PUBLISHED BY AUTHORITY OF THE COUNCIL

OTTAWA, JUNE, 1900

NOTICE.

The Institute as a body shall not be responsible for the statements or opinions advanced in the papers which may be read, or in the discussions which may take place at its meetings

—*Par. XI., Constitution and By-Laws.*

NOTICES TO MEMBERS.

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INSTITUTION OF MINING ENGINEERS.

The Council has made arrangements whereby members of The Canadian Mining Institute are permitted to purchase copies of the Transactions of the Institution of Mining Engineers of Great Britain at the special rates named below :—

Vols. 1, 2 and 3, 25 shillings each, post free.
Vol. 4 to date, 10 shillings each, post paid.

All applications and remittances for these copies should be addressed to the Secretary.

CAPE BRETON MEETING.

Arrangements are in progress to hold the next meeting of the Institute at Sydney, Cape Breton, in conjunction with the American Institute of Mining Engineers and the Mining Society of Nova Scotia. This meeting will be held during the last week in August. Announcement of arrangements will be made to members later.

SUBSCRIPTIONS.

Members are reminded that subscriptions for the ensuing year were payable at the Annual Meeting, 1st March last, and arrears should be remitted without delay to the Treasurer, Mr. John Stevenson Brown, Temple Bdg., Montreal.

LIBRARY AND READING ROOM.

The Library and Reading Room (Room IV., Windsor Hotel, Montreal) is open daily for the use of members from 10 a.m. to 6 p.m.

CHANGE OF RESIDENCE.

The Secretary will be obliged if members will notify him promptly of any change in their address.

B. T. A. BELL, Secretary.

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Notes on the Ymir Mine and its Mill Practice.

By S. S. Fowler, A. B., E.M., Nelson.

Lying north of the International Boundary, west of Kootenay lake, east of Columbia river and south of Nelson, and the outlet of Kootenay lake, is a roughly quadrangular mountainous country covering about 1,450 square miles.

Occupying the central portion of this quadrangle is the drainage area of the Salmon river, a considerable stream which has its source within a few miles of Nelson, and flowing south joins the Pend D'Oreille near the Boundary.

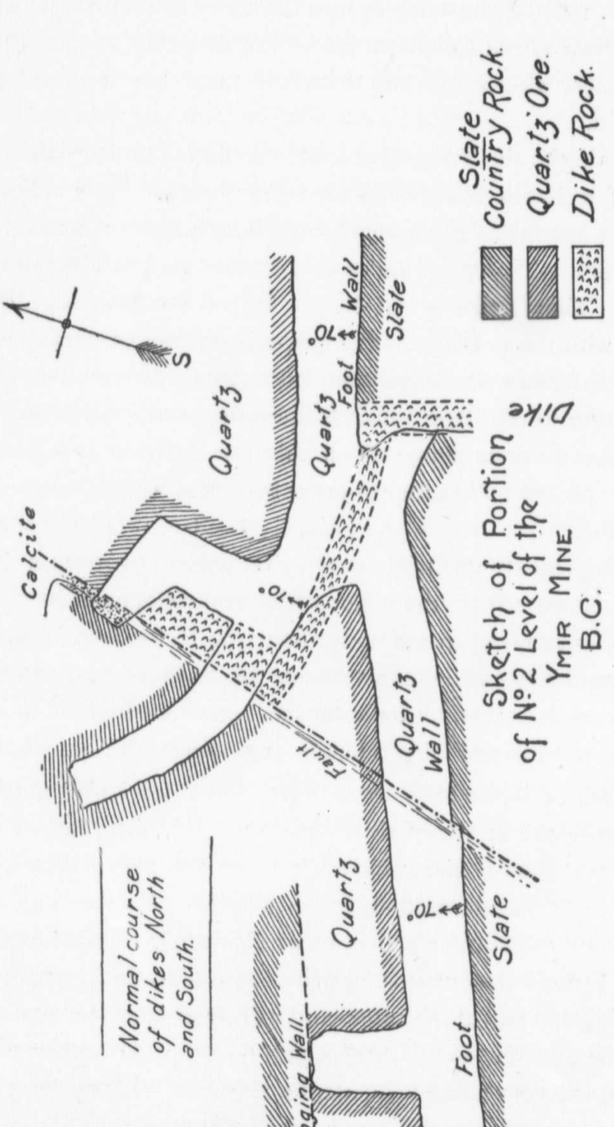
This Salmon river country, covering about 900 square miles, was practically inaccessible until the construction of the Nelson & Fort Sheppard railway in 1893, and it was not until the summer of 1896 that any considerable mining activity was manifest. The country, therefore, is possessed of a very brief history. Aside from the placer mining operations of 35 years ago, which were carried on near the mouth of Salmon and along the Pend D'Oreille, there is now no evidence of mineral location until about 1885, when, some two years before the discovery of the Silver King near Nelson, by the Hall brothers, locations of quartz claims were made by these same men near the head of Wild Horse Creek, a small stream entering the Salmon from the northeast at the present town of Ymir, 18 miles from Nelson.

Nothing more appears to have been done for the next decade along the Salmon valley, but, as stated above, in 1896 many claims were staked, and since then the district has made substantial progress. To-day, aside from the property named in the title, the Fern, on Hall creek, the Porto Rico, on Barrett creek, the Yellowstone, on Sheep creek, the Second Relief and Arlington on the North Fork of the Salmon, are considerable producers, or nearly in condition to produce, and there are many other properties throughout the district affording excellent prospects, and indeed some of them have made small shipments of smelting ore.

Physically, the Salmon country is not complicated in structure. It is mountainous, but few of the mountains reach an altitude of more than 7,500 to 8,000 feet, and the summits are generally rounded. The creek valleys are deep, however, and glaciation appears to have been an important factor in determining the present topography. The glaciers, however, have I believe all disappeared, although in the Slocan country to the north there are many remnants of that powerful moulding agent to be seen.

The rocks which underlie the region being described, are predominantly of igneous origin. In a very general way it may be said that east of the Salmon the granites are in evidence, while to the west augite porphyrites, schists derived from them, some small gabbro bosses and large areas of tuffs and agglomerate occupy the field. But throughout these rocks may be seen considerable inclusions of sedimentary rocks, principally slates, except along and near the range which forms the watershed between the Salmon and Kootenay lake, where there are thick beds of quartzites and some crystalline limestone, extending more or less continuously south-westerly into American territory. The country is a very interesting field for geological research, and deserves more extended study than can be given it for a long time. The Dominion Geological Survey sent a party into this field under R. G. McConnell during the summer of 1897, but little more than a general reconnaissance was accomplished, the shortness of the season and smoke from forest fires usually causing an early return of the field parties.

As to the respective ages of the rocks hereabouts, the slates have not been traced to connection with the Kaslo series, east of the Slocan slates, but from their lithological features one is inclined to ally them with that series, and if that is proper then the small slate areas of Salmon river are probably of Cambrian or pre-cambrian age. The various basic igneous rocks may be of different ages, but Mr. McConnell places the augite porphyrites in the carboniferous. Some of the granites appear to be comparatively recent, but the youngest rocks of the vicinity occur in dikes of blackish to dark grey color, varying much in texture and composition, and piercing the rocks above named, and


Sketch of Portion
of No. 2 Level of the
Ymir Mine
B.C.
Slate
Country Rock.
Quartz Ore.
Dike Rock.
N
S
Calcite
Quartz
Quartz
Quartz
Quartz
Dike
Fault
Foot Wall
Slate
Quartz Wall
Slate
Foot
Hanging Wall.
70°
70°
70°
Normal course
of dikes North
and South.

I believe, most of the veins of the district. Generally these dikes may be described as mica diabase, the biotite probably being a first product of alteration, while frequently the whole mass has become completely kaolinized.

Coming to the Ymir mine itself; we find it on the west side of the valley of a North Fork of Wild Horse creek. This valley lies in a slate area several miles in length and about 4,000 or 5,000 feet wide. The slates are limited on the east by granite and on the west by porphyrite. They strike about N. 35 E. and stand on edge, the line of contact with the porphyrites being approximately parallel to the strike. Extending from a point near the contact in a direction about N. 65 E. is a fracture in the slates which is traceable several thousand feet, but within the distance along which this one fracture can be identified there are no ore bodies known other than that which has become the Ymir mine.

This property was taken over by its present owners in November of 1896, since which time 5,000 feet of development has been done, resulting in showing an ore body about 500 feet in length, with its end limits practically parallel and vertical. A depth of nearly 500 feet has been attained, but very little water has been encountered, in fact barely sufficient to justify running a pump for sinking.

In plan this ore body shows a decidedly lenticular shape, with a maximum width of ore of about 30 feet. No disturbances of importance have shown themselves, but there are many slips and several partially open narrow fissures, while two principal dikes with a number of branches cross the deposit generally nearly at right angles to the latter. From a structural standpoint these dikes form one of the most interesting features of the mine, and will be alluded to again. Beside the numerous horses of slate, which in so wide a fissure must be frequent, the vein filling is quartz, impregnated with pyrite, galena and blende, no copper mineral ever having been found.

The ore appears to have been deposited at two different periods or else derived from different sources, for, the eastern 300 feet shews a perfectly white quartz, and the sulphides contained are coarser in structure and brighter in color than in the western 200 feet of the ore chute, where the quartz is not only frequently of dark smokey blue color and often nearly opaque, but the gold tenure is considerably higher. Near the region where these two varieties of quartz join they are curiously intermixed, but may be easily distinguished. Throughout the mine the walls are usually very free, but in places along the hanging of the blue quartz there is not only no clay parting, but the quartz seems to have replaced the slate, retaining the structural features of the latter and becoming difficult to distinguish underground from the country rock.

Subsequently to the deposition of the ore of both these bodies, the dykes were intruded and the fractures which rendered their presence possible seem to have been followed by movements more or less in the direction of the plane of the vein and in parts, along both walls, with the result that other fissures were formed, some extending for some distance into the footwall country, diagonally to the strike of the vein, and others along the hanging wall. These last fissures are filled with a very nearly barren white quartz, carrying at times sharply angular fragments of slate.

The later movements have also created fractures in the ore body, along one of which at least, where there is a local concentration of galena,—oxidising action has been going on with the result of producing a band of " carbonate " affording fine specimens of Cerussite and a local but marked increase in the gold values, the gold being largely free but invisible except after careful panning.

Another effect of these movements is the faulting and fracturing of the dikes and their being rendered more easily subject to alteration. This faulting movement is in the direction of the plane of the vein, but nowhere has it been extensive; *i.e.*, not more than 3 or 4 feet. The material along the plane is usually so soft as to make it difficult to get specimens shewing striation, still we have one from the hanging wall side with two distinct series of striae.

Stoping has not yet proceeded far enough to enable us know all we desire of the structural features of the vein, but before leavingth is part of our subject, I may cite an interesting freak of the larger of the two main dikes we have met with. In the No. 2 Level a four foot dike comes squarely up to the footwall, where it turns a right angle to the left along the wall, and so continues, gradually curving to the right for 20 feet where it crossed the drift squarely. Going through the dike we found slate, and cross-cutting on the outer side of the dike, we found it suddenly turning again and butting against a fault fissure, nearly filled with 2 feet of calcite. Just how or where the dike proceeds into the hanging wall we do not yet know, nor is it specially important. The main point to be observed is that our failure to closely examine what we presumed to be the footwall rock led us astray, and into an expense which was useless at the time except to reveal an interesting structure.

We have not yet developed any special mining system at the Ymir, nor have we so far encountered the necessity of any, for the first stoping was done only in March last, and since the first of June our mill has been principally employed in handling an accumulation of several thousand tons on dumps.

However, the fact that much of the ore body is too wide for stulls and that good mining timbers are scarce, together with the presence of what will probably prove itself to be a not too strong hanging-wall, will undoubtedly necessitate a system of combined crib-work, filled with waste and of square setting.

The mine produces two general classes of ore; first, mill stuff; second, crude ore. The former is sent directly to mill by a Hallidie Ropeway, about 2,400 feet in length from the mouth of No. 3 Tunnel, *i. e.* the lowest which has exit to the surface. The second general class consists of two sub-classes, crude galena, and oxodized ore or carbonate. Both of these are small in amount compared to the milling ore, and they are shipped directly to the Hall Mines Smelter at Nelson, the crude ore in bulk and the carbonate in sacks. Milling material on reaching a bin at the lower tramway terminal passes through a No. 3 Gates Crusher, which reduces the coarsest to pass about a 2-inch ring. Below the crusher is a 200 ton bin from which the feed passes by a tram-car after being weighed, into the battery bins proper. The crusher and tram terminal are in a separate building, but the cost of tramming is a very small item.

The mill proper embraces a 40 stamp 850 lbs. battery, arranged in four sets of ten stamps each, eight silvered copper plates 56 in. x 12 ft., four sets of 4 cone Classifiers, and twelve 6 foot Frue Vanners. This plant is driven by water with a 6 feet Pelton wheel under 415 feet net head, the crusher being separately driven by a 24 inch motor under 320 feet head. The stamps make from 96 to 102, 6½ inch drops per minute, and with an average issue of 7 inches, crush a little over 100 tons per diem through No. 9 diagonal slot screens, *i.e.* slightly over 2½ tons per day per stamp.

We have found a tendency toward banking of the pulp at each end of the mortar, to avoid which we give the first and fifth stamps about 1½ inch greater drop. In this connection it may be noted that at 102 drops the banking is largely diminished—in fact practically nil—but at certain times of the year the volume of water does not permit so high a speed. I may also say that we intend trying the method of introduction of feed water advocated by Mr. Bernald McDonald, which formed the subject of an interesting paper by that gentleman read before the Institute.

In operation we employ one inside plate, and on it accumulate about 40 per cent. of our gold. The outside plates slope 2 inches in a foot, and on the upper 24 inches of their length we gather about 80 per cent. of the recovered free gold which passes the screens. The lower part of the plate, (10 feet) we find to be very valuable, and it passes an extremely small amount only of free gold. An interesting feature of the operation of the lower part of the plate, is that the amalgam on that portion is very much higher in silver than that gathered elsewhere, and proportionately lower in gold.

Zinc blende and pyrite cause us no trouble in keeping the plates clean, but the extremely small size of the galena particles, together with their gravity, causes them to catch in the minute depressions of the amalgam and gradually to cover the latter. For this reason our plates are dressed every six hours, and thus we are able to keep them in excellent condition. This result we consider good work in view of the fact that our concentrates amount to $6\frac{2}{10}$ per cent. to 10 per cent. of the mill feed, and contain over 14 per cent. lead, and 10 per cent. zinc.

The bullion produced averages about $\frac{580}{1000}$ gold, $\frac{400}{1000}$ silver, and $\frac{20}{1000}$ base, thus showing practically no amalgamation of lead, but the presence ef a very considerable amount of free silver.

Without disclosing the gold tenure of our tailings, I may say that they are most satisfactory, and in fact are remarkably low when we consider the apparent baseness of the ore. Of the total gold and silver recovered we find in the bullion 82 per cent. of the gold, 27 per cent. of the silver, and in concentrates 18 per cent. of the gold and 73 per cent. of the silver.

The ore, thus far, has shown itself quite free from acids and from arsenic, antimony and tellurium, a fact which is partially reflected in the very low consumption of quicksilver, viz., about $\frac{2}{10}$ of 1 oz. avoirdupois per ton crushed.

Other properties in the vicinity of the Ymir are not yet sufficiently developed to show whether or not this mine is exceptional in its size or the character of its ore, but it seems highly probable that the success which seems in store for it will have much to do toward bringing the Salmon river country into prominence.

The Small Economies in Mining.

By Howard West, A.R.S.M., New Denver, B.C.

In presenting a paper of this character at an important meeting of the Institute, I do so with a full knowledge of the vastness of the undertaking—which may seem possibly on a review of the title a somewhat paradoxical statement to make—and the grave responsibility which I am incurring in venturing to discuss a subject which has been so ably and thoroughly gone into by the most eminent authorities in every quarter of the globe.

Granting that much of what has previously been written will apply equally to this section, my excuse is that there may still be some matters which have not been brought to the notice of mine operators, and also that local conditions have such an important bearing on the subject that only those who are thoroughly in touch, can form a conception of the nature of the problems met with in each particular locality. It is unnecessary to add that almost all the world's great producers depend on the strictest economy for their successful operation, for we know that where the cost of extraction on a large scale approximates in any degree the average value of the ore, a very small saving indeed is sufficient to constitute an important item in dealing with the profits, which after all is the fundamental object of mining from a commercial point of view.

The term "small" as applied in this sense is of course merely relative, as a small economy involves a great saving where quantity is concerned.

It would be digressing I think to refer in this paper to the tremendous strides which have been made in this direction of late years by other countries, notably perhaps the Transvaal, where the adoption of the cyanide process for the subsequent treatment of slimes and tailings has done so much to raise the standard of efficiency attained, because conditions here can scarcely be deemed analogous; nevertheless we in British Columbia can boast of isolated examples of economical management which will bear favorable comparison with the best of undertakings elsewhere. No one will contend for a moment that we are as yet all that is possible or indeed that we might be in this direction; my object, however, is only partly to notice the more palpable and obvious shortcomings which may be seen at the majority of mines, but principally to throw light as far as I am able on the apparently unimportant, because often unobserved, details. Before proceeding let me say that I have no intention of ignoring the many disadvantages under which mine operators labor in this country, as compared with other centres of the industry, nor do I wish to insinuate that we are in any way behind rival districts which may have found themselves at one time or another similarly handicapped. My desire is merely to draw attention to the fact that through various causes, many of which it must be confessed are quite incomprehensible to an ordinary individual, real economies are not effected in the manner in which one is taught to look for them, and to explain some few of the reasons why these conditions are allowed to continue.

As this subject can only be conveniently dealt with by taking into consideration the different varieties of ores and the peculiar conditions encountered in each division, I shall confine my subsequent remarks to a very important section of the country, and one of which you have all heard—namely, the Slocan. Having been myself a resident of this district for nearly five years, no one can accuse me of prejudice in expressing the opinion that for a region where mining has assumed permanent proportions, the economies effected are still of the most elementary description. Admitting this then for the sake of argument, we will proceed to observe carefully the cause of this apparent neglect of one of the first principles underlying the success of any industry. Among the chief reasons I am inclined to think is the large element of chance which enters into mining in all localities, but which is perhaps a more noticeable factor in the Slocan than elsewhere. At Rossland, and in fact all camps where medium and low grade ores can be handled to advantage, the tendency is ever towards quantity rather than quality, within specified limits, which as a natural consequence brings matters down to a more or less mathematical basis, so that comparisons of the cost of production and the value of the ore can easily be made, and the profits estimated with a certain degree of accuracy before hand. This, of course, is the origin of all mining on a large scale, and it must be candidly acknowledged that so far as the Slocan is concerned some considerable time will elapse ere it attains to this desirable end. Not that quantity is despised by any means, but quality is the one essential requisite before a deposit can be considered of practical value. Seeing then that only ore of a fairly high grade will pay to ship (from the reports of the Minister of Mines we find that the average silver and lead contents of Slocan ores for the last two years were 103 ounces and 46 per cent. respectively) it becomes a question of developing small veins of relatively high grade ore in preference to larger ones of somewhat lower value; and in working a deposit under ordinary conditions, one is forced to ignore the wide bodies of what is commonly referred to as concentrating ore and push on towards the richer chutes where the values have already been determined in nature's laboratory. By this I must not be understood as advocating the principle of gutting a mine of its richest ore and leaving behind stacks of material which under fostering treatment would become marketable; I simply wish to point out in extenuation the allurements which this district offers to the investor in the shape of quick returns, as has been repeatedly demonstrated in the past, in contrast to the system of uniform though more modest gains, which is a feature of lower grade camps. In short, the tendency of those responsible for the operation of our mines in the past, after exercising due judgment and discretion in the selection of properties to work upon, has been to regard mining as essentially a gamble and chance the main factor, because many of the deposits were sufficiently rich near the surface to render economy apparently superfluous; unmindful of the fact that for every mine so favored there are probably a dozen which could be made successful from a business standpoint by the adoption of an economical system of working and development. Fortunately for the survival of the reputation of the district these early impressions are rapidly giving place to more healthy aims, and it is easy to see that simultaneously with the influx of capital more attention is being paid to the other primary factor, namely, that of quantity or tonnage than has been possible to those of small means. This of course is only to be expected, for the old saying that "money makes money" holds true in this department of life as in others. Mine managers in the Slocan are accustomed to pride themselves above all else on the richness of their deposits, which enables them to compete on equal terms with other districts offering considerably more advantages for cheap production. This, however, in no way relieves us of the responsibility which we feel as mining engineers of endeavoring to raise the industry to the position where it will give employment to the greatest number of men and return the maximum of profit to those who show their faith in the province and its resources in the most practical method of all, by investing their surplus capital in our midst. As I have before showed, statistics amply prove the right of this district to the title of a high grade camp, but this is not saying but what there are thousands upon thousands of tons of second class ore—much of which would doubtless not be so designated in more favored regions—which would soon double and treble the production of the district could it only be worked at a profit. The accumulations which are a burden in their present condition are capable of being converted into a source of revenue under efficient management, so that when the necessary co-operation from money centres is forthcoming one of the most important elements of loss will be obviated.

Let us look for a moment at the true meaning of the word "economy." An economy can only be said to be effected when the saving resulting from an operation or a series of operations is greater than the expense connected therewith. We must be careful therefore to avoid in our handling of the subject too close a comparison with districts differently situated. In speaking of economy then it would be incorrect and misleading to apply the same hide-bound rules which govern mining in far away places to the conditions in the Slocan, and to say that because ore carrying 10 per cent. lead and six ounces of silver per ton can be made to pay in Ontario or Quebec, therefore we are not economical in British Columbia if we cannot do the same thing; our object should be rather to stimulate investigation into the causes which render mining in the provinces first named profitable, and afterward to seek as far as possible a solution of the difficulties here met with. Take as an example my casual mention of an ore carrying 10 per cent. lead and six ounces silver; the reason this can be made to pay in Quebec is because under conditions which are favorable it can be converted into a marketable commodity by the simple process of concentration, whereas by no known method can it be turned to account in the Slocan. I merely instance this as one case in a great many where natural obstacles render it next to impossible to treat with ore which could be handled elsewhere to advantage. This of course does not apply alone to material which is susceptible of concentration, for there are values too vast almost to realize concealed in ore which has already attained its maximum limit through natural agencies and which is too poor even in this condition to warrant further investigation. The utilization of these reserves should be a matter of paramount concern to the engineer, in the study of which he is called upon to exercise his utmost skill and ingenuity; and perhaps it might not be out of place right here for me to add my oft repeated protest to that of others against the practice of placing unqualified engineers in charge of developed properties and leaving to them the details of management, when men of experience are to be obtained without difficulty. In the first stage of operations this can hardly be avoided to some extent, the expense of a trained technical adviser being often beyond the means of pioneers, and his presence too not always so necessary as when the finer matters of treatment are under consideration; but with all due respect to the practical man—and I have every reason to thoroughly appreciate his many excellent qualities—I submit that he is utterly incapable of supervising economic details, many of which require men versed in geology and mineralogy to properly comprehend. This I argue is the first step that must be taken if the mines of any district are to be worked to advantage, and whatever the shortcomings in this direction in the past, it is gratifying to observe that the better class of mines in the Slocan are now almost without exception in charge of men who are equally practical and theoretical.

The main reasons why comparatively low grade ore will not pay to mine in the Slocan are not far to seek, many of them being common to all mining camps in their early history. The necessarily high cost of transportation and treatment is one of the chief factors to be considered, and though little progress appears to have been made during the last few years, we may rest assured that as soon as developments warrant and capitalists see their way clear to erect reduction works nearer the source of supply, they will not hesitate to act upon their convictions. Of equal importance is a matter that I am somewhat chary of touching upon, namely that of the removal of the duty on lead, so much having already appeared upon the subject from those better qualified to discuss the subject in all its different aspects. Looking at it, however, from an economic standpoint, one stares in amazement at the amount which is collected yearly by the United States officials in duty, and speculates idly on what effect it would have on this district were lead added to the free list.

Then again the question of cheap transportation from the mines to the railway is by no means an easy one to solve, even when operations are assured on a large scale, but the advent of capital is bringing machinery of every description to our aid—matters being greatly simplified by the introduction of tramways of various types.

Economies in marketing the ore are admittedly hard to effect, as the majority of smelters have a combined freight and treatment charge and a uniform method of estimating the values which leaves little in favor of any particular establishment. There are, however, one or two points in this connection which are well worthy the study of the intelligent manager. In the first place it should be his aim where the quantity of reserves will permit to secure the very best rate possible by guaranteeing the entire output for a given period to one smelter, other things being equal. In this way it is sometime possible to save hundreds of dollars in a year. Then again he should endeavor to suit his ore as far as convenient to the requirements of the smelter by eliminating, where the expense is nominal, objectionable material which would otherwise tend to increase the treatment charges and incidentally the cost of transportation as well. I have in mind a case where a manager succeeded in bargaining for a considerable reduction in smelter rates through being able to guarantee that no shipment would contain upwards of 5 per cent. of zinc, and similarly a company which found that its ore invariably overstepped the 10 per cent. limit allowed by most smelters, was enabled to save a dollar a ton by shipping to a concern which inflicted no penalty until a maximum of over 12 per cent. was present. Moreover, by a judicious mixing it is often possible to avoid paying any penalty whatever, and in some instances I have known, matters have been so manipulated that credit was obtained for one ingredient which would not otherwise attain the necessary standard, as in the case of an ore carrying a little less than $2 per ton in gold; by shipping in conjunction with material giving higher returns of this nature, the whole of the gold contents will receive recognition.

The idea of smelters being intentionally dishonest and not paying on the real assay value of the ore received, is one largely held by those who are either suspicious of everyone on principle or in the habit of incorrectly sampling their ore before it leaves the mine. This view I need hardly say is not accepted by the more observant managers, but that smelters may occasionally make mistakes, possibly to the disadvantage of the miner, will be conceded even by their own employees, and therefore a preliminary sampling before the ore is shipped is important to serve as a check on the smelter returns.

When convenient it is more satisfactory perhaps for the shipper to go himself or send a representative to supervise the sampling done at the smelter, for I know of one case at any rate where the check pulp corroborated the actual returns as given by the smelter, and yet on a representation from the mine that it did not accord with their preliminary results the car was re-sampled and the returns materially increased.

The value of pulp as delivered for check purposes is, I suppose, questionable, unless the shipper has, as suggested, personally seen his ore weighed, crushed and sampled, and further assisted at the moisture determination, but the smelter company practically agreeing to pay on the assay value as shown by this sample, it is always advisable and sometimes profitable to carefully check their returns. It will detract in no way from the recognized efficiency of smelter assayers if I say that even they are occasionally caught napping, and in justice to their integrity I wish to record the fact that on several occasions I have discovered that the smelter has paid for more than other competent assayers were able to detect in the pulp which was furnished them.

One other matter to which I should like to draw your attention is that I have been taught by experience that owing possibly to a slight difference in practice, smelter assayers themselves vary to a degree, which is well worthy of consideration, and that whereas I invariably obtain a fraction of an ounce less than actual returns as given by some smelters, the reverse is the case in others, one instance coming to mind where there is always a deficiency of from one to three ounces. We are justified in assuming therefore, that slightly better returns will be obtained on the same ore from an establishment belonging to the former class than from one of the latter, and in practice it is manifestly economy to take advantage of experience of this kind.

Then too in the case of ore which is characterized by containing part of its value in the form of metallic prills there is need for the most searching investigation, as owing to the unevenness of its distribution smelters are sometimes doubtful of their own assays even representing the contents of the ore in bulk, it being much more convenient to entirely ignore the prills, a course of procedure which I have been assured is occasionally followed where the value represented is small in comparison to the whole.

These are all doubtless matters of little importance by themselves, but in the aggregate they mount up and may assist in determining the difference between the successful and unsuccessful management of a property. I do not, however, cite them as common experiences by any means, but simply to show that they may occur unless guarded against, and that therefore it pays to devote the most careful attention to detail in every direction alike.

It frequently happens that a variety of minerals of an essentially different nature are encountered in the same workings, but we find that very often, owing possibly to prejudice or the apathetic determination to follow custom in the matter, no effort is made to dispose of anything but the main product. This is a very serious error, and one which may be rectified by a careful study of the situation and the demand for any particular class of ore. It is safe to say that tin mining in Cornwall would not have survived to the present day but for the recovery of the associated copper, arsenic and tungsten minerals, and instances abound the world o'er where the comparatively unimportant element has furnished the margin of profit on the investment. Hitherto the Slocan has been regarded solely as a silver camp, no other metal, with the exception of the lead, having found favor in the eyes of smelter men. It is by no means certain, however, that other descriptions of ore, some possibly unknown at the present time so far as this region is concerned, will not eventually constitute part of the output ; indeed there is one mineral very intimately associated with galena which ought to be turned to account, and this in spite of the fact that it has so far proven a source of considerable loss and been regarded generally as a detriment—I refer of course to zinc blende. It is no secret that the Bosun mine has disposed of several car loads of ore in London at a large profit, for which it was absolutely impossible to find a market this side of the Atlantic, constituting, if I am not mistaken, the first record in the history of the Slocan where actual payment has been made for the zinc contents, although the penalty inflicted by American smelters on ore of this class may be avoided by shipping to certain works on the Manchester ship canal. I commend this to the attention of mining men generally and those of this district in particular, as there is a possibility that in many cases it may lead to encouraging results. The ore in question I may say was hand picked until it averaged roughly 45 per cent. metallic zinc, 1.5 per cent. lead and from fifty to eighty ounces of silver per ton.

The ever widening nature of the subject I have chosen is becoming so alarmingly apparent as I progress, that I find it expedient to make no effort to complete the undertaking in the manner originally contemplated. I beg leave, however, before concluding to refer to two other matters which fully merit our notice. The first is the absolute necessity of every mine being supplied with a proper system of accounts so that the manager can refer whenever he desires to the cost of any particular piece of work and make the necessary comparisons as he goes along. There is no need, however, for me to dwell upon this at length, even if I had not already trespassed too long upon your time, for I notice that Mr. Hardman, the worthy president of the Institute, intends to go into the subject more fully in his contribution to the proceedings.

The other matter which I had in mind would fill a volume if necessary, as it relates to the much vexed subject of concentration. While I have had some little personal experience in work of this kind, and am thoroughly conversant with the principles underlying the process, there are members present I know who have been making a special study of this branch for months past, so that I shall be very brief indeed, in order to give them an opportunity to speak for themselves. I would willingly have omitted all mention of this matter were it not self-evident that the process is destined to be the chief factor, if I may be allowed to say so, in the future advancement of the district. In no other department perhaps is the strictest supervision so essential to success, for even a little carelessness may result in large values being persistently run to waste. It is economy of the first order to employ a thoroughly competent mill man, as he will save hundreds of dollars worth of ore in a month which would doubtless be irrevocably lost under less skilful treatment. So too the highest professional skill is the cheapest in the long run, and a mine owner makes a serious mistake when he employs an engineer or an assayer simply because his fee may be lower than that of others.

The type of concentrator generally adopted in this district was dealt with in a paper entitled "Mining Machinery in the Slocan," which I submitted some eighteen months ago. Since that time but little alteration or improvement has taken place, if we except the introduction of the Wilfley table at the Alamo works where it is used in place of the round buddles. In the newer types of concentrators now under consideration to be erected before long, it is probable that in view of the prospective importance of the zinc blende in the ore, four compartment jigs will replace those previously employed so as to facilitate the recovery of this product.

The Bridge River Gold Mining Camp.

By Fritz Cirkel, M.E., Vancouver, B.C.

The discovery of gold in the Lillooet district dates back as far as 1858, when a great many prospectors, on their way to Cariboo *via* Lillooet, tested the bars and benches of the Fraser River, and its tributaries, Bridge River and Cayoosh Creek.

Indian and Chinese miners have since that time located and worked a number of placers with varying success. It is reported that up to 1890, about 2 million dollars worth of gold has been bought by the Express companies, not counting the amount which has been carried away by Chinese. But it was not until the year 1387 that endeavors were made to find the leads wherefrom some of the smaller creeks had derived their supply of gold and we find that in that year several claims were recorded, but no attempts to explore and to develop them were made and consequently the locations were abandoned. From 1893-95 however, we find a good deal of exploratory and development work going on on several claims along Cayoosh Creek and the information obtained concerning the mode of occurrence of gold, is interesting from a geological point of view. Amongst these claims may be mentioned the Golden Cache and the Bonanza; the history of these claims is too well known to be repeated here. In 1897 the scene of excitement changed from Cayoosh Creek to the upper tributaries of Bridge River, when in the middle of August several quartz leads showing a fair amount of visible gold, were discovercd on the right bank of Cadwallader Creek. Early in the spring of the following year we see a large influx of prospectors and it did not take long before both the east and west banks of Cadwallader Creek and South Fork were staked for over 15 miles. The epidemic for staking claims was evident, and certain parties, armed with axe and pencil, used to stake without any previous prospecting, several claims daily; it did not matter much whether there was any ore in place as the law required, as long as the reward was paid by the people who sent these prospectors out. The natural consequence was that most of the claims had to be abandoned, and towards the middle of the year 1898 we see only a limited number on which assessment or further development work was undertaken. Before entering into details regarding the results of the exploratory work on the various claims, a description of the route to the camp, the topographical and geological features of the country, may not be out of place.

The Bridge River Mining Camp is situated at a distance of 75 miles from the next post office and town of Lillooet, 138 miles from Ashcroft, and 122 miles from Lytton, both of these towns being stations on the Canadian Pacific Railway. The most practical route leading to the Camp is over Seaton Lake to the Indian Mission, a distance of 17 miles, thence over the Mission Mountain to Jacques Landing 7 miles; crossing the river at this point the trail follows the sinuosities of the river for 43 miles over Tyaughton to Sucker Creek; here the river is crossed again and the trail leads up to South Fork and Cadwallader Creek and parallel to the latter finally to the Ida May and Ben d'Or Camp. In glancing over the accompanying map we find that we are approaching more and more the Coast Range of mountains and if we draw a straight line from Upper Cadwallader Creek to the next salt water, Jarvis Inlet, the distance is not more than 50 miles. This route of course would be much shorter—approximately 300 miles—taking Vancouver as the starting point, but it appears that no one except Coast Indians, has ever attempted to reach the camp by this way; as the very high peaks and rough plateaus, visible from the mining camp, and covered all the year round with snow, do not look as if a practicable route could be established, especially during the winter.

From the Indian Mission on S Lake a good government trail built on a wagon road grade permits of an easy ascent of the Mission Mountain, which at its lowest point on the summit has an elevation of 3,200 feet. From Jacques Landing up, the river is closely bordered on both sides by high mountains, which as a rule slope up steeply from the river banks without any intervening flat lands. Sandy and gravelly benches are also found and around Tyaughton and Gun Creeks; they are very extensive. A few patches of agricultural land along the river have also been noticed, but so far no serious attempt has been made to make use of them. On an average most of the mountains are pretty fairly covered with good timber, a species of Norwegian pine predominating. As to the Bridge River proper it must be mentioned that, although for 35 miles the difference in elevation is not more than 125 feet, it is entirely unsuitable for navigation by reason of its shallow and rocky spots. The river rises every summer for about 15 feet. presenting then a very swift current, and many difficulties are experienced in crossing at that time, as no bridges have been built yet on any of the ferry points. From Gun Creek to Sucker Creek the river valley gradually widens out; the mountains are not of the abrupt and cliffy nature as observed on the lower part of the river, and on Sucker Creek a magnificent view is obtained all over the surrounding country at different points of the trail, which ascends a gently sloping and sparingly wooded mountain to the south. This mountain forms the base for a long mountainous range, which composes the east bank of South Fork and Callwallader Creek for over 15 miles, and which has been the scene for the activity in mining of late. The first group of claims we cross by trail is the Forty Thieves; this group is staked along the course of and on both sides of South Fork, which runs in a deep narrow gorge, bordered to the east by a cliff of a height of 1,200 feet. After ascending the next series of hills, the trail leads for several miles with small interruptions across a level and wide wooded terrace; we pass the Lorne group of claims and from here up the country and the east bank of Cadwallader Creek for the next 10 miles presents an open intervening flat, sloping gently towards the creek covered for the greater part with a light second growth of timber; further to the east it is bordered for several miles by a steep and bluffy mountain range of apparently 8,000 feet height, which is devoid of any timber. From different points of this mountain we obtain a magnificent view over a part of the Coast Range, and the appearance of this region is that of a rough, irregular, mountainous country, in which the higher points are grouped towards the centre of the mountains, which are divided by each other by the valleys and gulches of the smaller streams. The height of a great number of these mountains exceeds 8,000 feet and considerable snow remains throughout the summer on some of them. The country is generally wooded and in the lower and more sheltered valleys much good timber is to be found, especially on the west bank of Cadwallader Creek. In a number of places along the west side of the valley the tracks of snowslides are apparent, but these are confined to the higher part of the mountains and do not come down to the creek.

As to the geological structure of the region traversed it must be stated that it appears to be very complicated, especially along the the course of Bridge River, and the scanty information obtained is not sufficient to allow of a systematic and satisfactory description of the rocks occurring in them. It suffices here to mention that the rocks along Bridge River dtffer widely if not in age, at least in lithological character and degree of alteration from those met with on the Ranges of Cayoosh Creek. Most of the rocks met with up to Tyaughton are highly altered greenstone, overlain by various schists, quartzites, conglomerates and dolomites. From Tyaughton further up the river we find groups of dark banded rocks composed apparently of tuffs and ash rocks with limestone, interrupted at places by granite intrusions. From Gun Creek to Sucker Creek we find to a great extent porphyrites of various kinds, gabbros, breccias, diabase, agglomerates and fine grained slaty ash rocks. Exposures of a fine grained green eruptive can be noticed on the high mountain range east of Sucker Creek in the vicinity of the Forty Thieves to the east. This belt of diorite follows approximately parallel the course of South Fork and Cadwallader Creek beyond the Ben d'Or group of claims for over 7 miles, flanked to west by a succession of various porphyrites, syenite and hornblende schist, and to the east by a series of greenish metamorphic schists, gneiss and granite. About half a mile beyond the Lorne group of claims we notice a highly metamorphosed reddish granite, apparently setting through the formation at right angles. Descending down to Cadwallader Creek we notice a hard glassy porphyry, replaced in the vicinity of the creek by blueish argillites, dipping to the west with a strike N.E.–S.W. At the Ida May group of claims the formation consists of coarse syenite, flanked to the east by a succession of diorite, fine grained gneiss, and greenish schists. The high lofty mountain ridges surrounding the Cadwallader Mining Camp appear to be composed of various eruptives and volcanic rocks in association with porphyries; fragments of these rocks are strewn all over the lower part of the country, while also, granite boulders of the biotite variety can be noticed wherever the soil has been removed. Glaciation of hard rock surfaces was observed at various places in the vicinity of South and Fork and Cadwallader Creek, and the striation and glacial groving appears to follow the direction of the valley in a southerly sense. Evidences of this kind, clearly the result of the movement of glacier ice were found at a distance of about 4 miles from the Forty Thieves in south-eastern direction, at an elevation of 4,100 feet, where the mountain slopes away towards the creek, and also on projecting points of rock.

The auriferous quartz lodes so far discovered occur in what may be termed the metalliferous belt, which commences at the confluence of Bridge River and South Fork and extends for over 15 miles along Cadwallader Creek. The rocks occurring in this belt, the various eruptives and adjacent members of the formation are charged with granular iron pyrites, and more abundantly so in the vicinity of the quartz leads. In some places the entire superficial portion of these rocks has been more or less oxidised to a depth varying from a couple of feet to twenty feet and over; at one place about half a mile south of the Ben d'Or group near the river bank the decomposition near the quartz lead is so complete that the rock may be removed easily with pick and shovel. The majority of the quartz leads occur either in diorite or in syenite and porphyry near the contact with the former; on upper Cadwallader Creek several claims have been located in a hornblende and argillitic schist crossing the strata, but so far they have not proved of importance. All veins possess a certain degree of similarity; with the exception of the Forty Thieves vein, which strikes N.W. 70°, all quartz leads of importance have a N.E. strike, and although some of the locations are miles apart, the veins appear on the map as a parallelism of straight leads. Their dip is east and where surface disturbances have not displaced the original vein as observed only in two cases, the same varies from 65 to 85 degrees. They psssess all characteristics of fissures, in having very distinct well-defined and perfect walls, which cross the strata wherever such is noticeable. Small cross veins or so called feeders occur only on the Lorne group, but they are of minor importance, as the small values obtained therefrom do not warrant further development work. Judging from the surface exposures, and the development so far done on the veins, it is worthy of note that no large faults or displacements of any account are noticeable; it must be inferred therefrom that the encasing formation has undergone hardly any movements and shiftings by dynamic forces, after the deposition of the quartz out of the mineralizing solutions in the fissure. A small breakage is noticeable at the Ida May and McKinley veins, where a part of the vein near the surface outcrops, is broken off and subsequently tilted over. In treating some of the leads on the surface one cannot but be impressed with the great regularity as to their horizontal extension. Reference is made to the main vein of the Lorne group of claims; this vein strikes N.E. 70 degrees with a dip of 85 degrees east and has been opened up by some 15 cross-cuts and one shaft of 70 feet depth all over a length of 1,200 feet; the same shows in all its openings such striking regularity as to its staucture and mineralization as will be seldom met with in any mining camp in British Columbia. Another fine example is that of the Forty Thieves vein, which has been traced for over 4,000 feet without showing the slightest alteration in its strike, dip and general character. The same applies to the Ben d'Or vein. The breadth of the quartz lodes varies considerably; some maintain a width of 2 feet wherever observed, others show from a few inches up to 4 feet. The largest quartz vein—though low grade—so far observed, is the Blackbird and McKinley veins, which appear to maintain a width of from 7 to 12 feet.

The quartz met with throughout the country is of opaque, white, flinty, and near the surface of rusty appearance. The gold associated with a small amount of silver occurs through the gangue generally in a coarse and often nuggety state—and specimens have been obtained, where pieces of quartz were held together by gold nuggets weighing half an ounce. In this respect it must be mentioned that a great quantity of the finest specimens were obtained during the progress of the work at the Ben d'Or and Ida May mines, while at the Lorne group a large quantity of float quartz containing small gold nuggets were found strewn all over the slopey side of the hill. From a number of different assays of different sections of several veins in the district, it appears that the gold is very irregularly distributed throughout the gangue; while some parts of the leads average high values, others in immediate vicinity are entirely barren, devoid of even a trace of gold and to arrive at a final conclusion as to the average value of the ore in a vein is a task which presents many difficulties.

From a number of experiments made with large quantities of ore it appears that from 40 to 70 per cent. of the gold is free milling, the lower percentage being obtained from ore below the line of oxidation. Sulphides occur in most of the leads, in some to the extent of 5 per cent. of the ore. They consist of different sulphides of iron and copper, stibnite, magnetic iron and sometimes galena. Carbonates of copper were also observed in the Lorne vein, Why Not, and McKinley, in the latter at places to such extent as to render the ore all refractory. At the Ida May a peculiar steel gray mineral was observed, accompanying the gold wherever such was visible, which proved upon further investigation to be an iron sulphide. The gold values contained in the sulphides are throughout very high and are in some cases as high as $1,000.00 to the ton. It may be of interest to give here the results of a test made with 490 pounds of Ida May ore in San Francisco:

The assay value per ton was:	Gold 4.44 ozs. equals	$91 93		
	Silver 7 ozs. equals	4 56		
		$96 49		
The 490 pounds amalgamated gave:	Gold 1.82 ozs. equals	41 per cent.		
	Silver 0.21 ozs. equals	5 per cent.		
Amount of concentrates approximately		5 per cent.		
These yielded per ton:	Gold 40.97 ozs. equals	$847 00		
	Silver 77.30 ozs. equals	46 38		
		$893 38		
The final tailings assayed:	Gold 0.50 ozs. equals			$10 66
	Silver 3.65 ozs. equals			2 19
				$12 85

Therefore

Amalgamation gave 39 per cent. of assay value.
Concentration gave 45 per cent. of assay value.

Total extraction.......... 84 per cent.

As far as the writer is aware there are in the neighborhood of 15 quartz leads discovered along the banks of Sourh Fork and Cadwallader Creek, and also nearly all are auriferous, only in a few of them ore chutes have been established, which warrant the expenditure for further extensive development work. The Ben d'Or mine has opened up a well defined quartz lead, which can be traced on the surface for 1,600 feet; the width of the same varies from a few inches up to 3 feet and developments are said to be of such satisfactory nature that, a 10 stamp mill is now in course of construction, which considering the costly transportation of machinery for 150 miles, partly over a bad mountain trail is an undertaking of more than ordinary importance. On the Lorne group of claims an arrastra has been installed about a year ago, and although eastern capitalists have relinquished a bond, which they had on the property, it is learned on good authority that the above primitive apparatus is turning out about $500.00 worth of gold weekly from ore obtained in a recently discovered lead, particulars of which are not to hand. On the Forty Thieves group of claims a tuunel has been driven for 200 feet, but not far enough to cross-cut the lead, which outcrops on the top of a steep bluff about 350 feet high. It is reported that the tunnel will be continued shortly and as some good values are obtained on the surface, it will be very interesting to learn what the developments are at the above depth. The Forty Thieves vein has been traced over three claims and is considered by experts as the strongest quartz lead in the Lillooet district. Very high values are obtained from the outcrops of the Ida May vein, and although the quartz which is 20 inches wide, has been replaced to some extent by secondary rock matter as a result of of latteral pressure, it is not unlikely that the original pay chute may be located in lower levels.

Looking at the Bridge River Camp as a whole it must be stated that out of a quite a number of discoveries only a few, so far, have proven of value. At the present juncture it would be rash to prognosticate what the future developments will be as the work with only a few exceptions consist so far of surface scratchings; but those few prospects of value have steadily brightened during the last 12 months, and great hopes are entertained that they eventually will turn into mines. Several factors however, seem to retard the healthy progress of the Bridge River Camp, and one of them is the remoteness from railroads. The present road from Jacques Landing to the camp is not fit either for safe travelling or for proper transport of supplies, and the Government should at least build a proper trail and provide for bridges over the river for proper communication. The writer has had the experience that during the high water in the summer months, pack trains with supplies from Lillooet were 6, 8 and even 10 days on the trail, and communication several times came to a standstill. The lack of good roads and bridges seems to be also one of the causes why the district has not been given more attention by the investing public and mining men, and as capital is proverbially cautious in recognizing the merits of the new camp, we cannot wonder much that so far very limited capital has found its way into the Bridge River Camp.

Again it must be mentioned that this camp has been held by the investing public as being identical with another in close proximity, where several failures in quartz mining have been recorded—on upper Cayoosh Creek. It would be beyond the scope of this paper to enter into details concerning the mode of occurrence of the gold bearing quartz in this locality, it suffices here to state that while we have on Cadwallader Creek in an eruptive formation as outlined above, fissure veins which can be traced for thousands of feet, the occurrence on Cayoosh Creek may be described as irregular wide and narrow bands, nests and disconnected pockets of barren looking quartz, conformably imbedded in the argillitic schist formation and from the development on several claims it appears that these highly irregular quartz deposits are more frequent, wherever the formation has undergone considerable fracture and disturbance. Reference is made to the Bonanza claim, where bands and small pockets of gold bearing quartz occur in a twisted, contorted and much wrinkled argillitic schist, in a reversed fault, and development work has shown that these quartz deposits were of very limited extent and for the greater part entirely barren. Examples of the same were noticed on other claims in immediate vicinity, and although some of the larger quartz deposits have yielded the finest gold specimens it must be stated that mining on these uncertain occurrences has to be undertaken with the greatest reserve.

The Chicago Main Drainage Channel.

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By J. F. Lewis, Chicago, Ill.

It is not easy for us to realize that at one time our land was covered with ice thousands of feet thick, but according to Professor Wright, the recent advancement in knowledge of glacial geology has established beyond all controversy that within a comparatively recent period the condition of Greenland extended over all the Dominion of Canada and the southern part of the United States, and that ice, thousands of feet in thickness, produced by the accumulation of snow over Labrador and the region about the southern part of Hudson Bay slowly moved outward in every direction along the lines of least resistance until it was melted by the warmth of more congenial climes.

The marks of this ice movement are unquestionable. Canadian boulders have been found several hundred miles from their parent ledges and deposited in such positions that any other agency than glacial ice is excluded from the question. We find the rocks scored and scratched in lines parallel with the ice movement. The glaciated area is also indicated, especially near its margin, by a great depth of boulder clays, which is an unstratified deposit composed of the grist ground up by the glacier as it moved over the rocks and dragged them along under it and spread out over the surface of the country. The depth of this glacial grist or "Ground Moraine" as it is called, averages probably one hundred feet or more over Central New York, Northern Ohio, Indiana, Illinois and Minnesota, everywhere down to the southern border of the glacier can be traced boulders of granite rock that are found nowhere except north of the great lakes. The movement was westward as well as southward, so that Lake Superior boulders are found in Central Dakota, west of the Missouri river as well as in Northwestern Kansas, Southern Illinois and Central Ohio. One of the four great ice streams passed south through Lake Michigan and the Illinois valley, and Chicago lies directly in its path. During the excavation of the Chicago drainage channel abundant evidences were found to prove that the canal recently excavated has not for the first time opened the Des Plaines valley for drainage away from Lake Michigan, and that this valley as well as the site of the City of Chicago is very closely connected with the processes and effects of the ice period. The site of Chicago was formed by the filling in of an ancient bay formed during the passing of the ice stream down the valley, the bay after a time being formed into a lake by sand drifting across the mouth of the bay.

The slope of the bay from north to south was almost a perfect level, but it had a slight inclination towards the lake, being a little above datum, where the foundations of our present buildings rest upon it, but below datum at the lake shore.

This lake at one time stood about 11 feet above datum. The silt from the flood waters of the Des Plaines and north branch in the meantime continued to fill this lake from the rear until these flood waters broke through the sand barrier and eroded the channel which we now call the Chicago river, and the site of Chicago was completed. After this the silt was discharged into Lake Michigan, the ancient discharge being thus reversed.

While these great changes were taking place on the shores of the lake a forest was growing in the surrounding country and was evidently destroyed by a cyclone and the trees were blown into the lake, as the lake filled up these trees were buried and many of them have been found while excavating for foundations and sewers. They show great age and that they were magnificent trees, the annual rings indicating at least 250 years growth.

The destruction of this forest and its burial marks the close of the first post-glacial epoch, and the beginning of the second. This takes in the filling of the inland lake with wind-drifted sand from Lake Michigan, and slit or yellow sandy loam from the turbid floods of the north branch and the Des Plaines. If this conclusion is correct the age of this timber is approximately six thousand years, for in eight thousand years not only has a considerable part of the site of Chicago been deposited by the process above described, but five miles of the south end of Lake Michigan have been filled.

History tells us that in the winter of 1674–5, Marquette with two others coasted down Lake Michigan and entered the mouth of the Chicago river, at that time covered with ice. They were obliged to haul their boat two leagues to what is now the intersection of Robey street and the new canal with the Chicago river. In March the country was flooded and Marquette and his companions were obliged to take to the trees for safety.

There has been a monument built at this point with boulders that were brought down from the north with the ice.

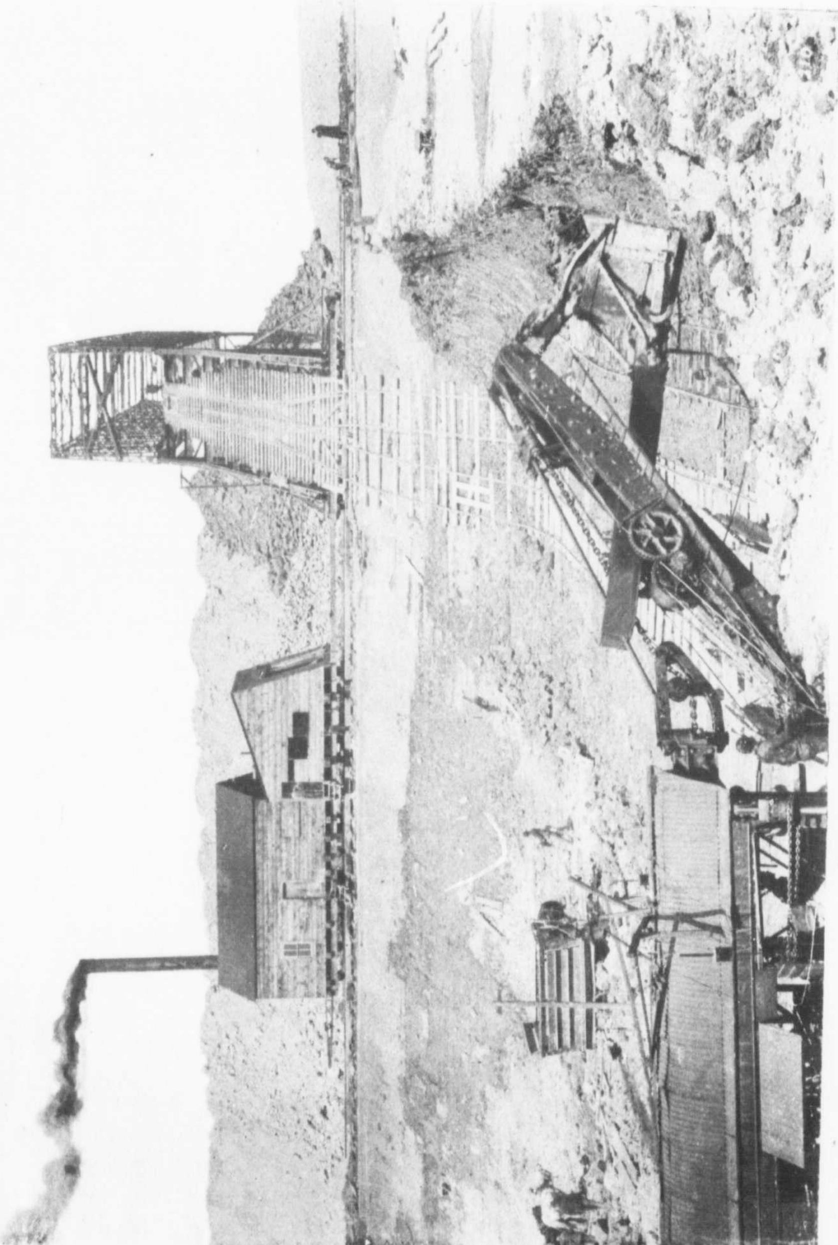
For a number of years the question of pure water has been uppermost in the minds of the citizens of Chicago. No doubt that the water of Lake Michigan, could it be taken from beyond sewage contamination, is perfectly pure and healthy to drink, but when one considers the fact that on a lake front of 32 miles, 300,000 of population drains to the lake at all times, and 1,493,000 whenever the river, from any cause, discharges lakeward. There would seem to be sufficient reason to doubt the purity of the water. The city limits include an area of 181 square miles, or 116,320 acres. There were built to January 1st, 1892, 4,690,538 feet, or 888,321 miles of sewers since 1855.

In 1886-7 the Legislature passed bills providing an adequate system of drainage for the city. Then came the organization of the Sanitary District, October 14th, 1889. This Sanitary District is 18 miles long from north to south, and 9½ to 15 miles wide.

In order to carry out the plan as proposed by the Engineering Department, it was found necessary to divert the Des Plaines River, which ran in a zig zag line through the valley. This has been done by cutting a channel 200 feet wide, and 4 feet deep, along the line of the drainage canal. The total length of this canal proper is $28\frac{5}{100}$ miles, divided into 29 sections, 14 of them practically all dirt or glacial drift, 6 sections glacial drift and rock, 9 sections all rock.

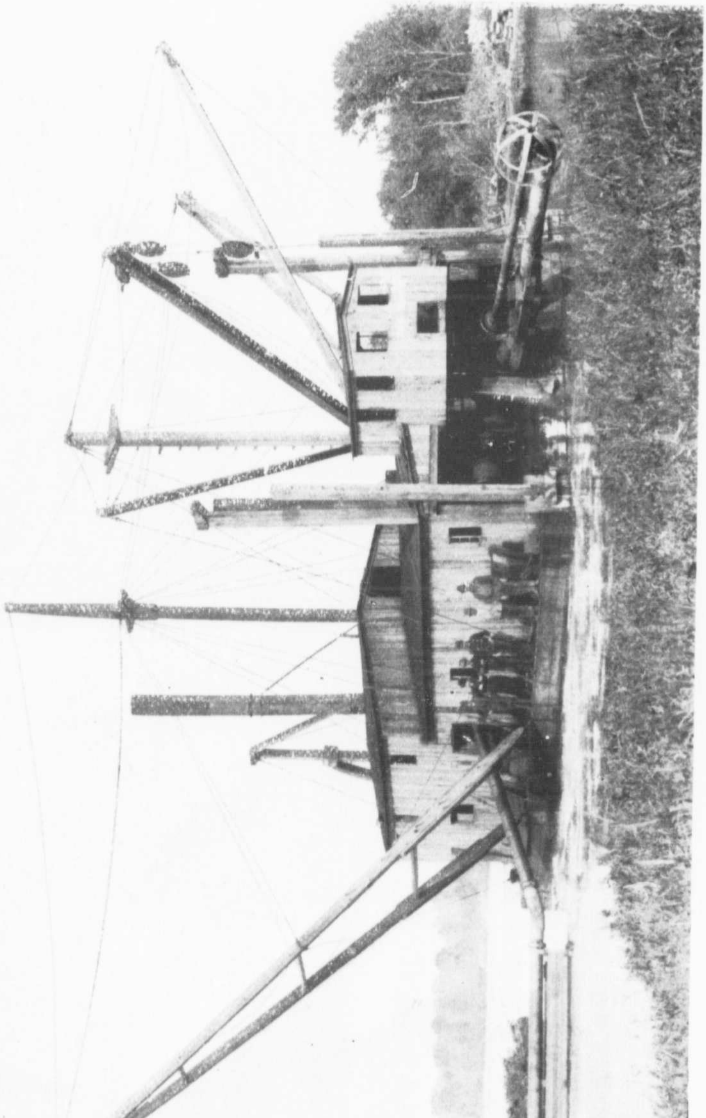
The dimensions for $14\frac{9}{10}$ miles through solid rock cut, are 160 feet wide at the bottom, 162 feet wide at the top and in the glacial drift for 13.15 miles, it is 202 feet wide at the bottom, 290 feet at the water line when channel is carrying 22 feet of water. The channel at the junction of the Chicago River is 24.55 feet below datum, and at the

CHICAGO DRAINAGE CANAL.



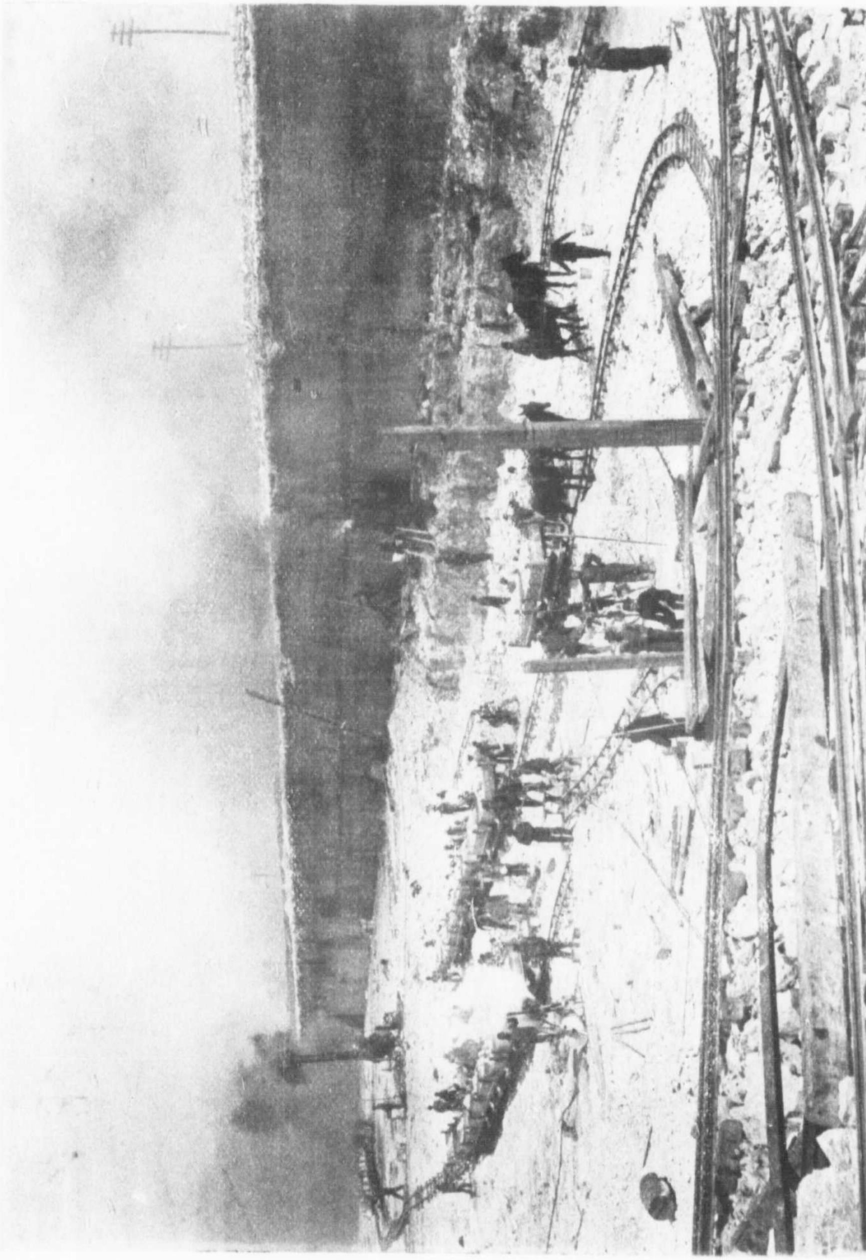
Excavating Earth with Steam Shovel.

CHICAGO DRAINAGE CANAL.



Excavating Silt by Pumping Dredge on Section 6.

CHICAGO DRAINAGE CANAL.



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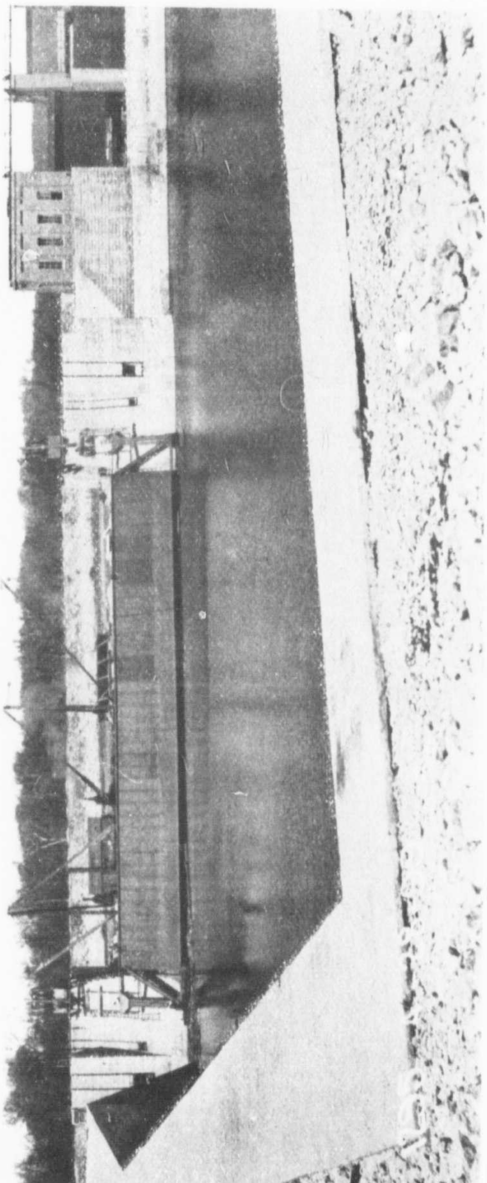
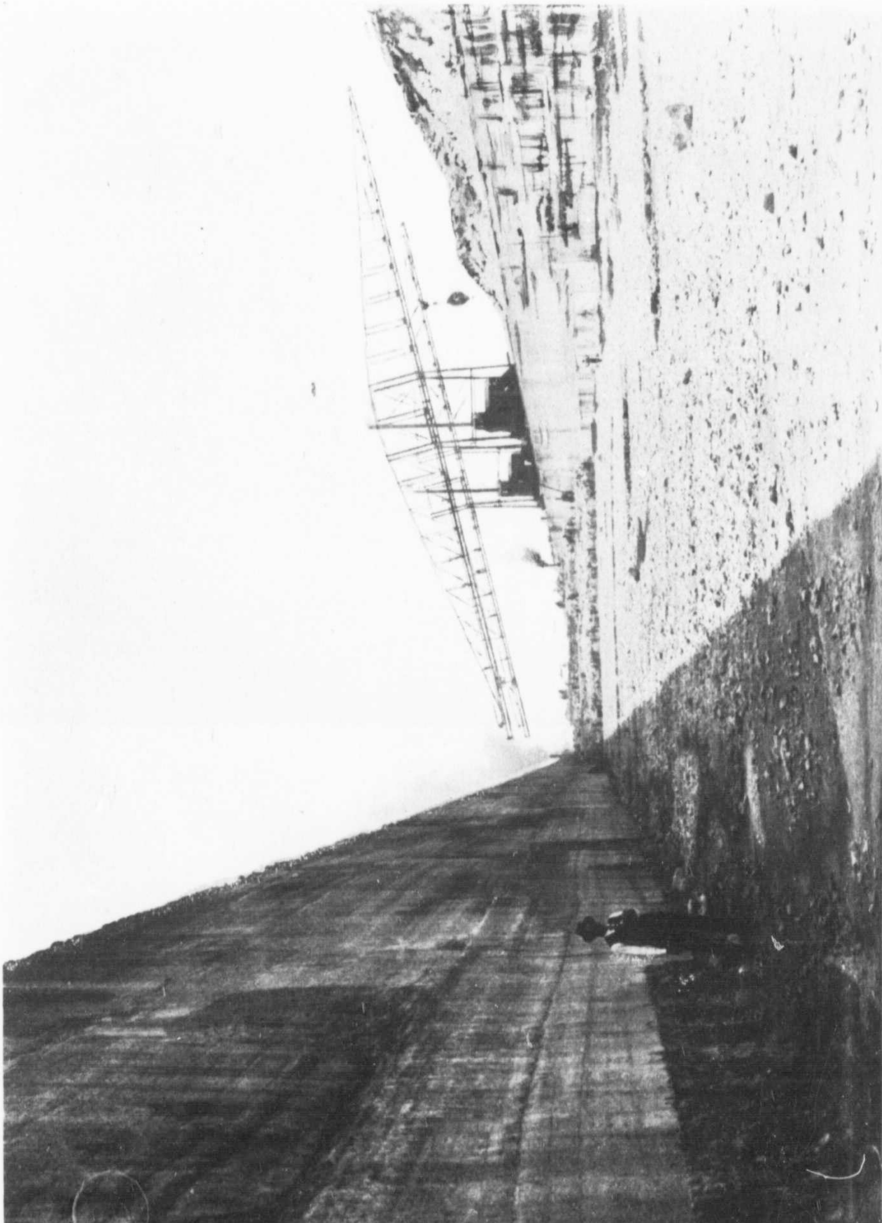


View of Bear-Trap Dam and Controlling Gates.

Bear-Trap Dam under Construction.

CHICAGO DRAINAGE CANAL.



CHICAGO DRAINAGE CANAL.

Quarrying Stone from Excavation for building Side-walls.

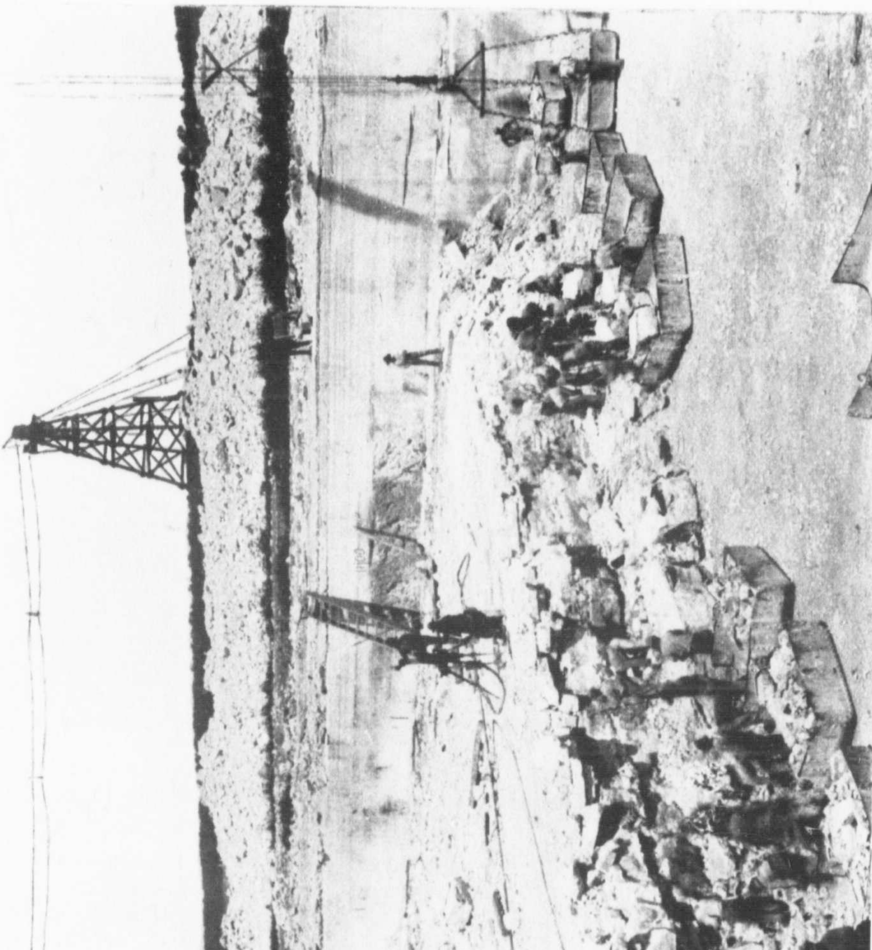
CHICAGO DRAINAGE CANAL.

Excavating with the McMyler Derricks on Section 7.

CHICAGO DRAINAGE CANAL.

Taking out Rock with Lidger-Wood Hoist and Rope Tramway.

CHICAGO DRAINAGE CANAL.



CHICAGO DRAINAGE CANAL.

Excavating Rock after a Blast, with Steam Shovel, Section 16. Contract price, 59 cts. per cu. yd.

Lockport end 30.1 feet below datum, thus giving a fall of less than 6 feet in the 28 miles. Canal datum was established in 1836, and the mean level of the lake for 8 months in 1847 about coincided with the canal datum of 1836.

Excavation of glacial drift, 28,059,488 cubic yards.

Excavation of rock 12,343,416 cubic yards, or a total

Excavation of 40,402,804 cubic yards.

Number of cubic yards retaining wall 371,969.

Average contract price for rock $76\frac{3}{10}$ cents per cubic yard. Glacial drift 28.9 cents.

Average price per cubic yard for retaining wall $3.27.

After the bids were awarded, the "lucky" contractors felt as if they had drawn a white elephant, especially the ones who fully appreciated what they had to do in order to fulfil their contracts in the time specified and do it at a profit. There were many special conditions on the work that required a great amount of ingenuity and skill to overcome. Some of the sections had to be fitted up with two different plants, first for glacial drifts, then for rock excavation, and many ingenious devices for handling the material were brought out.

The cost of machinery and equipment was about $2,750,000.

Greatest number of employees 8,500.

There were used about 10,000,000 pounds of explosives.

The maximum work executed in one month was,—

Glacial drift, 555,737 cubic yards; solid rock 120,780 cubic yards; retaining wall built, 45,380 cubic yards, at an aggregate value of $403,464.92.

Section "O."

Efficiency of Dipper Dredges delivering into barges was about 600 cubic yards per day, at a cost of 12 cents per cubic yard.

Sections "L" and "M."

Incline conveyors loaded with steam shovels, average output was 750 to 800 cubic yards per day, at a cost of about 12 cents per cubic cubic yard.

SECTIONS "K" AND "I."

New Era Graders and Wheel Scrapers, during a period of five months excavated 475,000 cubic yards, at a cost of from 10 to 11 cents per yard by the New Era Graders, and from 14 to 15 cents by the Wheel Scrapers. The New Era Graders are credited with about 500 cubic yards per 10 hours.

Truss Bridge Conveyors, operated in connection with four steam shovels removed on this section 1,800,000 cubic yards of glacial drift at a cost of 15 cents per cubic yard.

SECTIONS "G" AND "H."

Bates Rubber Belt Conveyor—consisted of two rubber belts 22 inches wide, running tandem on rollers made in the shape of a double cone, one belt extending across the cut and up onto the steel truss bridge which spanned the spoil area and carried the second belt. The combined length of the two belts was 908 feet. Steam shovel delivered the material to a brick-maker's granulator, which cut up the clay and fed it upon the belt, which in turn transported it to the dump. The granulator was mounted on trucks travelling on tracks parallel to the belt. The bridge carrying the belt was mounted on tracks so that it could be easily moved forward as the excavation advanced. The average capacity was about 500 cubic yards per day, with a maximum of 1,200 yards.

Hoover & Mason's Steel Belt Cantilever Excavator. This machine spans the canal, being mounted on two cars placed on either side of the channel. The conveyor consists of a series of steel pans hinged together at the ends, forming practically an endless belt. The total length of the belt is 1,000 feet with 250 pans. Total weight of machine, 180,000 lbs.; cost $35,000. It excavated the material at a cost of 8 to 9 cents a yard.

SECTIONS "A" AND "B."

Hydraulic Dredge Method removed 1,500,000 cubic yards of material at a cost of about 5 cents per yard.

Gould Conveyor.—Capacity of 968 cubic yards per day, at a cost of about 8 cents per cubic yard. Best record made with one of these conveyors was 33,431 cubic yards in 35½ ten-hour shifts day and night work.

Lidgerwood Travelling Cableways.—This is not a new method of transporting material, but its use in canal building was new, and the construction of the Drainage Canal served to bring out and develop many valuable improvements in this method, for instance, the portable or travelliug towers and the aerial dump, without either one of which the cableway would not have been a success. Span of cable from 550 750 feet, with towers 93 and 73 feet high. Efficiency 300 to 400 cubic yards per ten hours, handled at a cost of from 28 to 30 cents per yard, which included labor of loading skips, superintendence, fuel, oil and waste repairs, maintenance of track, and pay of crew to run the cableway. Nineteen of these cableways were used costing $14,000 each.

SECTION "3."

Cost of drilling on this section with compressed air was 6 cents per cubic yard, channeling 7 cents per yard, blasting 9 cents per cubic yard, and pumping 2 cents per cubic yard.

Cost of drilling with steam power was 8 cents per cubic yard.

McMyler Revolving Derricks.—After these derricks were taken from the pit and placed upon the berm, the boom lengthened from 82 feet to 123, giving a radius of 97 feet, two of these derricks being worked together opposite each other on each side of the channel, and each removing half of the excavation, delivering it direct from the pit to the spoil bank, hold the banner record over all others for the greatest 10-hour output, when two of these derricks removed 505 bucket-loads, giving a total volume of 980 cubic yards of solid rock, working 59 laborers in the pit, making the amount of rock handled 16.6 cubic yards per man.

SECTION "10."

Brown Cantilevers.—These machines had a total length of 355 feet. The height of the arm extended over the dump was 95 feet above the ground. The crane is mounted on trucks, and is moved back and forth along the berm on the tracks by gearing connected with the engine. Speed of moving can be varied from 150 to 400 feet per minute. Three levers control all movements of the machinery. Total weight of the Cantilever is 150 tons. Cost, $28,000 each. The travel of the bucket is 343 feet, and the load is dumped automatically at any desired point on the upper arm. After the first year these machines reached a monthly output of 15,000 to 16,000 cubic yards per Cantilever, equivalent to 600 cubic yards of rock per ten hours. There were eleven of these machines on the line. Eight of them were installed by the builders who took out the rock under contract for 15 cents per cubic yard after it was loaded in the buckets. These eight machines worked 3,608.7 ten-hour shifts, and moved 2,084,700 cubic yards solid rock, at a cost of two cents per cubic yard. This cost included only cost of conveying the rock from the pit to the dump, including labor operating the Cantilevers fuel, oil, waste and repairs.

Geraldine Double Boom Self-contained Revolving Derricks.—The average output of this machine was about 350 cubic yard per day.

CONTROLLING GATES.

Discharge from the Drainage Canal into the Trail Race leading to the Des Plaines River, will be controlled by a series of sluice gates and a beartrap dam. These gates are rivetted steel, and weigh 15 tons each. There will be seven gates in actual use, and 8 blind gates, which are for use in case of emergency. This trail race below the canal is now under construction, and will be finished in October.

BEAR TRAP DAM.

The bear trap dam has an opening of 160 feet and an oscillation of seventeen feet vertically. This dam is essentially two great metal leaves hinged together and working between masonry bulk heans.

The down stream leaf is securely hinged to a very heavy foundation, and the up-stream leaf is so placed as to present the barrier to the water. This structure is operated by admitting water through properly constructed conduits, controlled by valves, beneath the leaves just described. To raise the crest of the dam, water is admitted from the up-stream side and the discharge shut off until the desired height is obtained, and then the valves are adjusted so that the volume of water beneath the leaves shall be constant. To lower the crest, the water beneath the leaves is drawn off until the desired height is reached, when the valves are again arranged so as to maintain a constant volume of water.

A Method of Cost Accounting, with Special Reference to Mines.

By Mr. John E. Hardman, S.B., Ma.E., Montreal.

Definition.—In this paper the term "Mine Accounts" will be interpreted in the restricted sense of applying only to those accounts with which the mine manager is directly concerned, and not as applying to or dealing with the books and accounts which it is more particularly the province of the head office to keep.

The ultimate work to be done about a mine is the getting of mineral, to effect which is the object of all the organization both of men and materials. Therefore, any system of cost accounts which may be adopted at the mine should show accurately the various items of expenditure which enter into the cost of the production of one unit, whether that unit is an ounce of gold, a pound of base bullion or matte, or a ton of shipping ore. Furthermore, it should enable the manager to know *what* work is going on, *where* it is going on, what such work is *costing*, whether more or less than yesterday, last week, last month or last year, and whether the work is doing at a profit or at a loss, and should enable him to answer these questions at any time by spending a few moments with the cost books.

Desirability.—While to the average shareholder in a mining company the main point of interest is the dividend earned upon the investment, (which is really the difference between the total cost, and total value, of production) nevertheless, to the man who is superintending that production, the different items which enter into that total cost are of the first importance, and it goes without saying, that no mine is too small or too insignificant to keep such books, and few are so small that it is not a direct economy to have an employee whose first duty it is to write up these books daily. In accordance with the limitation of the term as given in the paragraph above, the matters of share registers, dividend and call ledgers, and generally, the accounts kept by the head office, will not be referred to in this paper, and only those books and accounts which it is necessary to keep from the standpoint of costs will be dealt with. The only merit claimed for the method which follows is that the manager of a mine or smelting plant will be enabled by its use to know each day what each and every man on the time sheet has done and is doing, the relative value of the different men, what advance each heading or winning is making and at what cost, and to detect leaks and wastage and take steps to remedy them, to note where additional saving is possible, and additional expense is inevitable and must be provided for in estimates, and in this way to be able to employ the rest of his day in personal supervision of the business of the company to very much better advantage than is otherwise possible.

The paper is offered only as a skeleton, to be expanded or simplified to meet each case, and as a suggestion for the skilled accountants often employed.

Primarily, the accounts at a mine are very simple, being but a form of single entry bookkeeping.

Debit Accounts.—The debit items are few, being in the form of proceeds from drafts, remittances from the head office, and credits from sales of ore or bullion, and in some cases the minor items of rents received, supplies sold and interest earned locally. Money, afterwards to be expended for labor and supplies, is received by concerns not yet on a self-sustaining basis, usually in the form of a remittance from head office direct, or as a credit in the local bank.

Credit Accounts.—The credit items are more numerous and will vary with the size and importance of the mine, but the chief item is always *Labor*, followed by *Supplies* and *Expense*, and these three main headings may be subdivided by the manager to such limits and in such form as the needs of the case, or his personal idiosyncracies, may suggest.

For the outside business done by a mining company a simple cash account suffices. A daily cash book itemized in a suitable form will enable the cash items to be posted directly to the various accounts in the ledger without the intervention of a journal, which is rarely needed and takes some time to write up. It is not necessary here to describe the forms and manners of keeping this account, as any text-book on bookkeeping will give ample information for the simple work to be done.

For the sake of making this paper more symmetrical, however, I insert the following forms from actual experience: Form 1 illustrates a simple form of cash book, and form 2 shows a voucher which it has been my practice to use.

As will be seen, this form is filled out according to the different items in any account or tradesmrn's bill which is sent in, and the distribution of the various items to the different ledger headings is marked on the back of the folded sheet. It has been found to be as easy to post from these slips as from a journal, and to involve less clerical labor.

From the Cash Account thus kept it is a simple matter to draw up a "Monthly Statement" for transmission to the head office, which will show the condition of the cash at the mine office.

Labor.—The largest and most important item of costs is labor, and the various methods of engaging men and keeping their time is one of the matters to which reference is frequently made in the occasional publications which appear on the subject matter of this paper.

According to the size of the mine and the number of its employees it is customary either to have regular timekeepers or to have the time kept by the different foremen or shift bosses employed. The latter method is much to be preferred, inasmuch as the foremen are more constantly with the men (or should be), know them more intimately than the timekeeper, and the time kept by them should, therefore, be more correct.

The value of the labor items in cost accounts depends upon their being correctly charged; no man's labor should be lumped, he has been doing *something*, and that something has cost his wages, which must be charged to the proper account.

Each of you who has had personal experience in handling men knows that there is always a certain number of roustabouts who may to-day be employed on surface work and to-morrow on underground work:—John Smith, for example, may be helping to lay a surface track until 10.30 a.m., when he is suddenly taken off to help to do the same work underground, or to help on the sorting floor, or, if he is a good hammersman or drill runner, to work out the shift of some miner who has been taken ill or has been injured. The subdivision of such men's time should be by the hour, and with a capable foreman such man's time can be divided accurately enough to turn in such subdivision to the office each night or at the end of every shift.

The necessity for such subdivision and for arriving at correct labor costs for many different departments and working places led me in my own practice, about ten years ago, to use what I have called a "Detail Labor Book," one form of which is shown in Form 3. The data from which this book is written up can be obtained in various ways, but I have preferred to obtain it directly from the foremen's timebook by requiring each of the foremen to turn his timebook into the office when he comes off duty, that is at the end of his shift. The clerk's instructions are to enter the time from the foremen's timebook as soon as it is received, so that each foreman may again get his timebook when he goes on duty at the beginning of his next shift. Other good and various ways may be devised by the manager to suit his own convenience and ideas.

The form given (Form 3) shows that the left hand column designates the *place* where the man or men were employed, which is also the heading of a particular page in the cost minute book hereafter referred to. The second column gives the names of the workmen employed. Where many men are employed their respective numbers instead of names may be used to lessen the clerical labor involved. In this column a fraction after the name or number of a man means that that portion of the whole shift was worked by this man in this particular place ; search below will show the remaining fraction if the man worked his full shift, and reference to the foremen's time book will confirm the record of a full or fractional shaft. The third column shows the amount of the wages of all the names or numbers on that line, and the fourth column gives the total of the labor or wages for that day in each place worked, and this amount is the amount which is posted directly to the page in the "Cost Minute" book, which is headed by the name of the place worked. This "Cost Minute" book will be explained later. At the end of any day the total at the foot of the fifth column gives the total sum expended for labor during the month to the end of that particular day, the sum total of the preceding days being carried forward in red ink to the top of each succeeding page.

At the end of the pay period, whether weekly, fortnightly or monthly, the total of this column shows the total amount of the pay roll, and should agree exactly with the total of the foremen's timebook. The fractions arising from the subdivision of time must be carried out decimally, or there may be a possible disagreement of a few cents in the money total.

Another form (Form 3A) which originated, I believe, with the Canada Iron Furnace Co, is also given.

The foremen's books are also copied into one large book in the office, which is the original voucher for the pay sheet; in this large timebook the names of the men may be classified according to the department in which they work.

Where a mill, or a concentrating works, is an adjunct to the mine, the same method should be used, and in fact in all departments whether surface or underground.

In my personal experience this record of detailed labor has been found most useful and well worth the time required from the accountant.

In regard to the matter of pay rolls or pay sheets, they are perhaps necessary where a company store is kept, and where the workmen are supplied with goods furnished them by the company, in which case I need not enlarge upon the form, as it is well known to all of you. It must show the total time of each man with the rate per day, and total amount due said man, together with all the items with which he has been debited such as fines, goods supplied, advances made, rentals due, &c., &c., the total of which, deducted from the total amount due, shows in the final column the net amount required to be paid him in a cash envelope or by cheque. In my own experience I have avoided these pay sheets as being cumbersome and usually presenting a soiled and tattered appearance by the time the last name is signed and they are ready for filing away. As an alternative I submit the form of a due bill, Form 4, which I have used with great satisfaction. This due bill is drawn from a stub book after the manner of a bank cheque, full particulars being entered upon the stub as they are entered upon the due bill. The due bill is given to the employee some hours before the pay is ready, and the employee has a chance to compare it with his own record of his time, and debits and credits, and to see the foreman (or the clerk) if any of such matters are incorrect, for rectification. He signs this due bill upon the back, and at the hour of pay he hands it in through the wicket and receives in return an envelope (Form 4A) containing his cheque or the amount of his wages; upon which envelope is printed, as upon the due bill, his time, total wages, deductions and net wages. From these due bills, or from the stubs of the same, the accounts can be rendered just as satisfactorily as from the time sheet, and the only objection that has ever been made to this system is the entanglement which sometimes arises when an employee loses his due bill.

The above method provides a satisfactory system of recording labor costs, embracing the three necessary factors of (1) keeping full time by the timebooks, (2) aggregating and dividing that time so that correct proportions can be properly charged to the respective accounts by means of the detail labor book, and (3) paying the individual for that labor, by segregating each man's debits and credits on a due bill or pay roll sheet.

Supplies.—Next to Labour in importance comes "Supplies," under which heading material of every sort which is used in the operation of the property should be included.

To keep a correct account of the receipt and re-distribution of supplies it is advisable and almost necessary to have a building or general storehouse where everything purchased must be received and receipted for, and from which all deliveries for consumption must be made. Articles in bulk, such as pit timber, lumber boards and fuel can not, of course, go into the storehouse, but their receipt and delivery should be noted in the books kept in the storehouse by the storekeeper.

Timbermen and carpenters should turn in an account of material used every 24 hours.

Every supply when it comes in should be debited to a "General Stores" account, and a receipt for it given by the store keeper, if required; everything going out from the storehouse is credited to "General Stores" account, and charged against the particular account or cost heading by which it is used or requisitioned. Nothing of any kind is too small to permit it to be taken from the storehouse without charging it against some particular account.

In the best practice nothing can be obtained from the store-keeper without a requisition (Form 5); these requisition forms are supplied from the office in the convenient form of a pad to the different foremen or heads of departments. The store-keeper keeps these requisitions when presented and turns them into the office daily, having previously entered upon his "Stores Delivery Book" the name and amount of the supply issued and the account to which it is charged.

The store-keeper may keep a "Stores Received" and "Stores Delivered" book, or he may make a daily report, on slips, to the office. In the latter case the account of stores received and delivered is kept in the mine office, and is perhaps to be preferred.

It is not necessary that the store-keeper should know the price at which supplies are bought or charged, his duty is concerned only with amounts received and again delivered, but a general stores book should be kept in the office, in which should be entered not only the *invoice* cost price of all goods received, but also all freight and transportation charges upon them, together with the amounts paid for handling and distribution of the same, and also the *pro rata* cost of the store-keeper's wages, &c. The total of these items determines the *actual cost* price of each article, which is the figure at which each article should be charged against the various accounts in the cost minute book. There should be no additions for profit, as the results would be misleading. Contractors may be charged an increased price for their supplies if the manager chooses, but such an increase does not in the long run lead to any benefit or cheaper results. Company Stores kept for supplying the workman with food, clothing, etc., are of course entirely separate from these supply accounts.

It is usually necessary to keep the storehouse open only at specified times during the day, say from 6 to 8 a.m., 12 to 2, and 6 to 7 p.m.

To prevent waste or petty pilferings it is advisable to take periodical stock takings, and to facilitate this the following form of a general ticket to be kept on the bin or rack in the store-room, or on file in the store-room office is often used (Form 6). This ticket must be checked or audited every week by the clerk in the office from the stores account book. It is unnecessary to say that these stores should embrace every kind of article or material used about the works.

Expense.—The third factor in costs I have called "Expense," and under this heading may be aggregated a lot of petty items which are usually charged to a "General Expense" account, but which have a certain, though varying, ratio to the output or amount of work done.

Expense includes—postage, telegrams and cables, subsistance and transportation of Manager (or one of the staff) when on company business, stationery, umpire assays, advertising, express and mint charges on bullion, insurance, taxes and legal expense at the mine, &c., &c.

These items are often considered to be head office matters, but to take, for an example, the case of a disputed value of an ore shipment, the cost of letters, telegrams, umpire assays and (possibly) travelling expenses of the assayer, should be charged against that particular shipment or lot of ore. Likewise expense incurred in hurrying a delayed hoist or compressor should be charged against that particular machine. I am not going to urge this point, as the whole object of this paper is to suggest, provoke discussion, and arouse interest in a subject which is altogether too much neglected by Canadian mines and managers. But those of you who will attempt this subdivision of an account usually lumped, will, I am sure, never abandon it.

Having obtained, by the methods above indicated, an accurate account of what labor has been employed, what amount of supplies has been used, and what expense has been incurred, in any one day, and where it has been so employed, used, or incurred, it is a comparatively simple matter to collect the various items under such accounts or headings as will give you the cost desired.

For this purpose I have made use of two books, one of which has been referred to above as the "Cost Minute" book, the other is a cost ledger.

Cost Minute Book.—The Cost Minute book (as its name implies) is simply a book in which is entered daily, minutes of all the work done that day ; the labor items coming from the detail labor book, the supply items from the requisitions sent to the store-keeper and by him returned to the office, the expense items from the regular office books.

This book may be arranged as the taste of the accountant wishes ; I give as a sample, some pages from the actual working of a company operating a free milling gold mine.

It will be noticed that each day of the month has a separate line. The first column on the left contains the date, and there follow numerous columns headed by the numes of the different supplies used in the place or department indicated by the heading entered at the top of the page.

In mine work there is a column each for "Dynamite," "Fuse" and "Caps," "Electric Fuses," "Sharps," "Drill Parts," "Short Steel," "Shovels," "Pick Handles," "Hammer Handles," "Candles," &c., &c.

In surface accounts, such as Power or the Engine Room, these columns are headed with the names of the supplies used, such as "Cylinder Oil," "Black Oil," "Cotton Waste," "Tallow," "Hemp Packing," "Rubber Packing," &c , &c.

After these columns for supplies there will be noticed the one headed "Labor" which is ruled as for dollars and cents, and it is to this column that the amount obtained by classification in the detail labor book is posted.

In mining work, as in sinking or driving, there are two or more columns following the labor column in which are noted the total number of tons hoisted that day from that particular heading. The first column is headed "Waste" and includes all rock which is not sent to the mill or ore bins for further treatment ; the second column is headed "Ore" and requires no explanation. I have sometimes added another column to represent the amount of waste or seconds picked from ore when it has been necessary to resort to hand picking.

The figures of these respective columns are obtained from tally boards kept by the lander at the mouth of the shaft, and checked by duplicate tally boards kept at the various station plats underground by the trammers; or by tally boards, near or at the working faces, or mill passes, of the various stopes. The figures from the surface and underground tally boards must correspond. The underground tally is taken off and brought to surface by the head trammer, or by the foreman, at the end of each shift. The surface tally board is noted by the lander or by any office employee designated for that purpose.

It will readily be seen that from this book, in the space of a few minutes, can be ascertained the amount of any one supply or article which has been issued for any number of days in the month, the total amount of labor which has been expended in any one heading for those days, and also what has been the production in tons, of both waste and ore, for such period.

At the foot of each column there is put in, in red ink, the actual cost price of each of the supplies used as obtained from the general stores book; and at the end of the month the amounts and prices are multiplied to give the cost in dollars and cents, which is put in the space reserved for it. The total of these amounts is the total cost of supplies for this particular account or heading for the month; the total of the labor column is the total labor cost of that account; the addition of whatever expense account is chargeable gives you the total cost of your piece of work, which can be reduced to cost per unit (foot, fathom or ton) by simple division by the number of feet driven or tons broken.

To make the cost *actual* and *accurate* there remains a sum to be added for management, and for power (if air drills are used). There is also the cost of pumping and hoisting to be divided *pro rata*, though these accounts should also be kept by themselves.

It is on these points that there is the largest room for personal equation and for differences of opinion, and also where the various publications on the subject maintain a discreet silence.

As I have said before, this paper is merely a suggestion, hence I feel free to describe how I have attempted these difficulties in my own practice.

In the first place the wages of the shift bosses or foremen underground are apportioned to the respective places of work in proportion to the number of men at work in each heading or stope : *e. g.* if there are 22 men in No. 6 Stope, 18 in No. 7, 12 in No. 9, 4 men in No. 4 level West, 4 in No. 4 level East, 4 in No. 5 West, 4 in No. 5 East, 6 in Winze K, and 9 in the main shaft, there are 83 men in the various workings ; if the foremen's wages equal $225.00 per month there will be $\frac{22}{83}$ of $225.00 to charge to No. 6 Stope, $\frac{18}{83}$ to No. 7, $\frac{12}{83}$ to No. 9 and so on.

The same plan is followed as regards management expenses, the sum total of the salaries paid the manager, accountant, assayer, and all the office staff is divided *pro rata*, according to the number of accounts amongst which they can be properly charged, and this sum is added to the cost of labor, supplies and expenses.

Another plan is (1) to determine the total number of hours (or shifts) worked on the property according to the detail labor book, and (2) to determine total salaries paid, from the manager to the foreman or shift boss ; and then to divide (2) by (1) giving a factor or constant per shift (or per hour) which is multiplied by the hours (or shifts) worked in each account, both surface and underground. The sum obtained by this multiplication approximates very closely the cost of superintendance for each particular account.

It is not denied that this is an arbitrary method and that the management may have spent much more time upon one department than upon another, but it is as good a subdivision as any other and is independent of any personal equation ; and as the item is, or always should be, an exceedingly small one, it does not affect materially the accuracy of the ultimate cost.

In the case of air drills and the amount to be charged for them, I have been in the habit of keeping a "Power" account ; to this account is charged all fuel, water, oil and other supplies used, and all repairs to boilers or machinery plant, and all labor of firemen and engine-drivers (excepting in certain cases the man at the hoisting engine and mill engine). The total of the Power account is then subdivided into "Hoisting," "Pumping," "Compressed Air," "Lighting," and other accounts where power is used, such as "Repair Shop," "Sampling Mill," &c., &c. This subdivision should be in the ratio of the power used by the different accounts, and to get at this approximately it is well to have each engine indicated properly, and to use recording gauges, revolution counters and such other devices as will make the measurement of the power more accurate.

For large engines running continuously, like mill engines, revolution counters are not necessary, but for large air compressors operating under variable loads I have found a counter of the greatest service in making up the power consumed by the machine. In the case of hoisting engines the number of buckets, skips or cages hoisted furnishes the necessary factor for determining a proportion. For pumps or pumping engines a card near by, upon which is noted time of starting and stopping, and the number of strokes made, gives the required information

The data from these revolution counters, cards, etc., is of course sent daily to the office.

In this subdivision of the Power Account much will depend upon aggregation of the plant in one spot, or upon having it scattered over the property ; whether all the boilers are in one house and make steam for the whole plant, or whether there are separate boiler plants for the hoist, the mill and the air compressor ; the method of keeping this account and its subdivisions must, therefore, be arrived at by the manager himself. If this account is accurately kept it is a source of great gratification (and of many surprises) to the manager to know just what it is costing him for power to pump the mine water, to hoist a ton of rock or to mill a ton of quartz, and in my own experience has made economies (previously unsuspected) possible and profitable.

I have been particularly struck in one or two cases which have come under my notice recently in British Columbia, with the laxity with which blacksmith shop accounts are kept. I give herewith a page from a company keeping a smithy account in a very good fashion (Form 10.)

All fuel sent to the shop is weighed and charged to it ; all iron, steel and other material is requisitioned for to the storehouse ; after shaping and working it is credited to the shop when sent out and debited to the account for which it is used. In addition to this, the smith is obliged to keep tally of every pick that is sharpened, of every hand drill sharpened, or every air drill sharpened, and the nippers or steel men are obliged to keep tally of all the sharpened steel and picks delivered into the mine. Wherever possible the steel is rounded up and weighed, once a month in the east usually, but in some western mines it is frequently impossible to do this more than once or twice a year. From the total cost of the blacksmith shop for labor and supplies is determined the actual cost of each pick sharpened or steeled, for each hand drill sharpened, and so on; furthermore a special account is kept in the smithy of the time and material used in repairs to old work, and material for new work. In this way a smithy account is not entered directly into the cost sheet, but is closed by being charged in the right proportions to the different cost headings underground and on the surface. I may say here that in my own practice I have found the blacksmith shop one of the first places in which a saving can be effected.

The surface accounts are simple; in case the ore is trammed from the mouth of the shaft or tunnel to ore bins or direct to the mill, such tramming charge is figured on the basis of total number of tons trammed. In the case of a free milling proposition, this tramming charge is considered as part of the milling expense, and not as part of the mining cost; in the case of shipping ore it may be reckoned as part of the mining cost. Similarly, all men on the surface employed in keeping the yard straight or in good shape are charged under any convenient heading that the manager may desire, say, "surface work," and the final closing in of this account depends to a great extent upon what these men have been doing during the period involved.

A carpenter shop account in large mines is as necessary as the blacksmith shop account, and should be closed in a similar fashion—that is, directly to the various cost headings in the mine or underground, for which the work may have been done; or, directly to the buildings on the surface, at which supplies and labor may have been used.

Cost Ledger.—At the end of each month the various pages or accounts in the Cost Minute book are closed as indicated above on page 61, the cost per unit being noted in red ink on the page. These accounts are then closed or posted into the Cost Ledger, which is simply an ordinary ledger, in which the items on the debit side of each account are the totals for labor, supplies, expense and superintendence as obtained from the minute book, and the credit items are the number of feet sunk, raised, driven, etc., and the number of tons won.

In my own practice I have endeavored to have the credit side also show, in dollars and cents, the value of the ore won and credited to the account, a matter which is comparatively simple in the case of shipping ore, if correct sampling and assaying is done, and in the case of milling ore, equally simple, if a sufficient provision of ore bins has been made to enable lots from different headings to be kept separate.

From this ledger it is easy at any time to make out a very complete and satisfactory cost sheet for any number of weeks, months or years.

From the book in which are kept the account of stores received and delivered, one can check the "stock-takings" which should be made periodically.

As regards cost books for smelting or milling accounts, they should be arranged on identical principles, the labor, supply and expense items being classified to the different accounts, and power being subdivided as necessary.

The furnace or mill is debited with all ore received, and credited with bullion produced. The assay value of the slag or tailings must be taken account of, if they are saved (or banked) for further treatment, as must of course all concentrates, speiss or other intermediate products which are not thrown over the dump.

In the case of a mine having its own furnace or mill, care must be taken that the unit used in the mine is the same as that in the reduction works, a ton, of 2,000 lbs. in one place, must be of the same number of lbs. in all other places.

Checking with Home Office Accounts.—While this system of accounts is one which is most desirable for the manager of a mine, it is not usually intelligent to the shareholder, nor, I might say, to the Directors, and therefore, to obviate the trouble and expense of keeping two sets of books it is desirable to be able to close these various cost accounts into the accounts usually kept by the home office; the average manager will find little difficulty in doing this. In this connection I desire to bring to your notice the admirable analyses of costs to be found in the reports of some of the South African mining companies, notably, the Crown Reef, Henry Nourse, Simmer & Jack, and Robinson Companies, whose annual reports will be found well worth perusal by those of you to whom the subject of this paper may especially appeal.

The main division into which the head office accounts are divided are *Expenditure* and *Revenue*, of which we need only concern ourselves with the former.

At the outset, we are met with the question of "Capital" account which usually occupies (especially with English companies) a very prominent position on the balance sheet; this, however, is not in the province of the manager, but of the head office, and nothing need be said about it further than the capital of a mine decreases each day that it is worked, since each day it contains less and less of the mineral for which it is wrought, and hence, each day its actual value is diminished.

All expend ture properly comes under one of the following headings, viz: Construction, Maintenance, and Operation; in some of the Lake Superior mines, construction is charged to operating expense, and the Alaska Treadwell Company (whose accounts are models) charge both construction and maintenance directly to operating, *i.e.*, all expenses are charged directly against the unit of one ton produced, which is unquestionably the soundest way. The number of expense accounts to be kept is a matter that must vary with the character of the mine, and the requirements of the directors

In the case of milling ores, the South African companies referred to, have the following classification.

MINE COSTS.

(1) Stoping,
(2) Tramming,
(3) Hoisting,
(4) Pumping,
(5) Development,
(6) Timbering,
(7) Tracklaying,

SURFACE COSTS.

(1) Tramming,
(2) Crushing,
(3) Sorting.

MILL COSTS.

(1) Milling,
(2) Power,
(3) Concentration,
(4) Cyaniding,

with General Charges, amongst which are put stationery, rents, hospital fees, directors' and audit fees, sundry expenditures, additions to plant, machinery and buildings, and road or surface improvements.

For general use I would suggest the following list, which can be added to or modified according to wants and conditions :

(1) *Prospecting or Exploration*—which should include all expense incurred in surface prospecting, exploration by means of diamond drills, or men sent out to test new or undeveloped claims.

(2.) *Construction.*—This account covers the first cost of all roads, tramways, buildings, foundations, machinery, ditches, pipe-lines, &c., &c, necessary to put the property on a producing basis. Each road, building or machine should have its own account, to be closed in to construction account at proper intervals. In building itemise grading, dry wall, mortar wall, lumber, plank, boards, hardware, glass, paint etc.; and in Plant, the excavation, concrete or rock foundation, invoice cost of machine, freight and duty on same, with all attachments of piping, belting, etc., etc The labor and supplies used in construction are obtained as previously indicated.

When the work is finished and closed into Construction its connection with this account ceases, all repairs or renewals should be directly charged against Operation. In many cases it is possible to charge off a certain amount each month, for example in the case of a wire rope which previous experience has shown you will only hoist a certain number of tons before renewal, an amount corresponding to the number of tons hoisted can be charged off each month.

(3.) *Development.*—This account covers the cost of all shafts, winzes, levels, cross-cuts and raises, and is easily made up from the cost ledger.

(4.) *Output.*—Into this account is closed all stope accounts.

(5.) *Pumping.*
(6.) *Hoisting.*
(7.) *Tramming.* These accounts are easily gotten from the cost ledger.

(8.) *Timbering* is an account which need not be kept separate unless the width of ore body, softness of walls and other conditions make the account a large and important one. In ordinary mines the timbering necessary is charged directly to the stope account, or, (in development) to the shaft, level or heading requiring it; its cost price is the first cost, plus the cutting and preparation, plus the labor of putting it in place, etc., etc.

(9.) *Transport* may be a separate account under the head of Surface Expense as will also be —

(10.) *Sorting*, and

(11.) *Crushing*, in the case of mines selling their product or sending it to public sampling works. The labor involved in making stock piles of ore, for which a higher than present market price is sought, may be charged to separate account or included in (9.) Transport should also include whatever labor is expended in loading ore wagons or cars.

(12) *Milling*, in the case of gold ores or concentrating propositions, is but a copy of the cost account.

If, as is customary with English companies, there is a Salaries, or Office account, it presents no difficulty.

There remain two other points to which I desire to call attention before closing, the first of these is what I might call "Management Cost per Ton" in which all salaries paid both at the Mine office and at Home office, including directors, auditors, and consulting engineer's fees and percentages, are divided by the unit of product. Such a cost item is most instructive to shareholders, but rarely desired by boards of directors.

The other point is a "Shift" record, in which one arrives at the production per single shift, or per man at work. The production of any one day, week or month is divided by the total number of single shifts in that period, including in this shift all the office staff and non-productive labor as well as the productive.

Finally let me draw your attention to a subject which is perhaps not germane to this paper, but which involves a cardinal point in the subjects of Costs, and that is the ratio between Producers and Consumers, as I have been in the habit of designating them for many years.

Classify as Producers only that labor which is *directly* producing material from which revenue or income is derived, such as the men stoping or developing; classify as Consumers all others who simply handle the valuable material produced without increasing its amount, such as nippers, trammers, and all surface men The smaller the proportion of consumers the more profitable the mine, the larger this proportion gets the less the profit becomes.

(Form 1.)

Dr. **CASH.** Cr.

1894				
Jan. 1	To amount at credit, Bank of Montreal	....	$3,250	17
" 2	" amount of remittance, Head Office....	....	1,000	00
" 25	" Proceeds 218.870 ozs. bullion delivered Bank of Montreal Jan. 3rd—			
	Gross value..........	$4,353 84		
	Commission, ⅛ ... $5 54			
	Express and Ins... 6 80	12 24		
			4,341	60
" 31	" Rent of tenements	....	14	00
" 31	" Supplies sold..........	....	56	23
			$9,662	00

1894		Check	V. No.		
Jan. 2	By expense (travelling J. E. H.) Hoist..........	......	1	$3	85
" 5	" Pay Roll for Dec.......	1018	2–105	2,364	75
" 5	" Fuel (Acadia Coal Co).	1019	106	120	00
" 5	" Timber, Jas. McDonald.	1020	107	63	25
" 5	" Explosives (Acadia Powder Co.)..........	1021	108	420	00
" 5	" Supplies (Austen & Co.)	1022	109	73	15
" 5	" Office (Allen & Co.) stationery	1023	110	4	50
" 5	" Expense, postage and telegrams..........	......	......	11	35
				$3,060	85
" 5	" Bal. on hand......	......	......	6,601	15
				$9,662	00

(Form 2, when folded.)

(**Form 2.**)

THE COLUMBIA MINING CO., LIMITED,

To .... *JONES, HATTON & CO.,* .... *Dr.*

1898				
Aug. 30	To 4230 lbs. 16-lb. rails at 40c.	....	$84	60
Sept. 3	" 4 kegs nails (3 4-dy., 1 8-dy.) at $3.50	....	14	00
" 14	" 1 Northey pump, 8 x 5 x 12	....	300	00
" 15	" Freight on rail shipment	....	14	42
" 29	" 6 doz. D. H. Shovels, at $9.60	....	57	60

Approved:

J. E. H.

RECEIVED from the Columbia Mining Co., Ltd.,

.... $\frac{}{100}$ Dollars

in full for the above account.

October 1st, 1898. ....

(Form 2, when folded.)

No. 219. $470.62

THE COLUMBIA MINING CO., LTD.

Favor of *Jones, Hatton & Co.*

....

Date charged .... Oct. 1st, 1898.

Folio 87.

DISTRIBUTION OF ACCOUNT.

Plant Account	$300	00
No. 5 Tunnel	99	02
General Stores	71	60
	470	62
....		
....		
....		
....		
....		
....		
....		

(Form 3.)

SAMPLE PAGE FROM DETAIL LABOR BOOK.

THURSDAY, JUNE 8TH, 1893.

Working Place.	Name or Number.	Line Total.	Heading Total.	
	Brt. forward........	....	....	$246.475
Main Shaft.	W. Meagher, A. Isenor, T. Jones.....	$4 40		
	J. Mallaby, T. Birkett, H. Foster	4 40	$8 80	
No. 7 Stope.	A. Livingstone, H. Kennedy, C. Robinson........................	4 40		
	L. Fraser, J. Whean, C. Boyer	4 30		
	J. Cutchett, T. Dowling	2 90	11 60	
450 Level E.	F. Bardon, J. Brouse	2 90	2 90	
150 Level W.	J. Otto, L. Otto, M. Ashley ½.......	3 55	3 55	
150 Level, W. Raise	A. McLeod, A. Wood	2 90	2 90	
"Baker" Shaft	P. Carr J. O'Brien, A. Paris.........	4 30		
	M. Ashley ½	65	4 95	
Hoisting ...	A. Ashley, Jas. Wood................	3 00	3 00	
Power......	J. Fisher, J. Campbell...............	3 00		
	E. Jones, K. Newton..................	2 80	5 80	
Mill........	V. Isenor, L. Shaughnessy	3 50		
	Wm. Isenor ½.........................	50	4 00	
Surface.....	S. Crase, E. McLean ¾...............	2 80	2 80	
Supt's House	E. McLean	50	50	
			$50 80	50.80
	Total carried forward........	....	....	$297.275

(Form 3A.)

THURSDAY, June 8th, 1893.

No.	Name and Occupation.	Hours.	Rate.	Wages.	Main Shaft.	No. 7 Stope.	450 Ft Level E.	150 Ft. Level W.	150 Ft. Level W. Raise.	Baker Shaft.	Hoist.	Power.	Mill.	Surface.	Supt's House.
1	Wm. Meagher	10	1.50	1.50	1.50										
2	A. Isenor	10	1.50	1.50	1.50										
3	J. Mallaby	10	1.50	1.50	1.50										
4	T. Birkett	10	1.50	1.50	1.50										
5	A. Livingstone	10	1.50	1.50		1.50									
6	C. Robertson	10	1.50	1.50		1.50									
7	J. Whean	10	1.50	1.50		1.50									
8	J. Cutchett	10	1.50	1.50		1.50									
9	F. Bardon	10	1.50	1.50			1.50								
10	J. Otto	10	1.50	1.50				1.50							
11	A. MacLeod	10	1.50	1.50					1.50						
12	P. Carr	10	1.50	1.50						1.50					
13	J. O'Brien	10	1.40	1.40						1.40					
14	T. Jones	10	1.40	1.40	1.40										
15	H. Foster	10	1.40	1.40	1.40										
16	H. Kennedy	10	1.40	1.40		1.40									
17	L. Fraser	10	1.40	1.40		1.40									
18	C. Boyer	10	1.40	1.40		1.40									
19	T. Dowling	10	1.40	1.40		1.40									
20	J. Brouse	10	1.40	1.40			1.40								
21	L. Otto	10	1.40	1.40				1.40							
22	A. Wood	10	1.40	1.40					1.40						
23	A. Paris	10	1.40	1.40						1.40					
24	M. Ashley	10	1.30	1.30				.65		.65					
25	M. Ashley	10	1.50	1.50							1.50				
26	J. Wood	10	1.50	1.50							1.50				
27	J. Fisher	12	1.50	1.50								1.50			
28	J. Campbell	12	1.50	1.50								1.50			
29	E. Jones	12	1.40	1.40								1.40			
30	K. Newton	12	1.40	1.40								1.40			
31	V. Isenor	10	2.00	2.00									2.00		
32	L. Shaughnessy	10	1.50	1.50									1.50		
33	Wm. Isenor	5	1.00	.50									.50		
34	F. Crase	10	1.30	1.30										1.30	
35	E. McLearn	10	2.00	2.00										1.30	.50
	Totals			50.80	8.80	11.60	2.90	3.35	2.90	4.95	3.00	5.60	4.00	2.80	.50

(Form 4.)

THE COLUMBIA MINING CO., LTD.

No..........

Name..........

Days..........

Rate..........

Total..........

Deductions..........

$..........

No.......... 189

DUE.......... ....the sum of

.... $\frac{}{100}$Dollars,

being for..........days at..........per day, less..........

....

$.......... *Manager.*

(Form 4A Envelope.)

No........ Date...........

Name......................

Days Worked.............

Rate......................

Total......................

Less Rents....................

" Supplies...........

....

....

....

....

Total Due, $

(Form 5.)

No........

....189

THE COLUMBIA MINING CO., LTD.

To the Storekeeper:

Deliver to ....

the following stores :—

....Signed.

Description.	Lbs.	No.	To be Charged to

(Form 6.)

CANDLES.

On hand, Sept. 1st, 189........	
Recd.........................	
Delivered:...........	
1..................	
2..................	
3..................	
4..................	
5..................	
6..................	
7..................	
8..................	
9..................	
10..................	
11..................	
12..................	
13..................	
14..................	
15..................	
16..................	
17..................	
18..................	
19..................	
20..................	
21..................	
22..................	
23..................	
24..................	
25..................	
26..................	
27..................	
28..................	
29..................	
30..................	
31..................	
On hand Oct. 1st, 189..........	

(Form 7.)

"D" STOPE.

Day.	Candles.	Dynamite.	Fuse.	Caps.	Sharps.	Steel.	Handles.	Spikes.	Nails.	Soap.		Labor.	Waste.	Ore.	Seconds.
1															
2	4	5	50												
3	6						1					$14.00	35		4
4	6	5	50	25								12.26¼	21	31	13
5	6	10	50									13.95			
6	6	5	50	18								13.95			
7	6	10										13.95			
8												13.95			
9	6	10	50	25											
10	6	10	50							½		13.95			
11	8	10	50									14.00	6		
12	10	10	50	25								14.05			
13	6	5										14.55			
14	8	15	50	25			1					13.97½			
15												11.25			
16	8							1 lb							
17	4											7.92½	22		
18	4											5.60		14	
19	4	5	50									5.60	1	24	
20		5	50	25								5.60			
21	4											3.50			
22												4.20	2		
23		8										4.20			
24	4							2				5.55			
25												4.17½			
26	4											2.80			
27												2.80	8		
28	4											1.42½			
29												7.00			
30	4	5	50												
31	4	5		25	1238	24						5.60			
												5.60			
Totals	122	123	600	168	1238	24	2	3		½		232.11¼	95	68	17
Prices	.11	.36	.0053	.008	.02	.14	.10	.04		.06	Supt'ce.	43.43			
$90.69 Supplies.	13.42	44.28	3.18	1.34	24.76	3.36	.20	.12		.03	Total labor Supplies ..	$275.54 90.69			
											Total cost..	$366.23			

Stoped :—

24.43 fathoms, costing $14.99 per fath.
180 tons, broken " 2.03 per ton.
68 tons, ore " 5.38 " "

(Form 8.)

SHAFT C.

December. 189..

DAY.	Candles.	Dynamite.	Fuses.	Sharps.	Steel.	Drill Parts.	Handles.	Shovels.	Spikes.	Nails.	Soap.	Time Fuse.	—	Labor.	Ore.	Waste.
1S.																
2.	4	5	10	...	321									$14.02½		7
3.	4	5		104										12.00	18	8
4.	4	5	12											10.07½		5
5.	4	5		96										8.30		
6.	4	5	10											11.70		12
7.	4	5		73				1						9.70		15
8S.																
9.	4	5	10	60								50		10.05		
10.	4	5												9.60		5
11	4	5		114										11.54		8
12.	4	5	6	52										7.62½		6
13.	4	5		50			1							7.62½		11
14.	4	5	10	61										8.85		4
15S.																
16.	4	5					1					50		8.10		3
17.	4	5	5	131				1						7.90		8
18.	4	5				$1.30								10.27		5
19.	4	5		111		1.00								8.20		5
20.	4	5	10											8.25		5
21.	4	5		120										8.25		9
22S.																
23.	4	5	10	49										11.50		5
24.	4	5												9.60		6

25......	4	5	....	116	....	......	....	....	....	....	....	....	....	7.90	....	8
26......	4	5	10	98	....	......	....	....	....	....	....	....	....	8.25	....	8
27......	4	5	....	....	....	......	....	....	....	....	....	....	....	8.25	....	8
28......	4	5	10	37	....	......	....	2	....	....	....	....	....	8.25	....	9
29S.....	....	....	....	....	....	......	....	....	....	....	....	....	....	....	....	....
30......	4	5	....	....	ret'd	......	....	....	....	....	....	....	....	11.70	....	....
31......	4	5	....	129	293	......	....	....	....	....	....	....	....	11.70	....	25
Totals	104	130	103	1411	28	......	2	4	....	....	....	100	....	$249.39	....	186
Prices	.11	.16	.045	.03	.14	......	.10	.81	....	....	....	.0053	Proportion for Supt'ce..	$32.47		
89.165	11.44	20.80	4.635	42.33	3.92	2.60	.20	3.24				.53	Total Labor............ " Supplies.......... From Power Acc. (Drills) " " (Pumps) Total............. Sunk 40 ft. 6 in. Cost $10.125 per foot.	$281.86 89.165 31.20 7.86 $410.085		

(Form 9.)

POWER ACCOUNT.

DECEMBER, 189 .

Day.	Oil, Vulcan.	" Black.	" Lt. Engine.	Packing, Rubber.	" Flax.	" No. 1.	" No. 2.	Tallow.	Cotton Waste.	Compression Grease.	Fittings.	Tools.	Candles.	Lamp & Lantern Globes.	Lead—Red and White.									Fuel—Coal, tons.		Labor.
																								Stock.		
1			5					3																12.25		$6 25
2	1								10	5																6 25
3																								20.5		6 25
4S																										3 00
5													2											12		6 25
6		1						4½																		6 25
7	1																									6 25
8																										6 25
9										5																6 25
10																								18.8		6 25
11S																										3 50
12	1		5																							6 25
13								3					2											10.5		6 25
14																										6 25
15																										6 25

16	....	....	....	....	....	....	....	....	....	....		1 chisel 1 wr'e'ch				....	....	6 25
17	1	....	....	1¼	3	2½	....	....	....	....	(1) 1½ Union			1	1	....	....	6 25
18S	....	....	....	....	....	....	....	....	....	....	14 ft 1½ pipe			....	....	16.7	....	4 75
19	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6 25
20	....	....	....	....	....	....	....	4¼	10	5	....	....	....	....	....	....	....	6 25
21	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	18.2	....	6 25
22	1	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	6 25
23	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6 25
24	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6 25
25S	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12.4	....	3 50
26	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6 25
27	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6 25
28	....	....	....	....	....	....	....	3¾	....	5	....	....	....	....	....	20.6	....	6 25
29	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6 25
30	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6 25
31	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6 25
Totals	5	2	15	1¼	3	2½	....	18½	20	20	....	....	6	1	1	141.95	....	$183 50
Prices	.49	.25	.38	.30	.25	.34	....	.07	.06	.18	....	....	.12	.10	.07	27.20	St'k	
	2.25	.50	5.70	0.375	.75	.85	..	1.295	1.20	3.60	.23 1.96	.25 1.75	.72	.10	.07			

310 hours Pumping.
554 " Compressing.
638 " Milling.

Charge	Pump acct.	$39 52
"	Compressor acct.	332 66
"	Mill acct.	157 19
"	Hoisting acct.	79 08
		$608 45

Supplies	21.60
Fuel	390.15
Labor	196.70
Total Cost	$608.45

114.75 tons.
$3.40
$390.15

Labor	=	$183 50
Add sup'ce	=	13 20
		$196 70

5

(Form 10.)

BLACKSMITH SHOP.

Dr. *Cr.*

Day.	Round Iron.	Flat Iron.	Blank Nuts.	Steel.	Borax.	Tools.	Fuel, lbs.	Labor.	—		Machine Sharps.	Hand Drill Sharps.	Picks.	Gads, Moils, &c.
1	17	......	....	....	10	File .30	In stock 900	$3.25	Chg. Car Repairs	.26	58	62	7	....
2	314	60	10	....	....	File .52	....	3.25	" D. Hoist, bolts........	$13.72	50	71	5	....
3	6½	......	....	....	....	....	....	3.25	" " plate washers	.92	61	60	7	....
5	......	......	....	....	....	....	....	3.25	" " straps	1.73	60	61	3	....
6	......	......	....	61	....	....	....	3.25	" Car Repairs	10.20	68	60	....	....
7	......	......	....	....	....	....	....	3.90	....	....	52	71	6	....
8	......	......	....	....	....	....	....	3.25	....	....	70	76	3	4
9	......	......	....	....	....	....	....	3.25	....	....	71	55	11	7
10	16	......	5	....	....	.08	1000	3.25	Chg. Mill Account, welding.	1.08	67	56	4	6
12	24	10½	5	....	....	....	....	3.25	" " "	2.14	60	68	3	....
13	......	......	....	....	....	....	....	3.25	....	....	52	73	3	....
14	......	......	....	....	....	....	....	3.25	Chg. Car Repairs	4.11	60	61	....	....
15	10½	......	....	....	....	....	....	3.25	" D. Hoist, bolts........	3.13	67	71	....	...
16	......	......	....	....	....	....	....	3.25	....	....	63	60	4	4
17	......	......	....	....	....	....	....	3.25	....	....	63	82	7	5
19	......	......	....	....	....	....	....	3.25	Chg. Pump Account, repairs	4.62	60	72	1	....
20	......	......	....	....	....	....	....	3.25	" "C" Engine, brake...	.27	64	51	3	....
21	......	......	....	....	....	....	....	3.25	....	....	60	57	3	....
22	......	......	....	....	....	....	....	3.25	....	....	61	70	7	5
23	......	......	....	....	....	....	....	3.25	....	....	57	61	2	5
24	......	......	....	....	....	....	1000	3.25	....	....	59	63	6	....

26	......	16	....	....	....	....	....							
27	......	......	....	....	....	....	....	3.25	Chg. Power Acct., Fire Door	3.01	67	68	2	....
28	......	......	....	....	....	....	....	3.25	....	....	61	52	1	....
29	......	......	....	....	....	....	....	3.25	....	....	56	55	1	....
30	......	......	....	....	....	....	....	3.25	....	....	61	53	6	....
31	......	......	....	....	....	....	On hand	3.25		....	47	60	....	7
							600	3.25	....					
Total	388	86½	20	61	10	....	2300	$88.40	....	....	49	64	2	1
Price	.03	.03	.05	.14	.26	....	@ $6.00	$11.25	for Supt'ce.	$45.19	1623	1713	97	44
							$6.90	$99.65			.03	.02	.02	.04
	$11.64	2.595	1.00	8.54	2.60	.90	Supplies, $27.275 Fuel, 6.90 Labor, 99.65	$133.825	Expended $133.825 Charged 131.84 Loss $1.985	$86.65 45.19 $131.84	48.69	34.26	1.94	$1.76

Natural Gas in Ontario.

—

By Eugene Coste, M.E., Toronto.

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 of shaly group	860 ft.	
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.
	Drift, mostly sand...	141 feet to	141 ft.	
Onondaga ..	Grey, drab, brown and blue dolomites with gypsum (shaly group from 585 ft. to 930ft.) (gypsum bed from 1055 ft. to 1070 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.
	Drift, mostly clay...	65 feet to	65 ft.	
Corniferous and Onondaga	White grey limestones and brown dolomitic limestones with gypsum below 260 feet	610 feet to	675 ft.	Sulphur water at 582 and 613 ft., probably the upper 100 ft. represents the Corniferous.
Onondaga ..	Grey blue dolomitic shales and shaly dolomites and drab brown dolomites with a good deal of gypsum, gypsum bed 680 to 690 ft ..	300 feet to of shaly group	975 ft.	
do ..	Dark grey and brown dolomites with gypsum, gypsum bed from 1,125 to 1140.............	200 feet to	1175 ft.	Salt water at 1172ft.

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

Formation.	Strata.	Thickness.	Depth.	Remarks.
	Drift, boulder clay..	120 feet to	120 ft.	
Corniferous.	White and yellow brown limestones..	130 feet to	250 ft.	
Oriskany ...	White yellowish fine sandstone	50 feet to	300 ft.	
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.	
Shaly Group 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 1315ft.

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 (gpysum 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 this 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	30 feet to	735 ft.	
Medina.....	Red sandstone......	55 feet to	790 ft.	A little salt water.
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	660 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..
Archaean...	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 330 ft.
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.	
Archaean ...	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 oil 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 continuaiion 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 142 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.............	"	"
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, Medina Lower White Sand	Welland County, Buffalo, 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.	"
Calciferous 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 flour 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 sratas, 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 northwestern 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 diminuation 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 inadmissable, 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 intermittant 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 hydrocarbon products. Similarly the oil region of Pennsylvannia 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, phenonenons 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 influnece 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.

A Prospecting Trip in Northern Omenica, B.C.

By E. C. Musgrave, Duncans, B.C.

In the early spring of 1899 reports came to Victoria, B.C., that beds of auriferous conglomerates had been discovered on Bear Lake, in the northern part of Omenica district, B.C.

It being determined to examine these conglomerates, three parties, one of which I accompanied, started from Victoria, B.C. on the 20th of April, 1899.

The three parties for the sake of convenience agreed to travel together.

We had the choice of two routes.

The first was by way of Ashcroft and Quesnelle through the Cariboo conntry, and from thence to Tatla Lake by way of Stewart Lake. From Tatla Lake Bear Lake could be reached by following the Driftwood River which connects the two lakes.

The second was by water from Victoria to the mouth of the Skeena River. From thence up the Skeena to Hazelton and from Hazelton across country to Tatla Lake.

We determined after making enquiries on the second route.

We left Victoria on the C.P.N. Steamer Danube on April 20th.

We had a full complement of passengers most of whom were bound for the Klondike.

The journey between Victoria and the mouth of the Skeena is a most curious and interesting one.

The steamer for nearly the whole distance threads its way through narrow passages between islands of all sizes and shapes.

One cannot help wondering how the captain of the steamer finds his way, as there are hundreds of passages looking very much alike, running in all directions between these islands and all are narrow and winding.

The physical conformation of these islands is curiously alike.

On each, there are two conical hills with a basin between them from which a small stream flows making it appear as if there was a lake in the centre of each island.

All these islands are thickly covered with stunted fir trees.

Most of these islands have been run over by prospectors who come up from Vancouver Island in small sloops and spend the summer months prospecting.

I have never heard of any valuable discoveries being made.

We finished the first stage of our journey on April 24th when we arrived at Port Simpson, an indian village near the mouth of the Skeena.

At this point we transhipped to the Hudson Bay Company's steamer Caledonia, a flat-bottomed river steamer which plies between Port Simpson and Hazelton during the summer months.

Our journey between these points, a distance of one hundred and eighty miles, was in many ways a memorable one.

For the first two days we were in the tidal waters and the broad easy reaches near the mouth of the river, and we covered about eighty miles.

From here the river began to get more swift and we were twenty-one days in covering the remaining hundred miles.

The weather became cold, and the river began to fall, and on the fifth day out from Port Simpson the steamer was tied up to the river bank, until the river should rise sufficiently to enable us to proceed. We remained here for seven days when at last, the weather having become warmer, the river rose and we started once more.

Our mode of progression was a curious one.

A wire cable about half a mile in length, was dragged along the bank and the end fastened to a stout tree. The other end was taken round a capstan placed in the bow of the steamer, and she dragged herself up by winding in the cable.

This was, of course, done by steam but was a very slow process.

When all the cable had been wound in, it was taken out again and fastened to another tree further up stream and the same process gone through.

Several times during the journey the cable parted and away we went down stream, whirling about like a chip.

Nothing but the extreme coolness and presence of mind of our captain and his intimate knowledge of river navigation saved us on these occasions from being dashed against the rocks.

On the fourteenth day out from Port Simpson, we tied up at the foot of the great canon of the Skeena.

As the paddle-wheel had been pretty well smashed to pieces, from pounding on boulders, etc., the steamer was tied up and repairs were inaugurated.

We took this opportunity to land and examine the canon.

It seemed, when looking at it from the bank, that it would be an utter impossibility to get the steamer through.

The whole river was compressed between two high walls of rock, and turned and twisted along, forming whirlpools at every bend.

It looked narrower than the steamer, and indeed, when the steamer afterwards entered it, there was very little room to spare on each side.

At the top end, where the river entered the canon, there was a large mass of rock right in the centre of the channel.

Next morning we managed to get through after bumping pretty hard against the walls in several places.

Men were stationed along the guards of the steamer with large rope fenders which they interposed between the steamer and the rock at every bump. After getting through we resumed our former mode of progression and pulled ourselves up with the cable the remainder of the way.

At this canon several prospects are being opened up. We saw some samples of the ore from them, which consisted of quartz containing copper pyrites and some erubiscite.

The ore is said to contain good gold values.

Until railway communication is established through this country, the difficulties of transport render these claims practically valueless.

We arrived at Hazelton on the evening of May 18th, thinking that we were over the worst of our troubles and that we should be able to proceed on our journey at once.

However, on making enquiries from the factor of the Hudson Bay Company's post, we learned that the Spring was a month later than usual, and that there was too much snow on the Babine range to admit of getting horses across.

There was nothing for it but to possess our souls in patience and pray for warm weather.

We were not alone in our troubles, as the managers and secretaries of the St. Anthony Mining Company, and the Forty-Third Mining Company, owning hydraulic properties on Germanson and Manson Creeks, were with us and had to cross over to Tatla Lake on their way to their grounds.

The principal features of Hazelton are its dogs and its cemetery. It is an Indian village and each Indian is the possessor of from ten to twelve dogs It is a matter of principle among the Indians, never to feed their dogs, and the village simply teems with emaciated looking creatures of wolf like appearance. The cemetery, which is situated on a bench above the town, into which the water from it drains, is a most curious place.

The Indians, although Christians, seem to still cling to the idea that the spirits of their deceased friends still have use for the material necessities and comforts of this life.

Over the graves they build small huts, some of which are opened at the sides and others having walls, doors and windows.

In these huts they place the clothes and other personal property of the deceased, and they are left there until they are, in the course of nature, resolved into their elements.

Although our experience of the Indians did not show them to be conspicuous by their honesty, none of them, even under the most severe stress of circumstances, will rifle these graves.

Reports kept coming in continually that there was still deep snow on the Babine Range, but early in June we began to get so impatient that we determined to try and push through.

We had a lot of provisions, tools, etc., with us and when we came to get these together we found that we should require at least ten pack horses to take them to Tatla Lake.

After much bargaining we secured, from Indians who possessed between them, the requisite number of horses, and on the 9th of June started off.

The trail winds up the valley of the Bulkly River, a tributary of the Skeena, crosses the Babine Range, passes along the end of Babine Lake and from there across the Frying Pan Range to Tatla Lake.

The Party en route from Germanson and Manson Creeks started a day ahead of us.

When they reached the Babine Range they found the snow too deep to allow of getting horses through, so sent back word to this effect to us. We were about seven miles behind them when we received the news, so, as there was good feed for the horses where we were, we camped at that spot.

We remained there for a week and then pushed through the snow, having some difficulty with the horses. We reached Tatla Lake three days later. Here we dismissed our packers and bought canoes in which we piled our supplies and paddled the first day up to the head of Tatla Lake, a distance of twenty-five miles.

Next day we started up the Driftwood River which was, at first, slow and placid. As we went up stream it became more swift and on the evening of the third day since leaving the lake we found further progress impossible.

The distance by the river from Tatla Lake to Bear Lake is about sixty miles.

We had now done about twenty-five of this distance and, the river being in a flood, poling was out of the question and paddling equally so.

We landed and built a cache putting most of our supplies in it, and then, each taking sixty lbs. of food, blankets, etc. on our backs, started under the guidance of an Indian to walk the remainder of the distance.

Across country, this was thirty miles, there was no trail but the country was an easy one to travel through and we arrived at Bear Lake on the third day.

From the point we had arrived at on the lake, we could see the conglomerate beds we had come in search of.

They lay piled, one on top of the other, forming sheer cliffs about six hundred feet in height, on the east shore of the lake, and stretched in a north-easterly direction for about twenty miles.

We crossed the lake and camped on the lake shore directly beneath the cliffs.

We then made arrangements for sending back one of our party with some Bear Lake Indians to bring up the canoes and the rest of our supplies when the river should have fallen sufficiently to admit of poling the canoes up the river.

They managed to bring them up about a week afterwards.

We now began our work of prospecting and very arduous work we found it.

Close behind our camp the ground rose very steeply for a distance of about eight hundred feet to the foot of the bluffs.

This slope was formed of slide rock consisting of masses of sandstone and conglomerate that had fallen from the cliffs.

We found a narrow gully full of what is known in B.C. as slide brush, a sort of alder, up which we were able to climb to the top of the cliffs.

The top formed a bench about a mile wide behind which was a similar row of cliffs apparently about the same height as the cliffs below.

We managed after some difficulty to get two rough sections of the cliffs which are from the lake shore up.

(1)	Rock slide	800 feet.
	Conglomerate bed	3 feet.
	Sandstone bed	300 feet.
	Coarse grits and conglomerate beds	2 feet.
	Pebbly conglomerates	8 to 10 feet.
	Sandstones and clay	2 feet.
	Quartz porphyry	35 to 40 feet.
	Sandstone and grits	160 feet.
	Quartz porphyry	20 feet.
	Sandstone and grits	150 feet.
	Quartz porphyry	50 feet.
(2)	Rock slide	800 feet.
	Pebbly conglomerates	4 feet.
	Massive grits, &c.	100 feet.
	Sandstone and conglomerate beds	300 feet.

Claystone	4 feet.
Quartz porphyry	35 feet.
Grits and sandstone	100 feet.
Quartz porphyry	20 feet.
Sandstones	150 feet

These beds have a pitch of about fifteen degrees to the east.

Our samples had to be taken from the slide rock, a lot of which apparently comes down every spring.

Our only means of testing on the ground was by pulverizing and panning.

From the sandstones we got some colours but failed to get any results from the conglomerates.

We brought a lot of samples out to the coast, principally of the sandstones, and had them assayed, some in Victoria, some in Vancouver, some in San Francisco and some in London.

A lot of them, principally the samples assayed in Victoria, were barren, but others gave results of from fifty cents a ton to twelve dollars and fifty cents a ton.

We were unable to remain on Bear Lake after the end of July so were only able to prospect part of the ground close to the edge of the lake.

The part we did go over was very much the same all along, as shown by the two sections given above. Our trip out to the coast was much pleasanter and much easier than the one in.

We went down the Driftwood River in a day and a half, down Tatla Lake in another day and from there to Hazelton in five days

There we found the Caledonia and did the trip down the Skeena from there to the coast, in one day. Rather a contrast to twenty-three days in coming up.

Whether Bear Lake will ever turn out to be a second Witwaatersrand is doubtful, but this spring parties will be sent up with a proper equipment for making tests of the rock on the ground, and find out whether enough of the beds are gold-bearing to enable them to be worked at a profit.

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 ffve 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-feet 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 flax 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-feet 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 stteams 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 sulphide (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 1½ 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.

The Factors in Concentration.

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By Mr. F. T. Snyder, Chicago.

On attempting to segregate the factors in concentration into various groups, they are found to vary regularly from purely commercial at one end to purely technical at the other.

Those from the extremities of a comparative list can be readily grouped, but the greater portion have their commercial and technical aspects so related that nothing is to be gained by attempting to consider them separately. Profits, the commercial aspect, mean that returns minus costs must have a positive value. The word "returns" is used to stand for the sum of all commercial values in the concentrates. The costs are made up of concentration, transportation of concentrates to points of sale and refining.

Considering the totals of any given proposition, the general law is, that the greater the concentration, the greater the loss of values; that is, the smaller the weight of material delivered for sale at point of refining, the smaller would be the amount of values delivered for any given tonnage treated by concentration. The two practical limiting cases are:

First. Where no concentration takes place and all the values are delivered, the cost of concentration being zero and transportation and refining each a maximum.

Second. Where pure values are produced and the minimum amount delivered, the cost of concentration being a maximum, the cost transportation being a minimum, and the refining cost reducing to zero.

This statement of the minimum limiting case exhibits the marked peculiarity in the form of the function expressing this general law, which, in definite concentrating problems, very greatly reduces the limits between which a solution need be sought. That is, the degree of concentration does not approach infinity as a maximum, but a definite value which is usually sharply determined by the existing mineralogical and industrial conditions. To the stamp mill man, the definite demarcation between the specific gravity of the pyrites carrying his concentration values, and the accompanying silica or silicates, clearly indicates the minimum limit of his concentrating problem. In these same concentrates later the matte smelter finds as definite a minimum limit for his problem in the equally marked differentiation of their copper contents.

Yet, while both theoretically and in a general way these limits are well marked, in practice there is a marginal zone within which the more profitable course of operation is not evident from inspection. This is caused by :—

First. The fact that the influence of factors other than the specific gravity (such as surface tension, etc.) is modified by the character of the crushing that preceded the concentrating; and

Second. By the fact that no practical limit of crushing will entirely release the materials whose separation is sought. Thus instead of there being a sharp margin up against which concentration can be carried, even in cases where the difference in specific gravity is marked, the limit is made indefinite by the presence of particles, mechanical mixtures of varying proportions with specific gravities varying over the entire available difference. Within the marginal zone occur the problems of concentration, the solution of which is not a matter of offhand professional experience, or of accumulated constants and data, but of comprehensive testing.

General experience (plus constants and data) will be of value in regard to the limits of this zone, and in the cases outside of it, can, given the transportation and refining factors, furnish a solution, both in regard to total investment and details of plant. Such a case would be the small concentrating plant usually placed below a stamp mill, or, in general, any proposition where on account of high transportation and refining charges the margin between smelting and concentrating ore is large.

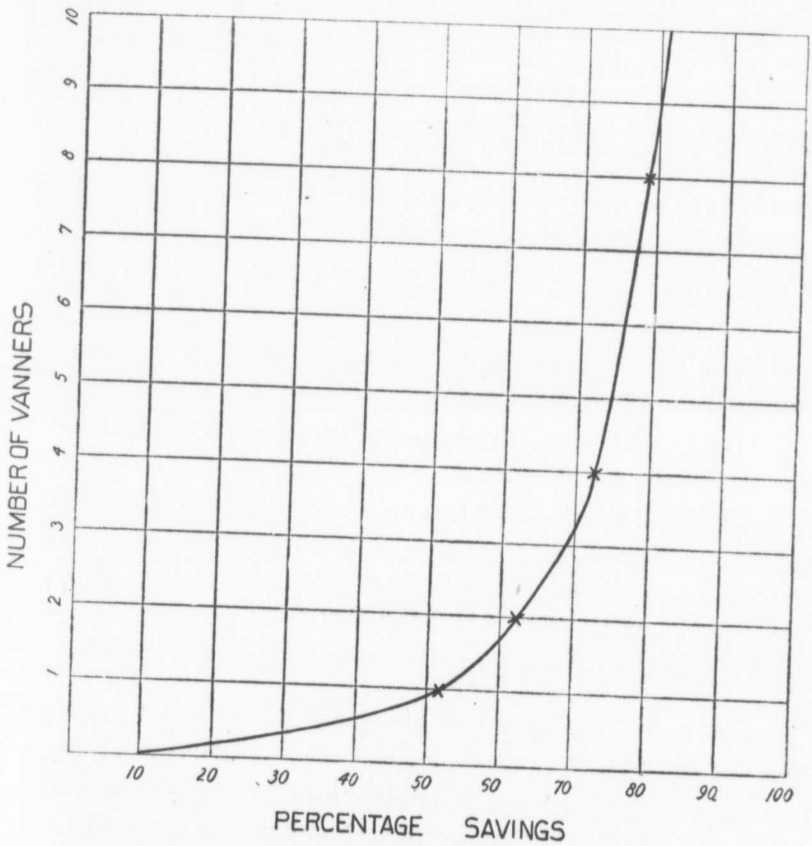
In such cases the criterion is the law of operation, that the saving will be higher the greater the investment per unit of ore handled. That is, the saving will increase with the investment and decrease with an increase of tonnage for any given investment. At the same time with increased investment comes increased cost as well as increased saving.

But while both the saving and cost of operation increase with the investment per unit of ore handled, the ratio of each to the investment is not constant, nor do they vary according to similar functions. Starting from the intermediate point where both cost of operation and investment are zero, the ratio of increase of cost of operation to increase of investment rapidly falls from that found in small under-capitalized plants to a value near, but slowly approaching unity. A closer analysis of this function shows that it is the sum of two co-operating effects, one due to investment in actual concentrating machinery, which adds in a direct proportion to the cost of operation, and the other, the investment in handling the machinery, to the effect of which can be traced all the variating in the ratio. Within the practical limits between which any given concentration problem must be solved, this change in ratio may be neglected. (A 200 ton concentrator can be run with a lower cost per ton than one of fifty tons, but that fact is of no use when only fifty tons of ore are available.) In other words, if the investment per ton handled be doubled the cost per ton will also be doubled.

Consider the simple case of a concentrating machine at work, will it pay to split its load over two machines? If the saving increased proportionate to the investment it obviously would pay, but it is equally obvious that the saving cannot increase in this way, for no matter how large the investment, no more values can be taken from ore than it contains. That is, while the investment varies from zero to infinity the saving varies from zero to unity.

With any given set of conditions, values, freight rates, smelter charges, depreciation, interest, labor costs, for some given investment, the ratio of returns to costs must reach a maximum, this being a matter of comparatively simple mathematics to formulate. The difficulty at present lies in the fact that almost no work has been done towards determining the constants of such a formula, these constants having to be determined for each type of concentrating machinery. Some tentative testing with vanners under the necessary conditions of uniform surroundings, showed that the ratio of investment to saving could be expressed closely enough by using three terms of the general conic equation, differentiating for the maximum value. But the desirability of using more than three values in the determination of the constants and the reduction of the constants so obtained to a single most probable formula by the method of least squares, makes the work, while simple, so tedious, that the graphic method of plotting a curve has been found much the more suitable for general practice.

The accompanying curve plotted from the following values experimentally determined from six foot side shake vanners illustrates the method.



No. of Machines.	Per centages savings.	Loss.
1	51	49
2	62	38
4	72	29
8	79	21

Necessarily the curve proved asumtotic to the per centage value 100.

Applying the case of the single concentrating machine, with assumed conditions.

Values of concentrates in each ton of ore	\$6 00
Tons handled per day	10
Ratio concentration with one machine....	10
Cost of operating each machine per day, including depreciation and interest	\$1 00
Smelter charges and freight on concentrates............	10 00

With one machine the net result is :

Returns = $\frac{10 \times 6 \times 50}{100} =$ 30

Costs = $\frac{10 \times 10 + 1}{10} =$ 11

Returns—Costs = 30— 11 = 19

With two machines the net result is :

Returns = $\frac{10 \times 6 \times 62}{100} =$ 37.2

Cost = $\frac{10 \times 62 \times 10}{10 \times 50} + 2 =$ 12.4 + 2 = 14.4

Returns—Costs 37.2 -- 14.4 = 22.8

That is under the conditions enumerated there would be a distinct gain in doubling the investment.

Applying it to eight machines :

Returns — $\frac{10 \times 6 \times 79}{100} =$ 47.4

Costs $\frac{10 \times 79 \times 10}{10 \times 50} + 16 =$ 15.8 + 16 = 31.8

Returns—Costs 47.4 -- 31.8 = 15.6

That is, with eight times the investment the net return is less than with one machine, although the amount of values shipped is greater.

By selecting various points on the curve the net result for various numbers of machines can be ascertained until the most profitable one under assumed conditions is determined.

This method as outlined is capable of ready application to the average concentrating problem. Given the data from which to plot the curve the other factors will usually be found fixed.

To obtain the curve data it is not necessary to have available a varied number of machines, but the same results can be even more readily obtained from one machine by varying the amount of pulp handled. It should be noted that in such testing results obtained by hand panning of heads and tails are unreliable. The better plan is by analysis; in the common case of sulphides, analyzing for sulphur and in other cases for the constituent element that accompanies the concentrating values. As with the average concentrating machine the differentiation of gold is only incidental to the gold accompanying some more abundant mineral, assays are misleading in questions of relative saving. Further, in recording such tests that they may be of general value, the actual size of the maximum sized particles experimented with should be stated in millimeter and not in the indefinite phraseology of "mesh."

In cases where the proportion of concentrates is less than five per cent., the variation due to a change in the concentration ratio can be neglected.

The question of crushing, while a definite factor in concentration, is usually so limited in range by the mineralogic and physical features of the ore as to render it practically as fixed a quantity in any concentrating problem, as the smelter charges on the product.

But while the size of the product to be concentrated is presented in, is thus definite for a given case, it exercises a controlling influence on another factor in concentration, the type of concentrating machines to be used. In general, all practical machines make use of the varying ratio of the surface friction in some medium to the weight of the particle; in most, agitation being used to overcome the difference betweeu the friction of motion and the friction of rest. The classification of a charge of particles being so effected, to render the process continuous requires that the classified particles be removed from the machine without admixture. From the method used to accomplish this, concentrating machines may be grouped into three types, those that discharge the concentrates through the bed they have settled on (such as the jig); those that shake the concentrates off of one edge of the bed (such as the modern stratifying tables); and those that remove the bed with its accumulated load of concentrates (such as the Buddle and the various forms of Vanners).

The differentiation of these types results from the fact that in the ratio, on which concentration depends, that of weight of particle to surface friction in some medium, this factor of surface friction is the resultant of two factors, the form of whose function differs so much as to make them practically independent variables. One is the friction of the liquid medium on the particle; the other is the friction between the particles and the surface that supports it. In the hydraulic classifier theoretically this factor is zero. In the jig is a minimum, greater in the shaking tables and is a maximum in the moving bed type of concentrators. Its proportionate influence on the total factor of surface friction is a function of the lineal dimensions of the particle, the influence being a maximum for the minimum size particle, and at a minimum with the larger sized particles.

A concentrating machine can be expected to do the best work when the ratio of these two factors of friction against fluid medium and friction against supporting surface, as used in its operation, compares most closely with the ratio of the influence of each on the mass of the given particle.

It should be noted that while the form of the function expressing this ratio remains the same, for different materials, the constants in the function change. That is, with a given material to concentrate, such as galena, a certain sized particle will always call for a certain type of machinery, while the same size of particle would probably require a somewhat different type of machine in the case of a different material, such as Barytes. For most of the common mineral mixtures the best type of machine for a given size of particle has been settled by the empirical and experimentation of centuries and is recorded in the design of profitable plants in concentrating district throughout the world.

Machines of a given type may differ in their mechanical arrangements for carrying out their typical work, but this difference should not be confused with the metallurgic difference of type. The fact that there are no sharp limits between which any type of machine must be used, the efficiency simply running down as it is used with other than its most efficient size of particle, has helped to confuse the distinction between mechanical and metallurgic adaptability, usually at the expense of the latter.

While the voluminous experience in concentration has broadly settled the relation of type of machine to ore particle, there is great desirability for compreheusive testing over the limiting margins of each type; with the jig, from one fifth millimeter material down; with the stratifying machine, from 1-20 millimeter down and with vanners up towards two and three millimeters. Here, when the usefulness of these machines over-lap, the difference in adaptability is too small to be decided by inspection and awaits systematic recording.

Summarizing.—Each concentration problem must be solved twice; first, backwards from general factors to details; then forward with settled details to a definite general result.

Starting with the general transportation and refining factors, the limits are found between which concentration is possible at any geographical point. Next the physical conditions of the problem under consideration determine the types of crushing and concentration machinery and capacity of plant.

Lastly, the values in the ore determines the investment; that is the number of machines of each type to be used per ton capacity desired. Then with these definite quantities applied to the general factors, the solution is retraced and a definite showing decides whether the return minus the costs will have a positive value.

There is to-day no risk in concentrating investments, aside from inefficient business management.

The Ontario Mining Law.

By J. M. Clark, M.A., LL.B., Q.C., Toronto.

Before dealing with the mining law of Ontario it may be convenient to give a brief history of its development.

Prior to 1845 there were in Upper Canada (now Ontario) no special laws or general regulations relating to mines. Each case requiring executive action was dealt with as it arose by Order in Council.

The Gold Mining Act of 1864 introduced a system of Gold Mining Divisions and Mining Licenses, one class of the latter known as "Crown Lands Gold Licenses" and the other as "Private Lands Gold Licenses."

This system was extended in 1868 to Silver Mining by the Gold and Silver Mining Act of 1868 which was in turn repealed the next year when the General Mining Act of 1869 was substituted. This Act introduced the system of mining locations in addition to that of mining divisions.

All royalties, taxes or duties theretofore imposed or made payable upon or in respect of any ores or minerals extracted from patented lands were repealed by this Act and such lands declared free from every such royalty, tax or duty.

The Ontario Mining Law remained substantially in this condition until the Mining Operations Act of 1890 was passed.

The whole law was radically amended in 1891 when royalties were again introduced and in 1892 all the previous legislation was amended and consolidated, the idea being that the law was then put in a permanent and definite shape. Since 1892, however, there have been several changes in the form of Acts to amend and improve the mining laws.

At present the statutory Mining Law of Ontario is contained in Chapter 36 of the Revised Statutes of Ontario, 1897, as amended in 1898 by by 61 Vic. Chapter 11 and again in 1899 by 62 Vic. (2)

Chapter 10, and a further amendment is threatened at the present session of the Ontario Legislature.

This legislation is divided into five parts, the first part containing general provisions, the second dealing with mining locations, the third with mining claims, the fourth with mining regulations and the fifth with offences and penalties.

Instead however of discussing the Mines Act and its amendments in the order in which the various clauses have from time to time been enacted I have concluded that it would be more convenient to deal with the matter by taking the case of prospectors seeking to discover mineral and following them through a course of prospecting, followed by acquisition of title and the subsequent working of the property until say they form a company in the ordinary course which company if not wound up on account of insolvency usually comes to grief on account of over-capitalisation.

Supposing that an individual prospector comes to the Province of Ontario with a view to acquiring mining property. It would first be necessary for him to decide whether he intends to prospect in a mining division of which at present there is only one, that of Michipicoton, or on lands not situated within any mining division. In the event of his choosing territory within Michipicoton which was set apart as a mining division on the 9th day of Sept., 1897* he will find that the first thing necessary for him to do is to secure a miners' license which he may do upon payment of the sum of ten dollars. This license authorises him to explore within the mining division for one year, when he must renew his license. A licensee who discovers mineral in any place within the division has the right to stake out a mining claim provided the lands have not been withdrawn from location or exploration or are not included in a previous mining claim, or in lands reserved by the Crown.

The mining claim is to be staked out in the manner prescribed by the Act, by four stakes and where there are standing trees the boundary lines have to be blazed.

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*See McPherson & Clark's Law of Mines in Canada, page 833. B.T.A.B.

The licensee cannot stake more than one claim on the same vein and cannot stake out and record in the same mining division within a radius of fifteen miles more than four claims in any year. The dimensions of a mining claim are defined to be a square of fifteen chains containing twenty-two and one-half acres, but there is power by regulation to vary this so however as not to make a mining claim exceed forty acres. The boundary lines are to run north, south, east and west astronomically and the ground included in each claim is bounded under the surface by lines vertical to the horizon.

The apex rule which was abolished in many countries on account of the interminable litigation inherent in the system of extra-lateral rights has now no place in the mining law of Ontario. British Columbia abolished the system in 1891 except as to rights previously acquired. Until 1897 a modified form of the apex rule applied to mining claims in Ontario but it never had any application to mining locations. This Apex Rule has been a source of trouble in several of the United States but the difficulties (mainly arising out of vested rights) in the way of its abolition there seem insurmountable.

The rule of the English Common law now in force in Ontario and in fact in the whole of Canada is much preferable.

A mining claim does not include a valuable water power. In Ontario there is important special legislation as to water powers.

The claim becomes forfeited unless the inspector is duly notified and a plan furnished him, and also becomes forfeited unless the license of the holder is kept in force.

$150 has to be expended every year upon each claim taken up in stripping and opening up mines, etc. The Act provides that this expenditure shall consist of labor actually performed by grown men to be computed at the rate of $2 00 per man per day. Where several parties combine to work five claims or less the mining operations may be carried on upon one of the claims. The licensee has a right to abandon his claim. Provisions are made as to party walls between claims and there is now a provision for a patent being obtained to a mining claim after the working conditions have been complied with for a period of four years.

Supposing the prospector to desire to prospect on Crown lands not situated within any mining division there is a statutory right to explore except in cases of lands withdrawn from sale, location or exploration as being valuable for their pine or for other reasons.

If the lands are wholly vested in the Crown in right of Ontario then they are dealt with as mining locations. If however the surface rights have been granted and the minerals reserved then mining rights can be obtained. Again, if the title has been completely granted by the Crown then the private owner would have to be dealt with. It is to be borne in mind that in the case of surrendered Indian Reserves where reserves were legally laid out prior to Confederation the title would have to be obtained from the Dominion Government. It has has further to be borne in mind that according to the law of England (which in this respect is the law of Ontario and indeed of all the Provinces of the Dominion) gold and silver mines, until they have been aptly severed from the title of the Crown and vested in a subject are not regarded as *partes soli* or incident to the land in which they are found. Not only so but the right of the Crown to land and the baser metals which it contains stands upon a different title from that to which its right to the precious metals, *i.e.* gold and silver, must be ascribed.

In the Great Mines Case the Judges decided that in the case of the baser metals, no prerogative is given to the Crown; whereas all mines of gold and silver within the realm whether they be in the land of the Crown or of subjects belong to the Queen by prerogative with liberty (to quote from the Justices) "to dig and carry away the ores thereof, and with other such incidents thereto as are necessary to be used for the getting of the ore."

This prerogative right to gold and silver mines is included in the term "royalties," which by Sec. 109 of the British North America Act are granted to the Provinces. There is not time to admit of a discussion of this important question in all its bearings. Suffice it to say that the mining man must at his peril see that he has a title not only to the baser metals but also to the precious metals.

Take the ordinary case of ungranted Crown lands, belonging to the Province of Ontario, if the prospector makes a discovery his first step is to apply to the Crown Lands Department, or to any agency thereof for the location. The application should be in writing and must be accompanied by an affidavit showing the discovery of valuable ore or mineral thereon by or on behalf of the applicant and that he knows of no adverse claim.

The applicant must pay into the Crown Land Department one-fourth of the purchase price or rental within sixty days and within three months the remaining three-fourths.

In the case of unsurveyed territory it is necessary also to have a survey in accordance with the Act put in within four months of the date of the application.

The area that may be obtained by an individual is limited to 320 acres, and that which may be obtained by any firm, partnership, syndicate or incorporated company is limited to 640 acres

The Act contains specific directions as to the form and size of the locations and the price is fixed by statute. The applicant may obtain either a patent granting him the freehold, or a lease which under the terms of the Act is renewable. In case there is no dispute the patent or lease is issued in due course upon the legal requirements being duly complied with.

In case of a dispute the matter is decided by the Commissioner of Crown Lands, according to what Chancellor Vankoughnet, who had filled the office with great ability, aptly designated "Crown Lands Law."

The facts are proved usually by affidavits more or less true, sometimes by *viva voce* evidence more or less false.

To illustrate how binding the obligation of an oath is considered, I may mention the case of affidavits filed in the Crown Lands Department at Toronto, to comply with the old regulations requiring agricultural lands to be fenced before Patents issued. It was the case of an officer who had a supreme contempt for the snake fences of Ontario, he and a military friend fenced round the land desired with swords after the most approved Aldershot style. Then he put in an affidavit that he had fenced round the land, and his friend swore that he was disinterested and was personally aware of the fact.

There is no appeal to the courts from the decision of the Commissioner which is usually final.

But the courts have jurisdiction to repeal and avoid letters patent issued erroneously or by mistake or improvidently or through fraud.

There is a provision for encouraging prospectors by giving to the first discoverer of minerals a free grant of a location of forty acres where the vein, lode or other deposit is not less than five miles from the nearest known mine. There is also a provision allowing prospectors to stake out locations in unsurveyed territory under regulations, where the Commissioner of Crown Lands is satisfied that the lands have no value for pine timber, and the prospector under this staking clause may hold the locations for a period of two years, subject to an expenditure of $3.00 per acre in the first year, and $7.00 per acre in the second year for actual mining work, after which he is required to complete his application as provided in the case of an ordinary lease or sale of a mining location.

In the case both of patents and leases $1.00 per acre has to be expended during the first two years, and not less than $1.00 per acre during each remaining year of a period of seven years, or in all $6.00 per acre during the first seven years after the issue of the lease or patent or its equivalent in less time.

It is also important to know that at the expiration of ten years the lease is convertible into a patent, or the lessee may at any time during the term upon payment of all rent due and performance of all other conditions become the purchaser. This part of the Act also provides for the case of one of several co-owners failing to contribute his proportion to the expenditure required under the Mines Act.

Where an owner of land has only the surface rights, the Department may sell the mining rights, and the owner of the mining rights may

The authorities are collected at p. 274 et seq of "The Law of Mines in Canada." B.T.A.B.

then work subject to payment of compensation to the owner of the surface rights. In the case of failure to agree on this the compensation is ascertained by the Director of the Bureau of Mines.

After the patent of a mining location is obtained, whether from the Province or the Dominion, the property is then subject to the jurisdiction of the Ontario Legislature, to which is granted by the British North America Act exclusive jurisdiction over "property and civil rights." The Province has also power to deal with all matters of a local or private nature in the Province, and also to levy direct taxation within the Province in order to the raising of a revenue for Provincial purposes. Under this authority Part 4 of the Mining Act has been passed adopting certain mining regulations.

These are substantially adapted from the English Metalliferous Mines Act of 1872, as amended by subsequent English legislation. The person working the mine is also subject to the jurisdiction of the Parliament of Canada as defined by the British North America Act.

The only headings of Dominion jurisdiction to which it is necessary to refer are: (Sec. 91)—

s.s. 2. The regulation of trade and commerce.
s.s. 3. The raising of money by any mode or system of taxation.
s.s. 24. Indians and lands reserved for Indians.
s.s. 27. The Criminal law.

The Dominion Parliament has the power to impose export duties, but the Provincial Legislatures have no such power either directly or indirectly.

Suppose the title to a mining property has been acquired and it is desired to form a company for the purpose of working the property, the Provincial Legislature has power to make laws for the incorporation of companies with Provincial objects. By reason of the grant of the residuum of legislative power to the Dominion by the British North America Act, the Dominion Parliament has power to legislate with respect to the incorporation of companies having other than provincial objects. If therefore, the company desire to mine in more than one Province, they may obtain a Dominion charter. If however,

Law of Mines in Canada, p. 792. B.T.A.B.

power only to mine in one Province is desired, then the charter should be obtained in the Province.

In the case of a Dominion or other extra-Provincial company a Provincial license is required.

The incorporation of the company is obtainable under the Ontario Companies' Act and the Supplementary Act known as The Ontario Mining Companies' Incorporation Act. This Act defines the powers obtainable by mining companies and contains elaborate and complicated provisions in regard to the stock and shares and the sale and disposition of them. Such companies also come under the stringent provisions of the Act respecting Directors' Liability. There would not be time to discuss the various provisions of the Acts which at the peril of the parties concerned must be carefully attended to. It is extremely desirable that the whole question of Company law should be carefully considered, and a comprehensive statute passed governing all companies. The subject has recently received great attention in England, and the law there is certain to be put on a definite basis within a short time.

In regard to the whole question of mining law it is a matter of congratulation that it is largely statutory.

The Crown Lands Department have of course extensive rights in regard to dealing with the Crown lands which are substantially the property of the Province, but the power to interfere with the mining industry by regulation is properly very much restricted. There is a general power to make regulations given by Section 7 of The Mines Act, but this section clearly limits the power of interference by Order in Council to very definite subjects which alone may be properly regarded as subject to executive action.

The most elementary principles of the British constitution require that no man's rights can be affected by Order in Council, unless the authority to make such Order in Council has been delegated by the Legislature.

One of the greatest living authorities on Jurisprudence, Sir F. Pollock, states as the criteria of just laws in a civilized community Generality, Equality and Certainty; these three, but from the standpoint of the Mining Industry, the greatest of these is CERTAINTY.

The Iron Industry in 1899.

By Mr. GEORGE E. DRUMMOND, Montreal.

The year 1899 has passed into the annals of the iron trade of the world as a remarkable one. The values of iron, steel, and all the products thereof enhanced by from fifty to eighty per cent. (50 per cent. to 80 per cent.) over the values of the previous year, great scarcity of ore and fuel everywhere in the producing countries, a rate of consumption unparalleled in the history of the trade, and a production of pig metal never before equalled in any one year.

The United States, the chief iron market of the world, produced 13,620,703 gross tons of pig iron as against 11,773,934 tons in 1898, an increase of 1,846,769 tons, or nearly 16 per cent.

In 1898 there was made 2,121,254 tons more than in 1897, and in 1895 2,788,920 tons more than in 1894. This will give some idea of the enormous strides that the United States iron producers have made in the development of their business during the past few years. The approximate consumption of iron in the United States for the year ending 31st December, 1899, was 13,774,727 tons, the consumption exceeding the production and lowering the available stocks in yard until they amounted to only some 64,429 tons at the close of 1899, as against 291,233 tons on December 31st, 1898.

The number of furnaces in blast at the close of 1899 was 289, as 202 on December 31st of the previous year.

The demand for iron is as active as ever, and the consumption is going on at such a rate that with limited vessel freighting capacity from the Upper Lakes, it is doubtful whether more than sufficient ore for actual requirements can be brought down to the Eastern furnaces during the coming year. It is therefore, safe to say, that prices will remain fairly high throughout 1900.

GREAT BRITAIN.

The actual figures of production and consumption for 1899 are not yet to hand, but the output will probably approximate somewhere about the figures of 1898, viz., about 8,600,000 tons. The stocks in public yards and in maker's hands have however, been very largely drawn upon, so that the total consumption in England and Scotland will exceed that of 1898, and the stocks on hand at the close of last year will be reduced to a very small quantity. The falling off in the shipments of Scotch pig iron to Canada, which has been a marked feature of the trade during the past few years, was completely changed in 1899. In Scotch pig iron alone the shipments to British North America exceeded 10,000 tons, against about 2,000 tons in 1898. This large increase is due to the fact that American furnaces were almost unable to supply the local demand, and the same can be said of Canadian furnaces. It is evident from the present condition of the market that a considerable quantity of Scotch iron will come to Canada during the first half of 1900 at least, as Scotch prices, although high, are still lower than American figures for delivery in the Eastern part of Canada. It is however, well to notice that while the climax in price has apparently been reached in the case of American iron and steel, such is not the case in Great Britain. The enormous development in the export trade in British coal has increased the cost of all iron products to such an extent, that there has been a marked advance in all classes of iron and steel since the beginning of 1900, and it is evident that this will continue during the present scarcity of coal. The war in South Africa is almost directly the cause of this advance in the price of coal, and the scarcity of shipping will also further increase the cost of material delivered on this side, owing to the expected advance in freights during the coming season of direct navigation. Scotch Warrants opened at the beginning of 1899 at 49/7, and closed at the end of the year at 66/11, showing a raise of 17 4 per ton. The highest price reached was was in July, when they touched 75/7, and the subsequent break in the market has been due entirely to the position of the financial market, and the uneasiness in England on account of the South African war. Iron masters however, do not hesitate to say that the Scotch trade is in a very firm position, and there is no liklihood of any material decrease in prices for a long time to come.

EUROPEAN PRODUCERS.

Figures are not yet to hand from the various iron producing centres of Europe, but Germany and Luxenburg, who stood third on the list in 1898, producing 7,232,988 tons, have experienced great prosperity in the trade during 1899, and when the figures are brought down they will probably show a production in 1899 exceeding that of the previous year. Basing on 1898 figures the European iron making countries stand in the following order as producers.

Germany and Luxenburg......	7,232,988	metric tons	(2,204 lbs.)
France......................	2,534,427	"	"
Russia and Finland..........	2,222,469	"	"
Austria and Hungary........	1,308,423	"	"
Belgium....................	979,101	"	"
Sweden.....................	531,766	"	"
Spain......................	261,799	"	"

CANADA.

Canada, which in 1898 occupied the tenth position among the iron producing countries, enters now in earnest upon her career as an iron producer. Advices received from Hamilton, Deseronto, Ont., New Glasgow, N.S., and Radnor Forges, Que., without including any allowance for the output of charcoal iron from the Drummondville furnace (the records of which are not yet to hand) show the largest output in the history of the country, viz., 101,931, net tons of pig iron, 23,000 tons of steel ingots, and 3,900 tons of steel forgings.

The year has witnessed the formation of the Dominion Iron & Steel Company to smelt at Sydney, C.B., the ores of Newfoundland with the mineral fuel of Nova Scotia. These furnaces are planned upon a splendid scale. It is said that 1,000 tons of iron per day will be the rate of output. This, at the lowest rate of calculation, would add 300,000 tons of iron per annum to the present Canadian output. Details of the plant and of the actual output are not at the moment available, but it may be relied upon that the works will go into operation within the next year on a very large scale of operations.

The new furnace plant of the Canada Iron Furnace Co. at Midland, Ont., decided upon during the year 1899, is now rapidly nearing completion, and will go into blast about the 1st of May next. The Midland works will have an output of at least 30,000 tons of iron per annum, these two new enterprises helping to place Canada, as a producer of iron, upon a level with Sweden.

For several years past the Canadian Mining Institute has been devoting considerable attention to the task of educating the Canadian public upon this most important question of iron production. At last these efforts are being rewarded. Legislators and capitalists alike are evidencing an interest in the industry that they have never shown in the past, and we believe that the experience of the next few years will serve to strengthen the faith of the Canadian people in their own country with regard to its possibilities as an iron producing centre.

A notable feature of the year's work is the good progress that has been made in the matter of developing the iron mines of the country Considerable activity has been shown in this respect in the Ottawa district, and also at various points in Ontario and Quebec, but by far the best discoveries and greatest development work has been done in the Michipicoten, Lake Superior district. The members of this Institute have long held that a thorough investigation would prove that the Canadian side of Lake Superior is as rich in iron as the American side, and the work now in progress in the district mentioned proves the correctness of this view.

The Helen Red Hematite mine, on Boyer Lake, in the Michipicoten district, was located by Mr. F. H. Clergue, of the Lake Superior Power Co., Sault Ste. Marie, less than a year ago, but already this gentleman, with indomitable pluck and energy has not only uncovered the deposits, but by means of diamond drills has demonstrated, at latest accouuts, that he has over 4,000,000,000 tons of high class Bessemer ore in sight. He has planned and almost completed the first link of the Algoma Central Railway from Michipicoten Harbour to the Helen mine, and thence onward to a point on the C.P. Railway. This line, when completed, will make the first link of a railroad destined eventually to reach James Bay, and open up a country rich in natural resources. At Michipicoten Harbour M. Clergue and his company have now under construction a magnificent dock for the handling of iron ore outwards to vessels. This dock will have a capacity of 500 tons per hour. The ore is of most excellent quality, comparing favor-ably with the very best grades from the American side of Lake Superior, and will find a ready market not only in Canada but also in the United States, reversing somewhat the condition of affairs that has existed for the past few years, when the Ontario furnaces had to rely to a very large extent upon the product of American labor and American mines, in the ore as well as in the fuel department.

The Nova Scotia Steel Co. report that in addition to the mining of ore for use in their own plants in Nova Scotia, they have largely increased the production of Wabana ore for shipment abroad, their output for 1899 aggregating over 300,000 tons; 190,000 tons of this going to Germany and Scotland, about 90,000 tons to the United States; the balance being used in the Ferrona furnace. They advise that the outlook for mining operations in 1900 at Wabana is equally as good as last year, and that they have already sold upwards of 200,000 tons for delivery in Philadelphia during the coming season.

It is to be hoped that field development work will be carried on vigorously throughout Canada from now forward. There will be ample market for the product of all the iron ore mines likely to come into operation during the next few years. It is reasonable to suppose that the furnaces at Sydney and North Sydney will be glad to have a supply of Canadian ore of the right quality for mixture with Newfoundland ores. This will be eutirely in their interest, so that mine prospectors and owners have a wide open field for their energies and enterprise in developing Canadian iron mines.

While the work of development, so far as the mines are concerned, is not at all likely to be over-done, the same may not be equally trne in the smelting department. By the close of this year the output of iron from Canadian furnaces will considerably exceed the consuming power of the country in so far as actual foundry practice, upon which we have most largely depended in the past, is concerned. The furnace owners will now have to undertake operations in the manufacture of steel of all descriptions, so as to work up a large part of their outputs into higher products than the majority of them have touched in the past. If this is carried out successfully, and on a modern basis, a great part of the output of the new furnaces can be absorbed within the country, and so far as the new works at Sydney are concerned, it is firmly believed that a very considerable part of their output will find a market among the consumers of Great Britain and Continental Europe. The same applies of course in the future, as in the past, to such high class charcoal iron as Canada may produce, for which a ready market may always be expected abroad. With proper management the business can be made entirely successful, but it will have to be planned upon a thoroughly modern basis in every department.

In considering the causes that have brought about the present most encouraging condition of the iron industry in Canada, naturally the principal credit should be given to those first adventurers in the enterprise of iron making, who have had to fight for a footing under the discouraging conditions that have existed during the past few years. Granting them first due praise for what they have done to establish the industry, we must also acknowledge cordially the good will shown by the Government and the Loyal Opposition in the Dominion House, in settling the question of the iron duties and bounties *upon something like a permanent basis*, thus encouraging capital to invest in the enterprise of iron making in Canada, an enterprise which we believe will do more for the building up of the country than almost any other industry, and which may yet become an important factor in Imperial considerations.

The Old Valley Gravels of the Klondike.

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By Mr. R. G. McConnell, Ottawa.

The gold-bearing gravels of the Klondike are of three kinds, viz.: the stream gravels, the bench gravels, and an old set of gravels resting on high benches distributed at intervals along the principal producing creeks. It is to the latter of these that I want to draw your attention for a few moments, as it presents some features which so far as my experience goes are unique.

The valleys of the principal producing creeks are bordered usually on one side and occasionally on both by wide benches, which owe their origin to a former sudden rise in the general elevation of the country. In consequence of this rise the grade, and cutting power of the streams were increased, and they were enabled to sink their channels some hundreds of feet below the old level. The portions of the old valley bottom not destroyed during the sinking, or by subsequent erosion, constitute the benches in question. They occur on Bonanza Creek from McKay Gulch at intervals all the way down to the mouth, on the lower part of Eldorado Creek, on Hunker Creek from above the Gold Bottom Forks down to the mouth, and also for some distance up Gold Bottom and Last Chance Creeks, and they are also found along Quartz Creek, a tributary of Indian River, between Calder and Canyon Creeks. They were not noticed on Sulphur or Dominion Creeks, the two principal Indian River gold streams

The benches vary in width from a few hundred feet to half a mile or more. They slope uniformly down stream, but at a lower grade than the present valley bottoms, and in consequence of this, rise gradually in the banks as we descend. Their elevation above the bed of the present valley increases from about 100 feet where they appear first, to about 300 feet at the mouths of Bonanza and Hunker Creeks.

The gravels resting on the benches consist of a deposit known as the quartz drift resting on bedrock, and an upper set of flat, rusty-colored gravels resembling those in the present valley, but very much thicker.

The quartz drift differs markedly in many of its characters from any deposit, either marine, lacustrine, fluvial or glacial, known to me. It is uniformly light greyish to whitish in color, and the long lines of white dumps from the workings now form one of the most conspicuous features of the valley. The color does not vary to any material extent with differences in the bedrock, as in many places heavy deposits of the quartz drift looking quite white at a distance, rest on wide bands of dark, graphitic schists.

The quartz drift consists essentially of a compact mixture of small, clear, little worn and often sharply angular quartz grains, and tiny scales of sericite, thickly packed with rounded, sub-angular, and wedge-shaped boulders of quartz, and less frequently of grayish mica schist, the principal rock of the district. The deposit is remarkably uniform in composition from top to bottom. Beds of coarse sand occur in places, but are infrequent, and in the great majority of the sections the siliceous grains and the light sericite scales have not been sorted into separate beds but remain intimately commingled throughout. The sands, however, become noticeably coarser towards the limit of the deposit on the upper parts of the creeks.

The boulders of the quartz drift are always more or less rounded and water-worn, and are found in all sizes from small pebbles up to large boulders 2 or 3 feet in diameter. They occur scattered irregularly through the sandy matrix or roughly stratified in it, but were nowhere found forming heavy homogeneous beds such as one would expect in a stream deposit. They do not show evidence of prolonged rolling. Well-rounded boulders are occasionally present, but in the majority of cases the edges only are worn away, and wedge-shaped, sub-angular fragments, still preserving approximately the shape of the short, blunt vein from which they originated, are very common. The proportion of quartz to schist boulders was estimated at about four to one.

The quartz drift varies in thickness from a few feet up to 120 feet and in width from 100 yards to half a mile or more. It increases in volume towards the mouths of the creeks.

The quartz drift is everywhere more or less gold-bearing, but the productive portion is usually confined to the lower 2 feet of the deposit. The distribution of the gold is more patchy and irregular than is the case with the creek gravels, and does not seem to follow any well defined channel. Spots of extraordinary richness, carrying hundreds of dollars to the square yard, are occasionally found close by comparatively barren stretches. Their general richness over wide areas is, however, attested by the fact that notwithstanding the scarcity of water and the great expense entailed in drifting in frozen gravel, in a region where labor commands a dollar an hour, hundreds of rockers are at work along the various creeks. The gold in the quartz drift is more angular and contains a larger proportion of nuggets than in the creek gravels.

The upper set of flat stratified gravels mentioned before as overlying the quartz drift, has not so far proved remunerative at any point. It overlaps the quartz drift towards the hillsides and in places occupies a deep depression between the ridge of quartz drift and the valley slopes.

The precise origin of this peculiar deposit is still somewhat obscure. It resembles a glacial deposit in appearance, and also, in places, in its ridge-like outline, and I was at first inclined to attribute it to ice; but no evidences of ice action either on the boulders or on the surfaces of the bedrock were found. The bedrock is rough and wavy, and is often soft and decomposed for some distance below the surface. A glacier could not have flowed down the valley without leaving some evidences of its work. It is not a lake deposit, as both upper and lower surfaces slope down streams running in all directions, and besides clays are conspicuously absent. It has not been formed *in situ*, as the boulders are all more or less rounded. It is not, finally, an ordinary stream deposit, a fact shown by its comparatively unsorted condition, the sharp angularity of the quartz grains, and the uniformity of the sections from top to bottom. It has not travelled far or the quartz grains would show more wear, and I am inclined to consider it as due to a wash from the neighboring hills conditioned by a sudden increase in precipitation acting on a previously deeply decomposed surface, and acting in conjunction with a stream moving slowly down the valley. The large boulders were probably partially rounded before the movement commenced, and were worn to some extent during the short journey, while the smaller grains would escape with less injury. This sudden and somewhat tumultuous mode of deposition would also account for the comparatively unsorted condition of the deposit. The explanation I have offered is, however, only a tentative one, and I would be glad of an expression of opinion from the members.

Results in the Use of a Rotary Pump as Against Straight Line Type.

By Mr. CHARLES FERGIE, Westville, N.S.

In bringing before the Institute the following few notes showing a comparison between a rotary mine pump with that of a direct acting straight line pump and using compressed air as the motive power the writer does claim to have discovered anything new, his object being simply to direct the attention of mine managers to the wastefulness and poor showing made by the latter as against that of a fly wheel pump.

At a test recently made at the Drummond Colliery, Westville, a good opportunity occurred to make comparisons. The two pumps stood side by side, were arranged to draw water from the same sump and deliver through the same column pipes which were 14,841 feet long, and gave a head of 185 lbs. per square inch as shewn at the pressure gauge.

The No. 1 was a single Knowles fly-wheel pump, air cylinder 14 in. dia., water plunger 5 in. dia., stroke 18 inches, with independent expansion cut-off valves.

The No. 2 was a Northey direct-acting straight line pump, air cylinder 14 in. dia., water plungers 5 in. dia., stroke 12 inches.

The fly-wheel pump had little clearance in the cylinder, not more than 1/4 inch; that of the straight line pump had 1 1/2 inches.

The great objection to the use of the common direct-acting pump is in the large amount of clearance to be found in the cylinders and passages; also, that such a pump seldom makes two consecutive strokes alike, and that it is impossible to make use of any expansive force there may be in the air and cut-off before the end of the stroke. On the other hand the fly-wheel pump must necessarily always make the same full length of stroke.

During these tests indicator diagrams were taken at the air compressor, and the water delivered was measured in barrels.

The No. 1 or fly-wheel pump delivered 6,579 gallons per hour and required the air compressors at surface to develop 77.6 I. H. Power to perform that work.

The No. 2 or direct-acting pump delivered 5,949 gallons per hour and required the air compressors to develop 117.3 I. H. Power to perform that work.

These figures show that the fly-wheel pump delivered 630 gallons more water per hour, and with a consumption of 33.87 per cent. less horse power than did the direct-acting pump.

Putting it in another way; for each H. P. at air compressor the fly-wheel pump delivered 84.78 gallons per hour, whilst the direct-acting pump only delivered 50.71 gallons per horse power developed at the air compressors, shewing a gain of 40 per cent. in the favor of the fly-wheel pump in work performed.

In the fly wheel pump the air in the cylinder was cut-off at 5-16 stroke.

The writer is so satisfied with the economy of the fly-wheel pump over that of the direct-acting one that he has decided to throw out all the latter and invest in new rotary pumps.

Notes on Increased Facilities at Wabana Iron Mine.

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

[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.

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 out--crop 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.

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.

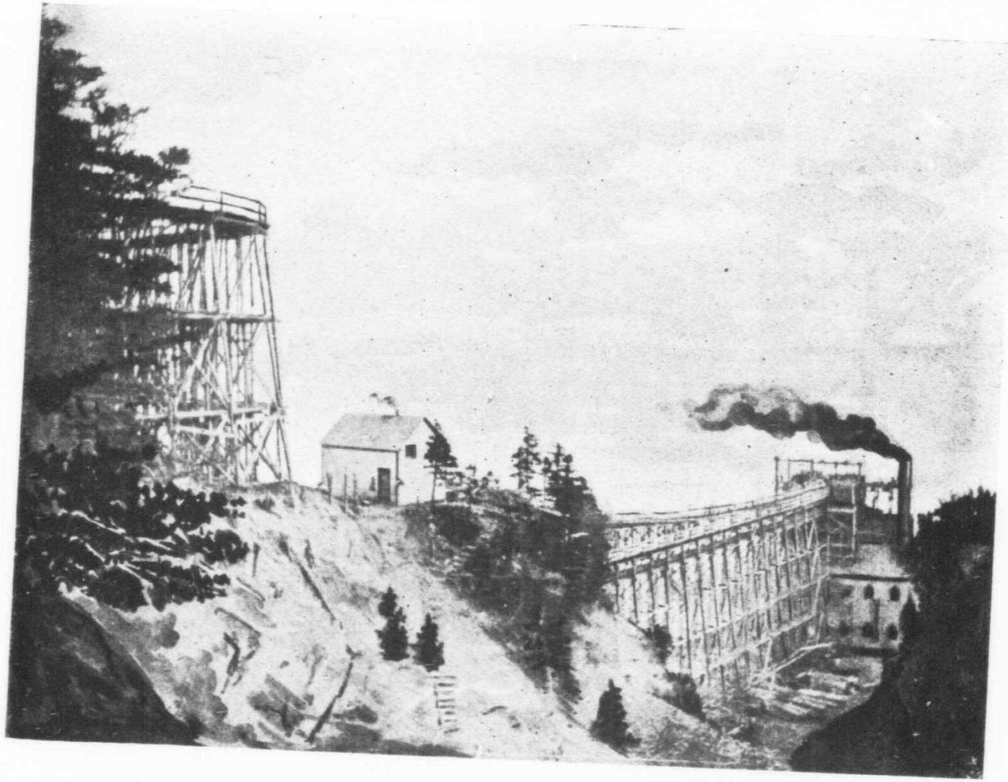
Fig. 2 shows the original haulage plant installed in 1895, and Fig. 4, that as on the ground ready for the season of 1900.

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.

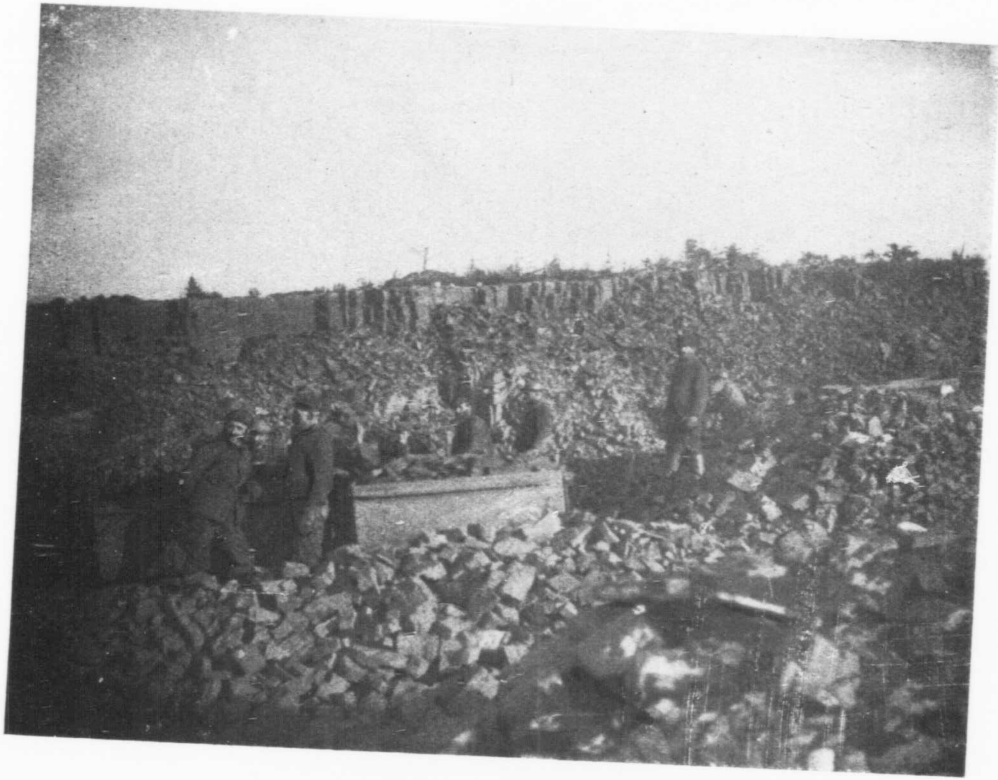
Ore Cars in Transit being attached to Cable.

New Ore-bin under construction at Wabana.



Pier showing Conveyor near top of Trestle, Wabana Mine.

Ore Bin and Tipple, Wabana Mine.



Mining by Open Cut, Wabana Mine.

Ore Cars in Transit, Wabana Mine.

Recent Advances in Electro-Chemistry and Electro-Metallurgy.

By Dr. W. L. Goodwin, Kingston, Ont.

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 simiItaneously 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 electrolysing 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 waterpowers. 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.

West Kootenay Notes.

By R. W. Brock, Ottawa.

I notice that my name has been placed on the programme for a paper on West Kootenay ore bodies. I do not know that I have much fresh material with which to supplement what was embodied in my paper of last year. I may state, however, that the conclusions there arrived at have received additional confirmation from the work of the past season.

Thus there seems to be no question of the genetic relationship between the "white dykes" or light colored porphyries and the ore bodies.

There are one or two points I will ask you to allow me to refer to a second time for the sake of emphasis. From what was stated of the mode of formation of these ore-bodies and their consequent irregularity, and of the faulting to which they have been subjected, in which the throw varies both in direction and extent, it is obvious how particularly necessary it is in mining these ores, to keep exploratory and development work well in advance of the actual mining, otherwise there are certain to be disappointing and discouraging stoppages in shipments, due to running out of ore.

It is also apparent that running out of ore does not necessarily imply that the ore body has been exhausted and that the mine is played out.

Another point which might be emphasized is that mineralization is seldom confined to a single plane, so that the ore-body is seldom an isolated body in a barren country rock, parallel ore-bodies are always a possibility, and hence the value of exploratory cross-cuts. For the same reason, when cross-cutting for the lead where it has been cut off by a fault, it is to be remembered—and this is not always done in practice—that the first ore encountered is not necessarily the continuation of the ore body originally followed, it may represent a parallel deposit, which has been brought up by the fault. An instance of this kind which came under my notice last summer might be given. In one well-known mine the vein continued strong and rich to a certain point, beyond which it became weaker and in about 50 feet petered out. Cross-cuts were run transversely to try to pick it up, but without success, and work in this direction was for the time being discontinued. On examining the point where the vein weakened, I found evidences of a fault—from the amount of triturated material, quite a considerable fault, suggesting, of course, that what appeared to be the continuation of the vein was in reality a parallel one brought up in place. On questioning the manager remembered having been struck at the time by the sudden change in the tenor of the ore, from high grade to a low.

There is a matter I would like to see discussed by this Institute, and that is the work of the prospector and how it can be made more effective. It is self-evident how important it is for a mining district that it be intelligently prospected, and the prospects intelligently tested. That the ordinary prospector is not always competent to do either of these of himself is apparent to any mining engineer who has an opportunity to look over his work. It is regrettable in every way that the prospector's labor, his time and his money are so often squandered, especially when this is largely due to a lack of technical knowledge. The annual assessment work represents far too frequently just so much time and money put into the ground ; often, in fact, it leaves the property in a worse condition than if nothing had been done. The same time and money expended on trails or some other such thing would often prove of much greater value to the prospector, as well as to the community at large. This is due in some cases to the idea that assessment work is a peculiar form of tax levied by the government, and which must be paid by the prospector to hold his claim. So the work is shirked as much as possible, and done not where it will be most valuable but where it can be accomplished most easily. The prospector who has this idea does not recognize the fact that, properly and systematically done, it is testing his property and adding directly to its value, if the property is worth holding. Another cause for this waste of capital is his not realizing that his object should be to show up ore, and that consequently there is a difference in the proper method of procedure in developing a prospect and operating a mine. He is not always acquainted with the rule which should be inviolable in West Kootenay—follow the ore; consequently he sinks outside his ore, or runs cross-cut tunnels to tap it at depth, instead of sinking on the ore no matter where it leads him, or better, where possible, of drifting in on it. He does not always realize how much information may be gained and how much the value of his prospect may be increased by exposing the surface outcrop, nor how much better results can be obtained where only a small amount of capital is available, if it be spent in prospect pits tracing the lead in place of a shaft or tunnel which may have to be discontinued while still in country rock.

Another cause of his squandering his means is the small use he makes of assays, and the fact that when he does have an assay made, it is not of a *sample* but of a *specimen.* Few prospectors indeed are capable of selecting a fair sample.

I think it is a wise move on the part of the British Columbia Government to oblige assayers to pass a government examination. The prospector was not always in a position to judge the reliability and ability of an assayer, but will now feel confident that the licensed man will make a trustworthy examination of his ore. If the prospector could be induced to have the assayer collect his own sample much would be gained. Not only would the prospector gain a much truer idea of the value of his deposit, but with a certificate of the value and extent of his "showing" from a reliable professional man he would find it much easier to secure the interest of mining men who, wearied of looking over wild-cats are sometimes too ready to dismiss the prospector's own description as the roseate opinion of a visionary. Also many of those damaging booms which originate from the assay of a *specimen* would be avoided. If the assayer were properly qualified he might, while collecting his sample, examine the property and explain on the spot how the prospect could be most advantageously proved and developed. At all events some properly qualified person should be engaged by the prospector to look over the property and furnish this assistance. The great difficulty, of course, is to make the prospector see the personal advantage in such an expenditure. Possibly if he were encouraged to incur it by having such expenditure for assays and "expert" advice allowed to count as assessment work, he might often be induced to undertake it. If so the gain to the prospector himself as well as to the province would fully justify the change from the present regulations.

There are several minerals which occur in West Kootenay, possibly in economic quantities, for which the prospector is not on the lookout. One of these is cinnabar. In a specimen of hæmatite found on Redding Creek, just across the Hooker Creek divide, a little cinnabar was noticed. A specimen of hæmatite collected by Mr. McConnell from Crawford Creek also yielded cinnabar on examination. On account of its resemblance to the streak of hæmatite it might easily be passed over.

Mining Pumps.

By Mr. C. E. Morgan, Toronto.

The subject upon which I wish to pass a few remarks today has a wide range, as mining pumps are made of so many different styles.

The class of pump most commonly used when a mine is being developed or sunk is the Sinker, and, as you gentlemen no doubt all know, is made vertically. It is constructed either of the piston or plunger type, and is largely used for sinking shafts. It is so arranged at the steam end, that should the pump become empty, the pump will still continue working without injury. This machine may be operated either by air or steam or by electricity when desired. The sinking pump being subjected to the rough usage which mine pumps invariably get, its valve gear. which is vital to the operation of the pump, should be protected in some way. The Northey Vertical Sinking pump has no external valve gear which could be broken by flying rock during the time of blasting.

When shaft is sufficiently deep a Station pump is usually installed. These are made in two classes, the direct acting or the rotative type, but when steam is of no consideration the direct acting is generally used. This pump may be made fairly economical by adding a condenser.

In mines where the water is acidulous, the plungers and cylinders of these pumps are made of non-corrosive material, plungers being covered with babbit and the cylinders lined with lead.

It is a very essential point in selecting a mine pump to be sure that its valves are properly constructed and that its valve area is amply large. It is considered a good practice to allow the water to come to the pump at a velocity of 200 feet per minute, so in order to insure the durability of valve and seats the area should be 50 per cent. of plunger. This point is often lost sight of when purchasing, and accounts for the difference in prices of the various manufacturers.

The water cylinders of these heavy service pumps should be specially constructed, and valves should be so arranged as to admit of easy examination. Each valve chest should be cast separately, so as to allow of renewing same without destroying the whole of the water cylinder. Valves should also be cushioned with rubber cushions in place of springs, as usually used, as this arrangement gives by far the best results. The faces of the valves should preferably be made of leather. This type of pump is termed the Pot valve pattern.

In a number of mines that I have visited, I have found that the pumps in use are altogether too small for the work to be performed. In selecting a mine pump for a Station pump, it should be so proportioned that it will perform the work at a piston speed not exceeding 50 to 60 feet per minute. This enables the pump to do its duty without injury.

A rule for proportioning a pump for handling a certain quantity of water is arrived at by taking the quantity of water to be handled per minute and reducing same to cubic inches. For instance,—Supposing we have to handle 500 gallons of water per minute, this, multiplied by 231, which is the number of cubic inches in a gallon, and divided by 600, which is 50 feet per minute, gives area of piston or plunger, if single ; divide by two for duplex.

If it is desirable to know the size of steam cylinder we would divide the quotient arrived at by the steam or air pressure available at pump. This will give us size of cylinder required. The result is for single cylinder pumps, and for Duplex would be divided by 2. Add 40 per cent for friction.

The pump can be lined with wood, if preferred, in place of lead The staves would be of soft pine, machine dressed radially, and the outer and inner grooves suited to their respective diameter. They are cut to exact length and arranged in place. Two of the staves are then bevelled to admit of a third stave between them, and also bevelled, which shall act as a wedge. The middle stave is then driven home with a maul, and the staves will now be firmly fixed in their places in the interior of the cylinder.

Any openings in the cylinder may be lined in the same manner, care being taken that the inner end of such staves closely fit the curviture of the main stave. When these are securely wedged in place, the opening may then be cut through into the working barrels.

When electricity is available and can be used with safety, the triplex power pump is a machine well suited for mining purposes. The principle of the Triplex power pump is as follows :—The crank shaft has three cranks equally spaced 120 degrees apart, and as the pump has three single acting plungers, actuated by connecting rods, with this arrangement of cranks the strokes follow and overlap each other, resulting in a very uniform flow from the discharge pipe of pump, and an equally uniform expenditure of power. This naturally results in the smooth operation of the mechanical parts, and is particularly useful where electric motors are employed.

In the Single or Duplex crank form, the column of moving fluid must necessarily have an intermittent action, but in the pump built on our single acting Triplex Crank principle, the column of moving fluid is constantly in action, and no power is lost.

Another class of pump, which is used in the gold mines of Nova Scotia, is the Cornish pumping engine. This was first used in the Cornwall coal regions of Pennsylvania. This type of pumping engine may be described as a single acting high pressure expansive condensing engine, working single acting pumps through the medium of a beam. These pumps are usually of the plunger pattern, plungers being loaded with iron weights sufficient to counterpoise the pressure of the water power. The engine may be considered as consisting of two parts ; the power of the engine is used to lift the loaded plunger, after which the steam end part of the machine is detached and the weighted plunger is allowed to descend by gravity, at a speed depending on the quantity of engine power in action at the rate in which the water is being drawn away. The chamber of the pump becomes full when the plunger is raised, and the act of inhaling the full charge through the suction valve is a portion of the work which the steam has to perform, and a portion also subject to variation. The speed of the engine is regulated by an adjustable cataract The exhaust valve first and then the steam valves are thrown open by threadle weight, as soon as the catches are detached by the cataract. The valves are closed by a tappit on a plug rod, first the steam valve and then the exhaust valve, the former at a period of a stroke varying in practice between one-third and one-fifth from the commencement, and the latter at the end of the stroke. In engines working on this principle, as also in all reciprocating engines pumping without cranks, there is nothing to limit the strokes of the engine to any exact length. It is necessary, therefore, that bumpers or catch pieces be provided to restrain the engine at both ends from undue length of stroke, and thick plates of indiarubber under hard wooden plugs are now used for this purpose in place of the spring beams formerly employed.

An engine thus arranged, working alone, lifting water from one fixed level to another, would work continuously with one length of stroke and at one speed, at whatever it might be set.

The single acting engine on the Cornish principle was thought to have some advantages over the pumping engine with crank and fly-wheel, in the fact that no power is required in the Cornish engine for keeping gearing in motion at each end of the stroke. A certain amount of percussion action is indeed necessary to overcome the inertia of the engine at the beginning of the stroke, but, on the other hand, the whole engine is brought to a dead stand at the end of every stroke by the whole effective power being completely absorbed in the work done in pumping.

Are there Diamonds in Ontario?

By A. BLUE, Director of Mines, Toronto.

In this last decade of the century it has been dawning upon ourselves, and more slowly upon other people, that Ontario is a mineral country. In former times our own people were led to believe that they must depend on the resources of the field and the forest for livelihood, and there was no lack of proofs that for the farmer and the lumbermen our Province was an ideal land for large possibilities. I am sure there was not in the whole of America another country of equal extent, where there grew trees of such girth and height as in the tracts lying between the River St. Lawrence and the Ottawa, between Lake Ontario and Georgian Bay, and between Lake Erie and Lake Huron. Within the lifetime of one man that great forest has been cut away, and in its place are fertile fields producing sustenance for two millions of people and much for export besides. Moreover, the farmer of to-day is a manufacturer as well as the producer of raw materials. He is not now content with growing wheat, oats and hay, as the pioneer was, and depending on his surplus of these crops for the profits of his industry. He converts grass and grain into beef, pork and mutton, poultry and eggs, butter, cheese and wool; and so earns a second series of profits, saves on freight, and keeps up the fertility of his soil. Mixed farming and intensive farming go together, and although larger results are possible, it is gratifying to know that as compared with any other Province or State on the continent Ontario is easily first. This is one thing established by eighteen yearly reports of the Bureau of Industries, and if that Bureau had done nothing else it would have justified its raison d'etre, its right to be. There has been given to our people a reason for settled confidence in the lands they till and the country they occupy; and, in so far as these convictions go, we have the assurance of a stable population. In the New Ontario of the north there remains a region of much greater magnitude to occupy and possess, and in its resources of soil and timber another two millions of people may find support and occupation. But if to soil and timber be added its unopened stores of minerals contained within an area of 100,000 square miles, and if the manufacturing idea takes possession alike of miner, woodman and husbandman, one can only say that we have the domain for a great Kingdom.

Taking the Old and the New Ontario together there is a mineral bearing belt that extends 1,000 miles from the River St. Lawrence to the Manitoba boundary. It is the backbone of the world, and has borne the stress and strain of unnumbered cataclysms. It is a mountain-built country, where the mountains have been cut down to hills, and the hills to plains. The thickness of some of the older formations is measured in miles, and they have been twisted, folded, fractured, crumpled, during the long ages of secular cooling into more forms than fancy can conceive or pen describe. There are great areas of igneous as well as sedimentary rocks, and almost everywhere throughout the wide country are to be seen conspicuous evidences of disturbance, deformation, degradation and reconstruction. It is just the character of a country in which a keen prospector for minerals would expect to find them in quantity and variety, and during this decade he has been rewarded with discoveries from one end of the belt to the other. Nickel and copper, iron and gold, graphite and mica, may be said to occur abundantly. Corundum also is now proven to exist in a tract of 400 or 500 square miles in extent, and where corundum is we may hope to find the gem forms of it, sapphire and ruby. There is, however, one mineral of the first rank of utility which we have not. Our Province emerged too early from the sea, and has stayed too persistently out of it. to favor the coal measures. We have neither anthracite coal nor bituminous. But may it be possible that in the bounty of Nature's compensations we have the pure carbon element in its gem form—the diamond? Are there diamonds in Ontario?

Interest and curiosity in this question have been aroused by papers published during the past year in two American magazines of good repute as scientific authorities. In the Journal of Geology for May-June, Professor William Herbert Hobbs of the University of Wisconsin, has dealt with it in an article entitled the Diamond Field of the Great Lakes; and in Appleton's Popular Science Monthly for November, the same writer discussed it in an article on Emigrant Diamonds in America. He had also written upon it in 1894, in the American Geologist, and has referred to it in other publications. Briefer notices have appeared at intervals in official reports and scientific records during a period of more than thirty years of isolated discoveries of diamonds in earth beds, rock debris and drift deposits in Atlantic, Pacific and Northern States, and mention may first be made of these as having precedence in the order of time.

There are newspaper accounts of the finding of diamonds in Virginia and North Carolina nearly fifty years ago; but the most authentic reports are in a paper by Dr. Genth on the Minerals of North Carolina, published in the Journal of the Franklyn Institute, November and December, 1871. The suggestive statement is there made that the diamonds were discovered in debris of old gneissoid rocks in which graphite is always found.

George F. Kunz of New York, who is an expert on precious stones, gave in the volume of Mineral Resources of the United States for 1883-4, accounts of a number of discoveries of diamonds in California, which usually were found in mines when cleaning up sluices or while washing off the bed rock, though in a few instances they were picked up on the surface. Fragments of diamonds had also been noticed in the tailings from quartz mills, being the remains of stones which had been broken under the stamps. In one locality they were found in the grey cemented gravel underlying a stratum of so-called lava or compact ash: but usually the gravel was mixed with lava, ashes or other volcanic matter, which gives a hint of the source of the stones. The paper of Mr. Kunz gives the first official notice of the finding of a diamond eight years before (in 1876) at Eagle, Waukesha county. Wisconsin, it having been thrown out with a bucket of gravel by a well-digger from a depth of 60 feet. This was the first Wisconsin diamond, and weighed 15 carats, but was slightly off color. "Having carefully examined a quantity of the gravel sent to different persons," Mr. Kunz wrote, "I have failed to find anything but the regular debris from glacial drift." One of the best methods of prospecting a new district for diamonds, in his judgment, is to familiarize the searchers with the lustre of real stones, for which purpose small imperfect crystals sold at $5 to $10 will suffice. "Several thousand searchers thus prepared would soon ascertain whether diamonds really existed, and the crystal would also serve for testing the hardness of the stone as well as the lustre."

Professor Hobbs has given a careful account of discoveries of diamonds in glacial drift since the finding in 1876 of the stone of 15 carats at Eagle, Wisconsin, mentioned by Mr. Kunz, to the finding of one weighing 6 carats of purest water at Milford, Ohio, in 1897. A tenant farmer s wife kept the Eagle stone seven years as a curious thing, and without faith in the old word, " Keep a thing seven years and turn it over," she sold it to a Milwaukee man in the jewellery business for one dollar. The jeweller submitted it to an expert, and was told that it was a diamond. Then the woman offered to re-purchase it for $1.10, and being met with a refusal she brought suit to recover its full value. The case was finally carried to the Supreme Court of the State, where a decision was given in favour of the jeweller on the ground that he, no less than the woman in whose well it had been found and who had kept it as a curious thing seven years, had been ignorant of the value of the gem when he bought it for a dollar. That stone has been purchased by Tiffany and Co., of New York, and is still uncut in the Tiffany collection. Another of the interesting incidents in the story of the Eagle stone is, that the discovery of it led to the booming of the property for diamond mines. In 1886 another stone was found by a farmer of Kohlsville, Wisconsin, while plowing in his field, and is still owned by his widow. The weight is 21¼ carats. In the years 1887, 1888, and 1889 the gravel bed of Plum creek in Wisconsin was prospected for gold, and ten or more diamonds were found, weighing from half a caret to two carats each, besides a number of microscopic size. Thsy were associated in the water worn gravel with garnets, gold, and platinum. Some were colorless, some bluish, and others yellowish. Late in 1893 a white diamond weighing nearly four carats was brought to Professor Hobbs by a farmer of Oregon, 12 miles south of Madison. The farmer's little son had found it while playing in a clay bank. It was this discovery that awakened the

Professor's interest in the subject of diamonds, and to it we are indebted for a number of valuable papers from his pen. Another diamond, reported to have been found at Burlington, Wisconsin, came into notice in 1893, but no particulars of it have been learned. In 1894 a stone weighing almost 11 carats was found in the glacial drift at Dowagiag, Michigan, on the Michigan Central Railway between Niles and Kalamazoo. The next reported find was in 1896, by a German farmer at Saukville, Wisconsin, but it had been in his possession 15 or 16 years. It was a white diamond of 6½ carats. The latest discovery mentioned by Prof. Hobbs was the one at the town of Milford, near Cincinnati. "No less than seventeen identified diamonds," he writes in the Journal of Geology, "varying in weight from half a carat to over two carats, have been discovered in the region of the Great Lakes of North America. That a considerable number of others have been found, which have not been reported because they escaped identification, hardly admits of reasonable doubt, when it is borne in mind that three of the stones found, including the two of largest size, remained in the hands of the farming population without their nature being discovered for periods of eight and one half, seven, and over fifteen years respectively. If it were possible to visit all the houses in the lake region," the Professor goes on to say, "I have no doubt that many diamonds would be discovered in the little collections of pebbles and local curios which accumulate on the shelves of country farmhouses. We have all seen these little collections of 'lucky stones,' as they are often called—or at least all of us who have visited at or lived in country homes—and to help in distinguishing diamonds from other stones (for we in Ontario are also in a morainic region), the following extract from Prof. Hobb's paper in Appleton's monthly may prove useful :—

"Diamonds never appear in thoroughly rounded forms like ordinary pebbles, for they are too hard to be in the least degree worn by contact with their neighbours in the gravel bed. Diamonds always show, moreover, distinct forms of crystals. They are never in the least degree like crystals of quartz, which are, however, the ones most frequently confounded with them. Most of the Wisconsin diamonds have either twelve or forty-eight faces. Crystals of most minerals are bounded by plane surfaces—that is to say, their faces are flat—the diamond, however, is enclosed by distinctly curving surfaces. The one property of the diamond, however, which makes it easy of determination, is its extraordinary hardness—greater than that of any other mineral. Put in simple language, the hardness of a substance may be described as its power to scratch other substances when drawn across them under pressure. To compare the hardness of two substances we should draw a sharp point of one across a surface of the other under a pressure of the fingers, and note whether a permanent scratch is left. The harder substances will always scratch the softer, and if both have the same hardness they may be made to mutually scratch each other. Since diamond, sapphire, and ruby are the only minerals which are harder than emery they are the only ones which, when drawn across a rough emery surface, will not receive a scratch. Any stone which will not take a scratch from emery is a gem stone, and of sufficient interest to be referred to a competent mineralogist."

All of the diamonds described in Prof. Hobbs' paper were obtained from deposits of glacial drift, except those found in the bed of Plum creek, which is in the near vicinity of glacial deposits. The localities of the discoveries are distributed over an area of 600 miles in length by 200 in breadth, and six or eight of them lie within an area of 200 miles square, with its centre near Milwaukee. Another important point is, that nearly all the localities are upon or near to kettle moraines. But before going on to deal with the probable source of the diamonds of these moraines, the question of origin will be considered.

In the view of Dana and other authorities the diamond has probably proceeded like mineral coal and oil from the slow decomposition of vegetable material, or from animal matters, which afford the requisite carbon. But it must have been formed under like conditions of heat as those which produced the metamorphism of argillaceous and arenaceous shales and their auriferous quartz veins, as it is found exclusively in gold regions or in the sands derived from gold-bearing rocks. The schists that were altered at the time may have previously been shales impregnated with petroleum, bitumen or other carbonaceous substances.

In the humid oxydations of carburetted hydrogen, Dana says, the hydrogen is oxydized, part of the carbon becomes carbonic acid, and the rest remains as carbon and may form crystallized diamond, just as sulphur is formed from hydrosulphuretted emanations. It has been observed, however, that the diamond crystal often contains microscopic cavities, so numerous in some stones as to render them nearly black, and under polarized light it showed evidence of compression, "as if from pressure in the included gas when the diamond was crystallized." In Brazil and the Urals the stone generally occurs in regions having a laminated, granular, friable quartz rock called itacolumite, while in South Africa it is found in place in a matrix commonly known as blue ground.

The first diamond workings in South Africa were commenced about a third of a century ago, in the gravel beds of the Orange and Vaal rivers, and in 1870 the dry diggings where the town of Kimberly now stands was discovered. Within a radius of 3½ miles four mines began to be worked, under conditions unlike those of any other known locality. What were at first supposed to be alluvial deposits were shown by the workings to be the vents or pipes of extinct volcanoes. The smallest of the four, known as De Beers mine, has a surface area of 22 acres; while the largest, known as Du Toits Pan, has an area of 45 acres. Operations were at first carried on by excavations of the diamond-bearing material, which for some distance from the surface was a soft, yellowish earth which crumbled readily when exposed. At 100 feet it became darker and harder, acquiring a slate blue or dark green color, ond resembled some varieties of serpentine. It is greasy to the touch, like serpentine, and is full of fragments of slate and other rocks. When exposed to the sun for some time it is readily crushed, and the diamonds are extracted by washing. In the De Beers mine two years ago the lowest workings had reached a depth of 1,500 feet, the method of mining adopted being to sink a shaft through the country rock and drive levels into the vent for stoping. In this way facilities have been afforded for a study of the geology of the Kimberley mines, but the scientists have not yet reached a stage of agreement upon all points. The shales which form the country rock underlie the district for many miles in every direction from the mines. In the opinion of some authorities the carbon for the diamond was supplied by these shales. The material of the neck, according to Prof Carvill Lewis, is a dark-green heavy rock, resembling a dense serpentine, in which one sees glistening plates of brown biotite, small deep-red garnets, large dark-green crystals or grains of olivine and bronzite, and a large number of angular fragments of altered black shale, so abundant as to give the rock a brecciated appearance. Olivine, he says, forms the most abundant constituent in the rock, placing it among the peridoties. There is also a large proportion of calcite, and among other constituents are pyroxene minerals, titanic iron, mica, apatite, talc, chalcedony, garnets and zeolites. In his second paper on the subject, read at the meeting of the British Association in 1887, Prof. Lewis said that explorations of the preceding few years had placed it beyond question that the serpentine rock called "blue ground" was in reality the matrix of the diamond. "Recent investigations," he wrote, "seem to place it beyond question that diamonds are as much a part of the Kimberly rocks as biotite, garnet, titanic and chromic iron and perovskite, and that, like these minerals, they may be considered as a rock ingredient. The fact that they continue just as abundant, if not more so, the deeper the mines are explored; that they are never found in, or especially associated with, the foreign inclusions of gneiss, granite or sandstone; that they are distributed abundantly through all parts of the rock; and that in each of the four principal mines the diamonds have distinctive features of color, lustre and shape, are, with the microscopical evidence of the eruptive character of the rock, strong reasons for holding that the diamonds now lie in their original matrix." *

On the other hand, Prof. Bonney, the Geologist of University College, London, and himself the editor of Prof. Lewis' papers, affirms in a paper read before the Royal Society last year that the blue ground is not the birthplace of the diamond, any more than of the olivine, garnets, pyroxenes and other minerals which it incorporates. A study of speci-

* Papers and Notes on the Genesis and Matrix of the Diamond, by the late Henry Carvill Lewis, of Philadelphia, edited from unpublished MSS. by Prof. T. G. Bonney, p. 44.

mens of eclogite from the Newlands mines † has convinced him that the diamond is as much a constituent of that rock as zircon may be of granite or syenite. His position is neither that the diamond was formed by the action of molten rock on carbonaceous material, nor produced in place by the action of steam or hot water in a subsequent solfataric stage of the volcano, but that it was formed like the garnets and pyroxenes "in some deep-seated holocrystalline mass which had not been scattered by explosions." The constituents of the blue ground, Prof. Bonney says, are chiefly water-worn pebbles of crystalline and sedimentary rocks, and probably have been supplied from the conglomerate which underlies the Kimberley or Karoo shales, and is supposed to be of Peruvian or Permio-carboniferous age. "If this deposit has supplied the boulders, the date of the genesis of the diamond is carried back, at the very least, to Palæozoic ages, and possibly to a still earlier era in the earth's history." This is as far as the English Professor goes. He does not suggest that the diamond was always diamond, nor that it it is anything else than pure crystallized carbon. And he does not gainsay the utility of volcanic force as an agency in the distribution of diamonds, even if through the dynamics of heat and pressure it had no lot or part in their genesis. It was the Kimberly volcanoes, or others like them, which brought to the earth's surface the diamonds first discovered in South Africa, in the lower valleys of the Vaal and Orange rivers.

Scientific theories are full of interest, especially when they are founded upon observed facts ; but although diamonds are said to have been produced in the laboratories of two or three men, no eye has witnessed the operation of the process in the alembics of Nature. We can gather and collate data, however, and in the clear light of

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† At these mines, in West Griqualand, the workmen occasionally come across well-rounded and boulder-like masses, some of which are a foot in diameter, of crystalline rock studded with garnets, and the specimens studied by Prof. Bonney were from these mines. One of them, which contained a number of imbedded diamonds, is described as a coarse-grained rock apparently composed of two green-colored minerals, one darker than the other (but possibly only different states of the same mineral), and of rich resin-pink colored garnets varying in size from a hemp-seed to a pea, with slightly irregular distribution. Putting aside the diamonds, the rock in its unaltered condition is a crystalline mixture of chrome diopside and garnet, with a few small enclosures of olivine, being a variety of eclogite and of igneous origin. "Take away the alkali from a magma with the chemical composition of a diorite, and the result would be garnets in place of felspar, *i.e.*, an eclogite."

facts and conditions we may reason our way to sane if not to positive conclusions; and having, as I think, built up a good working hypothesis, I come back to the question, Are there diamonds in Ontario?

It has been conclusively shown that there are diamonds in the glacial drift of Wisconsin, Michigan, and Ohio, for they have been found there. It has been conclusively established also that during the ice age the materials of the drift were borne down into those States from the Highlands of Ontario, for many of the stones, pebbles, and gravels constituting the drift are identical in composition and structure with varieties of ice-planed country rock which abound in regions northward of the great Lakes. From Ungava territory, east of Hudson Bay, and Keewatin territory, west of it, two great mantles of ice, moving south and south-west, shoved before them and carried with them all the disintegrated rocks, clays, sands, gravels, and boulders of every size. Whatever was loose on the face of the earth those ice sheets gathered up in their huge folds, to be broken and crushed and pulverised, and to be dumped off as one would unload a cart scores or may be hundreds of miles from the parent rock. The terminal moraine, which marks the southerly limit of the ice field, has been clearly traced across the States of New York, New Jersey, Pennsylvania, Ohio, Indiana, and Wisconsin; but there are many moraines of recession, whose positions are not so well known. One of the most important of these lies almost at our own door, known as the Oak Ridges in some sections of it, and in others as the Pine Ridges. It extends across the counties of York, Ontario, Durham, and Northumberland, but our geologists have hardly looked at it yet. Mention is made of it here merely to point out that it is very largely composed of materials derived from the rocks nearest to it—from the Hudson river, Utica, Trenton, and Black River formations. There are, of course, many fragments of crystalline rocks from the older formations; but as far as I have observed, the great body of the moraine has been built up with the debris of local rocks. The morainic ridges around Rochester, in New York State, are composed largely of material from the Medina sandstones and shales; and the terminal moraine in Pennsylvania consists chiefly of rock and earth carried down from formations which outcrop either in the northern counties of that State or from southern and central New York. There are, of course, many boulders and pebbles of Archaean formations, and I do not doubt that a good percentage are of Canadian origin. I have noticed, indeed, that when an American geologist comes upon a boulder of granite, or gneiss, or quartzite, he calls it a "Canadian." The fact is obvious, however, that glacial drift is not in the mass borne very long distances; and it would require good evidence to sustain the opinion of Professor Hobbs, that the moraines of Ohio, Michigan, and Wisconsin, in which diamonds have been found, are constructed out of materials carried upon ice or shoved forward by it a distance of 700 miles from the tableland of Ungava.*

We have not been looking for diamonds in Ontario, although Dr. Lawson and Dr. Coleman some time ago suggested the probability that they might be found in the Rainy Lake region. In his report on the geology of that region Dr. Lawson wrote: "The occurrence of bosses of serpentine suggests the possibility of diamonds, and some enterprising prospector may yet be rewarded for a close examination of the vicinity of the serpentine rocks indicated on the map, or of others that may be discovered, particularly if they be found near the carbonaceous schists that sometimes occur in the Keewatin."†

In these Keewatin rocks Dr. Lawson found evidence at several points of extinct volcanoes, one or two of which were of immense size. Dr. Coleman alluded to the matter in the Fourth Report of the Bureau of Mines, and in the Seventh Report he referred to the widespread occurrence of slates in the Keewatin, some of which have a graphitic look. He mentions one sample analyzed by Dr. Adams which gave 7.44 per cent. of carbon. But it will be said that these localities are too far west to supply drift material even for Wisconsin, as the direction of ice movement there was southwest. A locality in which con-

*Owing to their extreme hardness diamonds would be affected in very slight degree by wear and tear of glac[illegible] action; but as the ice was constantly losing part of its load, especially upon the southern slope of ranges of rocks, it is hardly conceivable that stones the size of diamonds would be carried the long distance of 700 miles.

†Report on the Geology of the Rainy Lake Region, by Andrew C. Lawson, p. 180, F. Geo. Sur. Report, 1887.

ditions equally favorable are presented is the north shore of Lake Superior, around Thunder Cape, where there is a thickness of not less than 1,000 feet of Animikie slate, cut through by numerous dikes of diorite with intrusive sheets of the same material which Lawson has shown to be laccolite sills. Logan counted thirteen of these dikes parallel to each other in a width of two miles, one of which has a thickness of 200 feet, and referring to the chert layers at Thunder Bay, in the report for 1846-7, he wrote: "Some of the chert bands appear to be made up of a multitude of minute, irregular, closely aggregated sub-globular forms, floating as it were in the siliceous matrix. and anthracite appears to be present in some of these, leading to the supposition that the color of the black chert, even where the sub-globular forms are not detected, may be owing to the presence of carbon." Another interesting fact is mentioned by Macfarlane, who found plumbago with copper, iron and magnetic pyrites on Pyritic Island, and that frequently large patches of the veinstone of Silver Islet were impregnated with graphite.*

In conditions like these, where carbonaceous slates have been subjected to the influence of molten rock in the forms of dikes and sills, under great pressure, I think we ought to look for diamonds and expect to find them. The likelihood is not less in a large dike than in a volcano neck, if one of the theories on the origin of diamonds is true; and we have been treated to too many surprises by new discoveries within the last ten years in Ontario to be deterred or dismayed by the man who says a diamond has never yet been found in a dike or a sill in a formation of carbonaceous slate. But there are numerous other localities in northern Ontario besides the region of Thunder Cape, where in like circumstances diamonds might possibly occur. I mention only one, the township of Balfour, near Sudbury, where a vein of anthracitic carbon was discovered four years ago in a formation of fissile slate. Analyses made by Dr. Ellis showed the vein matter to give 7.42 per cent. of fixed carbon and the slate 6.8 per cent. Samples of slate from the same region recently analysed gave as high as 13 per cent. of carbon.

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*The Canadian Naturalist, Vol. IV., New Series, pp. 461-463.

MEETINGS.

SUMMER MEETING.

ROSSLAND, B.C.

FRIDAY, 8TH SEPTEMBER, 1899.

During the excursion of the Institute to British Columbia the members attended a reception given in their honour, in the Miners' Union Hall, Rossland, Friday evening, 8th September, 1899. There was large attendance of the public and mining men.

Mayor Goodeve, who presided, in an excellent speech, extended a very hearty welcome to the members of the Institute, dwelling at some length upon the progress and prosperity of Rossland and the mines in its immediate vicinity.

Mr. Hardman, President, briefly and appropriately acknowledged the welcome and returned thanks on behalf of the visiting members of the Institute.

After the City Band had entertained the audience to a choice selection of instrumental music, Mr. W. F. Ferrier, for many years lithologist to the Geological Survey of Canada, and now an officer of the War Eagle Consolidated Mining and Development Company, gave an exceedingly interesting address on the geological conditions of the Rossland Camp. The veins of the camp, he stated, were true fissure veins; in fact, typical fissure veins, though they lacked the smooth, ultimate walls which were found in the "text book" veins, but which are the exception rather than the rule in actual mining. In Rossland mines the chemical solutions have in many cases obliterated the original planes which gave them access to the surface. There were in the camp several varieties of fissure veins which might be divided into three classes. First were those which had filled open fissures, probably of later occurrence than the others, and found, for instance, on O. K. mountain, where the filling was quartz, in which fine specimens of free gold are found. Second, the simple fissure veins, filled completely with metallic sulphides from wall to wall. The principal productive veins of Rossland belonged to the composite, or shearzone class, in which a series of parallel fissures have been mineralized, constituting, however, one vein system. The speaker said the replacement of the silicates in the country rock by mineral had been accomplished by the slow permeation of the formation by heated solutions from isolated reservoirs comparatively near the surface of the earth.

Touching on the values contained in the ores of the camp he gave an instance in which the ore carried over 4 ozs. of gold. The individual minerals in the sample, with the values in gold contained in a ton of each were: Pyrrhotite, 2.80 ozs.; mispickel, 21.24 ozs.; chalcopyrite, 130 ozs.; while the tailings carried 4 ozs., demonstrating that the values in that instance were mainly in the chalcopyrite. Referring to the working of the mines, Mr. Ferrier said the managers would find a system of assay plans, showing the distribution of values through the veins, of the greatest assistance in defining form and mode of occurrence of the pay shoots and in mapping out future operations.

Mr. W. A. Carlyle, Superintendent of the British America Corporation, was the next speaker. He said very few people, even in Rossland, realize the work going on down in the dark. One fact he mentioned, to give an idea of the extent of development in progress, was that in the B. A. C. properties there had been done over 23,000 feet of underground work. The work accomplished in Rossland had been development work, yet the camp had paid $1,400,000 in dividends. The work now being done is with an eye to the future, and the time is approaching when more and larger dividends will be paid. The policy of the Le Roi is to prepare still larger reserves of ore, and only small shipments, comparatively, have been made, yet the company has to its credit a sum that would make a very respectable dividend. He entirely agreed with Mr. Ferrier's remarks regarding the camp. It is a very hard district to work, but improved methods are being adopted and greater speed in working is being reached. In driving in the Le Roi, a rate varying from 110 to 160 feet a month is attained; with three shifts over 200 feet a month has been driven. The mine is equipped with a 40-drill compressor, which has proved equal to all demands, and this will be supplemented by a new 60-drill plant. The introduction of electricity, which is now being successfully applied to mining operations, will work wonders in the future. Speaking of the condition of the Le Roi, Mr. Carlyle said the consulting engineer of the London and Globe Finance Corporation, who had examined the property, thought so highly of it that he had agreed to a very extensive plan of development, and before long there would be a great increase in the amount of work carried on in the property which would add very materially to the prosperity of Rossland. He alluded to his approaching departure for Spain, where he will undertake the management of the famous Rio Tinto mines, and said he would retain the liveliest interest in Rossland. He predicted a wonderful future for the camp when the known veins are fully developed, and said still other veins would be disclosed in the mines.

Mr. Gerald V. Hopkins, of the B. C. Bullion Extraction Company, Limited, operating at Silica, followed with some details of the work being done at his company's mill, with a view to rendering profitable the low-grade ores of the camp.

Mr. F. H. Oliver, of the B. A. C. Corporation, favored the company with a couple of excellent songs and was followed by some humorous remarks by Mr. J. B. Hastings, managing director of the War Eagle.

Then came a capital song from Mr. E. Lorne Beecher, manager of the Deer Park mine.

Mr. E. B. Rathbone, late inspector of mines on the Witwatersrand, paid a high tribute to Mr. Ferrier's ability and the value of his address on the geology of the camp. He went on to say that when he first visited the camp, two years ago, he was greatly struck by the resemblance of the Rossland ore bodies to those of the Witwatersrand in one particular—the remarkably even distribution of the gold values throughout the ore. This condition was of very exceptional occurrence and of favorable significance. He was perfectly astounded, he said, to see the enormous amount of work that had been accomplished in the last two years. It was of the greatest importance that the outside public should be kept informed of the increased ore production and values, and he emphasized the necessity for the constant publication of information regarding the camp. To the managers of the mines he recommended the policy of sound, careful development work, in utter disregard of the demands for dividends made by shareholders. This province, he was sure, was about to experience one of the greatest mining booms the continent had ever seen, and he believed it would be concentrated in Rossland.

Mr. Feodor Boas, on behalf of the members of the Institute, and in an excellent address, moved a vote of thanks to Mayor Goodeve, the members of the Rossland Board of Trade, the citizens, the mine owners and managers for the generous hospitality and the liberal entertainment provided for the party that evening and during their visit to Rossland.

Mr. Hector McRae contributed a highly humorous review of the characteristics and peculiarities of a number of prominent mining engineers and mining experts, well known to the camp.

After a number of songs and recitations by Mr. H. Allan, W. J. Nelson, L. H. Webber and Jas. D. Sword, a thoroughly enjoyable and interesting evening was brought to a close by the singing of the National Anthem.

SUMMER MEETING.

NELSON, B.C.

TUESDAY, 12TH SEPTEMBER, 1899.

An Ordinary General Meeting of the Institute was held in Nelson, B.C., on Tuesday evening, 12th September.

There was a large attendance of members, local mine managers and mining men.

Mr. John E. Hardman, President of the Institute, occupied the chair.

The Chairman called the meeting to order at 8.30, and opened the proceedings with an address in which he stated he was glad to see so many of the citizens present at a meeting of the Canadian Mining Institute. He briefly referred to the aims and objects of the Institute and of the benefits which had already accrued through it to the members. He added that if any of the gentlemen present were desirous of becoming members he would be glad to have their applications handed in at once to the Secretary in order that they might be voted in at this meeting.

The minutes of the last meeting were held as read.

OBITUARY NOTICES.

The Secretary announced the death, since last meeting, of Mr. McGregor, mining engineer to the New Vancouver Coal Mining and Land Company at Nanaimo, B.C., and of Mr. Nelson, secretary-treasurer of the Intercolonial Coal Mining Company at Montreal.

NEW MEMBERS.

The following new members were elected:

J. B. Hastings, M.E., War Eagle Con. M. and Dev. Co., Limited, Rossland.
W. F. Ferrier, do do do
E. B. Kirby, do do do
A. A. Cole, do do do
R. A. Palmer, Le Roi Mining Co, Rossland.
Capt. T. R. Duncan, Duncan Mines, Limited, Nelson.
J. Roderick Robertson, London and B. C. Gold Fields, Limited, Nelson.
Ernest Woakes, M.E., Duncan Mines, Limited, Nelson.
Bruce White, Molly Gibson Mining Co., Nelson.
H. Montgomery, M.A., B.Sc., Ph. B., Trinity University, Toronto.
W. J. Sutton, M.E, Victoria, B.C.
E. Lorne Becher, Manager Deer Park Mine, Rossland.
L. H. Webber, Bullion Extraction Co., Silica, B.C.
G. V. Hopkins, do do

G. B. Meacham, Montreal.
J. Percy Taylor, Montreal.
D. J. McDonald, Mining Engineer, Rossland.
J. R. Giffard, Ontario Boulder Mining Co., Rat Portage.
Chas. Dundee, Dundee Gold Mining Co., Rossland.
A. B. Clabon, Rossland.
John Stevenson, Jr., Newcastle, Pa.
A. W. Crookston, M.E., Glasgow, Scotland.
John P. Kinghorn, Glasgow, Scotland.
John Knox, M.E., Calumet, Mich.
H. G. Nicholls, M.E., Nelson, B.C.
J. L. Parker, M.E., Rossland, B.C.
A. R. Heyland, M.E., Nelson, B.C.
Ronald Harris, M.E., Greenwood.
Alexander Sharp, Mine Supt., Greenwood, B.C.
R. W. Brigstock, Nelson.
H. A. Barton, Nelson.
Wm. Bennett, Rosekear Fuse Works, Rosekear, Cornwall, England.
G. W. Hughes, Idaho Mines, Idaho Basin, Slocan District, B.C.
John L. Vanstone, Nelson.
Robert B. Ross, Board of Trade, Montreal.
J. Herbert Larmonth, Mechanical Engineer, Ottawa.
Frank Robbins, Mining Engineer and Metallurgist, Phœnix, B.C.
A. C. Ross, North Sydney, Cape Breton.
Walter Ross, Rat Portage, Ont.
F. S. Wiley, Port Arthur, Ont.
C. B. K. Carpenter, Gaspé, Que.
Wm. Mann, Imperial Bdg., Montreal.
George T. Marks, Port Arthur, Ont.
W. G. Turner, Imperial Bdg., Montreal.
Ed. Wallingford, Perkins Mills, Ottawa Co., Que.
J. M. Harris, Sandon, B.C.
Geo. B. McDonald, Manager Noble Five Mining Co., Sandon, B.C.
Clarence J. Smith, Sandon, B.C.
Prof. G. R. Mickle, School of Practical Science, Toronto.
Bruce R. Warden, War Eagle Con. M. and D. Co., Rossland.
Edward C. Musgrave, M.E., Duncans Station, B.C.

Gold Dredging Machinery Admitted Free.

The Secretary intimated that by recent legislation at Ottawa gold dredging machinery was now admitted duty free. The following items would be of interest to those members interested in this industry in British Columbia and in the North-West Territory. An Order in-Council, under date of 26th June, 1899, provides:

"That the declaration of the Board of Customs that elevators of floating dredges used in mining submerged alluvial gold-bearing deposits, shall be free of duty under tariff item 555 as being elevators for hydraulic mining be approved—the Treasury Board so recommend."

The attention of dredging companies is also directed to tariff item 542, which provides:

* * * "And iron, steel or brass manufactures, which at the time of their importation are of a class or kind not manufactured in Canada, when imported for the construction or equipment of ships or vessels."

THE EIGHT HOUR LABOR TROUBLE IN BRITISH COLUMBIA.

THE PRESIDENT—I have been approached by one or two members of the Institute on the labor question, and I feel sure that it is quite within the Province of the Institute for any British Columbia member who may wish to do so to introduce a motion on that question and have it adopted. He called on Mr. Hill.

MR. LESLIE HILL—It is quite unexpected to me to have to speak on this question. There has been no resolution prepared, but perhaps one may be submitted later on. As you know, the passage of the eight hour amendment has been detrimental to this Province. The miners were being paid $3.50 per day, which I consider much too high a rate of wages. They were perfectly satisfied with the situation in every way. I do not think the trouble arose with the miners at all. It has been said men can do as much work in eight hours as in ten. It has been the custom here that where men have had to work in wet drifts or wet ground they have only worked eight hours, but in the Slocan mines, in particular, the ore has been stoped in dry stopes. There we cannot hurry them, because they have to sort the ore carefully, and there is no advantage in working eight hours, and it is absurd to say they can do as much in eight hours as in ten. This action of the Government has been very unfortunate and it had been very detrimental to the mining interests in this Province.

MR. H. E. CROASDAILE—I understand, Mr. President, that it is the intention to bring in a resolution affecting this question later on to which members can speak.

PAPERS READ.

THE PRESIDENT—Very well: we will then proceed to the regular business of this meeting. On the printed programme there are enumerated five papers to be read at this meeting, but I may now announce that I have had a letter of regret from Mr. Pellew-Harvey that he has been unable to get his paper ready in time for presentation at this meeting. I have also a letter from Mrs. Blakemore, informing me that her husband has been, and is still, ill with typhoid fever, and therefore unable to finish his paper in time for this meeting. I therefore must first call upon Mr. S. S. Fowler to read his paper on mining and milling practice at the Ymir mine. Mr. Fowler, gentlemen, is one of those men who require no introduction to this audience.

The Ymir Mine and Mill.

Mr. Fowler then read his paper on "The Ymir Mine and its Milling Practice" (reproduced elsewhere in the Journal), at the conclusion of which the President spoke of the great interest of the paper and invited discussion.

Mr. Woakes (Duncan Mines, Limited)—I would like to ask Mr. Fowler what he said the extraction was?

Mr. Fowler—Of the total extraction of gold, 82 per cent. is recovered in bullion by amalgamation.

Mr. Woakes—You said the pulp in the battery tended to bank up in the end of mortar. Do you think that is due to the issue being too high?

Mr. Fowler—Possibly; but I hardly think so.

A Voice—How do your stamps drop?

Mr. Fowler—1, 3, 5, 2, 4.

The President—My own experience some years ago, when milling in North Carolina, was of a similar nature, as I found the ore banking in one corner or end of the mortar. I was able to prevent this by changing the order of drop of my stamps to 1, 5, 2, 4, 3, and I would like to suggest that possibly a change in the order of drop at the Ymir mill would remedy this banking action. I would like to ask Mr. Fowler if the 12 ft. copper plates mentioned are silver plated for their whole length?

Mr. Fowler—Yes.

The President—At what depths do you get the carbonates referred to?

Mr. Fowler—At 115 feet. They do not go down over 200 feet.

The President—Are they accompanied by a watercourse?

Mr. Fowler—No, they are perfectly dry.

The President—I noticed one other thing in Mr. Fowler's paper, which was an allusion to a method of feeding water to the stamp battery, mentioned by Mr. Bernard MacDonald in a paper contributed to this Institute last March. I should be very glad indeed to have the method tried at the Ymir mill, as in other cases than the one quoted by Mr. MacDonald it has been found that the regulation of the water supply was a matter of great difficulty, and that the usual result of this method of feeding water was to make the dies wear unevenly by leaving the coarser material upon one side of the die.

Col. Hay (Port Arthur)—I wish to ask Mr. Fowler in what form the carbonates are found?

Mr. Fowler—So far as we have gone the stopes in that material are not over 25 feet in length, and the strike is parallel with the vein. That body is fairly continuous; no break in the body so far as gone. It is perfectly continuous so far for about 25 feet.

On the Small Economies in Mining.

Mr. Howard West, A.R.S.M., New Denver, presented his paper on this subject (reproduced elsewhere in the Journal).

Mr. DICK—I would like to ask Mr. West whereabouts and when, in Quebec or in the Lower Provinces, has ore carrying 10 per cent. lead and 6 ozs. silver to the ton been mined profitably?

Mr. BELL—We have the Government Inspector of Mines for Quebec, Mr. Obalski, here to-night with us, and I think Mr. Obalski can answer that question if anyone can. I might say, however, that several carloads of high-grade argentiferous galena have been shipped this year to Belgium from the Grand Calumet mine in Pontiac county, and several shipments have also been made from the Zenith mine at Rossport, on the north shore of Lake Superior, in Ontario.

THE PRESIDENT—I might refer to one machine which Mr. West has spoken of in his paper, viz., of the Wilfley table, as being most efficient. It is now being used in one of the largest concentrators in the greatest copper camp in the world, viz., Butte, Montana, and used successfully. I think I may also say that a modification of almost all the concentration plants which have heretofore gone into the Slocan district would tend to effect a great saving.

Mr. West has asked us in his paper to look up the meaning of the word "economy and has given us the definition. If I have understood his language rightly there was an economy when the saving resulting from an operation was greater than the expense connected therewith, or in other words when the amount expended was less than the amount realized. I must question this as being a definition of economy. I think rather that it is a definition of "profit." For example—a man may be producing an ore, realizing a total amount of $10 per ton, and the expense attendant upon the realization made be $12 per ton. Now if a new management comes into effect which produces that same $10 at a cost of only $11, obviously an economy has been effected, bnt there has been no profit because the amount expended has been greater than the amount realized. I would suggest a revision of this definition.

Attention to small economies in the Province of Ontario during the last year or so has changed the condition of some mines there very materially. I might say (although not pertinent to this discussion) that I have had occasion to go through that country frequently as well as through British Columbia, and that the opportunities for small economies are greater in Ontario by far than in British Columbia.

Mr. R. C. CAMPBELL-JOHNSTONE—I might say in regard to some of the points which have been mentioned by Mr. West in his paper that silver values do not always run with lead values, and that the losses of silver in the Slocan are due to losses of mineral which is not in combination with the lead ore of the vein.

Mr. FOWLER—I consider the problems of concentration of very great importance. I have had to do within the last year with one of the more recent mills in that country, namely, the Whitewater. I had hoped to be able to prepare some notes on operations at the Whitewater, but I have been too busy to put them together in form. However, as Mr. Johnstone suggests, I can back him up in saying that the principal losses in silver in the Slocan are due to losses in silver not in combination with lead.

We find in the Whitewater there is silver in slate, silver in siderite, in quartz and in calcite, and often we cannot get any lead even by wet tests.

Another matter attention should be called to is the system of making lead assays by fire. We have found by repeated tests that the fire assays when applied to such material as low-grade tailings do not afford a reliable index to the efficiency attained—for a fire assay of lead showing, say, ½ of 1 per cent. might become 2 per cent. by wet method, and while there might be an apparent efficiency of 80 by the former, the latter might only show 50. I would point out that it is a matter of extreme importance in this or any other country that lead assays by fire are not dependable upon very low-grade material, and there should be a more general adoption of wet lead tests, thus permitting the exact study of means leading to increased savings.

COL. HAY—Our friend (Mr. West) who has just read this paper, thought it very advisable to put a man in charge of a mine who, whether or not practical, is theoretical, and it is often overlooked that a man who is a mining engineer may be both, but for that reason his mind is so much absorbed with the details of mining that he is apt to overlook the business detail. There is as much room for economy in business detail of mine management as in the technical.

MR. WEST (replying to Mr. Fowler)—There is one method effective when ore is not too low in lead: if you put a certain amount of silver in the crucible with the lead, etc.

MR. LESLIE HILL—In regard to what Mr. Fowler says about the presence of silver in lead, in the Vancouver mine we find that we actually shipped ore higher in silver in 40 per cent. lead than in 60 per cent. lead.

A paper on "The Bridge River Gold District, B.C.,' was presented by Mr. Fritz Cirkel, M.E., Vancouver, and read by title.

THE PRESIDENT presented a paper on "A Method of Cost Accounting" (reproduced elsewhere in the Journal).

THE EIGHT HOUR LAW.

THE PRESIDENT—Now that all the papers have been read we are ready to receive any resolution which will open for discussion this vexed question of the eight hour law in this Province.

MR. CROASDAILE—We take this matter up as the Institute is interested in mining throughout the Dominion, and as this matter affected mining in this district. We lately had legislation imposed on us which was not desired, and a class of legislation generally approached with the greatest caution, interfering as it does with freedom of contract. In New Zealand, where labor legislation has been carried to the greatest extreme, there is no interference with freedom of contract. In the British Columbia Legislature at the end of the session legislation was brought in interfering with freedom of contract. Men can work in railway tunnels 12 to 14 hours, but because it is the mining industry men cannot work more than 8 hours. I do not want to go into the political part of the question. I therefore beg to move the following resolution :

"Be it resolved that this Institute feels the necessity of recording its strong dis-"approval of recent legislation in this Province, legislation that was unasked for by "the miners and which interferes with freedom of contract by restricting the hours of "labor underground; the which has led to the closing down of many active mines in "this Province and has caused a disturbance of the cordial relations which had "hitherto existed between capital and labor.

"Also resolved, that the Council of the Institute be authorized to take such "action in the matter as it might think fit, and forward a copy of this resolution to "the Hon. the Minister of Mines for the Province of British Columbia."

Mr. LESLIE HILL—I beg to second this resolution.

Mr. BELL—What steps have been taken by the mine operators themselves to have the obnoxious legislation repealed? I suppose you would like to have the Institute as a body take action upon the resolution?

Mr. CROASDAILE—I do not know whether the local house would be much influenced by what the Institute thought, but we would be glad if the Institute saw fit to take any action in the matter.

THE PRESIDENT—I may say that many of the members from the East have only heard of this Act through the newspapers. The distinction is made that men can be employed on railway work underground for as many hours as they like, whereas mining companies can only employ men for eight hours underground.

Mr. J. R. ROBERTSON—I would like to say that this matter has been discussed by most companies and in the general press of the Province. At a recent meeting held in Rossland of the Associated Boards of Trade of British Columbia, a strong resolution was passed and sent to the Minister of Mines requesting the withdrawal of this legislation. That is the position the Boards of Trade of British Columbia have taken on this matter.

Mr. FOWLER—I might also remark that not only have the Boards of Trade sent this request to the Government, but soon after we learrned of the importance of the legislation passed, delegations proceeded to the Coast representing this district, the Slocan and the Rossland districts, presenting their views and requesting the rescinding of this legislation.

THE PRESIDENT—Have the mining men obtained a legal opinion as to the validity of this section of the Act?

Mr. FOWLER—Yes; it is not unconstitutional.

Mr. CROASDAILE—We had the privilege of a visit from the Minister of Mines, who introduced this amendment to the Mines Inspection Act, but in answer to a question by myself, the only request the Government received for this legislation was from one member of the Rossland Union, but the Government took no steps whatever to ascertain the views of the employers of labor, or to take the views of the miners throughout the Province, but considered it advisable to bring in a resolution and smuggle it through the last session of the House without anyone knowing about it.

THE PRESIDENT—Is this a paragraph of the Mines Inspection Act?

Mr. CROASDAILE—Yes.

Mr. ROBERTSON—The clause as at first printed referred simply to boys under sixteen yhars of age. There was no mention of the eight-hour clause for adult miners, and it was brought in as an amendment on the 24th of February and the Legislature prorogued on the 27th, and there was no getting of newspapers before that date. The whole thing was run through without any discussion of the matter.

Mr. CROASDAILE—In our own mines we occasionally work three shifts, but it is exceptional. Most mines cannot work three shifts, and the result is the actual production of the mine is reduced from 20 hours to 16. It might be argued that we can put more men on, but you cannot where only two shifts can be worked. There is only room for so many men in the stopes and drifts, and naturally the output of the mine is actually lost by about 15 per cent. owing to this legislation.

Mr. ALEX. DICK—I doubt very much whether it is advisable for this Institute, representing all of the Provinces, to interfere in local matters in British Columbia. I do not know that at any meeting we ever had in Nova Scotia the Canadian Mining Institute ever took any prominent part, and I think, Mr. President, you will bear me out in that statement. I believe out here the mine owners have formed associations, and no doubt any moral support given by the members as a whole would be welcome, but I doubt whether it would be wise for the Institute to take any action.

THE PRESIDENT—I must take exception to one of the words Mr. Dick has used, viz., "interfering". It is not interfering in local matters in British Columbia to have this Institute discuss a matter which is of vast importance to the Province's interests. Furthermore the language of the resolution only records "strong disapproval" of the Government's action.

Mr. BELL—I think this is a question upon which the Institute may be fairly called upon to exert its influence. Any legislation which is so detrimental to the successful development of the mining industry as this eight-hour Act has proved itself to be in the Slocan, should be combatted by the mine owners and mine managers, not only of this Province, but by their confreres in the other sections of the country. The Institute, while partaking largely of a technical character, is, I take it, primarily a protective organization. It has been so in the past. Mr. Croasdaile's resolution appears to me to be perfectly in order, and I think we shou'd do all we can as an Institute to secure a repeal of this obnoxious interference with the mining industry of the Province.

Mr. ALEX. DICK—I think an appeal should be made to the Federal authorities at Ottawa praying for a repeal of the Act, and at the same time we would be doing a greater service to British Columbia than by petitioning the Provincial Government, which is to my mind a repetition of what has already been done.

Mr. CROASDAILE—There has been no resolution sent to the Government by the local organizations. I do not know what your methods are, but I think it is a perfectly legitimate matter for the Institute to take up.

The resolution was then re-read, put to the meeting and carried.

Publications.

Mr. Bell—I should be pleased to have our British Columbia members express their opinion upon the present form of our publications. It has been suggested by some of our members that instead of the bound volumes we should issue in pamphlet form the proceedings of eaeh meeting and the papers which are read separately. These pamphlets might be issued immediately after a meeting, and by being paged continuously could be bound for those members who desired to have bound copies at the end of the year. The point to be gained would be an earlier publication of individual papers than is possible in a bound journal on the lines of our publication hitherto.

Mr. Croasdaile—I think we find it most convenient to have the book in its present form.

Votes of Thanks.

Mr. Feodor Boas—I think it will be in place for the Institute to express its thanks to the two British Columbia gentlemen who have favored us with papers. I am sure all those who have listened to Mr. Fowler have been struck with the excellence of his paper. Mr. West has given the mining men ample room to think also.

Mr. Boas referred in eulogistic terms to the great and brilliant future of British Columbia, and said that the Institute would use every effort to make known its great mineral wealth that only needed capital to develop, and concluded with a warning against bogus companies and wildcat schemes.

Mr. Stevenson—I have pleasure in seconding this motion of Mr. Boas'. I consider the eight-hour law most serious, and think very little capital will come into British Columbia so long as such obnoxious laws are on the Statute Books, and when the mining men get together and do some missionary work with the Provincial Legislature and get that Act repealed the mining situation will be much improved.

The Secretary submitted the following:—*Resolved*, that the members place on record in the minutes of this meeting their hearty appreciation of the many kindnesses and courtesies extended to the members and the very excellent local arrangements which had been made for them during their excursion to British Columbia, and that the Secretary be authorized to send a letter of thanks at the earliest opportunity to the Canadian Pacific Railway; the H. W. McNeill Co., Limited; Mr. Douglas, Superintendent of the National Park; the officers and staff of the British America Corporation, Limited, and the War Eagle Con. M. and Dev. Co., Limited; the Mayor, Corporation and Board of Trade of Rossland; the officers and staff of the Canadian Pacific Smelting Works, and to Messrs. H. W. Croasdaile, S. S. Fowler and Captain Troop at Nelson.

These resolutions being carried unanimously, the meeting adjourned.

ANNUAL GENERAL MEETING.

MONTREAL.

WEDNESDAY, THURSDAY, FRIDAY, 7TH, 8TH AND 9TH MARCH, 1900.

The Third Annual General Meeting of the Institute was held in the Club room, Windsor Hotel, Montreal, on 7th, 8th and 9th inst. The following signed the register of attendance :—

Mr. S. S. Fowler, S.B.M.E., London & B.C. Gold Fields, Nelson, B.C.
Mr. Charles Fergie, M.E., Intercolonial Coal Co., Westville, N.S.
Mr. David G. Kerr, C. & M.E., Cordova Exploration, Ltd., Marmora, Ont.
Mr. P. Kirkgaard, M.E., Canadian Gold Fields, Ltd., Deloro, Ont.
Major R. G. Leckie, Can. M. and Metallurgical Co., Sudbury, Ont.
Major-Gen. Sir Henry C. Wilkinson, Regina (Can.) Mine, Rat Portage, Ont.
Mr. Charles Brent, Metallurgist, Rat Portage, Ont.
Mr. A. M. Hay, Dominion Gold Mining & Reduction Co., Rat Portage, Ont.
M. Leslie Hill, C. & M.E., Vancouver, B.C.
Mr. H. M. Wylde, Sec. Mining Society of N.S., Halifax.
Dr. Robert Bell, Geological Survey, Ottawa.
Dr. J. Bonsall Porter, McGill University, Montreal.
Prof. W. G. Millar, School of Mining, Kingston.
Dr. W. L. Goodwin, School of Mining, Kingston.
Mr. Russell L. Blackburn, Blackburn Mine, Ottawa.
Mr. J. B. Tyrrell, M.A., M.E., Dawson, N.W.T.
Mr. R. G. McConnell, Geological Survey, Ottawa.
Mr. A. P. Low, Geological Survey, Ottawa.
Mr. J. C. Gwillim, Geological Survey, Ottawa.
Mr. R. W. Brock, Geological Survey, Ottawa.
Mr. Archibald Blue, Director of Mines, Toronto.
Mr. J. Obalski, Inspector of Mines, Quebec.
Mr. J. W. Evans, C. & M.E., Sudbury, Ont.
Mr. James Johnston, Crow's Nest Pass Coal Co., Fernie, B.C.
Dr. A. E. Barlow, Geological Survey, Ottawa.
Mr. Theo. C. Denis, Geological Survey, Ottawa.
Mr. A. W. Fraser, Ottawa.
Mr. J. M. Clark, Q.C., Toronto.
Prof. Courtenay DeKalb, School of Mining, Kingston, Ont.

Mr. J. F. Higginson, Buckingham, Que.
Mr. W. F. Holland, Victoria Nickel Mine, Whitefish, Ont.
Mr. Eugene Coste, M.E , Prov. Nat. Gas. and Fuel Co.. Toronto.
Mr. Wm. Blakemore, M.E., Montreal.
Mr. Feodore Boas, Montreal.
Mr. R. T. Hopper, Montreal.
Dr. Frank D. Adams, McGill University, Montreal.
Mr. George E. Drummond, Canada Iron Furnace Co , Montreal.
Mr. James T. McCall, Montreal.
Mr. C. E. Morgan, Northey Pump Co., Toronto.
Mr. Robert Jaffery, Crow's Nest Pass Coal Co., Toronto.
Mr. George MacDougall, Montreal.
Mr. A. W. Stevenson, Montreal.
Mr. A. W. Morris, Montreal.
Mr. S. J. Simpson, Jas. Cooper Manufacturing Co., Montreal.
Mr. E. W. Gilman, Canadian Rand Drill Co., Montreal.
Mr H. W. DeCourtenay, Firth Steel Co., Montreal.
Mr. J. Stevenson Brown, Montreal.
Mr. J. Burley Smith. M.E., Montreal.
Mr. F. H. Hopkins, Dominion Wire Rope Co., Montreal.
Mr. James D. Sword, Rossland, B.C.
Mr. Thos. P. Bacon, New Rockland Slate, Co., Montreal.
Mr. Robert Meredith, Montreal.
Dr. James Reed, Reedsdale, Que.
Mr. Dwight Brainerd, Hamilton Powder Co., Montreal.
Capt. E. C Adams, Montreal.
Mr. B. T. A. Bell, Editor CANADIAN MINING REVIEW, Ottawa.
And a party of mining students from the Kingston School of Mines and McGill University.

The proceedings opened at 10.30 on Wednesday morning. In the absence of the President, Mr. George E. Drummond was called to the chair. The minutes of the last annual meeting having been published in the Journal of the Institute were, on motion, held as read.

NEW MEMBERS.

The following were elected to membership :—

Mr. Henry S. Poole, M.A., A.R.S.M., Mining Engineer, General Manager Acadia Coal Co., Stellarton, N.S.

Mr. Sydney B. Wright, Chemist and Metallurgist, Canadian Gold Fields Ltd.. Deloro, Ont.

Mr. E. A. Daly, Mining Engineer, General Manager Dufferin Mines, Nova Scotia.

Mr. Arthur G. McNaughton, Mine Manager, Bluenose Gold Mining Co., Goldenville, N.S.

Mr. David G. Kerr, Mining and Mechanical Engineer, General Manager Cordova Exploration, Ltd., Marmora, Ont.

Mr. William Francis Little, Colliery Manager, General Manager H. W. McNeill Co., Ltd., Anthracite, N.W.T.

Mr. James Johnstone, Colliery Manager, General Manager Crow's Nest Pass Coal Co., Fernie, B.C.

Mr. Douglas John Gillon, O.L.S., Civil Engineer, Fort Frances, Ont.

Mr. E. R. Faribault, B.A.Sc., Geologist, Geological Survey, Ottawa.

Mr. E. Nelson Fell, A.R.S.M., Mining Engineer, Athabasca Gold Mine, Ltd., Nelson, B.C.

Mr. F. H. Clergue, Sault Ste. Marie, Ont., General Manager Lake Superior Power Co.

Mr. A. P. Turner, Canadian Copper Co., Copper Cliff, Ont.

Mr. McMillan, Mine Manager, Mikado Gold Mining Co., Rat Portage, Ontario.

Mr. Pengelly, Metallurgist, Mikado Gold Mining Co., Rat Portage, Ont.

Mr. W. H. Holland, Whitefiish, Ont.

Mr. Charles Meyer, Ottawa, Ont.

Mr. A. W. B. Hodges, Supt. Granby Consolidated Mining & Smelting Co., Grand Forks, B.C.

Mr. A. Mackenzie, Dominion Coal Co., Montreal.

Mr. E. A. Haggen, Assayer, Golden, B.C.

Dr. Carl Hoepfner, Hoepfner Refining Co., Hamilton, Ont.

Mr. John Patterson, Hamilton.

Mr. Walter S. Keith, Mining Engineer, Greenwood.

Mr. J. Walter Wells, Assayer, Belleville, Ont.

Mr. G. Herbert Dawson, Vancouver, B.C.

Matthew T. Hunter, Managing Director Wendigo Gold Mining Co., Rat Portage, Ont.

Robert Rogers, Managing Director Bullion Gold Mining Co., Rat Portage, Ont.

Alan Sullivan, Manager Anglo-Canadian Gold Mining Co., Rat Portage, Ont.

Dr. S. S. Scovil, Mine Owner, Rat Portage, Ont.

Mr. E. F. Kendall, Mine Owner, Rat Portage, Ont.

Mr. Paul Johnson, Metallurgist B.C. Copper Co., Greenwood, B.C.

Mr. W. T. Rodden, Hamilton Powder Co., Montreal.

Mr. D. M. Sexton, Canada Life Building, Montreal.

Mr. J. M. Clark, Q.C., Toronto.

Mr. G. S. McAvity, St. John, N.B.

Captain John Lawson, Mining Engineer, Canadian Copper Co., Sudbury, Ont.

Prof. Courtenay DeKalb, Mining Engineer, School of Mining, Kingston, Ont.

STUDENT MEMBER.

Mr. M. M. Campbell, 68, St. Famille street, Montreal.

SECRETARY'S REPORT.

The SECRETARY submitted the following review of the operations of the Institute during the past year :—

" It is extremely gratifying to be able to congratulate the members upon the continued growth and success of the Institute during the past year.

MEMBERSHIP.

" When the Institute was re-organised on its present basis, in March, 1898, our membership numbered 63 ; at our last annual meeting it had been increased to 193. while during the past year we had no fewer than 297 members, including 15 students, on our register. The distribution of this membership may be gathered from the following comparative statement :—

	1899.	1898.	Increase.
Province of Quebec	77	66	11
" Ontario	68	44	24
" British Columbia	65	42	23
" Nova Scotia	16	16	—
" New Brunswick	1	2	—
North-West (including Yukon)	5	5	—
Newfoundland	1	—	—
United States	17	11	6
Great Britain	9	4	5
China	1	—	1
Honolulu	1	—	1
Spain	1	—	1
Died since last report	4	1	3
Address unknown	1	—	—
Struck off for arrears	15	—	—
Resignations going into force at 1st March	4	—	—
Student Members	15	2	—
Applications for Membership on hand	34	—	—

" (NOTE.—Since the above summary was prepared, it has been learned that three members, Messrs. Hamilton Merritt, J. E. Leckie, and Thos. Brown, are serving with the colours in South Africa.)

OBITUARY.

"Since our last annual meeting, the Institute has to deplore the loss of the following members by death :--

"Mr. James MacGregor, Mining Engineer to the New Vancouver Coal Mining and Land Co., Nanaimo, B.C., killed by an unfortunate accident in the pit.

"Mr. W. J. Nelson, Secretary-Treasurer of the Intercolonial Coal Co., Montreal, a gentleman widely known and highly respected in the Upper Canada coal trade.

"Mr. Maurice A. Bucke, of Kaslo, B.C., a mining engineer, occupying a prominent position in the profession, killed in a runaway accident in Montana.

"Col. T. J. Tuck, of Sherbrooke, one of the oldest members of the Quebec Association.

MEETINGS, PAPERS, AND EXCURSIONS.

"At our Annual General Meetings held in March, twenty-three papers were presented, and these, together with the discussions and proceedings, have been published in the second volume of our Journal, issued to members in July. Many of these papers have been reproduced in European and American technical journals and magazines.

"In September a party of the members enjoyed a most delightful and highly interesting excursion to some of the prominent mining districts of British Columbia, visiting the collieries at Anthracite, the Hot Springs and National Park at Banff, the Le Roi, War Eagle, Centre Star, Columbia, and Kootenay and other mines of the famous Rossland Camp, the Pelatin-Clerici Mill at Silica, the Smelting Works at Trail, and the Silver King and Athabasca mines and the Hall Mine's Smelting Works at Nelson.

"At every point touched by this excursion our members were received with the greatest courtesy and kindness, and in many instances with the most lavish hospitality.

"Through an unfortunate and greatly to be regretted misunderstanding, the party, as a whole, did not visit the celebrated Slocan district, where considerable trouble and expense had been gone to by the authorities at Kaslo and other points to make the visit profitable and enjoyable. Those members who did visit this district speak in the highest terms of their reception and entertainment.

"Smaller parties visited the Boundary District and Pacific Coast.

"Largely attended and thoroughly successful meetings were held at Rossland and Nelson, the papers and proceedings of which have been withheld by the Council, pending the publication of Volume III. of the Jonrnal, of which some 90 pages have been printed.

" Five meetings of Council, most of them held in conjunction with the Library and Executive Committee, were held during the year. There were also held four meetings of special committees.

CIVIL ENGINEERS' BILL.

" In accordance with the action taken at the Annual General Meetings, Mr. Coste and myself appeared before the Private Bills Committee of the Ontario Legislature in opposition to the Bill concerning the practice of engineers promoted by the Canadian Society of Civil Engineers. The Bill was given the six months' hoist.

" Subsequently, I had several interviews with delegates from this Society in the hope that some compromise might be effected satisfactorily to the members of both organisations.

" On 3rd January, the Canadian Society tendered the following amendment to Section 2, clause E of the Act :—

" ' Unless he is at the time of passing this Act, a member in good standing of the Canadian Mining Institute who is practising as a mining or metallurgical engineer; or a person engaged in the management or operation of mines or metallurgical works, until and for such reasonable time (not exceeding two years) as may be required by the Canadian Society of Civil Engineers and the Canadian Mining Institute to agree upon a basis of joint action for the advancement of the profession of Civil Engineers in this respect.'

" This Amendment was considered by a committee of mining and mechanical engineers, members of the Institute, who reported to the Council that, in their judgment, the time was not ripe for the introduction of exclusive legislation affecting the profession and practice of engineers in Canada. It was therefore referred back to Mr. Coste and myself to take whatever action might be necessary to defeat the Bill in Ontario or in any of the other Provinces.

CUSTOMS AMENDMENTS.

" Acting on behalf of our members engaged in dredging for gold in British Columbia and the North west Territories, I had several interviews with the Commissioner of Custams which resulted in an Order in Council being passed in June whereby gold dredging machinery and appliances were added to the Free List.

EXEMPTION OF MINERAL PROPERTY FROM MUNICIPAL TAXATION IN QUEBEC.

"I am also pleased to be able to report that in reply to representations made on behalf of the Institute a Bill passed its third reading during the present Session of the Quebec Legislature, exempting mining property from municipal taxation in that Province for a further period of ten years.

GEOLOGICAL SURVEY.

"The resolutions adopted at the annual general meetings concerning the value and importance of the work of the Geological Survey of Canada to the mining industries of the country, were duly forwarded to the Hon. the Minister of the Interior, and it is a matter for satisfaction that several members of the staff of that excellent institution have since received a more fitting recognition of their services by an increase to their salaries. There is also a likelihood of an appropriate grant being soon placed in the estimates whereby the Government will provide this Department with a safer and more commodious building for its work and the housing of its unsurpassed collections.

EIGHT HOUR LABOUR LEGISLATION.

"At our Nelson meeting a resolution strongly disapproving of and asking for a repeal of the Eight Hour Labour Law enacted by the Legislature of British Columbia. was unanimousiy adopted and forwarded to the Hon. the Minister of Mines for that Province

THE LIBRARY AND READING ROOM.

"The collection of books in the Library has been materially increased during the year, notably by the additions of the volumes necessary to complete our set of the transactions of the American Institute of Mining Engineers, various Telegraphic Codes, and a number of the best standard works of reference on mining and metallurgical practice. Many of our periodicals, exchanges, and magazines have been suitably bound, and a series of handsome cases provided for our pamphlets and loose literature.

ENQUIRY BRANCH.

"During the year I have answered numerous inquiries and given information respecting our resources and mining industries to yisitors, and in some instances have furnished extended reports upon particular industries to Banks, Members of the Administration, &c.

GOVERNMENT GRANT.

"The work of publication and the maintenance of our Library has been greatly assisted by the grant of one thousand dollars given to us during the past two years by the Dominion Government through the offices of our good friend the Hon. W. S. Fielding, the Finance Minister, and I am also pleased to report that through his consideration the amount has again been included in the estimates for the ensuing year.

" The above briefly summarises the features of the work and operations of the Institute during the past year and is respectfully submitted."

MEMBERS SERVING IN SOUTH AFRICA.

The SECRETARY,—It will interest the meeting to learn that three of our members were at the present time on active service. Mr. Hamilton Merrit, of Toronto, was with Brabant's Horse, doing gallant work in South Africa. Mr. J. Edwards Leckie, of Greenwood, was serving as a lieutenant with Strathcona's Horse, and only that morning he had received a letter from Cape Verde Islands from Mr. Thomas Brown, an assayer, late of Nelson, stating that he was serving as a trooper with the 2nd Battalion Canadian Mounted Rifles, but hoped to return in time for the next annual meeting, when perhaps he would give them a paper on lyddite (laughter). As a slight recognition of the services of these gentlemen to the Empire he now moved that their subscriptions for the ensuing year be remitted. (Applause.)

The motion was unanimously agreed to.

THE LATE MR. HENRY BUDDEN.

The SECRETARY made a touching reference to the recent death of Mr. Henry A. Budden, for many years prominently identified with the coal trade of Nova Scotia. The late Mr. Budden took a keen interest in the work of the Institute, and would be greatly missed.

THE PROGRESS OF MINING IN CANADA DURING 1899.

The SECRETARY,—Coincident with a report upon the work of our Institute, it would perhaps not be out of place to present a few notes summarising the progress of mineral development during the past year. The following figures would approximately represent the net value of the output of minerals :—North-West Territories (including Yukon) $18,000,000; British Columbia, $11,000,000 ; Ontario, $8,500,000 ; Quebec, $3,000,000 ; Nova Scotia and New Brunswick, $8,000,000—or a total production, roughly speaking, of about $48,000.000—an increase of quite $10,000,000 over the previous year. (Applause). The following notes had been supplied by the courtesy of the officers of the various Departments of Mines :—

YUKON GOLD OUTPUT.

The Department of Interior reported : The total gold production from the Ynkon territory for the calendar year 1899 as shown by returns to the Department is $9,730,636.19 ; and that of this $2,193,346.97 was exempt from the payment of royalty. The amount of gold exempt from royalty for the same period was $753,729.42. Large quantities of gold were however, known to have been taken out which was not reported to the Government.

THE MINING INDUSTRY OF BRITISH COLUMBIA IN 1899.

In reviewing the progress of the Mining Industry of the Province for the past year, it may safely be said that, taken as a whole, the results show that there has been a very material and real advance.

In certain districts and in certain branches of the Industry, the results obtained have not been altogether satisfactory, but on the other hand, other districts and other branches have shown such a remarkable growth, that when a general average is struck, it is found that there is an ample margin of progress and advancement to the credit of the year.

The official statistics of production are not yet available, but from such figures as are, it is evident that this past year will show a material gain in the output of placer gold, lode gold, copper and coal, with a serious falling off in the output of silver and lead.

The most gratifying part of this summary is, that there is every indication that the increases are healthy and legitimate, that they have "come to stay" and grow up with us—while the decreases are illegitimate, because unnecessary and unhealthy, the result of that malady known here locally as the "labour trouble," and in no way attributable to the failure of any of the mines involved.

So much has been said about our "Labour Troubles," much of which is absolutely untrue, and such wide circulation has been given to these tales, that it is probably best to give a summary of the conditions.

Leaving aside all artificial causes, the real source of the trouble is, that the growth of the mining industry in this Province has been so rapid that the demand for skilled mine labour has become greatly in excess of the supply.

The miners realised these conditions. and demanded the same pay for the decreased hours (eight in twenty-four) that they had received for the ten hours, on the ground that they could do as much work in eight hours as they could in ten.

This the managers considered equivalent to a demand for more pay, and refused it.

Hence the dead-lock in many of our best mines, chiefly in the Slocan district. and therefore our decreased output in silver and lead, which gives the question its greatest importance.

As the matter stands now, the managements cannot get men locally at the old rate per hour, whereas the men seem to have been absorbed elsewhere, as they are not standing around idle.

Each side thinks it has the best of the argument ; so far there has been no friction.

It looks as if a compromise would be effected shortly and sensibly, for as usual, the right is not all on one side.

Considering the Province by Districts and beginning with Atlin, this District managed last year to get shaken down into something like regular mining order, thanks chiefly to a firm hand at the head of affairs, and after the froth has been blown away, it is found that the district is all that level-headed men ever thought it was—a very snug little camp with plenty of gold in it ; some placer workings, but for the greater part the deposit is so deep as to demand hydraulic plants. The output last year was good, considering all the drawbacks, and the outlook is distinctly favourable.

The indications are that quartz mining will be an important factor in the district, but it is of course premature at present to count on this until more development has been done.

Omineca and Cariboo, of glorious traditions of gold picked up by the pound lying around loose anywhere. It does not "lie around loose" now, by any means. When the old time placer miner got through, there was not much lying around loose, he took everything within reach he could lay his hands on; and they were good workers, were those old timers. We of today can't give them any points on placer mining. But, after all, their reach was limited to a few feet ; today we have at our service longer arms —we employ giants and other far reaching contrivances. These cost a lot of money to buy and to haul on to the ground, and they consume a quantity of water, but it appears the former is as plentiful as the latter by the way it is pouring into the district.

There are some 30 to 35 strong companies working in the district now, the average cost of the plant of each of which when completed, will be in the neighborhood of $200,000.

These companies are only getting equipped and starting to run, yet their prospects are such that others are following them in rapid succession, and the indications are that Carboo will have "new days" quite as glorious as the "old days."

The year's output of these districts alone will be about $350.000.

The Coast District has of late been attracting a great deal of attention as a copper mining district. On the west coast of Vancouver Island and at various points on the mainland coast as far north as Skeena, and even farther, there have been some wonderfully fine surface showings of copper discovered, but carrying little silver and gold.

The prospectors think these ore bodies run through to China; the capitalist is not so sanguine, and there has not been enough work done as yet to settle the question.

This year, however, the output of copper ores from the District has become appreciable, if not important, estimated at 6,000 tons.

As usual, the enterprising American has been investigating, before the Englishman and the Canadian (as they are called here) wake up.

The Vancouver Island Collieries, notwithstanding the fact that the Crow's Nest Colliery has taken their Kootenay trade, have again broken the record —the output is away up and the price of coal has been away up—so between the two they ought to have had a most prosperous year.

East Kootenay: Fort Steele Division has begun to feel the influence of railway connection, and two or three "producers" have been added to her list of mines—silver-lead and copper propositions.

The Crow's Nest Pass Coal Co. at Fernie, with its 800 employees; an output of 500 tons a day, and 200 coke ovens is also to be noted. But for all this, there was a threatened coal famine in the Kootenays this summer, which speaks well for the market, if it does not say much for the "get up" of the coal company and railroad.

Windermere Division is excited—she is a producer and hopes to "stay with it"—she has shipped a few tons of galena with good silver values, just to show what she can do, and has an array of partly developed properties up in the neighborhood of Toby Creek that look good enough to eat; whether or not they are only sugar coated remains to be seen. They are only about a year old and have not yet been proved with depth.

The ores are chiefly argentiferous galena with some copper ores, grey and yellow.

Golden Division, not to be distanced by Windermere, has some ore on the dump ready for shipment in the spring. She has had that in past years but it did not pay for some reason, but it is hoped this new discovery, with an exceedingly promising showing of copper ore will prove profitable. But it will have to be done on 14 cent copper, for 18 cent copper has passed away I am afraid.

Rossland has done herself proud. Last year she produced 111,282 tons, worth $2,470,811, this year she mined 180,300 tons, worth $3,211,400, an increase of 62 per cent. in production, and 30 per cent. in value.

The producers are the same old standbys, with Centre Star added. The rest of the properties seem contented to even be in such company, for there are no new producers.

Rossland has held her head so high, she has been above the fog of the

"Labour Troubles," but she has had to stand on her tip toes to do it. Whether she will get tired of this unnatural pose remains to be seen,

Slocan: Poor Slocan, the brightest of our jewels, is sulky; she wont even smile; she has the "Labour Trouble" badly. The output last year was over 30,000 tons, valued between 2½ and 2¾ million dollars. This year the output is estimated at 18,000 tons, worth 1½ millions, and her mines are just as good and better than they were last year or the year before, for they had a lot of development work last winter.

Nelson has jogged along in her steady old way—never brilliant but reliable—she too, has had a touch of the prevalent malady, or she would have done better.

The Boundary, the latest addition to the family. She has been expected for some time, but it required the railway to bring her to life. She can't walk yet, but crows very loudly, and is, taken altogether, a promising youngster.

The ore bodies are big, too big—they are low grade, quite how low it is hard to say; it is impossible to sample them. Nothing but the smelter test will settle what the average assay of output of any of the mines may be.

There is no question about the ore, it is there and easily mined, but the life of the camp is in the hands of the metallurgist, and it needs the best obtainable; the question of the cost must not be counted.

Several of the mines have considerable ore on the dump, but none have shipped, nor can they afford to until they have the best of railroad and smelter facilities completed.

The following figures have been officially reported to the Institute:

HALL MINES SMELTER.

	Ozs. Gold	Ozs. Silver	Lbs. Copper	Lbs. Lead
Quarter ended 31st March.....	329	96,583	299,771	....
" " 30th June......	1,122	190,781	143,109	1,243,921
" " 30th September	1,550	272,249	777,044	339,963
" " 31st December.	1,389	113,093	288,844	506,666
	4,390	672,706	1,508,768	2,090,550

CANADIAN PACIFIC SMELTING WORKS, TRAIL.

	Ozs. Gold.	Ozs. Silver.	Lbs. Copper.	Lbs. Lead.
Quarter ended 31st March.....	5,827	14,827	305,599	Nil.
" " 30th June.......	11,661	27,388	587,242	Nil.
" " 30th September..	15,976	31,048	760,398	Nil.
" " 31st December..	18,754	28,147	925,478	Nil.
	52,218	101,410	2,578,717	Nil.

CROW'S NEST PASS COAL CO.

The output officially reported was—

Tons of Coal Mined	116,200	of 2000 lbs. each.
" " Sold	69,819	" "
" " To Coke Ovens	43.065	" "
" " Used by Company	3,316	" "
" Coke Made	29,658	" "

Made up as follows :—

Tons of Coke Sold in Canada	23,377
" " " United States	5,750
Tons on hand at close of the year	531

MINING IN ONTARIO.

The area of mineral lands sold and leased in Ontario last year was 98,307 acres, and the revenue from sales and rentals was $150,975. In 1898 the area disposed of was 68,440 acres, and the revenue derived was $97,962. The statistics of mineral production for 1899 are not quite complete, and returns have not been received for salt, silver, sewer pipe, and graphite. As far as completed they show values of $8,051,309, and wages paid for labour of $2,737,490, the number of employes being 9,477. When the full returns are received, they will make up a production of not less than $8,500,000, or 17 per cent. more than in the previous year. Structural materials of stone and clay show a total value of $3,936,681, oils and gas $2,075,339, metals $1 984,681, and miscellaneous minerals $54,512.

THE YEAR IN QUEBEC.

The output of minerals from the Province of Quebec, except in one or two instances, will show little change from previous years.

Asbestos.—The shipments of asbestos of all grades amounted to 17,019 tons, and 8,534 tons of asbestic. Prices steady and demand increasing.

Pyrites.—The output of pyrites at Capelton was 38,778 tons, of which 23,578 tons were shipped, the balance being utilized locally at the chemical works.

Pig Iron.—Charcoal pig iron to the extent of 7,094 tons was made at Radnor and Drummondville.

Ochre.—The production of ochre at Three Rivers was 1,430 tons.

Chromite.—The shipments of chromite from BlackLake amounted to 1,980 tons, 445 tons of which were concentrates.

Mica.—The shipments of mica in Ottawa County exceeded $150,000. Prices good and market strong.

Felspar.—About 3,000 tons mined in Ottawa County.

Petroleum.—In the Gaspe Oil Field a refinery has been built and over 20 miles of pipe line laid.

Gold.—Prospecting on the Gilbert river country yielded 272 ozs. of a value of $4,896.

Copper.—Some mining was done at the old Acton mine, near Sherbrooke, and 100 tons of high grade ore were won from Harvey Hill.

Phosphate.—A number of sales were made at improved prices, and the outlook for this mineral is distinctly better.

Graphite.—The mills near Buckingham resumed operations at the end of the year and an improvement in output may be looked for in 1900.

The net value of all minerals will be about $3,000,c00.

PROGRESS IN NOVA SCOTIA.

In many respects the advance in mining in Nova Scotia last year was highly encouraging. In coal mining particularly progress has been most satisfactory. The local sales were, as far as can be learned at this moment, 2,664,794 tons, an increase of 527,386 tons over the shipments of the preceding year. This increase was due to a larger demand in every market reached by provincial coal. The trade up the St. Lawrence for the first time passed the million ton mark. The starting of the New England Gas and Coke Works, at Everett, Mass., assisted somewhat the sales of the Dominion Coal Company, the largest producer, but the effect of this large enterprise, now fairly under way, on the coal trade of Cape Breton will be more apparent next year.

The establishment of the Dominion Iron and Steel Company at Sydney, Cape Breton, opens another large and unexpected home market, amounting to some 800,000 tons annually. The projected establishment of factories to handle the pig and steel made at Sydney, will still further increase the demand for coal. The collieries in Pictou and Cumberland Counties also shared in the general prosperity. The future of the coal business seems assured for the next few years.

In iron and steel making there has been little novel to be noted. The production of iron ore, principally by the Nova Scotia Steel Company, amounted to 18,000 tons. About 30,000 tons were imported by the Company, and also smelted. The Mineral Products Company commenced the mannfacture of ferro-manganese at the furnace of the Charcoal Company at Bridgeville, Pictou County, but operations were discontinued in the fall. At Londonderry nothing was done, except at the pipe foundry. In Cape Breton some prospecting was done on various iron properties, but the determination of the Dominion Iron and Steel Company to use Newfoundland ores has discouraged local men.

In gold mining the production fell off, being about 28,000 ounces, compared with 32,165 ounces in 1898. A number of the mines, notably in

Guysboro County, Moose River, Montague, South Uniacke, and Leipsigate and Brookfield were worked profitably. There were a large number of mines bonded, and not worked, and others were held by their owners for sale. This lessening of mining work was due, I presume, to the unusual number of enquiries made for gold speculation purposes.

The presence of bodies of manganese ore of good quality and apparently extensive, was proved in Lunenburg County. Sample cargoes were sold readily, and it is expected that the railway now under construction in that district will afford a cheap transportation. The amount of coke increased to about 58,000 tons, partly on account of the inclusion of the coke made in the by product ovens of the Halifax Gas. Co. The production of plaster, grindstones, barytes, limestone, tripolite, etc., was about as usual.

During the year 1899, following explorations carried on during 1898, copper mines were opened at Wentworth, in Cumberland Co., and at New Annan, Colchester County.

The ores met are various copper sulphides in hard shale and sandstones, in places rich, in others much disseminated. These mines are owned by the Copper Crown Company, which has completed the erection of a smelter at Pictou. The Company report that in addition to the product of their own mines, they will receive ore from the numerous exposures known in Colchester, Pictou, and Antigonish Counties. In all probability the Inverness copper lead districts will furnish supplies, as there seems to be a large amount of ore in the Cheticamp district.

Should the supplies at present visible suffice to keep the smelter at Pictou in operation, there is no doubt that prospecting will be encouraged, and copper mining take its place as one of the regular mining industries of the Province :—

As all the figures for the calendar year are not available, Mr. Gilpin gives the following for the fiscal year ended September 30th, 1898 and 1899. As the production, except in the case of coal, is regular, they will, not inaccurately, show the calendar year production :—

		Year Ending Sept. 30, 1898.	Year Ending Sept. 30, 1899.
Gold	Ozs.	31,104	27,772
Iron Ore * †	Tons.	31,050	16,169
Manganese Ore †	"	75	100
Coal Raised †	"	2,281,454	2,642,333
Coke Made †	"	42,000	55,484
Gypsum † ‡		131,000	140,000
Grindstones, etc §		38,000	50,000
Limestone †	Tons.	24,000	32,000
Barytes		......	335
Tripoli and Silica		......	893
Copper Ore		......	400

* Not including imported ore. † Ton of 2,240 lbs. ‡ Amount exported. § Value in dollars.

On motion of Mr. Wm. Blakemore, seconded by Mr. J. Burley Smith, the Secretary's Report was unanimously adopted.

VOTE TO PATRIOTIC FUND.

The Secretary moved, seconded by Mr. Burley Smith, that the sum of $250 be appropriated from the current year's income as a subscription to the Canadian Patriotic Fund. He also reported having received $100 each as a subscription to the same Fund from the Acadia Coal Company, and the Canadian Copper Company. The vote was passed unanimously.

TREASURER'S REPORT.

The Secretary, in the absence of the Treasurer, presented the following statement :—

TREASURER'S STATEMENT, YEAR ENDING FEB. 1ST, 1900.

Receipts.

Balance from 1898		$ 219 82
Subscriptions 172 at $10.00	$1,720 00	
" 80 at $7.50	600 00	
" 13 at $2.00	26 00	
		2,346 00
Sales Copies of Journal Proceedings		11 86
Interest of Bank Deposit		3 74
Grant from Dominion Government		1,000 00
		3,581 42
Less.		
Disbursements as per Statement		3,096 55
Balance on hand		$ 484 87

SUMMARY STATEMENT.

Showing Distribution of Disbursemeuts to the various Work vnd Business of the Institute.

Federated Canadian Mining Institute—		
Balance of liabilities assumed by and paid by Vote of Council	105 75	
		105 75

Publications—		
Printing Report of Council 1899	17 50	
" advance copies of papers	29 00	
" Vol. I Journal of Proceedings	68 00	
" Vol. 2 " "	399 75	
" List of Members	22 00	
Wrapping, mailing and postage on above	71 61	
Engraving line and half tones	131 49	
Re-drawing plans, maps, blue prints, &c.	18 75	
		758 10
Library and Reading Room—		
Rent to 1st Feb. 1900 (11 months)	366 67	
Binding books, pamphlets, mounting maps, &c.	87 50	
New Bookcase	29 04	
Purchase of new Books, &c.	172 90	
Librarian's Salary and sundry expenses	81 09	
Insurance Premium	14 25	
		751 45
Legislation—		
Secretary's expenses and disbursements re C.E. Bill	50 00	
		50 00
Meetings and Excursions.		
Annual Meeting—		
Stenographing, printing, postage, telegrams, Secretary's expenses and various disbursements	171 52	
Council and Committee Meetings—		
Secretary's expenses and various disbursements	135 60	
British Columbia Meetings and Excursion—		
Secretary's expenses and disbursements	175 00	
Printing and postage	36 75	
		518 87
Annual Dinner—		
Balance Shortage	74 30	
		74 30
Secretary's Office—		
Annual Grant	600 00	
General Printing	11 10	
		611 10
Treasurer's Office—		
Annual Grant	150 00	
Printing	11 75	
Postage, telegrams, &c.	23 72	
Bank commission	31 51	
Audit 1898-99	10 00	
		226 98
		$3,096 55

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. Wilmot 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 elsewhere in the Journal), 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 of 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 bonusing 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.

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 Kimberly 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 disccovered 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 Mendeléeff 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.

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 expansor. 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 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."

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 wastrels 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 woutd 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.

arlow, 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 100lb. 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 ta overcome difficulties and I feel certain that some skilful 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 conduced 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 cf 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.

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 n t 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 Klondike. 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 the to 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 discused 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.

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 rhe 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—ard 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. Tyrrell, one of our members now a resident of the Yukon, who I see has just come in.

Mr. TYRRELL—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. TYRRELL—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. TYRRELL—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. TYRRELL—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 certiffcates 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 tor buying the gold.

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

Mr. TYRRELL—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. TYRRELL—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. TYRRELL—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 numbei of interesting lantern slides illustrating some of the features of the country and the inhabitants of Labrador.

The meettng 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.) Ross and.

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 amendable 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 organisation 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 enconiums from me. (Applause.)

The motion war 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. Tyrrell—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 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 lives in Dawson and is perfectly acquainted with the subject and knowr 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 Governmeut, 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 themselve. 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. TYRRELL—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. Tyrell, 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 rascality. 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 Whitefish 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 arseniurets 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 unflagging 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, desseminated 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 Philapelphia, 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 Worthington 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 throngh 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, yieldin 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 1890, 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 lense 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 on 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 at an early opportunity to renew the negotiations opened with the British Government in 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 develope 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 develope 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 uumber 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 develope 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 importauce 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 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 develope 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 in 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 1¼ 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 ⅓ 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 duton 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 monoply 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 paralize 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 is 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 Instiute 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 without 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 understoad 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 cablegram which came to the Crown Lands Department on Monday last, and is dated March 5th, 1900. "To Crown Lands, Toronto, from Hamburg. Visited Papenburg. 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 organised in Hamilton to manufacture nickel steel that will have an investment of $10,000,000. Another company has been organised 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 paralyze 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 co-operation andadvice 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-Conncil ot 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 judgmennt 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 indnstry 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. H. 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.

MEMBERS.

LIST OF MEMBERS, 1900-1901.

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HON. W. S. FIELDING, M.P., Ottawa.
DR. A. R. C. SELWYN, C.M.G., Vancouver.
JOHN BIRKINBINE, *Mining Engineer*, Philadelphia, Pa.

MEMBERS:

Adams, Dr. Frank D.,
McGill University, Montreal.

Adams, Captain Robert C., *Mine Owner*,
45 Metcalfe St., Montreal.

Aldridge, W. H., *Mining Engineer and Metallurgist*,
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Allan, Alexander B., *Ironmaster*,
7 Langside Crescent, Campside, near Glasgow, Scotland.

Allan, William A., *Mine Owner*,
Victoria Chambers, Ottawa.

Ami, Dr. Henry M., *Palaeontologist*,
Geological Survey, Ottawa.

Andrews, C. F., *Mining Engineer*,
Isaac's Harbour, Nova Scotia,

Atkinson, D. C. T., Ba.Sc., *Mining Engineer*,
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Bacon, F.,
377 St. Paul St., Montreal.

Bacon, T. P.,
377 St. Paul St., Montreal.

Baker, Hugh C., Ba Sc., *Mining Engineer*,
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Bartlett, E. T.,
Standard Chambers, Montreal.

Barton, H. A.,
Nelson, B.C.

Becher, E. Lorne,
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Belcourt, N.A., Q.C., M.P., *Mine Owner*,
Central Chambers, Ottawa.

Bell, B. T. A.,
Editor CANADIAN MINING REVIEW, Ottawa.

Bell, Dr. Robert,
Asst. Director, Geological Survey, Ottawa.

Bell, John W., *Mining Engineer*,
Schroder Mine, Shasta Co., California.

Bennett, William,
Rosekear Fuse Works, Rosekear, Camborne, Cornwall, England.

Bielenberg, Ernest, *Mine Owner*,
Greenwood, B.C.

Blackburn, Russell L., *Mine Owner*,
Sussex St., Ottawa.

Blakemore, Wm, *Mining Engineer*,
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Blue, Archibald,
Director of Mines, Toronto.

Blue, John, *Civil and Mining Engineer*,
Eustis Mining Co., Eustis, Que.

Boas, Feodor,
St. Francois Xavier St., Montreal.

Bodwell, E. V.,
Victoria, B.C.

Bonner, W. T.,
Babcock & Wilcox Boiler Co., St. James St., Montreal.

Boss, J. E.,
Spokane, Wash.

Bowen, Cecil, *Civil Engineer*,
Coburg, Ont.

Braden, Wm., *Mining Engineer*,
Helena, Montana.

Brainerd, Dwight,
Hamilton Powder Co., Montreal.

Brelich, Henry, *Mining Engineer*,
c/o Messrs. Arnold Karberg & Co., Shanghai, China.

Brent, Charles, *Metallurgist*,
Rat Portage, Ont.

Briedenbach, Theo., *Mine Manager*,
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Brigstock, R. W.,
Nelson, B.C.

Brock, R W., *Geologist*,
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Brown, J. Stevenson,
Temple Building, Montreal.

Brown, Thos., *Assayer*,
(At present serving with the colours in South Africa.)

Bruce, R. Randolph, Ba.Sc., *Mining Engineer*,
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Carpenter, C. B. K.,
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Carriere, C. H., *Mechanical Engineer*,
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Carry, H. E. C , *Civil and Mining Engineer*,
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Chambers, R. E., *Mining Engineer*,
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Champion, James, *Civil and Mining Engineer*,
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Chewitt, J. H , *Civil and Mining Engineer*,
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Cirkel, Fritz, *Mining Engineer*,
Hotel Vancouver, Vancouver, B.C.

Clark, J. M., Q.C., LL.B.,
King St. W., Toronto.

Clabon, A. B.,
Rossland, B. C.

Clergue, F. H.,
Lake Superior Power Co., Sault Ste. Marie, Ont.

Colby, Hon. C. C.,
Stanstead, Que.

Cole, A A., B.A.Sc., *Assayer*,
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Cooper, James,
Victoria Square, Montreal.

Coste, Eugene, *Mining Engineer*,
34 Madison Avenue, Toronto, Ont.

Coste, Louis, *Civil Engineer*,
Dawson, N.W.T. (address c/o Eugene Coste, Toronto.)

Cowans, J. R., *Colliery Manager*,
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Cowie, F. W., *Civil Engineer*,
Department of Public Works, Ottawa.

Cox, E. Strachan,
Toronto.

Crawford, J. D.,
Westmount, Que.

Croasdaile, H. E.,
General Manager Hall Mines Limited, Nelson, B.C.

Crookston, A. W., *Mining Engineer*,
St. Vincent St, Glasgow, Scotland.

Curran, Neil McLeod,
North Star Mining Co., Fort Steele, B.C.

Daly, Edwin A., *Mining Engineer*,
Dufferin Mines, N.S

Davys, M. S., *Civil and Mining Engineer*,
Nelson, B.C.

Dawson, Dr. George M., C.M.G.,
Director Geological Survey of Canada, Ottawa.

Dawson, G. Herbert,
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Deacon, T. R., *Civil Engineer*,
Rat Portage, Ont.

DeKalb, Prof. Courtenay, *Mining Engineer*,
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DeCourtenay, H. W ,
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Denis, Theo. C., *Mining Engineer*,
Geological Survey, Ottawa.

Dick, Alexander,
Rossland, B.C.

Dimock, Clarence, *Mine Owner*,
Wentworth Gypsum Co., Windsor, N.S.,

Donald, Jas. T., M.A., *Assayer and Geologist*,
112 St. Francis Xavier St., Montreal.

Donkin, Hiram, *Civil Engineer*,
General Manager Dominion Coal Co., Glace Bay, Cape Breton.

Douglas, Dr. James, *Metallurgist*,
99 John St., New York.

Drummond, George E.,
Canada Iron Furnace Co., Canada Life Bldg., Montreal.

Drummond, Hon. G. A.,
Montreal

Drummond, John J., *Mining Engineer*,
Midland, Ont.

Drummond, Thos. J.,
Montreal Car Wheel Co., Montreal.

Drury, Harry A..
Imperial Oil Co , St. John, N.B.

Duncan, Captain T. R.
Duncan Mines, Nelson, B.C.

Dundee, Charles,
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Evans, J. W., *Civil and Mining Engineer*,
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Faribault, E R., *Geologist*,
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Fell, E. Nelson, A.R.S.M., *Mining Engineer*,
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Fergie, Charles, *Mining Engineer*,
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Ferrier, W. F., B.Sc., F.G.S., *Mining Engineer*,
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Fraser, A. W.,
Leslie's Chambers, Ottawa.

Fraser, Graham,
Nova Scotia Steel Co. Limited, New Glasgow, N.S.

Gallagher, W. H.,
Vancouver, B.C.

Galt, Elliot T.,
Managing Director, Alberta Ry. & Coal Co., Lethbridge, N.W.T.

Gaylord, F. B.,
Deseronto Iron Co, Deseronto, Ont.

Gibbs, Dr W. T., *Metallurgist*,
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Gifford, J. R., *Mine Superintendent*,
Hall Mines Limited, Nelson, B.C.

Gillon, Douglas J., O.L S., *Civil Engineer*,
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Gilman, E W., *Mechanical Engineer*,
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Goodwin, Dr. W. L,
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Gue, T. R.,
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Guess, George A., *Mining Engineer*,
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Guess, H. A., M.A., *Metallurgist*,
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Guilbault, Antoine,
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Gwillim, J. C., Ba.Sc., *Mining Engineer*,
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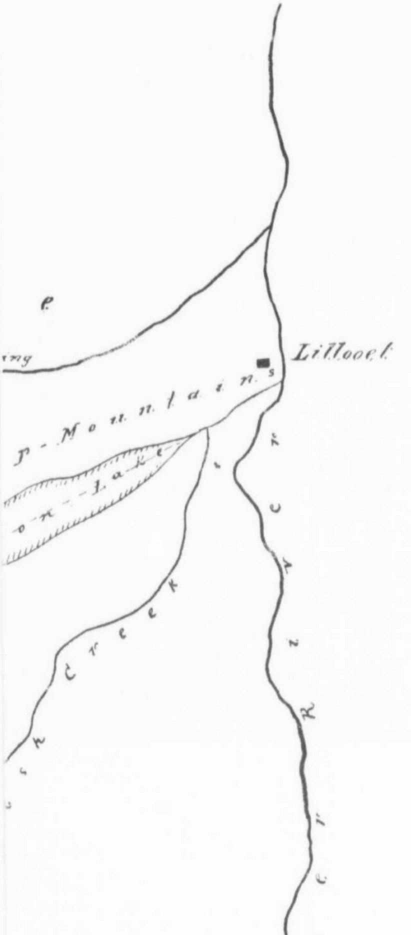
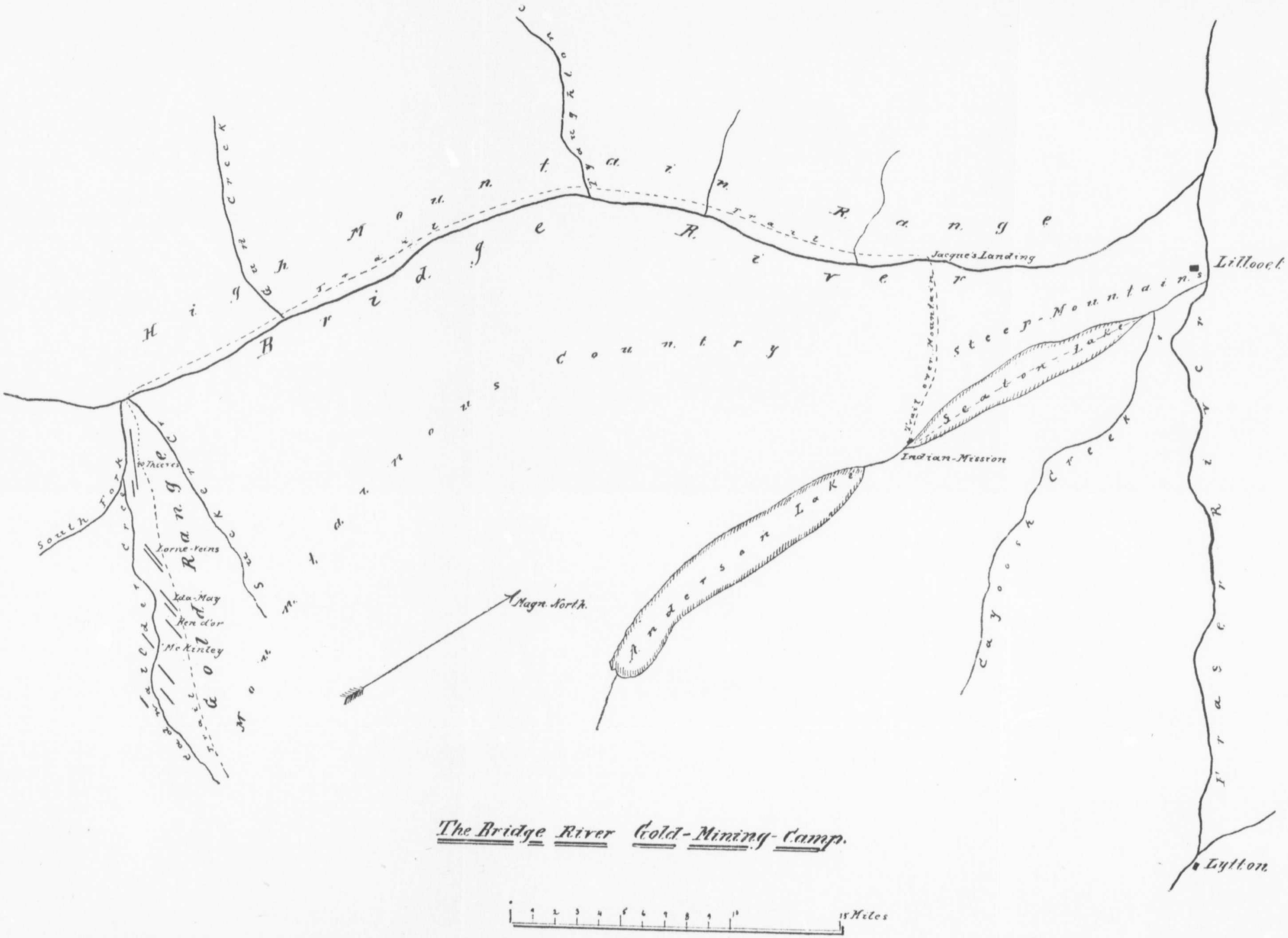
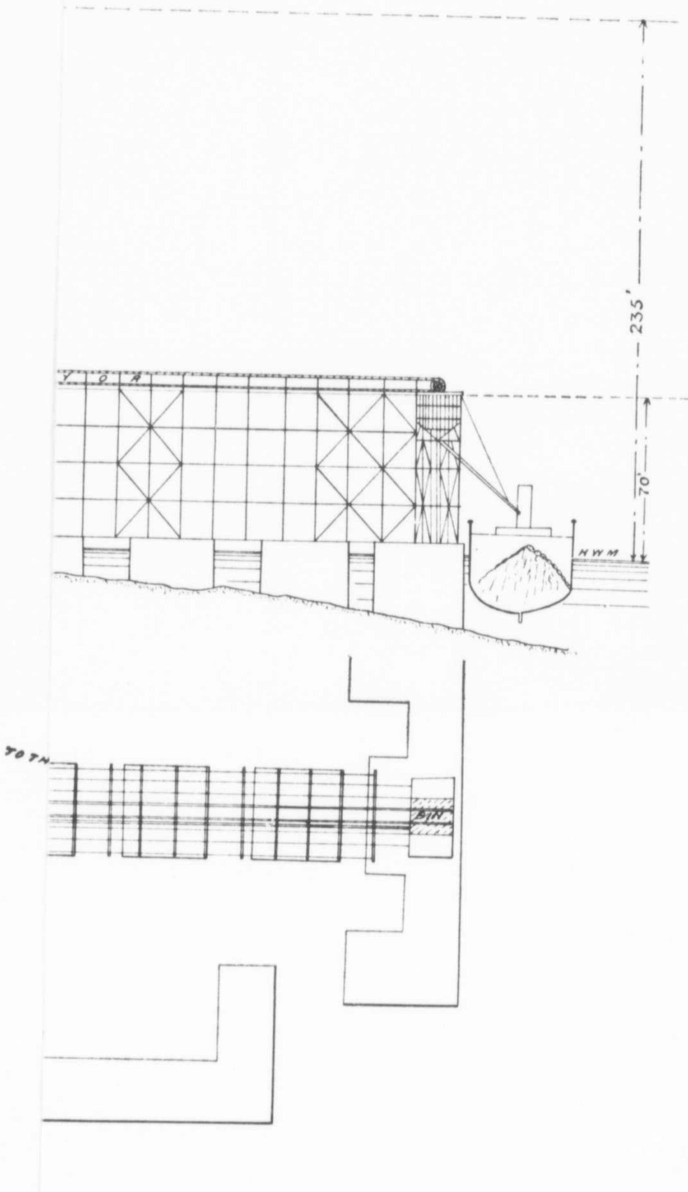
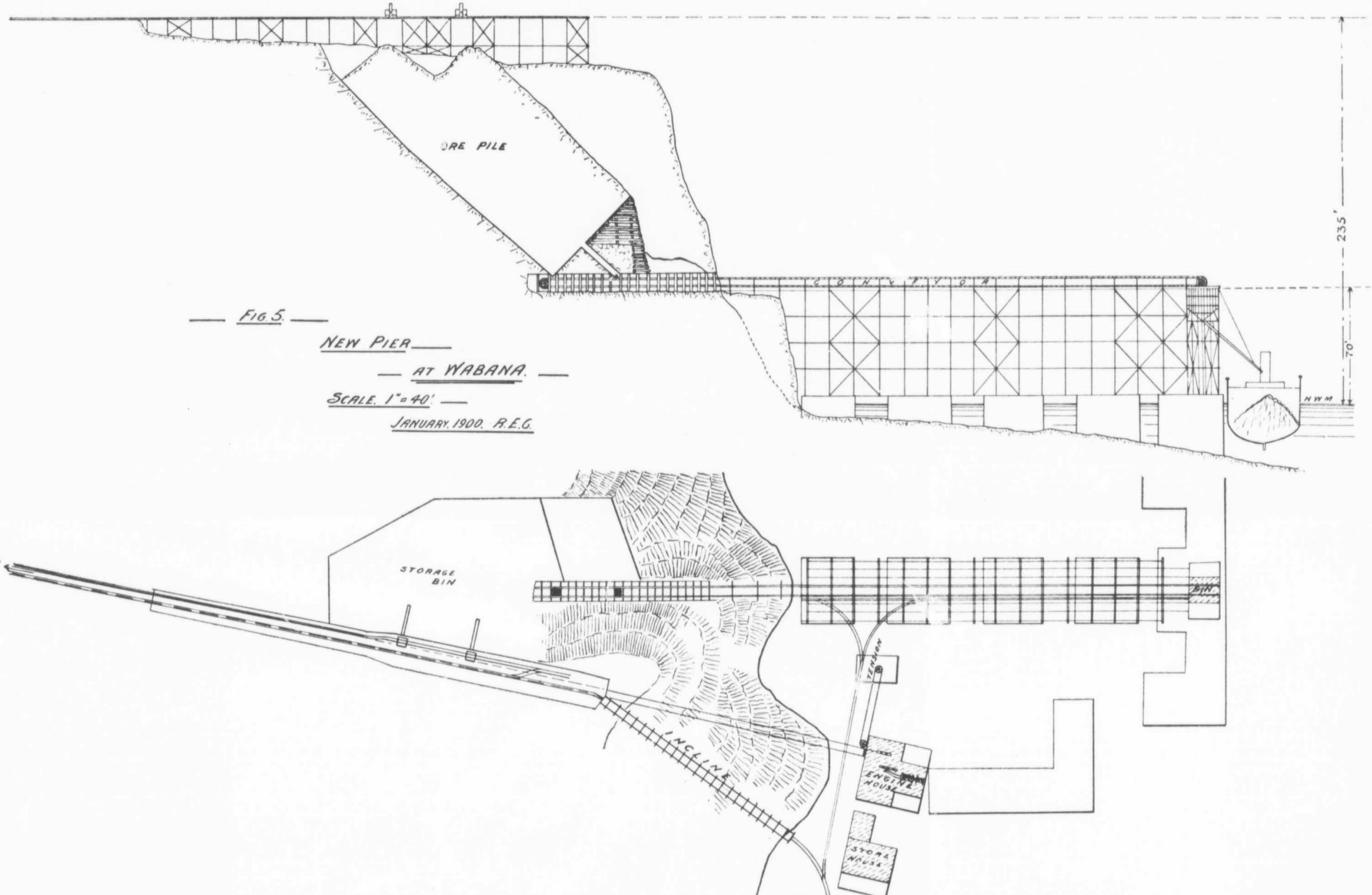


e
ing
Lillooet
p - Mountains
on - - Lake
Creek
Fraser River
Lytton



The Bridge River Gold-Mining Camp.


235'
70'
HWM
BIN



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

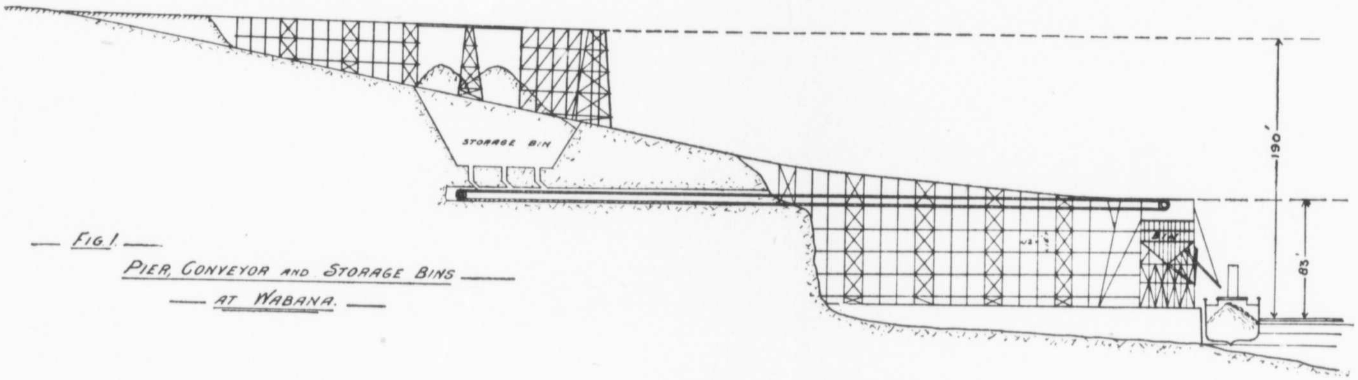


FIG. 1

PIER, CONVEYOR AND STORAGE BINS AT WABANA.

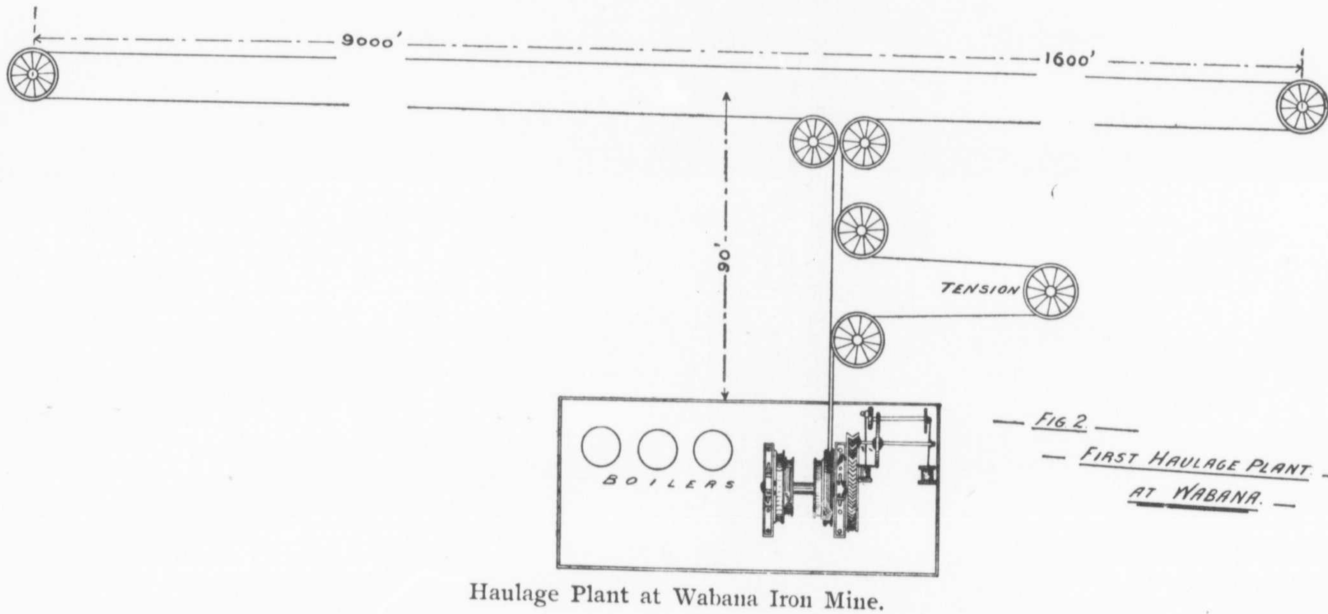
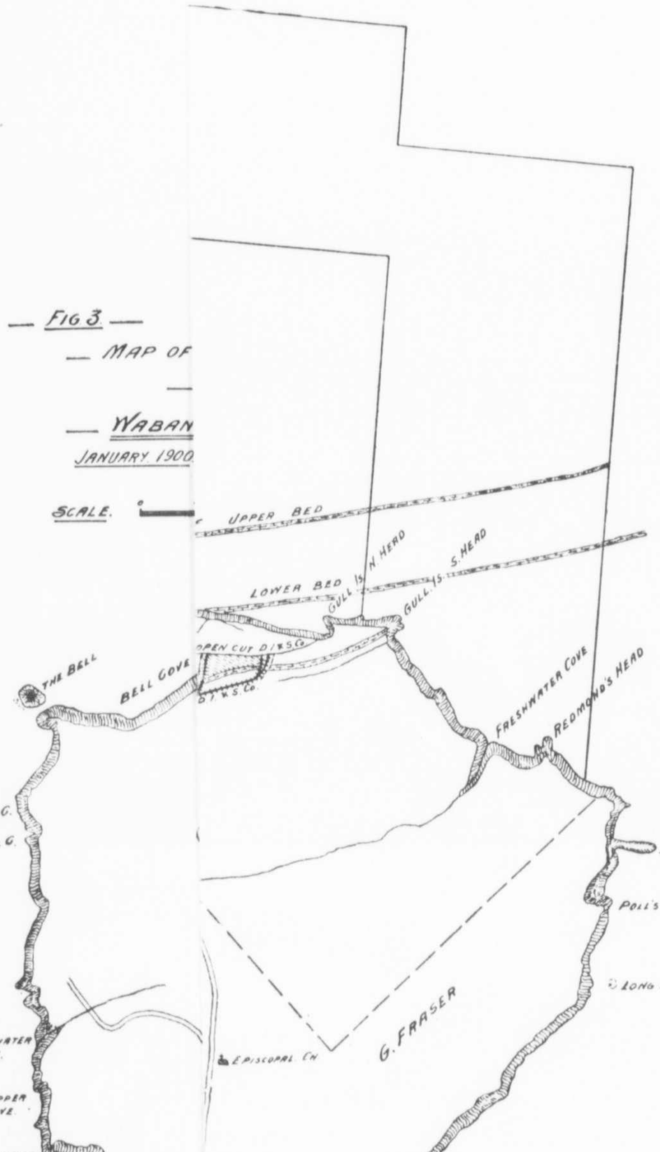


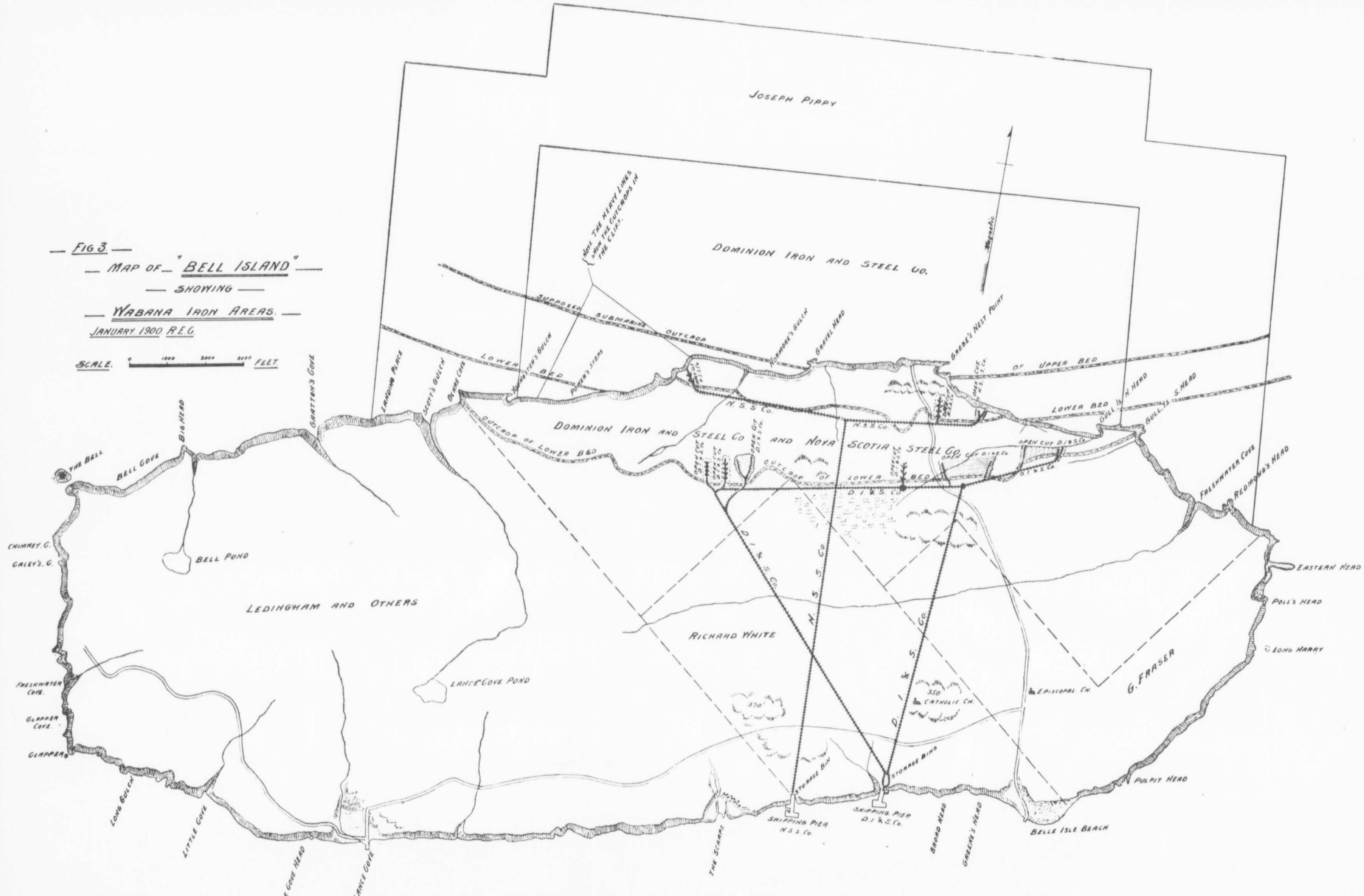
FIG. 2

FIRST HAULAGE PLANT AT WABANA.

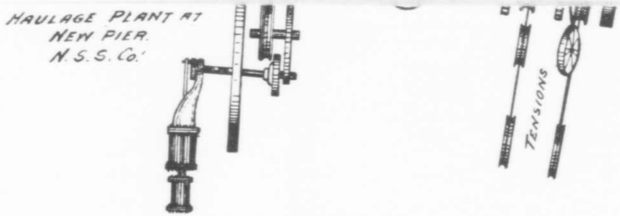
Haulage Plant at Wabana Iron Mine.



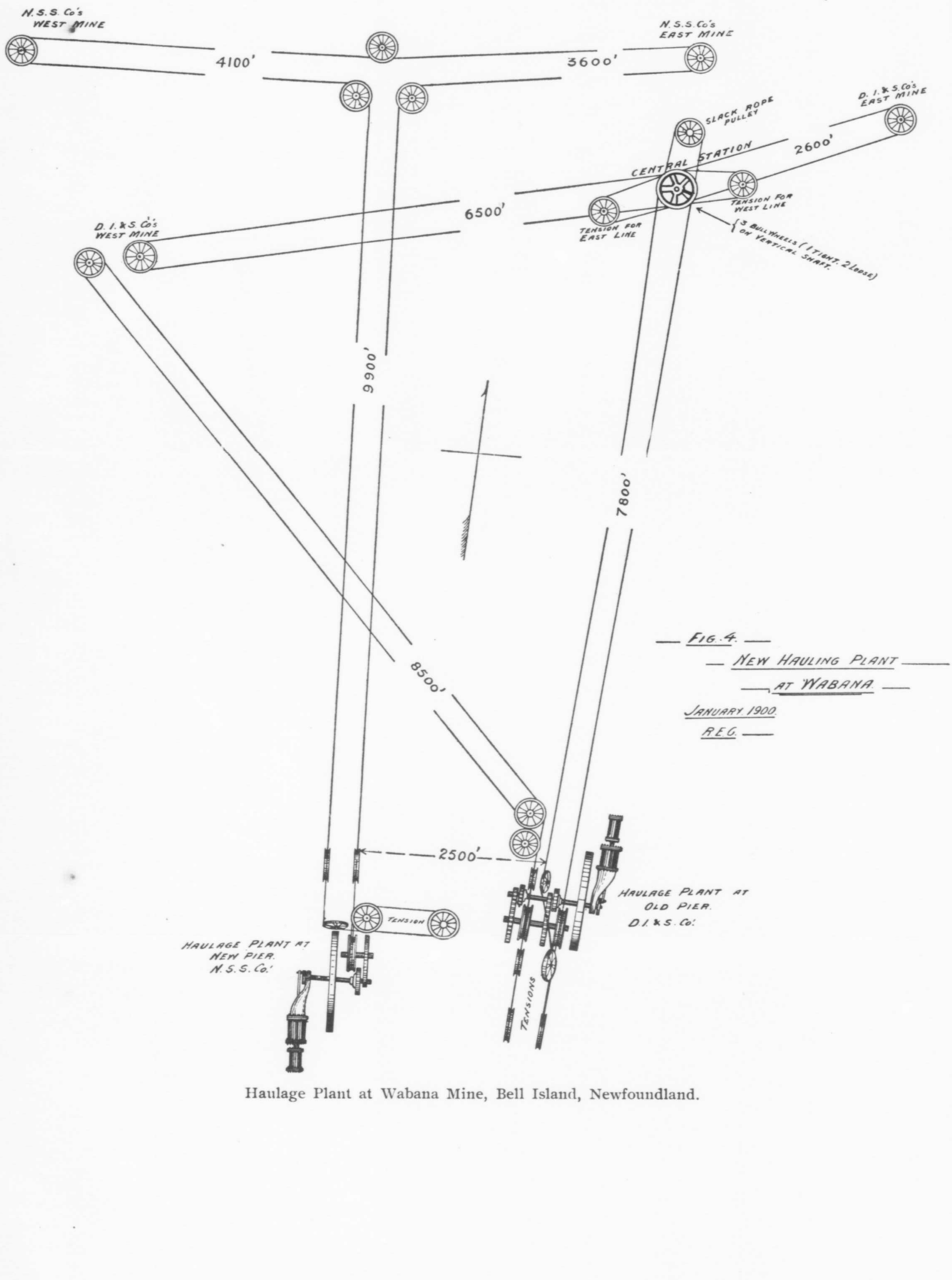
— FIG 3 —
— MAP OF
—
— WABAN
JANUARY 1900
SCALE
UPPER BED
LOWER BED
GULL IS. N. HEAD
GULL IS. S. HEAD
OPEN CUT D.I.&S.C.
D.I.&S.Co.
THE BELL
BELL COVE
FRESHWATER COVE
REDMOND'S HEAD
CHIMNEY. C.
CALEY'S. C.
EASTERN HEAD
POLL'S HEAD
LONG HARRY
G. FRASER
FRESHWATER COVE
EPISCOPAL CH
CLAPPER COVE
CLAPPER
PULPIT HEAD
LONG GULCH
BELLE ISLE BEACH



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



Haulage Plant at Wabana Mine, Bell Island, Newfoundland.



Haulage Plant at Wabana Mine, Bell Island, Newfoundland.