JOURNAL

OF

THE MINING SOCIETY

OF

NOVA SCOTIA.

VOL. III.

BEING THE TRANSACTIONS OF THE SOCIETY DURING THE YEAR 1894-95.

EDITED BY THE SECRETARY.

COPIES OF ALL THE SOCIETIES TRANSACTIONS MAY BE OBTAINED ON APPLICATION TO THE SECRETARY

AT

THE ROOMS OF THE SOCIETY,

129 HOLLIS STREET, HALIFAX.

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PAPERS.

OFFICERS

FOR YEAR ENDING MARCH, 1895.

Past President, 1892 to '94.

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DAVID MCKEEN, M.P., Glace Bay.
GEORGE W. STUART, Truro, N. S.

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B. T. A. BELL, Ottawa.

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Pearson, Fred. S.,	81 Milk Street, Boston.
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Reid, J. M.,	Musquodoboit Harbor.
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Stairs, Jas. W.,	Halifax, N. S.
Stairs, John F., M.P.,	Halifax, N. S.
Stemshorn, H. G.,	Mooseland, N. S.
Stuart, Geo. W.,	Truro, N. S.
Sword, S. W.,	Halifax, N. S.
Taylor, Frederick,	Lowell, Mass.
Thomas, W. R.,	Montague, N. S.
Touquoy, D.,	Moose River.
Turnbull, Dean S.,	Sheet Harbor, N. S.

WHITMAN, A. N.,	Halifax, N. S.
WILLIS, C. E.,	Halifax, N. S.
WILSON, B. C.,	Waverley, N. S.
WOODHOUSE, ALFRED,	Halifax, N. S.
WYLDE, H. M.,	Halifax, N. S.
ZIRKLER, C. W.,	Ferrona, N. S.

PROCEEDINGS.

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George
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Sword,
Editor
Halifax
London,

TRANSACTIONS
— OF —
The Mining Society of Nova Scotia.

The Society as a body is not responsible for the opinions and views expressed in the several papers published in the Transactions.

VOL. III. SESSION 1894-95.

The Third Annual General Meeting of the Mining Society of Nova Scotia was held in the rooms of the Society, Halifax, on Wednesday, 7th March. There were present:—

H. S. Poole, M.A., A.R.S.M., Acadia Coal Co., Stellarton; R. G. Leckie, M.E., Londonderry Iron Company, Londonderry; John E. Hardman, S.B., Oldham Gold Co., Oldham, N. S.; R. H. Brown, M.E., General Mining Association of London, Ltd., Sydney; W. Blakemore, M.E., Dominion Coal Co., Glace Bay, C. B.; G. W. Stuart, Caribou Gold Co., Truro; J. C. McDonald, Antigonish Gold Co., Country Harbor; C. F. Andrews, Richardson Gold Co., Country Harbor; J. D. Copeland, Richardson Gold Co., Country Harbor; Dr. E. Gilpin, Jr., Inspector of Mines, Halifax; Hugh Fletcher, B.A., Geological Survey, Scotch Village; J. T. Burchell, Cape Breton Coal Co., Sydney; James Baird, Joggins Mines; B. C. Wilson, East Waverley Gold Co., Waverley; A. A. Hayward, South Uniacke Gold Co., Waverley; R. G. E. Leckie, Torbrook Iron Co., Torbrook; T. R. Gue, Acadia Powder Co., Halifax; Duncan McDonald, Truro Foundry Co., Truro; W. G. Matheson, Matheson & Co., New Glasgow; Howard Clarke, Halifax; Dr. A. H. MacKay, Halifax; H. A. Saunders, Lake Lode Gold Co., Caribou; Capt. George MacDuff, Waverley; W. R. Thomas, F.G.S., Montague, N. S.; C. E. Willis, Canadian Rand Drill Co., Halifax; J. W. Sword, Ingersoll Rock Drill Co., Montreal; B. T. A. Bell, Editor CANADIAN MINING REVIEW, Ottawa; H. M. Wylde, Halifax; G. E. Francklyn, General Mining Association of London, Eng., Halifax.

The proceedings opened at half past ten o'clock in the forenoon, Mr. H. S. Poole, M.A., F.G.S., *President*, in the chair.

NEW MEMBERS.

The Secretary having read the minutes of previous meeting, the following new members were elected :—

Robert Archibald, Canada Coal and Railway Co., Joggins Mines; Dr. Martin Murphy, Halifax; W. Blakemore, M.E., Dominion Coal Co., Glace Bay; A. B. Sheraton, Halifax; Capt. A. L. Howard; H. A. Saunders, Caribou.

REPORT OF COUNCIL, 1893-4.

The Secretary then read the Report of Council for 1893-4, as follows :—

The Council has pleasure in reporting to the members the continued success of the Society during the year now closing.

On the founding of the Society in March 1892, there were enrolled some 58 members; at the end of the year the numbers had increased to 75, and now the roll includes 83 members, after deducting the names of several who have resigned, having severed their connections with the mining industry of the province.

The following is a synopsis of the finances of the Society for the past year: —

Receipts.

Balance, 1st March, 1893	$ 115 13
Subscriptions collected, 1893	790 00
Subscriptions in arrears	82 50
Balance	190 58
	$1,178 21

Expenditure.

Printing Transactions, &c	$ 584 67
Operating expenses— guests, postage, typewriting, &c	146 45
Reporting meetings	39 50
Subscriptions to CAN. MINING REVIEW	157 59
Secretary, 1893	250 00
	$1,178 21

Meetings.— Quarterly meetings were held in March, June, September and December. The June meeting, in response to the kind invitation of the members of the Society engaged in mining in Pictou Co., was held at New Glasgow. The works of the Pictou Charcoal Iron Co., the New Glasgow Iron, Coal and Railway Co., the Nova Scotia Steel and Forge Co., and other points of interest were visited and inspected. The Society is greatly indebted to the management of these companies for their kindness and courtesy in showing the visiting members of the Society over their works. The March, September and December meetings were held at the headquarters of the Society at Halifax. During the September meeting a visit was paid to the gold mining districts at Montague and Waverley, where the party was very hospitably received by Managers Hardman, Thomas and Woodhouse.

Transactions.— Five parts of the Transactions have been issued during the year, viz: Part I, Vol. I, containing the By-Laws, &c., and a history of the formation of the Society, and Parts I, II, III, IV, Vol. II, containing reports of the four quarterly meetings and papers. The Council would again take this opportunity of urging members to come forward with papers.

Exchanges.— A considerable number of exchanges have been added to our list during the year. The following papers and reports, &c., are on fyle in the Society's room:

The Engineering and Mining Journal.
The Iron and Coal Trades Journal.
The Colliery Guardian.
The American Manufacturer and Iron World.
The Journal of the British Society of Mining Students.
The Canadian Engineer.
Tne Canadian Mining and Mechanical Review.
The Canadian Colliery Guardian, Critic and Journal of the Iron and Steel Trades.
Transactions of the Manchester Geological Society.
The Proceedings of the South Wales Inst. of Engineers.

The Massachusetts Inst. of Technology.
The Transactions of the Am. Inst. of Min. Engineers.
The Transactions of the Canadian Inst.
The Transactions of the Mining Ass'n and Inst. of Cornwall.
The California State Mining Report.
Catalogue of Stratigraphical Collection of Canadian Rocks.
Transactions of Federated Inst. of Mining Engineers.
Geological Survey of Canada, and others.

The Importation of Mining Machinery.— In conjunction with the General Mining Association of the Province of Quebec, the Society had under consideration the necessity of a more uniform interpretation at the ports of entry of the present law respecting the free admission of mining machinery not manufactured in Canada. At the request of the Comptroller of Customs a statement showing the machinery known to be made in this country was prepared by a joint committee of machinery manufacturers and members of the Society and forwarded to Ottawa. This, it is hoped, will obviate somewhat the difficulties experienced by our mining companies in passing in machinery entitled to free entry. It was also resolved to ask that the Dominion Government when considering a revision of the tariff, should extend the language of the Act so as to include not only mining machinery but all "tools, supplies, machinery and appliances for mining, quarrying, handling, smelting, refining, concentrating and other processes for the mining, extraction and treatment of ores and minerals of a class or kind not manufactured in Canada." Copies of this resolution were forwarded to Ottawa.

Local Mining Legislation.— At the meeting of the Society in September, a numerous delegation waited upon Premier Fielding to urge that all new legislation in regard to mining should pass through the Mines Department before being introduced into either House.

Mr. Fielding, while agreeing with the spirit of the matter presented by the Society, pointed out the impossibility of precluding individual members from introducing private bills which

might affect mining legislation, yet assured us that so far as lay in his power he would endeavor that a hearing should be given to the Society and others in all proposed legislation affecting the mining industry.

Committees.— A committee appointed to co-operate with those of the School of Art and the Institute of Natural Science and other similar institutions, report that they met with a favorable reception from the Premier of the province, who expressed himself in sympathy with the movement looking to the erection of a suitable building for the proper exhibition of the Provincial museum, housing the libraries of the several scientific societies and supplying the needful class and lecture rooms for meetings.

The committee appointed to interview the Premier of the Dominion, Sir John Thompson, on the free admission of mining machinery not made in Canada and the transportation of explosives over Government railways and a reduction of duties on explosives, reported having received a careful hearing from the Premier, and the matters brought to his attention would, it was understood, be carefully considered.

The Report was adopted.

PRESIDENT'S ADDRESS.

MR. H. S. POOLE, M.A., A.R.S.M.— With the anticipated pleasure of seeing to-day elected as my successor in office one who has done so much to assist the development of our Society, and under whose guidance much more may be confidently expected, there is in me a feeling of gratification that the lot to appear at the head of a movement that holds out so much promise as does our Society should have been mine at its inception and until to-day. A continuance of such vitality as our organization has shown during the past two years warrants us in believing that more than a justification exists for the formation

and continuance of a mining society in Nova Scotia. The growth, the vigor of our Society is seen in the increased membership and in the prominence and character of the men who have joined us, and our growing weight in the community is marked by the general interest taken in our proceedings, and by the attendance at our meetings.

It was also a source of gratification to us to find members of our sister society, the General Mining Association of Quebec, made special effort to attend two of our meetings and take part in our proceedings. In addition to the Association's active Secretary we have an Honorary Secretary to draw us closer together when our cause is in common, and to stimulate us to healthy rivalry in membership and in the papers presented for publication in our Transactions. That the papers we have issued have been of more than local interest has been shown by the republication of some of them in English and American journals.

Of material for future papers we have an ample supply. A comparison of past with present practices is always interesting, and in the developments now rapidly making, and in the improved machinery constantly introduced, and in writing accounts of difficulties overcome, there will be a never ending source, if members will only set before themselves to tell of that which they do know.

In times past Nova Scotia was famed for her ship building, and in the days of wooden hulls her craft were to be met in every quarter of the globe. To-day the question is not a recovery of her once proud position in the shipping world, but in the economic carriage of minerals at all seasons of the year, and the adaptation of the barge system of transportation to our storm beaten and fog bound coast.

Our papers and discussions on gold mining have emphasized the fact that although this branch of our industry is over 30 years old, no gold mine has yet attained a vertical depth of 500 feet, an insignificant depth in comparison with that reached in other gold fields in half the time. Coupled with it there is a common belief that the pay streaks do not extend to any greater depth·

For my own part I am not satisfied that the reasons offered for holding this belief are sufficiently reliable or convincing, although at the same time I acknowledge a difficulty in proving either one theory or the other lies in the generally small extent of the pay streaks, and the want of a key to the order, if there be any, in which they occur. To the researches and mapping of the Geological Survey and carefully kept records of mining experience we can alone look for satisfactory guidance.

In connection with coal mining we have recorded a most unusual occurance, an explosion of mine gases by lightning, under conditions that leave no room for doubting the accuracy of the conclusion.

However well pleased we may be with the standing we have attained, however full our hopes may be of effecting one or more of the objects that specially instigated us to draw together, and however diverse our individual interests may be, we all feel the latter should be subordinate. That in making common cause against the varied difficulties that meet us as miners in this Province lies our strongest hope of successfully competing in the open markets of the world. That in united appeals to public opinion can the above hope for extraction from the sloughs of legislation through which well-meaning friends have diverted our road of life. It is perhaps not without some comfort to find that Nova Scotian legislation does not in this respect stand alone — New Zealand presses us hard for muddiness of mind on mining matters. We led off and publicly declared that after January 1st, 1884, "It shall not be lawful for *any* person not having a certificate of competency to be employed at *any* mine in the Province." To appreciate in full the force of this enactment, the broad definition in the law of what constitutes "a mine" should be remembered, and that boys and laborers are persons employed under ground. New Zealand, not to be outdone, in section 29 of the law of that Province enacts that no person under 18 years of age is to have charge of an engine for raising or lowering men, and the Act then proceeds under the general rule to forbid anyone under 21 years

of age to have charge of a steam engine. In the same Act, section 27 prohibits the employment of boys in any capacity, while section 31 carefully provides for the registration of boys employed in connection with mines.

Our turn to declare comes round again, and we enact, in the cause of humanity, that at coal mines the drivers of engines and of gins, and those in charge of windlasses, shall be holders of certificates of competency. Then we publish a standard for examination that would put to blush many a student of a course in mechanical engineering.* To make clear to those who may not know how foreign to construction and repairs are the duties of nine out of every ten engine-drivers at coal mines, this requirement may be likened to an enactment calling on all drivers of black horses to have passed a veterinary college. Mark the restriction, of *black* horses only, the drivers of horses of all other colors to be untrammelled as are the gin and engine-drivers at all other mines but those of coal under this Act.

But before saying anything more on the relevancy of such a Statute, let me remark no reflection is intended on the wisdom of opening the door of instruction on mechanics to engine-drivers and others laudably desirous of adding to their knowledge and fitting themselves for more responsible positions, but don't let it be done on the plea that a book-taught man will drive an engine or a gin, or turn the handle of a windlass, moving living freight more safely than one with experience alone. Again, I would repeat every credit is due for the facilities now supplied for the education of workingmen. The criticism I make turns on the muddiness of mind† that confuses the user of a machine

*From some seventy questions the substance of several is as follows:—
State the breaking strain of an engine shaft of a given size. What is steam? Find the mean effective steam pressure. What should be the area of a chimney where a given quantity of fuel is consumed? State the safe working load of a rope socket of given dimensions? How do you find the strength of steel chains, hemp and wire ropes? Explain the rule proportions of crank pins for different classes of engines.

†An amusing case of this is Chapter 43, page 84, of the Acts of 1893, which was enacted, so the title says, to encourage the growth of cranberries, a service to other plant life generally relegated to stable manure or commercial fertilizers; and Mr. B. Russell, Q.C., has lately pointed out in the public press that this characteristic is not confined to Acts relating to mines.

with a mechanic. As well insist that every dispenser of drugs shall be a doctor; every wearer of clothes a spinner and weaver; every printer, a paper-maker, or every master of a passenger ship carrying sons and daughters of Africa shall be a marine architect.

Let us turn again to the sections of the law here called in question and not the confusion that follows the attachment of the rider "holding a certificate of competency." Originally they grouped together the doers of certain things on account of their age only, for their duties call for no book learning, no knowledge of anatomy or abstraction of thought, but do call for prompt response to signals, quick observations and close attention to immediate surroundings. I unhesitatingly express the belief that nine out of every ten men who will make 60 per cent, of the marks on examination papers, such as have been published, will be thereby not one whit the better able to perform the work of driving engines, driving gins or turning windlasses, for their daily task will not give them any opportunities for exercising such an education.

Nor is this feature the worst part of such legislation. No alternative is open but to break the law, and break it too with the knowledge of the Department of Mines.

I have dwelt perhaps too much on this one amendment, but I wished to make it a typical case. I have already drawn your attention to other points in the Act which appear to me inconsistant with the fundamental object of the law, the preservation of life, and I will ask you to recall to mind what I said at Montreal a year ago. Inconsistencies that I then hoped had only to be pointed out to be remedied, but now I find they are defended. Credit is claimed for them as made in the interests of the working man; credit for deleting the General Rule which prohibits the unramming of shots, a rule expressly made to protect the working miner; credit for failing to allow work to proceed under substitutes in the absence through sickness or otherwise of certificated officials; credit for making the sinking of a hole for coal illegal, that when for water, or for gold, or for iron

is within the law. If such restrictions are right and proper the country should see that they be not exceptional, but are as a part of one harmonious system, dealing with all classes of labor impartially.

As a Society we should not be content until it becomes a recognized practice for proposed mining legislation to pass through the Department of Mines and opportunity be given for mine workers to fully consider and discuss it.

We should not be content until the right, given by the Legislature to the Dominion Coal Company, as tenants in dispute with a landlord to appeal to the courts of law, be a right equally enjoyed by every lessee of a gold or other mine in the province.

And finally with regard to much of our legislation, I may say it seems to me too generally thought that a remedy for a danger is affected when a law relating to it is framed, it matters not whether it be operative or not. Given the patient and the knife, skill in the surgeon is secondary; the knife may be double bladed and wound the hand that holds it, but the credit for work performed with it is due to it and the maker thereof only.

AMENDMENTS TO CONSTITUTION AND BY-LAWS.

MR. B. T. A. BELL gave notice of the following amendments to the Constitution and By-laws of the Society:—

Section IV. That there be a Secretary-Treasurer instead of a Secretary and Treasurer as heretofore.

That new sub-sections be added as follows:—

The President shall not hold office for more than two consecutive years, but shall be eligible for re-election to that office after an interval of one year.

Retiring Presidents shall be elected Past Presidents and shall hold office *ex-officio*.

All officers and members of Council shall retire annually, but shall be eligible for re-election.

Section V. Be amended by the addition of the following:—General Meetings for the reading and discussion of papers and the transaction of business shall be held twice in each year, at such time and place as the Council may determine. Any special business or subject for discussion shall be specified in the notice convening such meetings, and the Secretary shall give not less than fourteen days notice thereof to all members of the Society.

Extraordinary or urgent business may be transacted at any meeting when considered absolutely necessary by a three-quarter majority of those present.

ELECTION OF OFFICERS AND COUNCIL, 1894-5.

The following were elected for the ensuing year:—

Past President.

HENRY S. POOLE, M. A., A. R. S. M. (Acadia Coal Co.) Stellarton.

President.

JOHN E. HARDMAN, S. B. (Oldham Gold Co.) Oldham.

Vice-Presidents.

R. G. LECKIE, M. E. (Londonderry Iron Co.) Londonderry.
DAVID MCKEEN, M. P. (Dominion Coal Co.) Glace Bay.
GEORGE W. STUART, (Caribou Gold Co.) Truro.

Hon. Secretary.

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

Secretary-Treasurer.

H. M. WYLDE, Halifax.

Council.

W. R. THOMAS, F. G. S. (Nova Scotia Gold Mines Ltd.) Montague.

R. H. BROWN, M. E. (Gen. Mining Assoc'n. of London, Ltd.) Sydney Mines.
DUNCAN MCDONALD, (Truro Foundry and Machine Co.) Truro.
CHAS. FERGIE, M. E. (Intercolonial Coal Co.) Westville, N. S.
W. BLAKEMORE, M. E. (Dominion Coal Co.) Glace Bay.
W. G. MATHESON, (I. Matheson & Co.) New Glasgow.
C. E. WILLIS, (Canadian Rand Drill Co.) Halifax.
GRAHAM FRASER, (New Glasgow Iron, Coal and Railway Co.) New Glasgow.
GEOFFREY MORROW, (Stairs, Son and Morrow) Halifax.

VOTE OF THANKS.

MR. R. H. BROWN proposed a vote of thanks to the Past President and retiring officers.

MR. W. G. MATHESON seconded the motion, referring especially to the valuable services rendered to the Society by the ex-President.

THE PRESIDENT.—To the kind words used by Mr. Brown and Mr. Matheson, I wish personally to add that Mr. Matheson has not begun to rightly estimate the amount of work done by our Past President, and if the Society continues to flourish in the future as in the past, it will be due to the fact that the plant in its infancy was so tenderly nourished and well watered by the President.

MR. POOLE.—I will merely say this, that the labor which I have had in connection with the Mining Society has been a labor of love, and I am more than amply repaid by the pleasure and satisfaction it has given me.

MR. T. R. GUE.—As one of the retiring officers, I may say that any praise of my efforts would be entirely underserving. The only work done by me has been to sign cheques. I was very glad when the two offices were amalgamated to-day.

ELECTION OF HONORARY MEMBERS.

MR. B. T. A. BELL.—I desire to submit the name of Mr. John Rutherford, M. E., Stellarton, for election as an Honorary Member, and in doing so I need hardly remind you of his invaluable services to the Province as its late Inspector of Mines. Mr. Rutherford is now out of active mining, but he takes a deep interest in its welfare and the work of this Society. I am sure in honoring him we would greatly honor ourselves by this election.

MR. WYLDE seconded, and the election was carried unanimously.

FEDERATION OF CANADIAN MINING SOCIETIES.

MR. B. T. A. BELL.—At the last meeting of the General Mining Association of the Province of Quebec the question of consolidating the existing mining associations in Ontario and Quebec was favorably discussed and Mr. F. A. Halsey, of Sherbrooke, and myself were delegated to bring the subject before you. I regret exceedingly that illness in Mr. Halsey's family has prevented his being here. Two propositions were discussed. namely, complete consolidation into a Canadian Mining Institute, operated by a representative council and local boards of management. The other, federation. It has been thought that either of these propositions would considerably augment the influence of the various societies as they now exist, but before doing anything our Association would be pleased to have your views on the matter.

The question having been discussed, was referred to the following committee: Messrs. H. S. POOLE, C. E., Willis, the President and Secretary. To consider, first, the possibility of federation; second, that they be empowered to confer with representatives of other associations, and third, to report progress at the next meeting of the Society.

AFTERNOON SESSION.

Invitation to Visit Cape Breton.

The members met at two o'clock, the President in the chair.

Mr. W. BLAKEMORE.—You will remember that at our last meeting Mr. McKeen invited us to hold the summer meeting at Cape Breton. He now writes me to submit a programme. It is his desire to make the visit a pleasant one and he says both in the mines and shipping arrangements of Cape Breton and in the scenery of the country there will be found ample to repay anyone for making the visit. He says further that any member of the Quebec Association will be heartily welcomed. He suggests that the members leave Halifax on Monday, July the 9th. They will arrive at Sydney on the evening of that day. There will then be a large hotel in order and it will be ready to receive the gentlemen. On Tuesday it is proposed to take the members to the International Pier which will be one of the largest on the continent. It will load two vessels of the same size as the "Teutonic." There is an immense tower by which the buckets can be swung around to either side of the vessel. At the pier the works will be explained by Mr. H. Donkin, C. E. Then the party will be brought back on the steamer to the Sydney hotel and have lunch. In the afternoon they will go out on a special train to some of our mines, probably the Caledonia. That mine is being equipped in a superior manner. The shaft has been doubled in size. We are putting in self dumping cages, cages of double capacity in putting out coal. All the arrangements for weighing, etc., are new and very complete. The air compressor is a duplex compound steam compressed air of large size. The coal cutting machinery will be new. We have the Stanley heading machines, in the advertisement of which it is claimed that in eight hours the machine has been able to cut from ten to twelve feet. In a six feet heading, we are heading

thirty feet in eight hours, blasting it, loading and carrying it away. That is quite a record in heading, such as I think was never seen in the old country. We have also the longwall cutter for under-cutting the coal. We have the Sergeant and Harrison machines. All of this machinery will be interesting even to our gold mining friends from a mechanical standpoint. The mine is lighted up by electricity. You might then have the ordinary meeting in the evening, the reading of papers and transactions. The representatives of the Dominion Coal Company will read several papers explaining the workings of their departments. The Company's engineer, Mr. Pearson, will read a paper on compressed air, and I will read one on underground work. Mr. Brown, of the Sydney mine, has invited the members out to the old Sydney mines on the following day. They are the oldest in Cape Breton, and have a very interesting history. In the evening it is Mr. McKeen's desire to entertain the members at a public dinner at the hotel, to which will be invited the prominent men of Sydney. On the third day he will place a steamship at your disposal to take you to Louisburg. The cruise down the coast will be very interesting. Those desiring to return on Friday can do so, but if they desire to remain there are many things of interest to be seen. These suggestions are now open foryour approval. Mr. McKeen is anxious that our large and important property be inspected.

THE PRESIDENT.—I think I may say on behalf of the Society, that this programme which Messrs. McKeen, Blakemore and Brown have arranged, is exceedingly courteous in its character. I hope that this Society may be able to give a full attendance sufficient to warrant these gentlemen in going to this expense and interfering with their business to entertain us.

MR. B. T. A. BELL.—On behalf of the Quebec Association I can only express heartiest appreciation of the thoughtfulness which has prompted the invitation of our members. We had arranged to hold our June meeting in Quebec and were in hopes of having the pleasure of the company of members of the Min-

ing Society. I will, however, submit this kind invitation at the earliest opportunity and I hope to be able to report that our Association has cancelled its Quebec meeting and that we will be fully represented in Cape Breton.

The following papers were then read:—

On the relative cost of mining narrow Veins. Hand drills vs. Air drills by JOHN E. HARDMAN, S.B., Oldham.

Some remarks on the gold production of Nova Scotia and how it may be increased, by B. C. WILSON, Waverley.

On the value of Blast Furnace material, by R. E. CHAMBERS, Ferrona.

THIRD ANNUAL DINNER.

The third annual dinner of the Society took place in the evening in the St. Julian dining room, Halifax Hotel, some thirty members and guests being present, Mr. John E. Hardman, S.B., President, in the chair. After dinner had been served and the usual loyal and patriotic toasts duly honored, an informal programme was carried out, the opening feature being "the health of our most distinguished fellow citizen, the Premier," proposed by the chairman and received with all honors, the company joining heartily in "He's a Jolly Good Fellow."

HON. W. S. FIELDING, on rising, was greeted with loud applause. He said that he enjoyed an unexpected pleasure in being present. He had been one of the party at Montreal, and had many pleasant recollections of evenings spent around this board, and when he received the invitation to be present this evening it was with much regret that he thought he would have to decline. He was absent in a distant part of the county engaged in business which was occupying public attention at the moment and it seemed impossible that he could get here in time. Some years ago there was a Governor in this Province named Sir Hastings Doyle, and, at the same time there was a very

popular clergyman here, who was a neighbor and a warm personal friend of Sir Hastings. They were in the habit of meeting together frequently in an unconventional way and enjoying the pleasures of the table. One day Sir Hastings had some particularly fine soup for dinner that he knew his friend the clergyman would enjoy, and sent his servant over with an invitation to come and dine with him. The clergyman reflected with much sadness that it was a fast day, and sent word that he would not be able on that account to accept the invitation. But the attraction was too strong to be resisted, and before the servant had quite got out of the house the clergyman called him back and said "Never mind; tell Sir Hastings that I will grant myself a special dispensation and come." And so, after he had sent off the telegram to Mr. Bell, expressing regret that he would not be able to be present this evening, he concluded that he would grant himself a " special dispensation " and come. (Applause).

This was an age in which co-operation in every department of society was necessary, and if co-operation was necessary in other departments why should it not be made use of in respect to the many important interests to promote which this Society was formed. The formation of the Society was a wise step. Already the members had good results to look back to and no matter what government might be in power in the future, as the years rolled on the Society would find a large field of usefulness and as the results of the exercise of its legitimate influence upon public affairs there might be a development of the mineral wealth of the province that would be a source of profit to investors. Both as respects gold, coal and other minerals, which, perhaps had been too little considered, he believed that there would be a development of our mineral wealth which would be a source of pride to the province, of revenue to the provincial treasury, and, what was of equal importance, of profit to the pockets of the men who worked the mines. For years men had been boasting of the mineral wealth of the province and had been crying for capital to develop the mineral wealth and trade of the province. Now a time had come when, more than

ever before, capital was being drawn to the province, and though there might have been differences in the past he was persuaded that the members of the mining fraternity, united and working together, would be able to so influence legislation that capital would be attracted, justice done to all concerned, and the mineral wealth of the province be made a blessing to all who are interested in the country. (Applause).

Here MR. W. R. THOMAS contributed an excellent song, which was followed by a duet from Messrs. Bell and Sword "Drill Ye Tarriers, Drill," with banjo accompaniment, the chorus, as usual, being very much in evidence.

MR. W. L. BLAKEMORE, in responding to "Our New Members," said he was pleased to hear the Hon. Mr. Fielding expressing so cordially his appreciation of the importance of the mining industries of the province, and Canada as a whole. He (Mr. Blakemore) did not profess to know much about Canada, but, so far as he had been able to observe, the wealth of this province lay largely in the development of its mines. In saying this he did not loose sight of the agricultural possibilities which had been well illustrated recently at the World's Fair at Chicago. The possibilities of the mining industry were enormous. The value of the known mineral deposits was so great that they had only to be developed to bring enormous wealth not only to investors, but to the people. So far as the coal mines were concerned, one could not find in England a series of coal measures which for convenience of access, cheap working and ease of transport, could be compared with the mines in the Island of Cape Breton. There were of course, differences of quality and adaptability, but for the cheapness with which the coal could be worked and the ease with which the coal could be put on ship board, there was nothing in England to compare with the mines of Cape Breton. (Applause).

MR. JAMES BAIRD having done ample justice in a few humorous remarks, to the charms of the fair sex in responding to "The Ladies," songs were given by Messrs. Arnold Wylde, R. G. E. Leckie, Thomas and Sword. The health of the retiring

President, Mr. H. S. Poole, was given by the chairman Mr. Hardman dwelt on the fact that the existence and prosperity of the Society was mainly due to the work that had been accomplished by Mr. Poole. (Applause).

MR. H. S. POOLE, expressed pleasure that his efforts on behalf of the Society had been such as to merit the approval of his fellow-members. Knowing this he was fully repaid for any labor he had performed. As a substitute for a speech he would submit the following lines, being a revised version of an old and familiar song :—

OLD KING COAL.

Old King Coal was a jolly old soul,
And deep underground lay he;
On a fire- clay bed he had pillowed his head,
Under strata three thousand and three;
Till at last a mining man laid a deep and cunning plan,
And he says to his mates says he,
Let us dig a deep hole and get up this King Coal,
For a jolly old soul is he.

Chorus.

Then this man set up a whimsey, got a banksman and a bailie,
And a stout lot of sinkers got he.
They began to dig and bore, then they blasted, then they swore.
But they sank all the way jollily,
Through clunch and binds they knocked, black bat and pelton rock,
Through the gubbin and the balls d'ye see,
Then they drove out a big heading, just to search among the bedding,
For the place where King Coal should be.

Chorus.

So they found old King Coal at the bottom of the hole,
And his face they were glad for to see,
Though with thumb to nose it bore, the strange legend not of yore,
Pay up increasing royalty!
Then in all the country round, in every house is found,
Old King Coal smoking jollily,
And many a good fellow sits by him and gets mellow
As all jolly fellows should be.
For old King Coal is a jolly old soul,
And a jolly old soul is he,
And many a good fellow sits by him and gets mellow
As all jolly fellows should be. (Applause.)

MR. B. T. A. BELL responded to the toast of "Our Sister Societies." He thought that the attractive programme outlined by Mr. Blakemore at the afternoon Session would be certain to attract to Cape Breton a good representation of the members of the sister Association in Quebec. It was a great source of satisfaction, and it might be taken as fair indication of the advance-

ment of mining in Canada that the organizations of mining men were springing into activity and were accomplishing good work for the country. He commended the Mining Society to the government as an institution which merited their support, inasmuch as there was no better means of advertising the wealth of the province than the Society's publications. He concluded by reciting the following humorous composition on the present system of examination for a certificate for workers in coal mines, which was respectfully dedicated to their good friend the Hon. Mr. Fielding :—

OUR CERTIFICATE.

In learned professions, to carry more weight,
An expert should have a good certificate.
Now, all sorts of miners must hold one as well,
And how they regard it this chorus will tell.

I'm only a trapper and need no book lore
To teach me to open and shut-to a door;
Still, I have to study and addle my pate
Before I can pass for a certificate.

And I am a driver, I cannot go wrong,
As o'er the gate roads I pass carelessly on.
A very poor scholar can drive a horse straight,
Yet I must read up for a certificate.

And I work a windlass, it does not need brain
To turn a crank handle again and again;
Still, I'm not exempted; I hear 'tis my fate
That I, too, must pass for a certificate.

And I am a cutter, unpaid if I shirk
(The strongest of motives to keep me at work),
But yet I must grind all new theories to date
Before I can handle a certificate.

And I am an overman, high up the tree;
Good practical mining is expected of me,
Which I learned, with much more, I now beg to state,
Before I was crammed for a certificate.

And I'm an Inspector from nondescript trade,
Without special training, and fairly well paid.
I criticise freely, yet, strange to relate,
I cannot produce a certificate.

(Laughter and applause.)

MR. J. D. SWORD, a member of the Quebec Association, also replied on behalf of that organization, concluding with an excellent comic song and banjo accompaniment. Mr. R. G. Leckie also sang "Bonnie Dundee" in capital style.

MR. HECTOR McINNES, replying to the toast of "the Legal Profession," emphasized the necessity of technical education. He thought that the demand might be in part supplied by lectures of a popular character in various localities. If facilities were afforded for obtaining technical education in matters relating to mining the mistakes of the past might be better avoided, the experience gained in the past made use of to better advantage, loss of capital in unprofitable operations avoided, and more confidence given to investors.

MR. H. S. POOLE expressed his regret that the head of the Department of Education of the Province was not able to be present. From conversations which he had had with that gentleman he believed that he was of the opinion that the day when a classical education was considered as the *summum bonum* was drawing to a close. He thought that the government would keep this in view. A beginning had been made in connection with mines by which those who were at the bottom of the ladder were given an opportunity of rising to the top, if they desired to do so. Some men had shown a desire to do so and the Superintendent of Education was desirous of extending the idea in other directions. Men wanted more than the theoretical training given by the schoolmasters. What had been done so far was only a step. Men were apt to suppose when they passed the examinations to which they were subjected that they had reached the top of the tree, whereas, in reality they were only beginning to climb.

HON. MR. FIELDING proposed the toast of "The President and Office-bearers of the Society." In doing so he said that all who were interested in gold mining knew that the science of gold mining had been exemplified by Mr. Hardman, the President of the Society.

MR. HARDMAN called upon the first Vice-President to reply.

MR. LECKIE spoke briefly in reply. He expressed his pleasure in being present. He did not know of any other

profession in which the feeling of fellowship prevailed to the same extent as in the mining profession.

A number of excellent songs, recitations, and the sword dance, performed inimitably by Mr. George Stuart, brought to a close another thoroughly enjoyable annual dinner.

JULY MEETING.

The midsummer meeting of the Mining Society of Nova Scotia was held at Sydney, Cape Breton, on Tuesday evening, 10th July. There was a large attendance including the visiting members of the Quebec and Ontario Mining Associations, and prominent citizens of the town of Sydney.

LOCAL COMMITTEE.

DAVID MCKEEN, M.P.,	Glace Bay, C. B.
R. H. BROWN,	Sydney Mines, C. B.
CHAS. ARCHIBALD,	Sydney, C. B.
W. BLAKEMORE,	Glace Bay, C. B.

Mr. Jonh E. Hardman, West Waverley Gold Co., president, in the Chair.

The following were elected to membership: Mr. Geo. E. Boak, Halifax; Mr. Alex. Dick, M.E., Halifax.

The following papers were then read:

1 "The organization and development of the Dominion Coal Company, L'td," by J. S. McLennan.

2 "The introduction of endless rope haulage into Cape Breton, and method of laying out a new plant," by W. Blakemore, M.E.

3 "Some interesting data on the work of coal cutters and the Stanley header," by J. G. S. Hudson, M.E.

4 "The Rail Road System of the Dominion Coal Co'y," by H. Donkin, C.E.

5 "The sinking of Dominion No. 1 Shaft," by John Johnstone.

6 "Notes on the Geology of the Cape Breton Coal Fields," by Hugh Fletcher, M.A.

7 "Gold Mining in Nova Scotia, a review of operations in the various localities," by John Rutherford, M.E.

8 "Silver mines of West Kootenay, B. C.," by E. D. Ingall, M.E., Chief of Mining Statistics, Ottawa.

UNITED MEETING.

A united meeting of the members of the Mining Society of Nova Scotia and the General Mining Association of the Province of Quebec, was held in the Sydney Hotel, Sydney, on the evening of Thursday, July the 12th, to consider the matter of federation of all Canadian Mining Associations.

MR. A. W. STEVENSON, General Mining Association of Quebec, in the Chair.

MR. H. M. WYLDE, Mining Society of Nova Scotia, moved, after discussion, "That the Mining Society of Nova Scotia and the Mining Association of Quebec, do hereby federate and that a committee composed of the president and three members of the Society and Association respectively, be appointed to meet and draw up a basis of federation."

The motion was seconded by Mr. A. Drysdale and carried without a dissenting vote.

MR. JOHN J. PENHALE, Quebec Mining Association, then moved: "That the Ontario Mining Institute be invited to join in the federation, aud that the federation be known as the Canadian Mining Institute; and also that they be asked to call a special meeting of their institute and appoint their president and a committee of three members to act in conjunction with the presidents and committees the Mining Society of Nova Scotia and the Mining Association of Quebec, in drafting a constitution to govern the Canadian Mining Institute."

The motion was seconded by Mr. D. W. Robb, Amherst, and carried unanimously.

The meeting was then declared adjourned.

EXCURSIONS.

On Monday, July 9th, members and guests left Halifax in special cars at 7 a.m. en route for Sydney, C. B., where by invitation of the Dominion Coal Co., L'td, and the General Mining Association of London, L'td, a united midsummer meeting of the Mining Society of Nova Scotia and of the General Mining Association of Quebec was to be held.

At Truro and New Glasgow the party was augmented by the addition of members and guests from these localities, so that when the train arrived at Sydney the party numbered forty-seven. Headquarters were established at the New Sydney Hotel, and a Council Meeting was held that evening at 10.30 p.m.

The delegation from the Quebec Association did not arrive until the following day at noon.

Among the distinguished guests of the Society was the Hon. W. S. Fielding, Premier of the Province, who, with the presence of many ladies, made the long journey of two hundred and seventy-six miles one ever to be remembered for its pleasure.

By special arrangement of Mr. W. H. Price, the courteous travelling passenger agent of the Intercolonial Railway, (who accompanied and remained with the party throughout the trip,) the special cars were ferried across the Strait of Canso, avoiding delays incident to the handling of so much luggage and so many passengers.

On Tuesday morning, under the guidance of Mr. David McKeen, general manager of the Dominion Coal Co., L'td, assisted by other members of the Local Committee, the party left Sydney by steamer at 10 o'clock to inspect the International and Victoria shipping piers. The International pier is at present the largest pier in Canada, and has been specially constructed to handle a large bulk of coal in a short time. The pier and its appliances were not fully completed, but a steamer loading at the time enabled the visitors to get a clear idea of the system devised.

On leaving this pier, en route for Victoria mines, the party were met by a tug conveying the Quebec members from the S.S. Bonaviste to Sydney. With three cheers of welcome the Quebec contingent were transferred from the tug to the steamer, and the united party then visited Victoria pier returning to Sydney Hotel for lunch.

At 1 p.m. a special train conveyed the party to the Dominion Coal Co's *Caledonia* mine at Glace Bay. Here, the extensive bank head arrangements were inspected, including the steel pit-head frame, self dumping cages, new screening and loading devices then finished or under construction. A large party under the guidance of Mr. Wm. Blakemore, assistant general manager, donned pit suits and went below to witnsss the working of the Stanley Heading machine, the Harrison coal cutters, &c. Before reaching Glace Bay the train was stopped at Bridgeport, Dominion No. 1 and International Collieries, to permit of a hasty visit to the surface plant at each place.

In the evening at 8 p.m., the regular July session of the Mining Society of Nova Scotia was held in the Town hall, where the papers of this meeting were read and discussed.

On Wednesday morning the party, to the number of seventy, took the ferry to North Sydney where they were met by Mr. R. H. Brown, General Manager of the Genl. Mining Association of London, under whose guidance the party were successfully transported some three miles to the old Sydney mines. These workings extend over a mile under the sea, and a party was made up which took the trip underground. After inspection the visitors were driven to Beach Hill, Mr. Brown's residence, where Mrs. Brown ably assisted by the Misses Brown and Miss Franck-lyn, entertained the party at lunch. After a most delightful hour spent in the beautiful gardens and grounds, amid three rousing cheers for Mrs. Brown and the ladies, the party were driven to the ferry returning to Sydney at 6 p.m.

On Wednesday evening the visitors were dined by Mr. David McKeen, who had a most distinguished company to meet the visiting Societies.

On Thursday, under the guidance of officials of the Dominion Coal Co., some of the members and guests took train to Glace Bay where the Dominion Coal Co's powerful tug, the "Douglas H. Thomas," was waiting to convey the party to Louisburg by sea, a sail of about twenty-four miles. Unfortunately a dense fog and rain came up about noon, preventing any visit to the old historic town, and the party returned to Sydney, arriving about 7 p.m.

On Friday, the most enjoyable excursion took place, viz: a trip through the Bras d'Or Lake, by daylight, in the steamer "Marion." The day was perfect and the scenery unsurpassed.

On Saturday the special cars conveyed the members to Halifax, ending a most enjoyable and memorable midsummer meeting.

NOVEMBER MEETING.

The Autumn meeting of the Mining Society of Nova Scotia was held at Halifax on Tuesday 6th November.

There were present :—

Mr. John Hardman, S. B., Halifax, *President.*
Mr. H. S. Poole, M., A., A. R. S. M., Stellarton, *Past President.*
Mr. C. Fergie, M. E., Drummond Colliery, Westville.
Mr. W. R. Thomas, F. G. S., Montague.
Mr. J. H. Austen, Halifax.
Mr. B. F. Pearson, Halifax.
Mr. W. G. Matheson, New Glasgow.
Mr. Chas. Archibald, Halifax.
Mr. G. E. Boak, Halifax.
Mr. A. A. Hayward, South Uniacke.
Mr. C. E. Willis, Halifax.
Mr. J. D. Sword, Halifax.
Dr. E. Gilpin, Inspector and Deputy Commissioner of Mines.
Dr. Murphy, Halifax.
Mr. C. F. Andrews, Country Harbor.
Mr. R. C. Leckie, M. E., Londonderry.
Mr. M. R. Morrow, Halifax.
Mr. Alex. Dick, C. and M. E., Halifax.

and Messrs. W. H. Smith, J. E. Leckie and Mr. H. M. Wylde, Secretary.

After the minutes of the July meeting had been read and adopted the following were elected :—

NEW MEMBERS.

Mr. A. N. Whitman. Mr. J. E. Leckie, Mr. J. D. Sword.

FEDERATION.

THE CHAIRMAN — We have to go back as far as the March meeting on this matter, the whole question was referred to a committee consisting of Messrs. Poole, Willis and the President and the Secretary. That committee formulated a scheme which was sent on to the Quebec Association, amended by them and reported back at the Sydney meeting. The report is as follows :—

" In the matter of Federation of existing mining societies or associations, it was agreed :—

(1) That in so far as the subsequent paragraphs are concerned, it is deemed desirable that all existing mining associations or societies in Canada should be invited to join.

(2) That all members of such organizations should become ex-officio, members of the proposed " Canadian Mining Institute."

(3) That each organization should pay annually to the funds of the Canadian Mining Institute a sum per head of its membership to be hereafter agreed upon.

(4) That the first and *raison d' être* of the Canadian Mining Institute should be the printing and publishing in one volume under one editing, of all the transactions of each of such organizations, thereby relieving the local organizations of this matter and expense entirely ; the expense being met by the per capita contribution to the funds of the Canadian Mining Institute.

(5) That it is not desirable to have, or attempt to have, any large body of officials for the Canadian Mining Institute, but rather that such business as may arise should be transacted by a small body or committee to be composed either

(*a*) of the several Secretaries to the local organizations, or

(*b*) of one specially elected delegate, or

(*c*) of a specially elected delegation, based on one member per so many members, for each local organization.

(6) That the committee, or governing body, so constituted should appoint or elect one individual to act as Secretary-Treasurer — Editor of the Canadian Mining Institute.

(7) That each local organization preserve, to the utmost extent, its autonomy and individuality.

The report came before the Council of the Society and was indorsed by it before transmitting it to the Quebec Association. This is the first time it comes before this Society as a whole, and I will have to ask for your verdict on this report.

On motion the report was received and adopted.

THE CHAIRMAN — The next step is to read what action has been taken by the other associations. Ontario and Quebec have each appointed a committee, which committees have drawn up two schemes practically identical. The first is from the Ontario Mining Institute and is endorsed by their full committee.

It reads as follows, viz :—

(Par. 1.) NAME.

Sec. 1. The organization shall be named the MINING INSTITUTE OF CANADA.

(Par. 2.) CONSTITUTION.

Sec. 2. The Institute shall be a federation of Canadian societies interested in the advancement of mining, metallurgy, engineering and their allied industries. It shall have for its objects: —

(*a*) The publication in one volume of the papers and proceedings of the Institute and of the societies in the federation: —

(*b*) Action upon all matters affecting or relating to the mineral industries of Canada.

(Par. 3.) MEMBERSHIP OF SOCIETIES.

Sec. 3. The original founders are as follows:—

THE MINING SOCIETY OF NOVA SCOTIA,
THE GENERAL MINING ASSOCIATION OF THE PROVINCE OF QUEBEC.
THE ONTARIO MINING INSTITUTE:—

Sec. 4. Written applications from societies to enter the Institute shall be made to the Council by the President of the applying Society who shall furnish any information respecting it that may be desired by the Council.

(Par. 4.) ORDINARY MEMBERS.

Sec. 5 Any gentlemen interested in the Canadian mining industry but who may not be a member of any Society in the federation is eligible for election as an ordinary member. Ordinary members shall be elected by Council and shall pay an annual fee of ten dollars.

(Par. 5.) GOVERNING BOARD.

Sec. 6. The affairs and business of the Institute shall be managed and controlled by a Council consisting of the Presidents of the Societies in the federation and one member to be elected annually by each Society :—

Sec. 7. The Council shall elect a Chairman and a Secretary-Treasurer each year :—

Sec. 8. The Secretary-Treasurer shall be appointed by, and shall act under, the direction and control of the Council and his salary, if any, shall be determined by the Council :—

Sec. 9. The Secretary-Treasurer shall attend all meetings of the Council and shall record the proceedings in a minute book. He shall have charge of and conduct all correspondence relative to the business and proceedings of the Institute and of all committees thereof if necessary, and he shall be responsible, under direction of the Council, for the editing and publication of an Annual volume of proceedings. The fees, subscriptions and other income of the Institute shall be payable to him to be deposited in its name in a bank approved by Council :—

Sec. 10. All payments on behalf of the Institute shall be made by cheques signed by the Chairman of Council and the Secretary-Treasurer :—

Sec. 11 The accounts of the Treasurer and the financial statement for the year shall be audited by two members of the Institute, to be elected at the Annual General Meeting.

(Par. 6) SUBSCRIPTIONS.

Sec. 12. The Societies in the federation shall each pay an annual subscription towards the expenses of the Institute of such an amount as may be decided upon at each Annual General Meeting, but the contribution from each Society shall at no time exceed One-hundred and Fifty dollars per annum.

(Par. 7.) MEETINGS.

Sec. 13. The Annual General Meeting of the Institute shall be a United Meeting of the members of the various Societies in the federation. It shall be held in the month of July at such time and place as the Council may determine. Special meetings may be called at the discretion of the Council.

(Par. 8.) PUBLICATIONS.

Sec. 14. The publications of the Institute shall be supplied only to members in good standing in their respective societies, and no duplicate copies shall be issued to any member unless by order of the Council. The number of copies of each publication shall be determined by the Council :—

Sec. 15. The Institute as a body shall not be responsible for the statements and opinions advanced in the papers which may be read or in the discussions which may take place at the meetings of the Institute or of the federated societies :—

Sec. 16. The Council may accept communications from persons who are not members of the Institute and authorize them to be published.

(SIGNED) J. S. KINGSMILL, Q C., CHAIRMAN,
" A. BLUE,
" T. W. GIBSON,
" B. T. A. BELL, SECRETARY.

The second one is from the General Mining Association of Quebec and is signed by three of the four members of the committee, the forth member while endorsing it as a whole has forwarded a letter which, perhaps, will be better read after the schemes have come before the meeting. I think these reports sent by the Ontario and Quebec Societies are properly before the meeting for discussion.

MR. THOMAS — Are outside members to be represented on the Board ?

THE CHAIRMAN— No. In that connection I will read the criticisms of Mr. L. A. Klein in a letter to the Secretary of the Quebec Association :

" On the whole I approve of it for the purpose as a starter,— there are, of course, a good many things which I wished to have discussed at a full meeting of all the delegates.

(Par. 4, sec. 5.) While it may be a good thing to enable any one to become a member of the Federation *without* being a member of any society, in federation, I don't see where such members are going to have any representation from, *i. e.*, the Governing Board or Council ; further,

(Par. 5, sec. 6.) I am not in favor of this method of representation in Council, as it places all the larger and more important societies in a disadvantage, being eventually out-voted by smaller

organizations and such that have become members *after* federation. I would much more favor a "de capita" representation, but knowing there is a vast difference in the subscription fees (and therefore quite possible to acquire a large membership with a small fee) I would wish to have the representation in council based on the annual subscription list of each society *pro rata.* The idea may strike you as strange, but we will have to deal with this subscription list anyhow in some measure or another, viz: (Par. 6, sec. 12) re annual subscription of each society, which could not possibly be the same amount in each and every case. I would suggest that the council should consist of the Presidents (which would give a representation of any society in any case) and one member "*for every*, say $250 or $300, *Annual Subscription*," to be elected annually by each such society. The subscription list of the previous years to be governing.

(Sec. 7.) Is the Secretary-Treasurer to be elected from the delegates or from the members of any of the societies? I would suggest the latter.

It seems to me also that we touched a number of points at the Meeting in Sherbrooke which are worth while considering and I trust you will bring the matter before the Nova Scotia members so that we may be enabled to federate under conditions approved by all."

After a protracted discussion on the principles of Federation and the details of the scheme proposed which extended throughout the afternoon session, the following was adopted by the meeting and the Secretary was instructed to forward the same to the Ontario and Quebec Associations as the Nova Scotia basis for a Federation:

DRAFT OF CONSTITUTION AND BY-LAWS
approved by
THE MINING SOCIETY OF NOVA SCOTIA,
NOVEMBER 6TH, 1894.

(Par. 1.) NAME.

The Organization shall be named the **MINING INSTITUTE OF CANADA**.

(Par. 2.) CONSTITUTION.

The Institute shall be a Federation of all or any of the Canadian Societies interested in the advancement of mining, metallurgy, engineering and their allied industries. It shall have for its objects:

(a) The publication in one volume of the papers and proceedings of the several organizations in the Federation.

(b) Action upon all matters affecting or relating to the Mineral Industries of Canada, providing that nothing in this clause shall be construed as conferring jurisdiction, or power to act, with reference to any matter or thing affecting the said mineral industries, or any of them, unless thereto requested by a majority of the members of one or more of the Societies associated in said Federation.

(Par. 3.) MEMBERSHIP.

The original founders are as follows, viz:—

The Mining Society of Nova Scotia.

The General Mining Association of the Province of Quebec.

The Ontario Mining Institute.

Written application from Societies desiring to enter the Institute shall be made to the Council by the President of the applying Society, who shall furnish such information as may be desired by the Council.

(Par. 4.) GOVERNING BOARD.

(a) The affairs and business of the Institute shall be managed and controlled by a Council consisting of the President of each Society in the Federation, and one member for every forty and fraction thereof, full members of each federated Society to be elected annually. The qualification for full membership as specified above shall be an annual fee of ten dollars.

Nothing in this clause shall prevent the various Societies from having other classes of members, paying other rates or fees.

(b) The Council shall elect a Chairman each year. The office of Secretary-Treasurer shall be an honorary one, and this officer shall be elected by the individual votes of the members of each of the societies in the federation.

(c) The Secretary–Treasurer shall act under the direction and control of the Council.

(d) The Secretary-Treasurer shall attend all meetings of the Council and shall record the proceedings in the minute book. He shall have charge of, and conduct all correspondence relative to the business and proceedings of the Institute and of all committees, where necessary, and he shall be responsible under direction of the Council, for the editing and publication of an Annual volume of proceedings. The income of the Institute shall be received by him and be deposited in its name at a bank approved by Council.

(e) All payments on behalf of the Institute shall be made by cheques signed by the Chairman of Council and the Secretary-Treasurer.

(f) The accounts of the Treasurer and the financial statement for the year shall be audited by two members of the Institute. The Auditors shall be elected at the Annual General Meeting.

(Par. 5.) SUBSCRIPTIONS.

The Societies in the Federation shall each pay an annual subscription of such an amount as may from time to time be deemed necessary by the Council to conduct the affairs of the Institute; but the contribution from each such Society shall at no time exceed in amount the sum of Three Dollars per capita.

[Par. 6.] MEETINGS.

The Annual General Meeting of the Institute shall be a United meeting of the members of the various Societies in the Federation. It shall be held in the month of July at such time and place in said month as each Council may determine.

[Par. 7.] PUBLICATIONS.

[a] Publications of the Institute shall be supplied only to members in good standing in their respective Societies, one copy to each member, twenty copies to the authors of papers, and the balance shall be sold by the Council at such price as it may determine Copies of the Transactions sent for exchanges shall be accompanied with a request for a copy of such exchange for each Society in the Federation.

[b] The Institute as a body shall not be responsible for the statements and opinions advanced in the papers which may be read, or in the discussions which may take place at the meetings of the Institute or of the federated Societies.

[c] The Council may accept communications from persons who are not members of the Institute and allow them to be published.

VOTE OF THANKS FOR COURTESIES DURING CAPE BRETON MEETING.

The following resolution was carried unanimously: "The hearty thanks of the Mining Society of Nova Scotia are hereby tendered the Dominion Coal Co., L'td, and the General Mining Association of London, for the courtesy extended in opening their colliery and surface works to this Society and its fellow-guest, the General Mining Association of the Province of Quebec,

for visiting and inspection at the united meeting held in Cape Breton last July; and also to Messrs. MacKeen, Blakemore and R. H. Brown, for their great personal kindness in attention shown and hospitalities extended to the visiting members and the ladies of their party; and also to the president and members of the Sydney Club for courtesies extended."

COMMITTEE ON MINING LEGISLATION.

Mr. B. C. Wilson, seconded by Mr. Willis, moved the following:—

"Resolved, that the President is hereby empowered to nominate a Committee of five members of this Society to take into consideration legislation affecting the mining industry of this province and to secure such modifications and changes therein as may be desirable in the best interests of such industry."

PASSED.

The Chairman thereupon nominated the following Committee: Messrs. Poole, Drysdale, Stuart, Peasron and B. C. Wilson.

An Evening Session was held at the Halifax Hotel, at 8.30, for the discussion of papers read at the Sydney meeting, the meeting being brought to a close with a supper.

PAPERS.

On the Relative Costs of Mining Narrow Veins—Hand Drills vs. Air Drills.

By JOHN E. HARDMAN, S.B., Oldham.

(Read at the Halifax Meeting, March, 1894.)

Having recently had occasion to make up some data involving the cost of development work upon the narrow lodes common to our gold fields, I was led to investigate costs of mining when done by air drills as compared with the same done by hand drilling.

Believing that one of the objects of our Society is to make our individual experiences available for others, I have incorporated the results of my investigation in this paper.

By way of premise I may say that the figures given and conclusions reached are based upon the cost books of the last four years' work in Oldham District, where, during that period, I have had exceptional opportunities for comparing the two methods of work upon identical ground, and often side by side at the same time. The cost books referred to take account of all items. excepting only amortization of plant, and the costs mentioned are therefore actual ones and are reliable.

The figures given are the averages of large totals, e.g., those for stopping represent over 5000 tons, those for driving are averaged from nearly 4000 feet of levels, etc., those for sinking represent a total of 1100 feet.

For convenience I have tabulated the results as follows :

	BY HAND DRILLS.			BY AIR DRILLS.		
	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
	$	$	$	$	$	$
Shafts, per foot sunk..	23 58	4.81	14 32	16.46	13.82	15.52
Winzes, " " " ..	13.08	9.40	11 53	13.32	8.92	11.38
Raises, " " raised.	9 00	7.11	7 99	.....	.....	.....
Drifts or Levels, " " driven.	9 45	3.75	6 86	8 05	5.28	6.86
Cross-cuts, " " " .	10.19	3.52	8.84	4.54	4 23	4 45
Stopes overhand, " fath. stoped	23.48	6.91	14.40	18.34	11.32	15.34
" " " ton "	14.24	1 53	5 34	20 58	12.29	15.49
" underhand, " fath. "	36.07	14.26	30.73	19.41	14 12	15 69
" " " ton "	11 77	7 01	10.20	25.57	11.39	17.94

Taking first the figures for shaft sinking, it is seen that there is a slight difference of $1.20 per foot, or nearly 8% apparently in favor of the hand drill. This difference, however, is only apparent and not real. There are several factors of this question not shown by the figures, the lode, in addition to being small, is flatly inclined (at an angle of about 43°), the result is a practical impossibility of getting a hole to look in towards the hanging wall seam, making the use of a larger quantity of dynamite imperative, and necessitating much quarrying and often a hand hole to square down the corners. These items add much to the cost of sinking in such a vein with an air drill. In the case of a vertical shaft sunk during 1892-3, the figures stand at $23.58 when sunk by hand, against $15.52 when sunk by air, a difference of 33% in favor of the air drill as to actual cost per foot sunk, but a much greater difference is shown when the element of time is considered, the average distance sunk per diem of 24 hours by hand being 5 inches ; by air, 12 inches.

The great difference between the maximum and minimum costs by hand ($18.77), and the small difference between the same figures by air ($2.64) strengthen the view already expressed.

The figures for winze sinking, like those for shafts, are nearly identical, $11.53 for hand against $11.38 for air ; nor is

there much discrepancy between the maxima and minima, and what has been said as to shafts will apply equally to winzes.

The figures for the levels or drifts are identical, but on looking to the maximum and minimum columns we see quite a difference, and this difference draws attention to the explanation which is similar to that already given for shafts or inclines. On narrow veins, in levels driven by hand, every advantage can be taken by right or left hand strikers, to point the holes as shall be most advantageous, either to foot or hanging wall seam ; but the air drill, on account of its length (which in the Rand and Ingersoll types, runs from 4 feet 5 inches to 5 feet 2 inches), cannot be so pointed in narrow veins as to take an equal advantage with the hand drill. Hence, one of two things will result ; either one of the walls must be broken, to carry a wide drift, necessitating thereafter trimming and timbering, or the holes lie practically parallel with the enclosing walls, and hence require double or treble the explosive, and final costs about balance.

This explanation derives still further endorsements from a study of the figures relating to cost of cross-cutting. Here we see the wide difference of $4.45 per foot for air and $8.84 per foot for hand, the latter being practically double the former. Moreover, the difference between the maximum and minimum in the case of air is only 31 cents or about 7 % of the average, whereas by hand the difference between the maximum and minimum is $6.67 or 75% of the average. Showing that where there are no side seams, and where a sufficient width can be obtained in which to swing the drill, the petty matter of slips, seams and headings effect little the progress and general average cost of the work, but showing also that where by hand, good ground came in, the cost could be cut to $3.52 ; yet where these slips were troublesome the cost would run to three times that figure, ($10.19).

The figures for stopes are not by any means so flattering to the air drill. The explanation for this in the case of the overhand stopes is doubtless to be ascribed in part, as before, to the length of the machine, but also in part to its weight, and to the inevitable delay and loss of time in removing the heavy drill and

stoping bar to a place of safety when firing, and the bringing back and setting up of the drill afterwards. From the nature of the case in a narrow lode but few holes can be drilled from one setting up of the machine, and lightness becomes an all powerful consideration. The difference between having to carry a 150-pound drill and a 250-pound drill up a narrow flatly inclined belt over a back-stope, becomes painfully apparent when you try it yourself.

The drill made by the Rand people, weighing 147 pounds, and having a length of but 3 feet 10 inches, particularly recommends itself to this work. The same criticism will apply to the figures of cost for underhand stoping

One feature, I may be pardoned for alluding to here, is the great difference shown in favor of the overhand stope over the underhand. A cost of $5.34 per ton as against $10.20 should be sufficient to convince the most obstinate of those "old-timers," of whom, I regret to say, there are still many in the gold mining business here.

It would therefore seem, from the foregoing figures, as if there were scant grounds for advising the use of a compressed air plant for narrow vein mining, and were we to stop at the figures given, there would be little or nothing to be said for air drills. But what the table does not show is the great advantage in time that is gained by the air drill. In shaft and winze sinking the rate by air has been (with us) doubled, enabling one to sink 100 feet with air before hand drilling could reach 50 feet. In driving and cross-cutting the rate is from two to three times the speed obtainable by hand work, a monthly run of 57 feet in cross-cutting hard whin rock being compared with 20 feet by hand in the same cross-cut. In another case one shift with an air drill drove 1.4 as many feet as double shift by hand could do in the same ground, showing nearly three times the speed.

In mining (if in any business whatever) is time the essence of the business, for we must not forget that on general principles, other things being equal, the quicker a deposit of known value and magnitude is worked out the better and the bigger is the ultimate profit.

In all that I have said I desire to be distinctly understood as dealing only with the narrow inclined belts so common in this Province. As to the general economy and utility of the air drill, there has and can be no two opinions. There has, however, been room for a considerable divergence of views when attempting to apply such machinery to local conditions in the gold fields. But in view of our experience during the last four or five years, I feel little or no hesitation in advising the use of an air drill plant whenever the extent and richness of the deposit warrant the expenditure.

Some Remarks on the Gold Production of Nova Scotia and how it may be increased.

By B. C. WILSON, Waverley.

[Read at the Halifax Meeting, March, 1894, by the President.]

The last report of the Commissioner of Mines shows a falling off in the yield of gold in 1893 as compared with the previous year. It may be claimed that this decrease is more apparent than real, in consequence of the Government change in the fiscal year, whereby the report covers but nine months instead of twelve — yet, making correction for this, it still shows some decrease, and an examination of previous reports shows that decrease has been more or less continuous for the past four years.

To a person comparatively familiar with our gold mining, and who notices the statement from time to time of encouraging prospects and large yields from some exceptionally productive districts, it must be somewhat of a surprise that the precious metal does not materialize better and present an increased yield rather than a decrease, even though that decrease may be small, and also reasonably ask why it is when persons have a mine giving a continuous yield of five to ten ounces that less than 200 tons a year are mined ; and it is clearly in order to ask the "reason why" for this condition of things, as having an important bearing upon this branch of our mining industry.

Having been intimately associated with gold mining since its inception in the Province, and generally familiar with its "ups and downs," I fail to find any evidence — and do not consider — that the decreased yield of the past few years at all indicates any exhausting of the supply of gold, or that the profits of the industry are any less on the amount of gold produced, but is rather attributable to the altered conditions, requiring larger out-

lay of capital, consequent upon the transition from mere surface mining — or more properly *prospecting* — to a more advanced and systematic mode of operating, rendered necessary by the increased depth of the workings, the additional plant necessary to treat larger quantities of low grade ore, and the presence of more refractory ore — or more properly of ore which has not become disintegrated by elemental surface influences and from which our universal practice of free gold milling and amalgamation fails to extract the gold as it readily did from the surface rock where the gold had been liberated by natural process during untold periods of time.

Beside, a decline in yield, after a score of years or so, is but the history of gold mining generally, and notably so in the two great gold producing countries of modern times, California and Australia, and probably from the same, the exhausting of the easily reached surface deposits which were operated by numerous individual adventurers, with limited or no capital and incomplete appliances, and which decreased yield marked the transition period from these early primitive methods to the more complex and elaborate mining practice and management, involving increased capital and greater skill.

As a people we have not taken kindly to gold mining as a business, but have rather "dabbled" in it as a side venture, or "trying one's luck," as frequently expressed. Wherein we hoped to achieve grand results from a very small outlay, and the exceptional richness of some of our lodes at the surface largely favored this anticipation and was responsible for an ill-advised and extravagant style of mining (if it could be honored with that name) and called into existence a multiplicity of mining investments of a very limited and superficial character, operated with very primitive appliances and generally with worse mining ability, and just sufficient working capital to ensure a failure, and it is notorious that in the early days of mining here, and even till quite recently, the exploiting of our mines was largely relegated to men who had been unsuccessful in farming, fishing, trading, or other callings and whose only qualifications as miners, was, per-

haps, their impecuniosity, energy and sanguine temperaments and thus was inaugurated our mining practice which could hardly be considered other than prospecting or demonstrating the existence of gold in our ores.

This method was comparatively profitable for a number of years, while working near the surface with the old hand windlass, horse whim, or perchance an antiquated engine with a ship's pump and a hoist fearfully and wonderfully made and marvelously operated and with ore in which the gold held in the sulphurets had been liberated by the slow decomposition of the pyrites and making it susceptible to the simplest process of amalgamation.

But it was inevitable that our people should after a time find themselves confronted with the problem of deeper mining and more refractory ores involving more expensive plant and more complex methods of treatment, requiring men of greater mining and engineering experience and business ability as managers, and all of which called for an outlay of capital far in excess of what they had been accustomed to, or what the heretofore limited holdings of a few mining areas would warrant and hence a number of individual operators, whose only capital was their labor were forced out of commission, while their successor, the capitalist, acquiring extensive areas and bringing to his aid improved appliances, skilled management, and extensive operations had not arrived to take their place, or at least to but a very limited extent (not half a dozen instances in the whole Province,) while the small operators who had dropped out might be counted by the scores.

In evidence of this, and that our people are recognizing this condition of things, I may refer to the fact that for some three or four years past there has been a tendency or movement toward concentrating the numerous small properties into large compact blocks of ground which should include a majority — or if possible all — the known veins in a given district so as to thereby warrant the erection of efficient plant and extensive operations from one central point on a scale which would command competent

ability and economize management to a minimum; and this concentrating of interest, and the investing and introducing of capital, and equipping under a new regime has absorbed and will necessarily further absorb much time during which time there is but little gold forthcoming.

Our facilities for obtaining the most approved and efficient machinery, together with an abundance of ordinary and skilled labor, and all these at prices which defy competitiou anywhere in the world, place the mines of Nova Scotia in an exceptionally fortunate position, and our most pressing need is more capital judiciously invested under more advanced management.

I would not wish to be understood as undervaluing the native talent amongst our mining men. Many of them are capable of a good deal more than they have an opportunity to display, and they have not been without opportunities to criticise some object lessons of extravagance and incompetency presented by some imported "able management;" but if we are thus indebted for examples of some of the most stupendous failures in the country, it is only just to acknowledge ourselves also indebted to foreign brains and ability, as well as capital, for other examples of unqualified good management and snccessful demonstration of what our mines are capable. And educated by the failures on one hand and successes on the other we are beginning to appreciate our mines at their true value and recognize their wants, and comprehend how much money we have unadvisedly and uselessly spent, how much gold we have unwittingly lost in our treatment of the ores, and how extravagantly expensive has been our mining practice and business management.

Wherefore I do not attribute the decreased yield that has occurred during the past three or four years to any exhausting of the mines, to any decreased average of gold in the ore, or to any inability to make the industry as remunerative as heretofore, but rather to the gradually altering conditions of the business during that time — to that inevitable transition period, if I may so express it — the interim of transference from circumscribed areas, and limited, if numerous, operations, to the rehabilitating

under a new regime, with larger properties, improved management and plant and more extensive working, under more systematic and thorough mining practice.

And I have every confidence that under this reorganizing of the industry which is being initiated, with the infusion of a little more *esprit de corps* among our people, a generous interchange of ideas, ignoring all jealousies and lending a helping hand in the many inexpensive ways which a fraternal feeling will suggest, and particularly with the infusion of more capital, placed less as a speculation and more as a business investment, to be systematically and judiciously applied with the same rigid adherence to business principles as applies to manufacturing or other legitimate enterprises, gold mining in Nova Scotia will not be equally but more remunerative than in any other country of like magnitude in the world, and that the annual yield will go up far beyond what it has ever been, and what is more, keep up — for with all these favorable conditions, and the mines and the gold in them, how can it be otherwise?

I may be permitted to draw attention to certain side influences which have an indirect tendency to reduce the output of gold to some extent, and for which neither the mines nor the management are responsible. I refer to that litiguous propensity which seems to have crept into practice of late and for which we are perhaps equally indebted to foreign and native talent, and as it usually follows that the mine stands idle while the legal fight goes on, the absence of gold returns in such instances is commensurate with the law's delays.

It is regretable if any indefiniteness in our statutes tends to foster contention. We are assured there need be no misapprehension, yet in practice there has arisen a wide divergence of construction, and recently an individual facetiously defined a government lease to a gold mine as "a quit claim deed which guaranteed the owner in peaceable possession so long as the property was of no value." But, seriously considering that the miner has to pay the government as much for 17 acres of gold mining areas as does the agriculturist or the lumberman for 100

acres, and then has to keep on paying rents and royalties eternally, it is but reasonable that he (the miner) should expect to find that government as anxious to secure him in an incontestible title as to recieve his deposit, or if need be, put him in possession without recourse to the courts.

But perhaps such is not the case, and the evidences of contention which have arisen are rather the result of neglect, and an easy confidence in it turning out all right in the end, when a careful observance and following out of the details of the statutes at the outset would have obviated it.

DISCUSSION.

MR. G. W. STUART.—I am sorry that Mr. Wilson did not remain to read his paper; not that I can find any fault with the manner in which that office was performed by the President, but I would have liked to ask Mr. Wilson a few questions. One of them is this: Whether or not he has taken it for granted that all the gold raised in the Province is returned? I speak feelingly on that matter. It is only a short time ago I was called upon to pay a forfeit of $500. I happened to be bondsman for a company for its mill license. The fact had slipped my mind. I had long since lost all confidence in the management, but had entirely forgotten that I was on their bond. The mill ran for several years all right. They finally ceased to pay dividends or royalty. After a couple of years the manager left the country. I was called upon to pay up the money. That is all because the returns were not made. If we made a determined effort I think we could get the government to remove the royalty on gold. The old clause in the law about working was practically a dead letter. Practically, all we had to do was to pay two dollars per area. Since 1891 the law has been changed. We have been obliged to pay fifty cents per area rental as well

as the two dollars per area, when we acquire them. That fifty cents is more than equivalent to the royalty. The government could consequently very well relieve us from that tax. I would suggest that we take the matter up at our next meeting. If the government would establish an assay office and make it compulsory to bring gold to that office to have it assayed, valued and stamped with the government stamp, it would become legal tender. The charge could be a nominal one, merely enough to support the office. If that were done I think you would find the returns larger.

MR. POOLE.—Years ago there was on the Dominion statute book an ordinance requiring every purchaser of gold bullion to make a return of his purchase. I never was aware that that statute was repealed.

THE PRESIDENT.—That statute is still in existence.

MR. T. R. GUE.—It should go one step further. If a man is dishonest enough to buy gold of a thief he is dishonest enough to make his receipts very much less than they actually are. There is another case in which it is pretty well established that fifty or sixty thousand dollars worth of gold went out of the Province. I speak feelingly because I was left in the lurch in that case. Could we not have an office where the gold could be weighed by a proper officer?

THE PRESIDENT.—Referring to one of Mr. Stuart's suggesttions that the government were getting enough out of the rentaland could abate the royalty, that royalty is about one-half of the revenue derived from the gold fields. Under the Spanish code, in lieu of royalty, the yearly rental is made a larger sum, equivalent to about two dollars. The royalty is abated and the returns made to the government are merely sufficient to show the government that labor is performed. The unit of measurement is a hectare (about two acres.) Suppose a man has a hundred acres for which he pays rental, he can pay it for as many years in advance as he likes. He pays no royalty. If a man should get into difficulties, under the Nova Scotia law he

is liable to have his property forfeited. Under the Spanish law it is put up at auction, and the sum received from the highest bidder, after deducting the charges due the government, is turned over to the owner.

A Method of Ascertaining the Value of Iron Ore, Limestone and Coke in Blast Furnace Use.

By R. E. CHAMBERS, Ferrona, N. S.

(Read at the Halifax Meeting, March, 1894.)

For the purpose of obtaining the exact value of the raw materials in the manufacture of pig iron, formulæ may be devised for each furnace or district which would be of great service to the furnaceman, enabling him to compare the ores, &c. at his disposal and discard those of least value.

Taking as a basis of calculation the following materials:

Ore.— Metallic iron, 50 per cent.; silica, 10 per cent.; alumina, 3 per cent.; lime, 1 per cent.; magnesia, 1 per cent.

Limestone.—CaO, 53 per cent.; MgO, 1 per cent.; silica, 3 per cent.; alumina, 1 per cent.

Coke.—Carbon, 85 per cent.; ash, 15 per cent.

Ash of Coke.—Silica, 57 per cent.; alumina, 15 per cent.; lime, 2 per cent.; magnesia, 1 per cent.

We will use as a step toward obtaining the formulæ the methods proposed by F. W. Gordon in a paper read at the Baltimore meeting of the American Institute of Mining Engineers.

By his methods, for a slag equal in and basic constituents, these materials work out as follows, taking these values as a starting point: 50 per cent. ore, $2.50; limestone, with 53 per cent. CaO, $1; and coke with 85 per cent. carbon, $2.50.

1. Efficiency of limestone 0.50
2. Quantity of limestone to flux ore 0.22
3. Weight of pure lime to flux ore.....0.11
4. Weight of limestone per unit of fuel 0.206
5. Weight of pure lime per unit of fuel.....0.103

6. Weight of slag due to impurities of limestone.....0.084
7. Weight of slag due to impurities of limestone, per unit of efficiency.....0.168
8. Weight of slag due to impurities of fuel, per unit of fuel 0.243
9. Weight of slag due to impurities of fuel, per unit of fuel, using CaO.....0.223
10. Weight of slag due to impurities of ore and stone, per unit of ore.....0.323
11. Weight of slag due to impurities of ore and stone per unit of Fe_2O_3.....0.452
12. Weight of slag due to impurities of ore and stone fluxed with CaO.....0.273
13. Weight of slag due to impurities of ore and stone per unit of iron.....0.646
14. Carbon required per unit of slag.....0.228
15. Carbon required for fusion of pig iron 0.6604
16. Available carbon of fuel.....0.795
17. Fuel required per unit of slag 0.287
18. Fuel required per unit of pig iron not including fusion of slag 0.830
19. Total fuel required per unit of pig iron..... 1.01
20. Manufacturing cost of slag per unit of slag 0.587
21. Manufacturing cost of slag per unit of iron 0.687
22. Weight of slag to the unit of pig iron.....0.870
23. Value of pure carbon from cost of fuel and cost incurred by impurities $3.613
24. Value of pure lime from cost of limestone and cost incurred by impurities 2.24
25. Value of pure oxide of iron from cost of ore and cost incurred by impurities..... 4 43
26. Cost of iron per ton.....10.24

Formula for Value of Iron Ore.— The value of pure oxide of iron being, as ascertained above for the assumed conditions, $4.43 per ton, the value of any given ore will be proportional to its percentage of iron, less the cost of lime and carbon necessary to flux its impurities and the cost of handling the slag. If pure

oxide containing 70 units of iron cost $4.43 per ton, each unit of iron is worth $\frac{443}{70} = \$0.063$. From this is to be deducted the cost of the lime necessary, or 2.24 $(SiO_2 + Al_2O_3 - (CaO - MgO))$.

Also the cost of carbon, or weight of slag × 0.228 × value of carbon.

The weight of slag will be the total impurities of the ore, plus the weight of lime necessary to flux them, minus the volatile constituents of the limestone. Value of carbon equals

$$0.228 \times 3.613 \left\{ (SiO_2 + Al_2O_3 + CaO + MgO) + 0.56 \frac{SiO_2 + Al_2O_2 - (CaO + MgO}{0.50} \right\}$$

Assembling into one equation:

Value of ore in cents = per cent. of Fe × 6.3 − 2.24 $(SiO_2 + Al_2O_3 - (CaO + MgO))$

$$- 0.228 \times 3.613 \left\{ (SiO_2 + Al_2O_3 + CaO + MgO) + 0.56 \times \frac{SiO_2 + Al_2O_3 - (CaO + MgO}{0.50} \right\}$$

$$- 0.587 \left\{ (SO_2 + Al_2O_3 + CaO + MgO) + 0.56 \times \frac{SiO_2 + Al_2O_3 - (CaO + MgO)}{0.50} \right\}$$

Let $s = SiO_2 + Al_2O + CaO + MgO.$

$d = SiO_2 + Al_2O_3 - (CaO + MgO).$

$e =$ Efficiency of limestone.

$p =$ Per cent. of iron in ore.

Value in cents $= 6.3\,p - 2.24\,d -$

$$0.824 \left[s + \frac{0.56\,d}{e} \right] - 0.587 \left[s + 0.56 \frac{d}{e} \right]$$

(Equation 1.) Value $= 6.3\,p - 2.24\,d - 1.411 \left[s + \frac{0.56\,d}{e} \right]$

The constituents of iron ore not included in this equation, such as sulphur, phosphorus and titanium, have so important an influence on the quality of the product that rather than causing a variation in the value of the ore they will prohibit its use altogether for certain purposes when present in excessive amounts. They must therefore be considered separately in valuing the raw materials. Having decided on a limit for these impurities the value of the varying proportions of the others can be ascertained by these equations.

Proof.— The basis of value for iron ore upon which we started was

$2.50 for an ore the composition of

	Per cent.
Iron,	50
Silica,	10
Alumina,	3
Lime,	1
Magnesia,	1

If upon substituting these percentages in equation 1 we get this value of $2.50, it will prove the correctness of the formula.

$$\text{Value in cents} = 6.3\,p - 2.24\,d - 1.411 \times \left[s + \frac{0.56\,d}{e} \right]$$

$$= 6.3 + 50 - 2.24 \times 11 - 1.411 \times \left[15 + \frac{0.56 \times 11}{0.50} \right]$$

= $2.519 instead of $2.50, an error of 0.7 per cent., or less than 1 per cent., which can be explained by the small number of decimal places to which these calculations have been carried.

Value of Coke.— The value of coke will be proportional to its percentage of carbon, less the cost of lime necessary to flux the impurities and the fuel to melt the slag and the labor of handling the slag.

The value of pure carbon being $3.613, each unit of carbon in coke is worth $0.0361.

Let a = Per cent. of ash.

p = Per cent. of carbon.

s = $SiO_2 + Al_2O_3 + CaO + MgO$ of ash.

d = $SiO_2 + Al_2O_3 - (CaO + MgO)$ of ash.

e = Efficiency of limestone.

For fluxing impurities :—

The cost of lime will be 2.24 $a\ d$.

The cost of carbon will be $0.228 \times 3.613 \left\{ a \left[s + 0.56 \frac{d}{e} \right] \right\}$

The cost of handling slag will be $0.587 \left[a \left[s + 0.56 \frac{d}{e} \right] \right]$

Total value in cents = per cent. of carbon $\times$ 3.613 — 2.24 $a\ d$ — $\left[(0.228 \times 3.613) + 0.587 \right] \left[a \left[s + 0.56 \frac{d}{e} \right] \right]$

(Equation 2) Value = per cent. of carbon $\times$ 3.613 — 2.24 $a\ d$ — 1.411 $\left\{ a \left[s + 0.56 \frac{d}{e} \right] \right\}$

Proof.—The coke taken as a basis of calculation analyzed :

	Per cent.		Per cent.
Carbon	85	and the ash	Silica 57
Ash	15		Alumina 15
			Lime 2
			Magnesia 1

and cost $2.50 per ton.

Substituting in equation 2 :

Value in cents =

$$85 \times 3.613 - 2.24 \times 0.15 \times 69 - 1.411 \times \left\{ 0.15 \left[75 + 0.56 \frac{69}{0.50} \right] \right\}$$

= $2.517 instead of $2.50, or an error of 6/10 per cent. explainable as before.

Value of Limestone.—The value of limestone will be proportional to the percentage of pure lime it contains, less, as in coke and ore, the cost of fuel and lime to flux the impurities and the labor of handling the resulting slag. The value of pure lime having been found to be $2.24 per ton, each unit of CaO or MgO in a limestone will be worth $0.024. This is making MgO to be equal to CaO, which can only be done for small percentages, it being as a flux the more powerful.

Let p = Per cent. of CaO + Mgo.

s = SiO_2 + Al_2O_3 + CaO + Mgo.

e = Efficiency of the limestone $\times$ 100.

Value in cents $= 2.24\,p - 2.24\,(p - e) - 0.228 \times 3.613\,(s - e) - 0.587\,(s - e)$.

(Equation 3.) Value $= 2.24\,e - 1.411\,(s - e)$.

Proof.— The limestone taken as a basis of calculation :

analyzed { CaO, 53 per cent. ; MgO, 1 " ; SiO_2, 3 " ; Al_2O_3, 1 " } and cost $1.00 per ton.

Substituting in equation 3 :

Value in cents $= 2.24 \times 50 - 1.411 \times (58 - 50) = \$1.008$ instead of $1.00, or an error of 8/10 per cent.

Having thus proved to within pretty narrow limits of accuracy the correctness of the formulæ for value of ore, lime and coke we may consider them established, and proceed to use them upon the materials daily presenting themselves for consideration.

For any other set of conditions or for any other type of slag the items, but not the method of calculation, would be changed.

Once having the formula, it is only a matter of a minute or two to ascertain the required value of any material.

The convenience of this will be readily appreciated by furnacemen.

One or two points in connection with the following table require notice.

In ore No. 15 the basic constituents being in excess of the acid ones d becomes minus, thus changing the deductions into additions. This would hold good only when a carbonate ore of this class was used in small proportions. If used in large quantities the altered conditions would require a new formula.

In ore No. 33 the percentage of iron is so low, and of silica so high, that the value becomes a minus quantity, being $1.61 less than nothing, ore the ore would cause a loss of that amount for every ton used.

This also holds good in coke No. 5, where the heating qualities of the carbon are more than taken up by the fluxing of the slag resulting from the impurities of this fuel. From the table the great importance of the purity of the raw materials for blast furnace work can be seen at a glance.

Table of Values of Ore, Coke and Limestone, as determined from the Analysis.

ORE.

Value $= 6.3\,p - 2.24\,d - 1.41\,(s + 0.56\,\frac{d}{e})$.

Number.	Analysis.					Value.
	Silica, per cent.	Alumina, per cent.	Lime, per cent.	Magnesia per cent.	Iron, per cent.	
1....	1.3	0.4	0.5	0.0	68.23	$4.24
2....	0.8	0.4	0.1	0 1	67.	4.17
3....	6.1	0.0	0.0	0.0	65.5	3.81
4....	6.0	1	2	1	61.3	3.61
5....	4	1	3	1	59.2	3 54
6....	3.3	1	2	0	58.8	3 52
7....	7.1	2.3	1.9	0	61.6	3.44
8....	3.7	1.4	0.2	0	58 3	3.41
9....	5.8	1.0	0.3	0	57.7	3.28
10....	10.7	1	3.2	2	58.1	3.17
11....	4	10.9	1.9	0	58.5	2 95
12....	10.1	2	2	0	56 0	2.94
13....	7.3	6.3	0.4	0	55 6	2.80
14....	7.4	3	0	0	53 0	2.79
15....	1 7	0 0	2 3	9.1	39.6	2.67
16....	5.5	0.0	12.7	2.1	39.1	2.57
17....	12	4	2	0	52.0	2.49
18....	18.1	3	5	1	53.2	2.39
19....	15	0	1	0	49.5	2.36
20....	12.6	2	2	0	46 0	2.18
21....	18.1	3.5	2.3	1.0	50.2	2.11
22....	16	3	2	0	47	2.02
23....	19.8	0	2	0	45.2	1.86
24....	22.7	5.8	0.4	0 3	48.5	1.58
25....	24.5	3	3.5	1.7	44.9	1.52
26....	23.4	0	2	0	41.8	1.46
27....	26.5	5	1	0	47.5	1.37
28....	16.1	12.9	8	0	41.0	1.26
29....	25.6	0	3	0	36.1	1.00
30....	30	4	9	1	40.0	.99
31....	27.3	9.4	1.2	0	42.0	.70
32....	25	6.7	0.1	0.1	36.0	.61
33....	58.7	2	1	0	24.4	1 61

COKE.

$$\text{Value} = 3.613 \times \%\text{ of } c - 2.24\, a\, d - 1.41.\ ((s + 0.56\,\tfrac{d}{e})\, a).$$

Number.	Analysis.						Value.
	Carbon. Per cent.	Ash. Per cent.	Of Ash.				
			Silica Per cent.	Alumina. Per cent.	Lime. Per cent.	Magnesia. Per cent.	
1....	97.1	2.9	57	15	2	1	$3.40
2....	89.6	10.3	57	15	2	1	2.86
3....	85.	15	57	15	2	1	2.52
4....	80.9	19.1	57	15	2	1	2.22
5....	45.6	54.3	57	15	2	1	.35

LIMESTONE.

$$\text{Value} = 2.24\, e - 1.41\,(s - e).$$

Number.	Analysis.				Value.
	CaO. Per cent.	MgO. Per cent.	Silica. Per cent.	Alumina. Per cent.	
1.....	53.9	1	1.5	1.0	$1.10
2.....	52 8	0.8	2	1.3	1.03
3.....	53.0	0	3	0 5	1.01
4.....	51	1	5.3	1.5	.81
5.....	52.7	2	3.7	1.7	.95
6.....	53.5	0.8	2.4	0.5	1.07
7.....	45.5	1.5	13.5	1.5	.29

The Organization and Development of Dominion Coal Company, L'td,

By JOHN S. McLENNAN, M. A., Boston.

[Read at the Sydney Meeting, July, 1894.]

The outcrops of the overlying Cape Breton coal seams still reveal, in more than one place, the evidence of early working, usually attributed to the French. The character of the work as regards neatness, in some places, make it probable that it was done by them rather than by the coal smugglers, who, under the restrictive policy more or less rigidly carried out after the cession of the Island to Britain, defied the prohibition and attacked the coal seams where they were accessible to the open sea, for the supply of the scattered inhabitants of this addition to British territory.

The French work was lawfully carried on, so far as is known by the Government, and with a shipment made to Martinique as early as 1725, Cape Breton probably leads the rest of the continent in developing an export business.

The business, however, was never continuously prosecuted until the formation of the General Mining Association in 1825. This corporation now justifies in a vigorous maturity the sound principles on which it was based, and in Mr. Brown still enjoys the benefits of hereditary administrative ability.

After the relinquishment of its monopoly of the coal and mineral lands in Nova Scotia, there grew up, with all the vicissitudes of commercial enterprises, mining company after mining company, occupying the areas to the southerly side of Sydney Harbor. Many of these were started with a view to supplying the American market. Some have continued in operation through the hardships incident to the disappearance of this market and the development of a new one in the St. Lawrence.

A few years ago there were in this area between Sydney Harbor and Cow Bay nine working collieries, operated by almost as many corporations or firms. Each was an independent entity, not only in regard to mining, but also to the transportation and marketing of its product; none of them with a shipping port open all the year round; but all of them enjoying to an almost equal degree the advantages of a situation immediately on the seaboard, of seams of coal phenomenally regular, freedom from gas and water, and an adequate supply of labor indigenous to the soil, between whom and the management long intercourse, based upon the sound principles of mutual respect and good will, had established most satisfactory relations.

Within recent years their business had been constantly increasing, which had necessitated outputs far in excess of those for which the pits had been originally designed. Remember that the great prosperity of this trade was owing to the existence of the reciprocity treaty with the United States. Unite with these conditions the belief existing in New England in many minds that coal areas so situated were the natural source of supply for the north-eastern United States, and that sooner or later, natural tendencies would overcome obstacles placed in the way of their development by fiscal legislation, and it is obvious that the advisibility of uniting these various properties under one management must have presented itself to every mind interested in or familiar with the industry of this locality.

Those familiar with the local history will recall more than one attempt in this direction; and at least one pleasant gentleman, (who was represented by his local sponsor as having the requisite number of millions of dollars in his pocket), who paid us a visit, and departed, with no other material result than the postponement of the addition of a bathroom to the house of one too-confiding manager.

A somewhat settled scepticism took possession of those locally interested as to whether such a scheme, desirable as it might be in the abstract, would ever be consummated, although the game of "collieries" and their relative value was the regulation

amusement whenever the mine managers gathered about the hospitable board of their Dean. This was from time to time varied by discussion of the possibilities of advancement in the working of the mines, and the marketing of their product, which this project afforded.

It is only fair to say in reference to those in charge of the properties which have since been amalgamated under the ownership of the Dominion Coal Company that they were by no means ignorant of the advantages of consolidation. It was seen that one company could afford to make outlays in seeking new markets, could establish improved loading and discharging plants, could obtain concessions, which were not within the reach of any one of some eight companies. More than this, even had any one of these companies been disposed to make the necessary outlay, the volume of its business was not sufficient to give a remunerative return. Moreover, in Cape Breton, as elsewhere the possibility of an opening of the American markets from time to time recurred, and whenever the game of the "collieries" above referred to did not afford a sufficient scope for the post prandial activities of the managers, a more than satisfactory warmth was invariably imported into their meetings by a discussion of the effect of "Free Coal."

It was seen by one camp that whatever might be the effect of an opening of the United States market, that effect would be very different if the New England market was to be competed for by a number of small companies rather than by one large company with local affiliations of value; for in the United States, Cape Breton would meet in competition southern coal operators already in possession of a market of large consumption, for the satisfactory supply of which adequate and expensive facilities had been provided.

Such was the condition of affairs in 1891, when rumors of a new syndicate aroused the somewhat sated curiosity of the operators, then in the enjoyment of a very prosperous season, although somewhat disturbed by an active controversy with the Local Government in reference to tenure of their properties.

It is unnecessary to go into personal details of the way in which these beginnings proceeded to consummation in the formation of the Dominion Coal Company Limited. The more picturesque personal aspect of the matter was fully exploited in the press.

This matter was brought to the attention of Mr. Henry M. Whitney of Boston. His turn of mind, his previous successful experience in similar enterprises and his connections were such as to commend this enterprise to him, and to ensure success in the precarious and difficult task of organizing and getting into operation a new company. It was favourably considered by him to the extent that he had taken some definite steps in the matter when he learned of the controversy with the Local Government, and the short and uncertain tenure, at all events as regarded rental, under which mining properties in Nova Scotia were held. The objection was fatal. He considered it unwise to invest in property so held, and it was evident that his point of view would be universal among capitalists.

The state of the case was presented to Mr. Fielding the leader of the Local Government, who, looking at the matter in a broad and business-like way, introduced into a mining act then before the Legislature, in the Session of 1892, a clause enabling the Government to alter the tenure of mining leases,— so that this objection was removed,— and it is now possible to hold mining property in Nova Scotia for a reasonably long term at a fixed rental.

Mr. Whitney then proceeded to carry on the enterprise. He associated with himself the banking firm of Kidder, Peabody & Company ; the property was examined by experts, and satisfactorily reported upon ; options on the properties were obtained, and in due course closed ; a special charter, based on the legislation before referred to, was obtained ; and on the eve of a period of great financial stringency, which unfortunately still obtains in the United States, the Dominion Coal Company was organized and all its securities disposed of to the public, the number of Canadian, and particularly Nova Scotian, shareholders being an

additional guarantee to the promoters of the soundness of the enterprise on which they had embarked.

So much for the organization of the Company. As for its development, the only safe way is to leave this to time. This much may be said for the aims of its management: Already we have approaching completion, or under contemptlation, a railway and piers looking to the concentration of its shipping business, the building of central workshops which will increase the efficiency of the various subsidiary industrial operations, which, in an isolated locality, such as Cape Breton, are unfortunately inseparable from coal mining. We are building dwelling houses of a good type at our new openings, which should make the conditions surrounding employment with the Company desirable.

The value of local labor is fully recognised, and this labor will, we trust, be adequate to provide for the output which developement of the trade will make necessary. For a part at least of this increase in business, we shall have to meet in competition coal produced by the most approved modern methods, and we are therefore introducing machinery which will render greater the economic value of each miner, and thus enable us to meet the demands of an increasing trade without going beyond our natural territory for the supply of labor.

The advantages of consolidation have been seen in enabling us to deal more effectively with the transportation question and the marketing of our coal. Opinions have varied considerably as to the economic value of Cape Breton coal. This much is certain:—extremes on both sides are incorrect. What we believe, and what all our experience of the last year tends to prove, is that it is a good fuel; and those in New England who have tried it within the past twelve months seem in every case to be satisfied with the result.

Almost every form of administrative and economic error has been illustrated in the history of coal mining in Cape Breton. So too have been illustrated, with equal vividness, in the same little field, the principles which lead to success. To keep abreast of the progress of the art, to satisfy one's customers, and to

establish relations or mutual confidence and goodwill with one's working men, are, beyond a doubt, the aims of all the enterprises represented in this room ; and it lends color to a hopeful view of the future of the Mining Societies here assembled that their members may not immodestly congratulate themselves that what they have in the past achieved is the best guarantee of the attainment of these ends.

The Introduction of Endless Haulage into Cape Breton.

By W. BLAKEMORE, M.E., Sydney, C. B.

(Read at the Sydney Meeting, July, 1894.)

The three methods of mechanical haulage which have been introduced into mines and used in connection with cables or wire ropes are:

1st. Plain rope haulage—in which the load only requires to be hauled, the empties running back by gravitation and taking the cable with them.

This is of course the simplest and most economical so long as it satisfies the requirements of the mine, and is able to deal with the tonnage raised in a given time; but it is clear to any one acquainted with mining that as the workings proceed farther from the shaft or other exit, the rope must continue to travel faster in order to cope with its work, and finally the speed required to maintain the output will of necessity be greater than is either safe or practicable. It is probable that this safe limit is reached at about 8 to 10 miles per hour on any average mining road.

2nd. The next system in vogue is the main and tail rope, by means of which the full journey is hauled out and the empty journey is hauled in. This was devised to meet the difficulty presented by a varying grade, and can be adapted to work over alternating grades perhaps better than any other system. It further possesses the advantage of only requiring a single track the same as plain haulage. Its limitations are, however, precisely the same as in that system, it breaks down when the distance becomes so great that the rope requires to run more than about 10 miles per hour.

3rd. The third system, "Endless Haulage," succeeds just where the other two fail,— distance presents no difficulty, of course within reasonable limits, and so far as practical working is concerned, it is as easy to haul 1000 tons of coal per day along a road 5 miles by this system, as it would be to haul the same tonnage a distance of ¾ of a mile by either of the other systems, assuming the grade to be the same as the average of our Cape Breton mines, viz :— 3 inches in the yard, or 1 in 12.

This brings us to the essential difference between endless haulage proper and every other system—whereas they haul a full trip or journey at a time, consisting of from ten to twelve trams, direct from a given station to the shaft, and then take a corresponding trip of empties back. The former knows nothing of trips or journeys, but continues to travel perpetually as its title indicates, and the trams are attached and detached singly at any point required to facilitate the constant delivery of coal to the shaft. The advantages of this are obvious—instead of being all hurry and skurry to handle the journey when it arrives and start the empties back, necessitating a larger staff of men just at the moment of its arrival than are required again until the next trip comes in, the endless rope keeps delivering constantly and uniformly one tub at a time, never varying its speed or rate of delivery so long as the workings supply the coal.

My experience leads me to the conclusion that any stated tonnage of coal can be handled at its destination by half the number of men on this system, as compared with any other system of haulage I am acquainted with.

The next great advantage is that the speed of the rope (which in practical working I limit to two miles an hour) is so slow that the wear and tear is reduced to a minimum, and the liability to accidents arising from the trams jumping the rails, knocking out timber, and otherwise damaging the road which is so prevalent with high speeds is practically done away with, as it is possible if the signals are perfect to stop the rope at any point in a travel of 3 to 5 feet.

The third principal advantage of endless haulage is that so slow a speed is required only a small engine is necessary with high gearing—say 1 to 7, or even 1 to 8. With this gearing I have hauled 1000 tons a day with a 12 in. diameter cylinder single engine up a slope dipping 2 inches in the yard a distance of 4200 feet.

The disadvantages are :—

1st. That a double track is an absolute necessity to work the system efficiently, and if the roof is bad this means much timbering and increased cost of maintenance— and :—

2nd. Greater attention to detail in the working. I do not mean to create the impression that this system is impracticable with a bad roof—it is all a question of cost—but I do argue that where the roof is good it is unquestionably the best system known.

The greatest objection to its use comes from those who have not mastered my second requirement, "*attention to details*," that is the whole secret of its success or failure. You must commence by putting in permanent tracks with heavy rails and sleepers upon carefully graded roads with no abrupt bends—but as many easy curves as you like—follow on by fixing a horizontal roller every 24 feet, whether it appears to be required or not, fix vertical rollers round your curves and well into the straight lead both ways, these should never be more than 6 and often as little as 3 feet apart according to the radius of the curve. Use large pulleys for your turns not less than 3ft. 6 in. dia. for a ½ in. dia. rope, and 4 ft. 6 in. for a ¾ in. rope. I need not say, buy the best steel ropes —but I do say be certain to get them properly spliced, for a bad splice will spoil all the rest of your work. On a ¾ in. rope the overlap should not be less than 35 to 40 feet, and mind that the ends are well tucked in or they will soon "catch" and the rope will inevitably be stranded.

I will now briefly explain how these ideas have been reduced to practice in Cape Breton and the first instalment of endless haulage, I think I may say successfully made.

At the Reserve Mines of the Dominion Coal Company, the Phalen seam lying at a grade of 1 in 12 is being worked.

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age into Cape Breton."

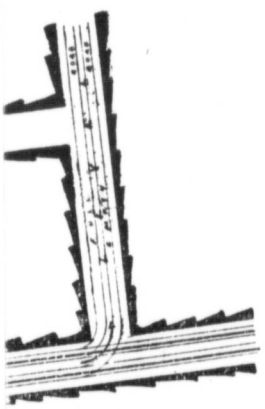
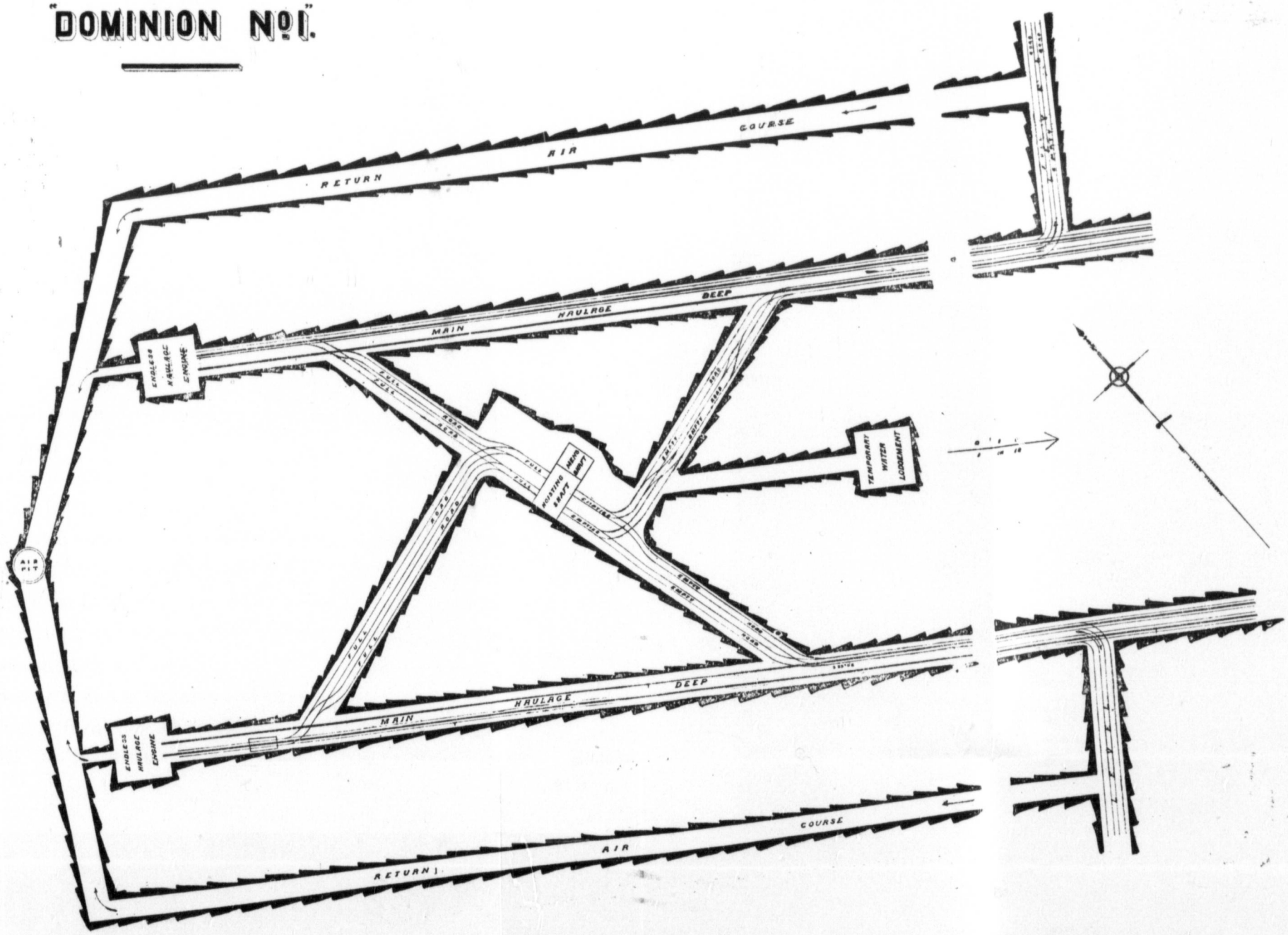


Plate I. Illustrating Mr. W. Blakemore's Paper, — "The Introduction of Endless Haulage into Cape Breton."

PLAN OF "DOMINION No1."



NOTE:— MAIN DEEPS TO BE DRIVEN ON THE FULL DEEP COURSE THE ROADS LEADING TO AND FROM THE SHAFT ARE SET OUT AT A TWO PER CENT GRADE SO THAT THE TUBS WILL RUN IN AND OUT BY GRAVITATION. —— THE HAULAGE ENGINES WILL EXHAUST INTO THE RETURN AIRWAY NEAR AIR PIT AND THUS SUPPLY THE VENTILATING POWER FOR SOME YEARS.

SCALE, 10 FEET TO ONE INCH.

Phalen seam lying at a grade of 1 in 12 is being worked.

There are two slopes from the surface, the "Main" and the "French," the former is down about 3000 feet and the latter 4000. Each slope has an independent single engine with cylinder 23 in. dia, and 3 ft. 6 in. stroke, the steam pressure is 50 lbs. to the square inch. Last year 500 to 600 tons a day were being raised from the French slope (which had the bulk of the working places) in the following manner: First, one engine hauled the journey of 10 to 12 tubs half way up the slope, then the second engine took hold of it and hauled it the other half, whilst the first ran the empties down to the bottom and got ready for another trip. Between times engine number two hauled an occasional trip from the Main slope which, however, under this arrangement only yielded 150 to 200 tons a day. The reason of all this is clear, the French slope had passed the limit at which it was possible for a single haul to fetch out the required quantity of coal. To obviate this complication as well as to increase the output, endless haulage was introduced in the following manner:—

1st. The slope was widened and a double track laid throughout with rails weighing 50 lbs. to the yard. (It must be remembered that our tubs loaded weigh from 2 tons to 2 tons 10 cwt.)

2nd. Electric signals with No. 12 copper wire and Leclanche cells were put in for instantaneous communication, which is an important point.

3rd. A driving drum (see Fig. 1.) 6 feet in dia., was keyed on the drum shaft of the existing engine as shown in Fig. 2. I wish to point out a special feature in this wheel. It differs from the driving drums used in Canada and the States in being perfectly plain, that is, having no grooves. The power is gained by having three laps or turns of the rope round the drum and the special advantages are:—

(a) That it is much simpler and cheaper.

(b) That it furnishes an element of safety inasmuch as the rope will slip on the drum in the event of any obstacle or

break-down in the mine instead of continuing to haul, and so cause a breakage either of rope or machinery as in the case of grooved or clip wheels.

4th. The gearing of the engine remained nearly the same, viz., 1 to 4, although to allow the engine to work efficiently it is contemplated to increase it 1 to 6. The engine is at present making only 50 revs. a minute instead of 70 to 80.

5th. To keep the ingoing rope tight tension gearing was provided on the surface as shown in Fig. 3, and at the far end of the slope underground as in Figs. 4 to 5.

6th. 4 ft. 6 in. dia. pulleys were used for all main turns as giving the minimum of friction and not straining the rope unduly.

7th. Vertical sheaves, as shown on Fig. 6, were placed at all slight turns in the slope, but especially round the main curve approaching the bank which is one of the most difficult I have ever had to deal with in any system of haulage, beiug a radius of 1 in 5 and 105 in length. It should also be noted that the engine stands not in the line, but at right angles with the slope, so that the conditions as to the direction are about as awkward as can be imagined. Thus a straight lead from the engine 80 feet, a lead at right angles along the bank 100 feet, round a curve with a radius 1 in 5 of 105 feet, then down the slope dipping 1 in 12, 4000 feet. The rope rises from the drum to the bank say 10 feet, then runs level 100 feet, then down the slope. In spite of these conditions the full and empty ropes work quite smoothly, which I attribute mainly to the fact that all round the curve the vertical rollers are only 3 to 4 feet apart on both tracks, and by this means the side pressure is equalized. The first day the haulage was started (2 months ago) between 200 and 300 tons were raised, to-day over 700 tons a day, and this quantity is limited not by the haulage but on other grounds. It was laid down to haul 1000 tons a day and can do it easily, having raised at a busy time over 90 tons in half an hour, being at the rate of 1500 tons a day.

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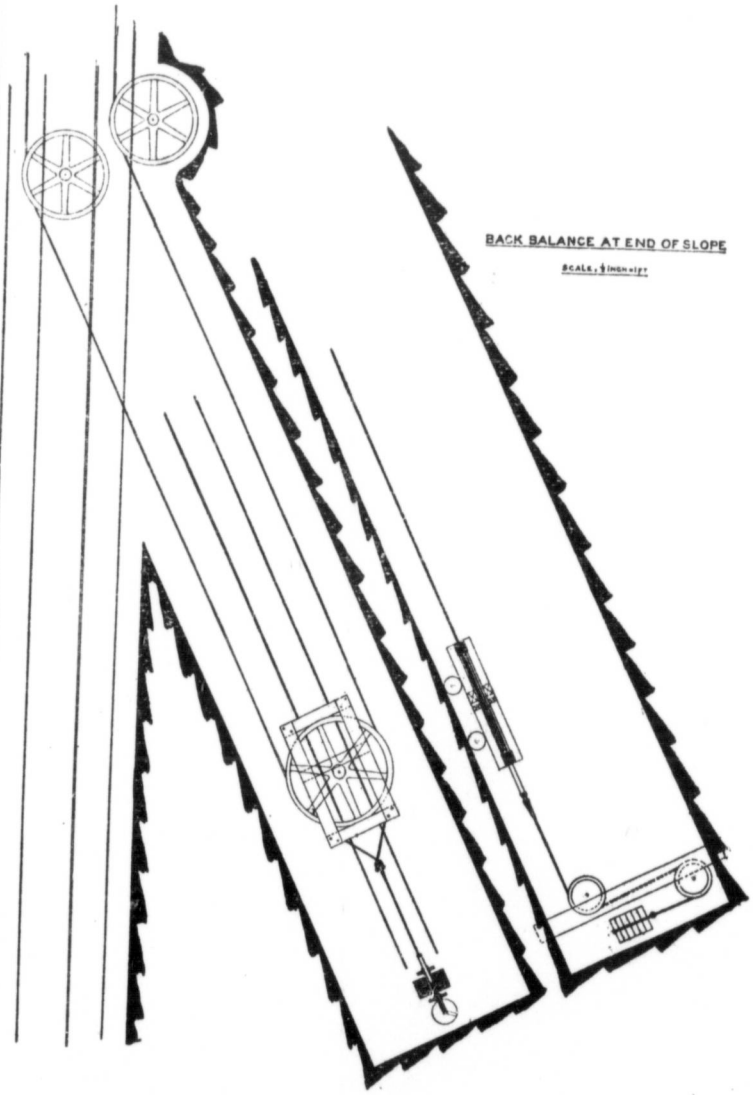
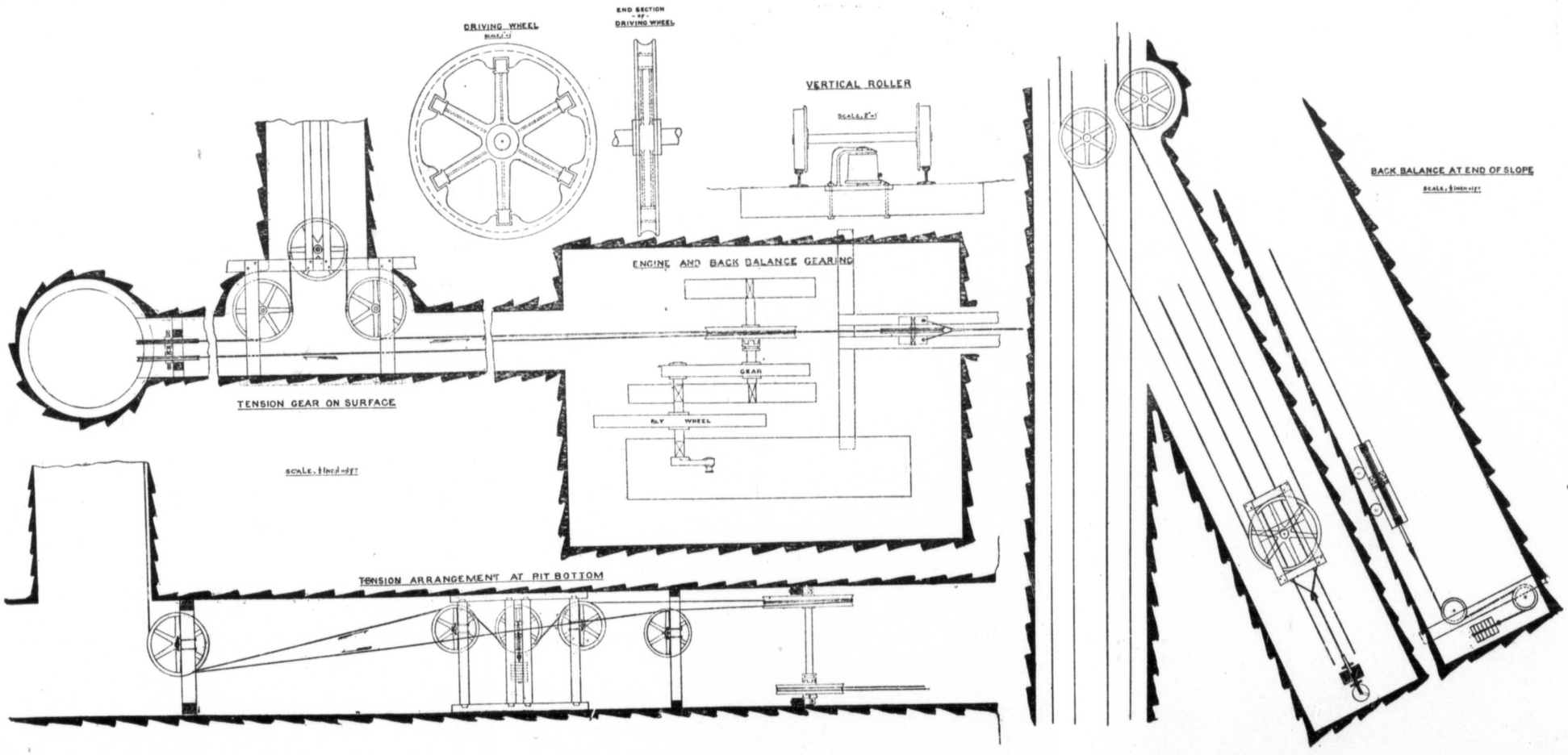


Plate II. Illustrating Mr. W. Blakemore's Paper, — "The Introduction of Endless Haulage into Cape Breton."

PLAN

—OF—

FITTINGS FOR ENDLESS HAULAGE



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By putting another hauling drum on the same engine it is intended to work the main slope on the same system and thus do away altogether with one engine and battery of boilers; this work will be done during next winter. I may remark that the present output of Reserve mine is as high as 1300 tons a day as against 900 tons last season, and as far as I know the difference is entirely due to the new system of haulage.

As to the cost it is estimated that in enlarging the slope, equipping with machinery, ropes and appliances about $3000 were spent. The result has been to increase the output already 300 to 400 tons a day, to give up the half use of another engine and battery of boilers, and to reduce the number of men handling coal on the surface by 6 or 7. At the present moment 4 men handle the 700 tons a day from the French slope on the endless rope, whilst it takes 10 on the main slope which still works on the old system.

Having tested its suitability in its mines the Dominion Coal Company has decided to extend its use, and at present it is being laid down in the Company's Caledonia and little Glace Bay mines, and has been determined on for the new and important Dominion No. 1 Plant, with respect to the layout of which I had intended to make some remarks in this paper, but finding it has already reached such a length, refrain from doing so. I cannot, however, conclude without on my own behalf as a mining engineer and on behalf of the profession to which I belong and which is so honorably represented by the two societies gathered here, thanking Mr. David MacKeen, the General Manager of the Dominion Coal Company, for furnishing me with the opportunity of introducing the first instalment of this important and efficient system of haulage into Cape Breton, and I venture to think that the result will fully vindicate his forsight and sagacity.

DISCUSSION.

(Halifax Meeting, November, 1894.)

MR. POOLE — Mr. Blakemore gives us so much information of value and so many details, that I venture to ask him for one or two more; I notice his driving wheel has its perifery curved like the letter C, and not merely inclined, say at 5 degrees, to one side as in many cases of endless haulage. When the inclined tread is used the rope enters on the high side, makes its three turns and comes off on the lesser diameter, slipping slightly onward as well as sideways. It is contended that this arrangement taxes the rope less severely than the plain surface. I noticed the driving pulleys of the New York Cable Tramway have their faces horizontal but grooved, and these with use and wear must in time have the ntering groove reduced in diameter with a consequent tightening of the coils with each succeeding turn and give an increasing strain on the rope. Whether this strain has prooved of serious moment I am unable to say; perhaps not, as the driving wheels are of exceptional size.

Speaking of the relative advantages of endless haulage compared with other systems on a grade of 1 in 12 the claim is made that it would be as easy to haul 1000 tons a day by endless rope a distance of 5 miles as the same quantity ¾ of a mile by any other system. While admitting many advantages appertaining to endless haulage, I am unable to accept the proportion as so large. With a good road, I have known a speed of not 10 but 15 miles an hour in mid-run, and with a double track, which endless haulage also requires, an equal output was met for the distance named and that on a greater inclination than 1 in 12, with reciprocating ropes, while the strain on endless haulage 5 miles in length would, it seems to me, be excessive and call for a rope of unmanageable weight.

In connection with endless haulage I may here anticipate a future hoped for report on a trial at the Albion mines where the grade will be very severe, about 30°, yet, I am assured the system can be satisfactorily adopted on such an inclination, and

preparations are now being made. Much, doubtless, will depend on the make of clip used for clamping the boxes to the rope, and I would like to know the style Mr. Blakemore has found efficient on his lighter grade.

I may mention what I do not suppose is generally known, that when the tail rope system was introduced at Springhill a few years ago, no less than 27 miles and 300 yards of ropes were bought to equip the pits, and if a description of the system in use here could be obtained it could not prove otherwise than of great interest to our Society.

MR. FERGIE — Mr. Blakemore puts the safe limit of speed at a maximum of eight to ten miles, where as a matter of fact we run, not at ten miles but as high as twenty miles an hour with safety on our slopes in a distance of four thousand feet. Ours is the plain haulage system, direct action, double road. We have no difficulty at all. We have no difficulty with the boxes, no difficulty with the speed. We can bring up about 120 tons an hour for a distance of four thousand feet, provided the faces give us the coal.

MR. DICK — Mr. Poole said he was at present fitting out a haulage at the Albion Mines. He might give us a paper on that.

THE CHAIRMAN — As I understood from one of Mr. Poole's remarks, the haulage system has been in use at Springhill for a long time. It would be interesting if some of the people acquainted with Mr. Cowans, would induce him to give us a paper on that subject.

MR. DICK — I expect to go there shortly. If he likes to give me the facts I could present them.

MR. FERGIE — Springhill has the tail rope system.

MR. ARCHIBALD — They have had that system in old Sydney mines for ten or twelve years.

MR. FERGIE — Mr. Blakemore said he would give preference to the endless rope haulage system in any case. I would like to have asked him, taking seams like those in Pictou where we work the coal by pillar and stall and run out our level three or four thousand feet, whether he would consider the endless rope

better. I think it is not ; for in our system, once we are at our boundary, our levels are being shortened every day, and the system is too elaborate where they are only going to last a few years. With the endless rope you must have a double track, and consequently drive wider levels.

MR. ARCHIBALD — I think he makes that exception, and he further says that where the roof is bad it means increased cost of maintenance.

MR. FERGIE — Where you are sending out twelve boxes to the train there would be no object in putting in the endless rope, because you would require seperate attendance with each box.

MR. POOLE — His rope could not be a very heavy one.

MR. FERGIE — I agree with Mr. Blakemore that where you can put in a permanent system of haulage it is better than any other system.

MR. BURCHELL — I don't think he is in favor of it where the grade is very steep.

MR. ARCHIBALD — As to the way in which the rope is applied to the wheel, it struck me that if a certain strain was put on it, it would slip, and that would be difficult to regulate.

MR. FERGIE — You must have a special driving pulley.

MR. DICK — On the Brooklyn bridge the rope goes three and a half times around both driving drums. The drums are not in the same plane, one is slanted slightly.

MR. BLAKEMORE — Replying first to Mr. Poole's remark on the construction of driving wheel. I am acquainted with the alteration he refers to in the periphery of the wheel with an inclined tread instead of being semi-circular as in the "C" wheel. I have used both classes of wheel, but my experience is that the "C" wheel gives better results. I found that in course of time the wheel with the inclined tread grooved deeply at the lower edge of the tread, and I also found that in the earlier stages the rope was more disposed to slip than on the "C" wheel. The only objection to the latter is the side friction of the various coils of rope as they press upon one another and are forced across the

tread of the pulley; but if leading pulleys are used, so as to open out the ongoing and offcoming rope a little, this side friction is reduced to a minimum; and in fact I do not know that it has any appreciable effect upon the life of the rope. I should also remark that I am now having loose segments of cast steel to form the tread of driving pulley; these being moveable, can be taken out as soon as they are grooved, and replaced by others. In this way, I believe that the "C" pulley is calculated to give the best possible results.

I notice Mr. Poole's reference to the grooved pulleys, which are such a notable feature of endless rope traction in the United States, but besides the objection I mention I would point out what is really the most important objection to their use in mines; this is, that they hold the rope almost as firmly as does a clutch pulley. Now the object of the "C" wheel is to allow the rope to slip, in the event of a tub getting off the road, or any other obstruction to the free passage of the journey. The engineman at once notices that the rope is slipping, stops his engine, and so prevents breakage. This will be impossible either with a grooved or clutch wheel.

Replying to Mr. Poole and Mr. Fergie on the broader question of the relative advantages of endless haulage compared with other systems, I may say, that whilst I am well aware that under exceptionally favorable circumstances journeys are hauled out on the single rope system at a much higher speed than 10 miles an hour, I maintain that on such system the wear and tear, and also the risk, is much greater than with a slow haul. It should also be borne in mind that much larger engines are required for the higher speed; whereas the endless haulage can be worked with a very small engine, because, running slowly, you can afford to gear it as high as 8 to 1. But I would point out that however excellent the arrangement might be for single hauling, or even main and tail rope hauling at a high speed bringing out a journey at a time, there is a limit to the distance which any practical machinery will fetch a large output of coal, say, 1,500 to 2,000 tons a day; and that distance is unfortunately reached

all too soon, in the case of a large mine; whereas, distance does not enter into the consideration of the engineer who is able to put down endless haulage. And here I wish to correct a misapprehension, probably due to inadequate explanation in my first paper on this subject; when I stated that it was as easy to haul by the endless rope system a distance of 5 miles as 1, I did not say with the same machinery and appliances, but I meant, and maintain, that the system is as easily adapted to the one distance as the other. Now I put it to any practical engineer, first of all, whether it is possible to haul 2,000 tons a distance of 5 miles, or even 2 miles on the single rope, or main and tail systems, that is bringing out large journeys of coal each trip, assuming a dip of 1 in 12, but suppose it were possible, let him sit down and calculate what size engines he would require, what steam power. what strength of rope, and what size of pit tub to achieve this result; and then let me set against that the fact that a pair of horizontal high pressure engines, with 24 in. diam. cylinders and 5 foot stroke, geared one to eight, and furnished with steam by 1 Babcock, or 2 Lancashire boilers 30 x 7 feet; and a steel cable 1⅛ in. diam., with tubs carrying, say 2 tons each, would easily deliver the larger quantity mentioned from a station 5 miles distant, under the conditions named, in every working day of 9 to 10 hours. Of course the longer distances to which I am able to point on the endless haulage system are not in a mine, but upon the surface, and I would refer to one with which I am well acquainted in the City of Birmingham, England; there the cable is 14 miles long, the haul being 7 miles from start to finish; the engines are placed midway, and travel the cars at the rate of 8 miles an hour. The grades are very steep, as much in places as one in six, and over the whole distance the road is undulating. At times there are as many as twenty cars, each weighing about 10 tons, without passengers, and the size of the cable is only 1¼ in. diameter. The system works perfectly, and has already far superseded in popularity and effectiveness the steam tramway and the electric tramway, which both operated in the same city; and on the score of economy I may say, that since the introduction of this system

the concern has for the first time been placed upon a paying basis ; steam and horse traction both having previously been tried.

The last remark I would make is this, I have successfully installed and worked endless haulage in North Staffordshire, Eng., and South Wales, on grades as steep as 1 in 4, and as time goes on I am more than ever convinced that this method of haulage must ultimately supersede all others. It is, of course, somewhat difficult to introduce it in a mine that was not originally laid out for the purpose, as it works to the best advantage with good straight roads laid from the shaft. At the same time, there is no other system which works better round curves, if every detail is carefully attended to in the laying down. I think the most significant fact in connection with the whole subject is that in Northumberland and Durham, where the tail rope system had its origin, and where it had been adopted in nearly every important mine, to-day you find more endless haulage than tail rope, and the latter is gradually being crowded out by its successful rival.

NOTES ON COAL CUTTING MACHINERY AT THE COLLIERIES OF THE DOMINION COAL COMPANY.

BY J. G. HUDSON, M. E., Glace Bay, C. B.

(Read at the Sydney Meeting, July, 1894.)

The Introduction of coal cutting by machinery into the colleries of Cape Breton was watched with much interest by all parties concerned in the production of coal, as it was acknowledged by the management of the colleries and the representatives of the different companies who had this class of machinery to sell, that the coal fields of Cape Breton presented very favorable opportunities for testing their capacity on account of the even nature of the pavement, the flatness of the seams, and their freeness from faults and impurities.

The Ingersoll Rock Drill Company of Canada accepted an offer of the Sydney and Louisburg Coal Co., to try their Ingersoll-Sergeant Machine at their Emery Colliery, and on the 27th June, 1891, an invitation was sent to the managers and engineers of the different collieries then working to witness the test at the above colliery.

The machine used weighed about 500 lbs., and the air was supplied by two Westinghouse air brake engines attached to a locomotive on the surface, and conveyed down the pit in two-inch pipes with the necessary hose and connections.

The room selected for the test was 21 ft. 6 in. wide and height of coal 5 ft. This room was undercut a depth of 4 ft. in 1 hour and 10 minutes.

The next test was in a level adjacent to the room already mined, and was 9 ft. wide, 4 feet deep, and was undercut in 40 minutes. The undercut, or low wheels on the machine were then changed, and the machine placed on high wheels to enable

it to shear the coal from top to bottom. The changing of the wheels occupied about 15 minutes, and the level was sheared 5 ft. high, 4 ft. in depth, in 23 minutes, ready for the holes to be bored for blasting. It was estimated that each machine should mine and work 45 tons of coal in one shift.

During the summer of 1892, Mr. McKeen, of the Caledonia Coal Co., contracted with the Ingersoll Rock Drill Company of Canada to put in an air compressing plant at the Caledonia Colliery, to run elght machines, and also the necessary pipes for the air. They put down one of their 20 x 30 air compressors and eight Ingersoll-Sergeant coal cutting machines. The follow ing figures will show work performed by their own men before the plant was accepted.

A room 18 ft. 6 in wide was undercut in 1 hour and 50 minutes, moving wheels from undercutting to shearing, 8 minutes. Shearing 4 ft. deep, 6 ft. by 10 in. high, 25 minutes, Total time to be ready to bore the holes for the shot, 2 hours. 23 minutes; estimated quantity of coal, 20 tons.

In level work the machine sheared to good advantage. The level selected was 9 ft. wide and was undercut 4 ft. deep in 1 hour and 43 minutes; sheared 4 ft. deep, 6 ft. 10 in. high in 55 minutes; shifting wheels from undercut to shearing, 16 minutes. The machine was then moved to the next level 250 feet away in 21 minutes, when the same man mined a level 9 feet wide, 4 feet deep in 1 hour and 30 minutes; preparing to shear and changing wheels, 14 minutes; shearing, 4 ft. deep, 6 ft. 10 in. high, 59 minutes.

From the foregoing figures it will be seen that the time occupied in performing the various operations was very much less than by the ordinary methods of mining. As far as I am able to judge, about one-sixth of the time, apart altogether from the question of actual cost, it will be seen that this is a great advantage in the production of the largest possible output in a limited period, as well as enabling the mine owner to produce a larger tonnage of coal with the same number of men.

The facility with which the machines can be adapted to the different processes is also worthy of notice.

During the shipping season of 1893 the following rates were paid at Caledonia colliery for hand picks in rooms 18 ft. wide and 6 ft. by 10 in. high; 38½ and 41 cents per ton. The machine men received 30 cents per ton for rooms the same height, the coal mined from the machines being loaded into the tubs under the same conditions as the hand picks, the company finding the machines and oil, and also running and laying up the pipes to within 50 feet of the working face.

The following figures will show the amount of coal mined from some of the Ingersoll-Sergeant machines working at Caledonia colliery during this period.

Pit worked 11 days.

Two rooms to each machine.

Gillis and Casey, the machine runners, employing two loaders to fill their coal, received 30 cents per ton of 2,240 lbs., sent up 416 tons.

McIntyre and Pass employing two loaders, 427 tons.

Campbell and McDonald, employing two loaders, 463 tons.

In all cases it was found that men with machines made better wages than those men who were employed with the small picks, but coal had to be taken away from them quickly so that it did not accumulate and prevent the easy running and shifting of their platforms, and the machines could be worked to the best advantage by having two rooms to work in, so that when one was undercut the machine could be removed through the cross cut into the next room, ready for working again, whilst the loaders were filling the coal in the first room, and so on, alternately working one room after another.

In driving levels the machines were found to work to good advantage both in reducing the cost of yardage and the increasing amount of work in a given time.

It has always been a mooted point whether the coal produced by machine mining is of as good quality and size as that obtained by the ordinary method.

This question is one to which I have given very careful attention and observation, having day after day examined coal in rooms adjacent to each other, worked by the two methods, and I am of opinion that as good round coal can be produced from machine coal cutters as by hand, and in reference to slack, while there may be a certain percentage of very fine dust made at the very back of the undercutting, yet a much better slack coal is made from the first part of the undercutting than by hand work.

The machines were not difficult to keep in order, and the amount of breakage comparatively small, the parts most liable to injury being those easy to duplicate, and a man who had been running a machine for a few months, could easily make all the connections necessary; the only parts of the machine which wear out quickly being the rubber cushions at the back of the piston.

The Harrison Coal Cutting Machine manufactured by the Canadian Rand Drill Company of Sherbrooke, Que., was also tried and worked satisfactorily, the only difference between the machines being in the mechanical construction of the air valves.

The Stanley Heading Machine was also introduced and worked both at Old Bridgeport and Caledonia. The description of a machine of this class would require a separate paper in itself, but briefly it may be described as boring a tunnel out of the solid coal 6 feet in diameter, making a perfect circle, and leaving a centre core which has to be blasted out. The advantages of this machine are that in a very short time levels would be driven, and a large area opened out, as the following measurement will show: In No. 4 East level at Caledonia Colliery, from 6 p.m. to 4 a.m. the level was extended 32 feet 6 inches, being 15 cuts of 26 inches each.

For airways and water levels, it is a most excellent machine.

The boring will in most instances give a sufficient size without further enlargements to the smooth round tunnel which offers the least resistance to the passage of the air current, and also forms the strongest natural arch to resist super-incumbent pressure.

From the foregoing facts it will be noted that coal cutting

machines of the most improved modern types can be used with advantage both on the score of economy and efficiency in the mines of Cape Breton, and that in all probability the advantages considerably outweigh the disadvantages. There can be no question that the difficulties of manipulation have been overcome, and that any miner of average intelligence can manage the machine and earn larger wages than by the drudgery of hand labor, in fact it is with this class of machinery, as with all labor saving appliances, more a question of skill than strength on the part of the user, and intelligence is afforded an opportunity to supersede mere physical force. For this reason, if for no other, the miners should hail its advent with satisfaction, and I have no doubt that they will in the near future, regard it as their best friend.

The disadvantages tell mainly against the capitalist, and consist chiefly in the heavy outlay required to put down the necessary plant and machinery to set the cutters in operation. The only motive power at present recognized to any extent is compressed air, steam being impracticable for obvious reasons, and electricity immature. The cost both of installing and maintaining compressed air appliances is necessarily high, and the working parts of the machinery apt to get out of order.

There is the further difficulty of contending with the conveyance of this motive power for long distances, as the effective air current becomes attenuated, and to retain the necessary power, increasing large pipes have to be used as the working progresses. I have no doubt, however, that the advancing cost as well as the wide spread difficulties which have recently arisen in the labor market of so many mining districts will have the effect of stimulating scientific research and practical experiment, until the present crude appliances of electricity are perfected, when compressed air as a motive power in mines will become a thing of the past, and the most powerful and efficient force which Nature has given us, will enable all classes of mining machinery to be utilized under favorable and profitable conditions.

DISCUSSION.

Halifax Meeting, November, 1894.

MR. DICK— I want to say a word or two in regard to the Stanley Header. I think it is unfortunate that Mr. Hudson is not here. The question of machine vs. hand labor is of great importance. I notice that Mr. Hudson says that they drove a heading 32 ft. 6 in., from 6 p.m. to 4 a.m. I read in the transactions of the Scottish Mining Society that at the Palace Craig colliery in Scotland, they are driving a heading 11 feet wide with a pair of Stanley headers, one 100 feet ahead of the other, and leaving a rib of coal 1 foot thick between the headers for the purpose of ventilation. The decision they came to on the work of these headers was that it cost twice as much to drive the headings with the machine as it had cost them with hand labor, but that it did it in one quarter of the time. In driving out the preliminary headings, speed is of great advantage. I would like to ask Mr. Hudson if he had any experience with the Stanley header in a seam of coal where there were slate bands. That point has never been brought out. I should like to know also, how the water in the headings effected the working of the heading machine.

Regarding coal cutters, we find that the Harrison and Ingersoll machines are a distinct kind that are received with favor on this side of the Atlantic. I believe they are thoroughly in advance of any English cutter so far as pillar and stall work is concerned. This Society should appoint a committee for the purpose of investigating the relative cost and efficiency of the English and American machines in pillar and stall working. I should like to know what percentage of the time they require in moving the Harrison and Ingersoll machines as compared with the Jeffrey machine. Mr. Hudson said that any man of ordinary intelligence could work the Harrison and Ingersoll machines. I have been told by a man using this machine in the United States that he found that of all the men put to work on the coal cutter there were only five per cent. who could stand the shock of the machine. This is at variance with Mr. Hudson.

As to the efficiency of the machines, I got up a paper a year ago on this subject for the "Mineral Industry," and I found from the data I had that these percussion machines cut 82-8 tons per day in a 7 ft. seam and 20 tons in a 3 ft. seam. In England they cut as high as 90 tons per day in a 2 ft. 6 in. seam and undercut 450 lineal feet of face. I think it is hardly possible to do it. I could not get this amount of efficiency out of a Gillet and Copley disc machine. This work was done in a long-wall seam. In one seam in Scotland the manager got a disc machine to travel along the face 9 feet every minute. I question this very much. I am simply raising this to try and find out whether the percussion machines can do that amount of work. The disc cutters cannot get through iron stone balls in the holing; it will strip the cutters off. With the percussion machines they dodge these balls.

MR. ARCHIBALD— I worked the Ingersoll machine for a while. There is no trouble about shifting. I mean it is adapted for pillar and stall work and the advantage in long wall would be this: In starting the cut there is time lost, but when you get it in it is all right. The one I work is only 500 lbs. A man could work it easily After you get it in 3 feet there is no time lost in moving it. You could simply draw it out of the way in a minute and clear away the coal.

MR. BURCHELL— One man at Caledonia has mined 90 tons.

MR. FERGIE— What power does it take to drive the Ingersoll Drill?

MR. BURCHELL—Sixty pounds of pressure. We have our compressors 16 x 18 and I don't think they will drive any more than five.

MR. SWORD— Mr. Dick has not given the disadvantages of the long wall cutter. They cut small slot and the coal drops right where it is mined, and has to be blasted out. In the other case it rolls down on the face.

MR. BURCHELL—We have never had the coal come down in such a way that we could not get at it.

MR. SWORD—The longwall machines are all right when you have a good face and good room. You must have everything in good order or you can't get them to work. It is expensive repairing them, while an ordinary blacksmith can do work on the other cutters. I think if the longwall cutters were such great things they would be used to a greater degree in the United States.

THE CHAIRMAN— Why is it that the disc cutters have not found favor on this side of the Atlantic?

MR. DICK—I want to know that myself.

MR. FERGIE—Where they are used in England the seams are thin. On this side they are thicker.

MR. ARCHIBALD—Because there is not longwall work in this country. In Cape Breton they are just experimenting in the Gowrie mines.

MR. DICK— They are working a seam in Scotland of the thickness of 4 inches, with a band of ironstone about 1 foot.

MR. ARCHIBALD—I think the machine they are experimenting with in the Gowrie mine has produced 150 to 200 tons per day, but of course it goes straight along.

MR. HUDSON — In reply to Mr. Dick, I might say that the Messrs. Stanley of Neweaton have in their catalogue a cut of a double header, for driving levels up to 12 feet wide, and also a machine for cutting through the ribs for ventilation. In driving levels with Stanley headers it will always be a question of speed, and of necessity, often regardless of cost, and in my former paper I simply stated what the man on the machine had per foot.

At Caledonia Colliery we had a band of hard splint running from 1 to 1½ inches, situated 22 inches from the pavement, which was cut through without any perceptible difference in the working of the machine; and in several instances we got both up in the roof stone and into the pavement, and it was simply a question of having enough cutters for any ordinary stone, which would come in anything like regular layers, but I understand and would think that ironstone balls would give the cutters a hard blow, and

that they would be liable to break or jump out of the wings.

The question of water makes little difference to the working of the machine, in fact having the level wet would be of considerable advantage, as it absorbs the dust which is made in cutting the circle, and which otherwise causes considerable trouble to the men in breathing.

In regard to the question of any coal cutting machine after the pattern of the Ingersoll and Harrison machines, I am very much in favor of the percussion type in room and pillar workings.

The following will, I think, answer Mr. Dick's question as to the relative time in the shifting the two types of machines named. The only Jeffrey machine which did any work in Cape Breton was at the Gardener mine, and among some data of work performed by this machine I find that it required from four to ten minutes in shifting from cut to cut. This seems reasonable when you consider that the Jeffrey machine weighs 3,050 lbs., and is on runners similar to a sleigh and has to be pinched with a crowbar from cut to cut; while the Ingersoll and Harrison machines are mounted on wheels and can be easily handled, so that practically the time moving from cut to cut does not count.

In reference to my statement that any man of ordinary intelligence can work the Ingersoll or Harrison machine, I am giving a short account of our starting coal cutting machines at the Sterling Colliery, and I most certainly join issue with Mr. Dick's authority as to the percentage of men standing the shock on the percussion machines. This was a matter to which I gave considerable attention during the summer of '93 at Caledonia Colliery, and in no instance do I remember of any of our men giving up a machine on this account, or that any of our men lost weight by working the machines.

During the summer, Dr. Black of Halifax, visited Caledonia Colliery and was very anxious to see the machines at work. During his inspection I brought this theory to his notice, and he made particular inquiry into this from the men themselves, and in every case was assured that they had suffered no ill effects from this cause.

For the consideration of your readers who may be interested in increased outputs, I am giving the following account of machine work at the Sterling Colliery : —

We commenced machine work at the Sterling pit on the 13th of August, and the first week got 530 tons, second week 644 tons, third week (in Sept.) 1,269 tons, and in 17 days of October we cut 3,622 tons from our machines.

I also give the quantity of coal cut by one of our machine men : — Aug. 16 to 31, 339 tons ; Sept. 1 to 15, 316 tons = 655 tons for one month ; and this man had never operated a machine until the date mentioned.

The Railway System of the Dominion Coal Company Limited.

By H. Donkin, C. E., Sydney, C.B.

(Read at Sydney Meeting, July, 1894.)

The railway system acquired by the Dominion Coal Company, Limited, at the time they came into possession of their coal property in Cape Breton, consisted of the International, a standard gauge railway 12 miles in length, with a branch to Old Bridgeport mines ½ mile in length, and a branch 1½ miles in length connecting with the Canadian Government railway at Sydney; a standard guage railway from New Victoria mines to shipping pier, Sydney Harbor, in length 5 miles; a standard guage railway 1 mile in length, from Caledonia mines to shipping pier Glace Bay; a standard guage railway ½ mile in length, from Glace Bay mines to its shipping pier; the Sydney and Louisburg Railway, (so called), a narrow guage extending from the harbor of Sydney to the harbor of Louisburg, in length 34 miles, with a branch to Schooner Pond of 10 miles additional; a narrow guage railway 1¾ miles in length between Gowrie mines and the shipping Pier, Cow Bay.

The aggregate length of these railways, not including length of sidings and yard accommodation, amounts to 64½ miles. Of these railways, the International carried the outputs of the mines of that name, the Old Bridgeport and the Gardner mines and was also carrying a passenger and freight traffic. The Sydney and Louisburg railway carried the outputs of the Reserve and Emery mines to the Shipping Pier, Sydney Harbor, a distance of 12 miles, but was not in use for traffic from Reserve mines in the direction of Louisburg or Schooner Pond. The Victoria, Glace Bay, Caledonia and Gowrie Railways carried the output of their respective collieries.

In addition to the railways enumerated and in view of the increased facilities for transportation which would be required to meet an enormously increased output of coal, the Dominion Coal Co., Ltd., decided to build a standard gauge railway from Sydney to the winter port of Louisburg, and which should connect with the collieries in operation.

To this end survey parties were organized and took the field in the spring of 1893. The question of modifying the gradients and curvature of the existing Sydney and Louisburg railway (so called), substituting structures intended to carry a heavier class of rolling stock, and adopting a standard guage was first taken up, and after due consideration (in which the remoteness of the so called Sydney and Louisburg railway from the collieries in operation in the Glace Bay and Cow Bay basins formed the most important factor) was abandoned in favor of extending the railway existing between Sydney and Bridgeport, hitherto known as the International railway, on to Louisburg.

The instructions given to the officer in charge of the survey parties were to find a line having no grades opposed to the traffic greater than one half per cent. or 26 4/10 feet per mile, and no curves with a less radius than 1,433 feet.

Such a line was found, but in order to obtain it a structure ¾ of a mile in length and of 70 feet average height would have to be built across the valley of the Catalone Brook, and as all structures were to be of the most permanent character, the cost of this one was considered serious.

The question then of introducing a steeper grade at this point, with an auxiliary engine was considered and compared with the enormous cost of the structure mentioned would have been the more economical if adopted.

In completing the necessary exploratory survey for a line of railway between the International mines at Bridgeport and the Harbor of Louisburg, limited to the grades and curves above described, it was found the length could not be brought below 31½ miles and the company took up the matter of slightly increasing the grades with a view to materially decreasing the length.

Careful surveys were made with the result of obtaining a line having a maximum grade opposed to the traffic of 8/10 or 42 feet to the mile, reducing the distance to 27 miles and at the same time connecting with or coming within easy distance of the collieries of the Glace Bay and Cow Bay Basins.

This is the line, all things considered, which the company decided to build and which is now approaching completion.

The railway now under construction between Sydney and Louisburg differs in some respects from railways intended for general traffic, inasmuch as, for the present at least, its heavy traffic will be in one direction only, therefore, in adjusting the grades, advantage has been taken of this peculiarity in order to reduce the cost of construction and to economize distance.

The total length of the line from Sydney to Louisburg when completed will be 37 miles in length. The maximum gradient opposed to the traffic will not exceed 42¼ feet to the mile on tangents, and is equated for curve resistance. The sharpest curve on the main line has a radius of 1,433 feet, and even this curve has been sparingly used. The width of the road-bed in cuttings is 22 feet, on embankments 16 feet; there will have to be moved in the formation of it about 600,000 cubic yards of material, of which a large percentage is rock. For the passage of streams and proper drainage of the road-bed there will be required about 7000 cubic yards of masonry of a class not surpassed by any on this continent. The important structures on the line taken in their order from Bridgeport to Louisburg, are as follows: Little Glace Bay Brook, Big Glace Bay Brook and Black Brook steel trestles 150 feet in length each, and in heights from 25 to 30 feet; Mira River Bridge, three spans of steel and iron of 100 feet each, of which one is a serving span; outlet of Catalone Lake, a span of 50 feet and a steel trestle (between the crossing of Catalone Lake and the Summit,) 360 feet in length and having an average height of 50 feet.

There will be over 3000 cubic yards of ballast per mile, the rails are of steel, weighing 80 lbs. per lineal yard, and these will be supported on cedar ties placed two feet centres.

The joint fastenings are of the latest, heaviest and most approved type, and steel "Servis" tie plates will be used throughout the whole length of the line. With the class of locomotive engines now in use hauling coal for the Dominion Coal Company, Ltd., the average train load of coal need not be below 600 tons to Louisburg, but the permanent way and structures are designed and intended for a heavier class of engine, so that the train load can be materially increased if desired. The design proposed shipping pier at Louisburg Harbor will be 600 feet in length and 90 feet in width, will have 26 feet of water at inner and 30 feet at outer end at low water, will be built of hard pine resting upon creosoted piles and will be approached by a trestle 450 feet in length.

In addition to the roads now in use and under construction, the writer has received instructions to extend the Victoria mines Railway a distance of 1 mile, and also to make surveys for and to report upon the best location for a railway to serve the Low Point coal fields.

Whilst the railway from Sydney to Louisburg is essentially a railway for the cheap transportation of coal, and has been located solely with that object in view, it will not be without interest to the travelling public.

The beautiful scenery in the vicinity of Mira Bay and Catalone Lake is unsurpassed in this country; as for historic Louisburg—the Atlantic terminus of the line—which has been the theme of able writers and historins, it would be presumptuous on my part attempting to add anything to what has already been said and written about that royal town, which under modern conditions, though on different lines, is certainly destined to resume something at least of its former glory.

Sinking of Dominion No. 1 Shaft.

By J. JOHNSTONE, Superintendent, International Colliery.

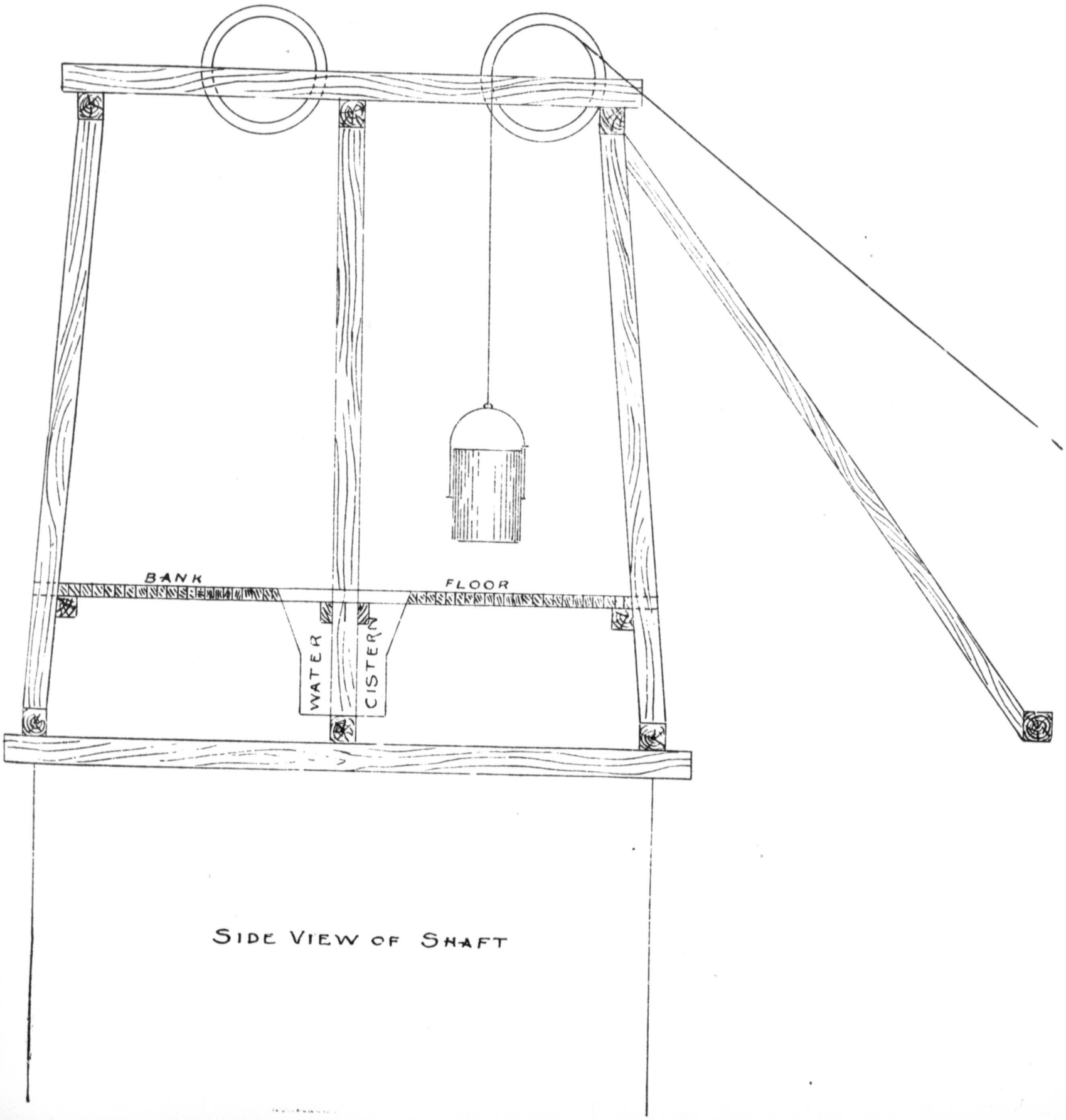
[Read at the Sydney Meeting, July, 1894.]

During the summer of 1893, the Dominion Coal Company decided to sink a shaft 24 feet long by 10 ft. 6 in. wide on their property, known as the Old Bridgeport, to the Phalen seam, which was found to be eight feet six inches in thickness.

Work began on the 25th of October, 1893, and by the end of the month the earth and clay were all removed, by the usual method of shovelling into dump cars, and carried some 300 feet to the railway dump. The earth and clay being about eight feet to rock, we continued about six feet into same to enable us to decide where crib bed was to be made, which was done by the sixth of November. Sinking was then stopped to allow the cribbing to be put in, thus to prevent the sides from falling in. It had been previously decided to crib the shaft with concrete made of one part cement, two parts sand and four parts broken free-stone. The cement and sand were thoroughly mixed together, wetted with water, and worked until in a pasty condition, when it was placed upon the broken free-stone, and the whole turned over four times, so that every stone became coated with the cement, and was then put directly into the casing prepared for the same.

The concrete wall was carried up from two to three feet all around the shaft to the height of ten feet from the crib bed. At four feet from crib bed there were also four additional buttresses on each side of shaft carried up with the wall, which projects out five feet by three feet wide, for the purpose of strengthening the wall, all of which was raised one foot three inches above surface

Plate III. Illustrating Mr. J. Johnstone's Paper, — "Sinking of Dominion No. 1 Shaft."



SIDE VIEW OF SHAFT

line, to prevent water from flowing over and into the pit while sinking operations were going on. The wall and buttresses were completed in eight days of ten hours each, and contained 114 cubic yards of concrete, 178 barrels of cement being used.

To make it clear with regard to cribbing and buttresses see annexed section "A" which shows ground plan and cross-section of same.

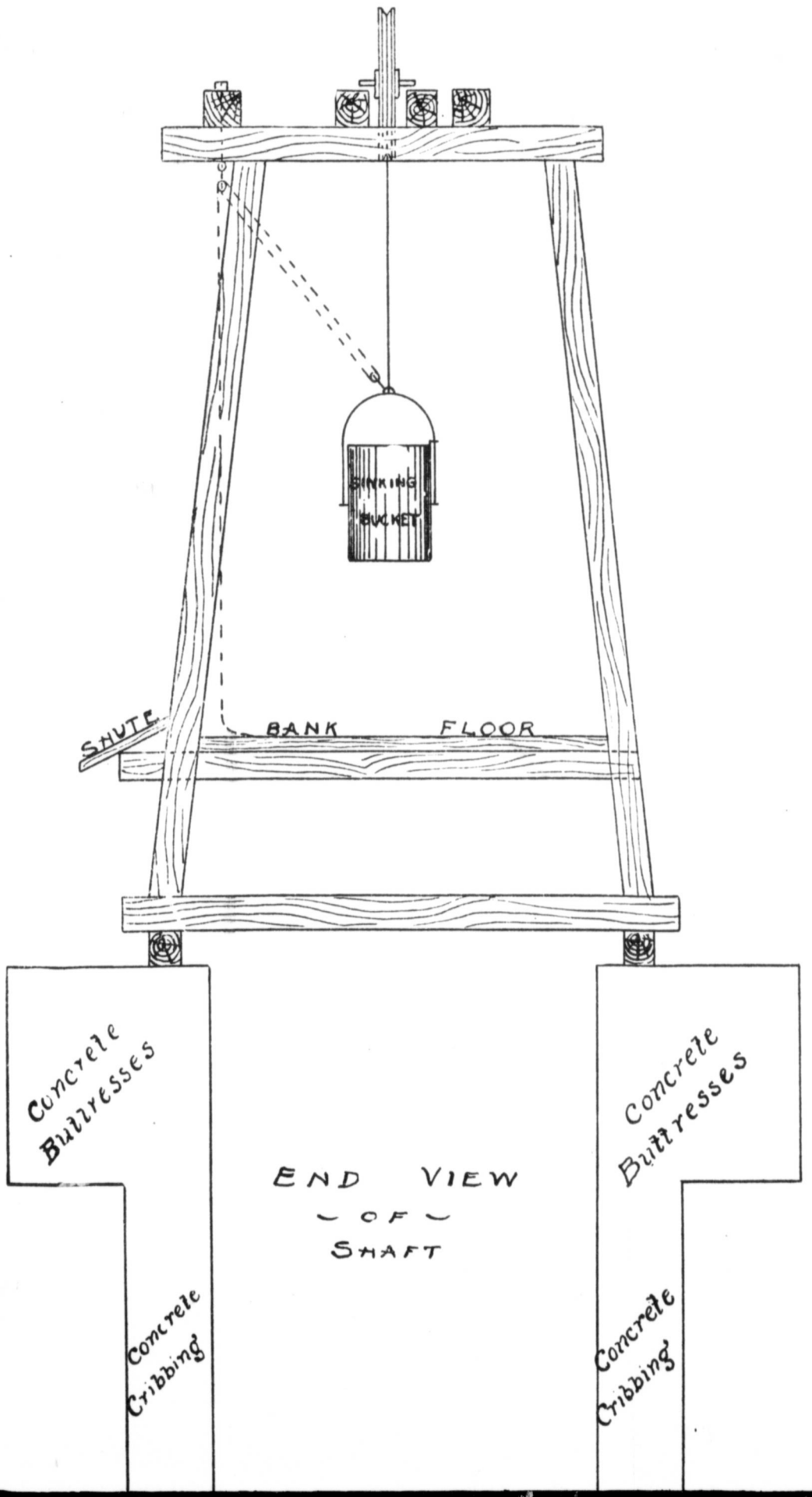
The concrete was allowed to stand for 12 days, during which time the necessary pulley-wheel and heap-stead were put in position for the purpose of raising the material and water, when sinking properly would begin. As soon as engine, boiler and heap-stead, with the necessary appliances were in readiness, sinking in rock began on December the first, and continued without interruption, except by the usual delays caused by ice forming on the sides of the shaft from frosty weather. It was finally completed on February the 17th, 1894, at a depth of 161 feet from the top of concrete. The shaft was sunk six feet below the main seam for the purpose of holding water which is continually running from the small coal seams and strata passed through in the course of sinking. The whole work of sinking was completed with but one accident, which was caused by the carelessness of the engine driver. After raising a tub of rock from the bottom of the shaft, he allowed the reversing handle of the engine to misplace, the tub returned to the bottom, striking one of the sinkers and injuring his leg. Section "B" shows the surface line, also height of concrete above same, and down to crib bed, continuing down and showing the strata and small seams of coal sunk through to the bottom of the shaft. Being aware of the importance of keeping the material away from the sinkers, and also the removal of unknown quantities of water, which always has to be contended with in the course of sinking, buckets made of iron were provided with a carrying capacity of one ton for rock, two of which were constantly kept at work, one on the bottom while the other was being hoisted and emptied. There were also two water buckets provided, with a carrying capacity of 100 gallons each, one of which was kept on the bottom to receive the water

from a ring which was cut round the shaft, at the bottom of the second coal seam, 50 feet from the surface to prevent the necessity of bailing by manual labor. The other bucket was used for taking the water from the bottom. At a depth of 25 feet the shaft was making 600 gallons of water per hour, from that to 50 feet it increased to 800 gallons, at 80 feet it increased to 1000, and at 100 feet it was 1200, until the bottom was reached, when it had increased to 1500 gallons per hour, all of which was hoisted to the bank in addition to the rock, by the buckets, and sinking was completed without the use of a pump in the shaft. Owing to the buckets being made so large, with a carrying capacity of one ton, it was quite evident that the usual method of dumping rock at the pit's mouth would neither be advisable nor safe. In order to dump the rock within as little time as possible and not to make the work laborious for the banksman, there was a pulley placed six feet from the centre of shaft with a rope over same, and hook attached so that when loaded bucket came up to the bank-floor, the hook was attached to the handle, and the bucket was hoisted about seven feet above bank floor, the other end of the rope had a short chain attached, which was placed into a catch on post of bank-frame.

The engine was then reversed, and the bucket swung out from the shaft mouth a distance of six feet, when the link which held the bucket in a perpendicular position was removed and the rock dumped into a shute, provided for the purpose of conveying the rock into the dump-car.

The above arrangement will be better understood by referring to section "C". It also shows that it prevents the falling of rock from the bucket into the pit when the sinkers are at work, as it is not over the mouth of the pit when emptied. It also does away with the necessity of having an extra bucket on the bank, as the bucket is not detached from the rope until it returns to the bottom of the shaft again. The water was disposed of by placing the cistern beneath the floor of the bank, so that when the bucket came up, and the centre was in line

Plate IV. Illustrating Mr. J. Johnstone's Paper,
"Sinking of Dominion No. 1 Shaft."



with the floor, the link was removed, the bucket turned over, and the water emptied into the cistern. From thence it was conveyed to a drain by pipes, so that it did not get back into the shaft. The water buckets were hung from the centre while the stone buckets were hung three inches below the centre, so that they would empty without any effort on the part of the bank top man. The following is a statement of labor and supplies for the sinking of shaft.

STATEMENT.

Sinking from surface to rock, 8 feet....	$ 108.10
Cribbing shaft.....	188.26
Sinking in rock.....	3994.01
Other labor performed for shaft.....	254.35
Erecting bank-top and pulley-frame ...	87.29
	$4632.01
Supplies for sinking, including cement, dynamite, oil and sundry materials,	1710.06
	$6342.07
Sinking labor, cost per foot.....	28.77
Sinking material " "	7.58
Cribbing " " "	3.04
	$ 39.39

The Sydney Coalfield.

By Hugh Fletcher, B. A., Ottawa.

(Read at the Sydney Meeting, July, 1894.)

In these notes nothing more is aimed at than to present a few facts of interest to members of the Mining Society unacquainted with the geology of the district. For fuller details reference may be made to Robb's reports for the Geological Survey from 1872 to 1875, from which they are a condensed abstract, to the "Coalfields of Cape Breton," by Mr. Richard Brown, one of the pioneer geologists of Nova Scotia, formerly manager of the Sydney mines and father of the present manager and of the Government Geologist of New South Wales, to Rutherford's "Coalfields of Nova Scotia," Dawson's "Acadian Geology," How's "Mineralogy," Gilpin's "Mines of Nova Scotia," Bell's "Mining Manual," Reports of the Department of Mines for Nova Scotia, Church's Mineral Map, and to papers in the transactions of various mining and scientific societies by Professors Lesley, Lyman, Brown, Routledge and other observers who have described the production of coal from the yield in 1758, by the simplest appliances, of 3000 chaldrons for the use of the garrisons at Louisburg and Halifax to the complex modern process described at this meeting of the Society.

This, the most valuable and most extensive coal field in Nova Scotia, known and worked for more than two hundred years, extends from Mira Bay to Cape Dauphin, a distance of thirty-two miles, being bounded on the north and east by the sea; it has been estimated to contain a land area of about fifty-seven square miles, colored as coal measures and embracing the 1838 feet of Mr. Robb's maps and reports, or about two hundred square miles with the lower seams of the millstone grit, some of which are in places of workable size, and a large sea area; but there is the usual uncertainty of such estimates.

The district is intersected by bays and harbors affording fine

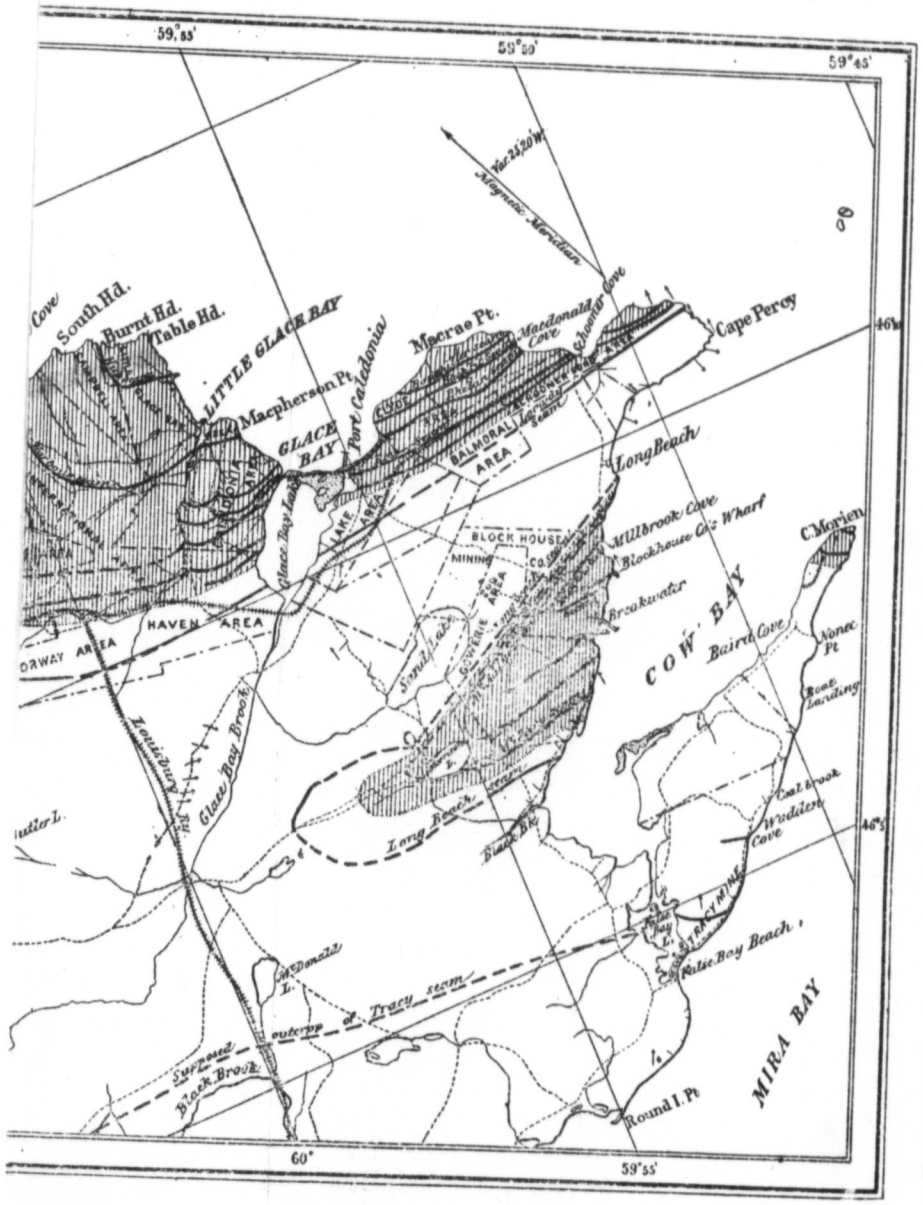
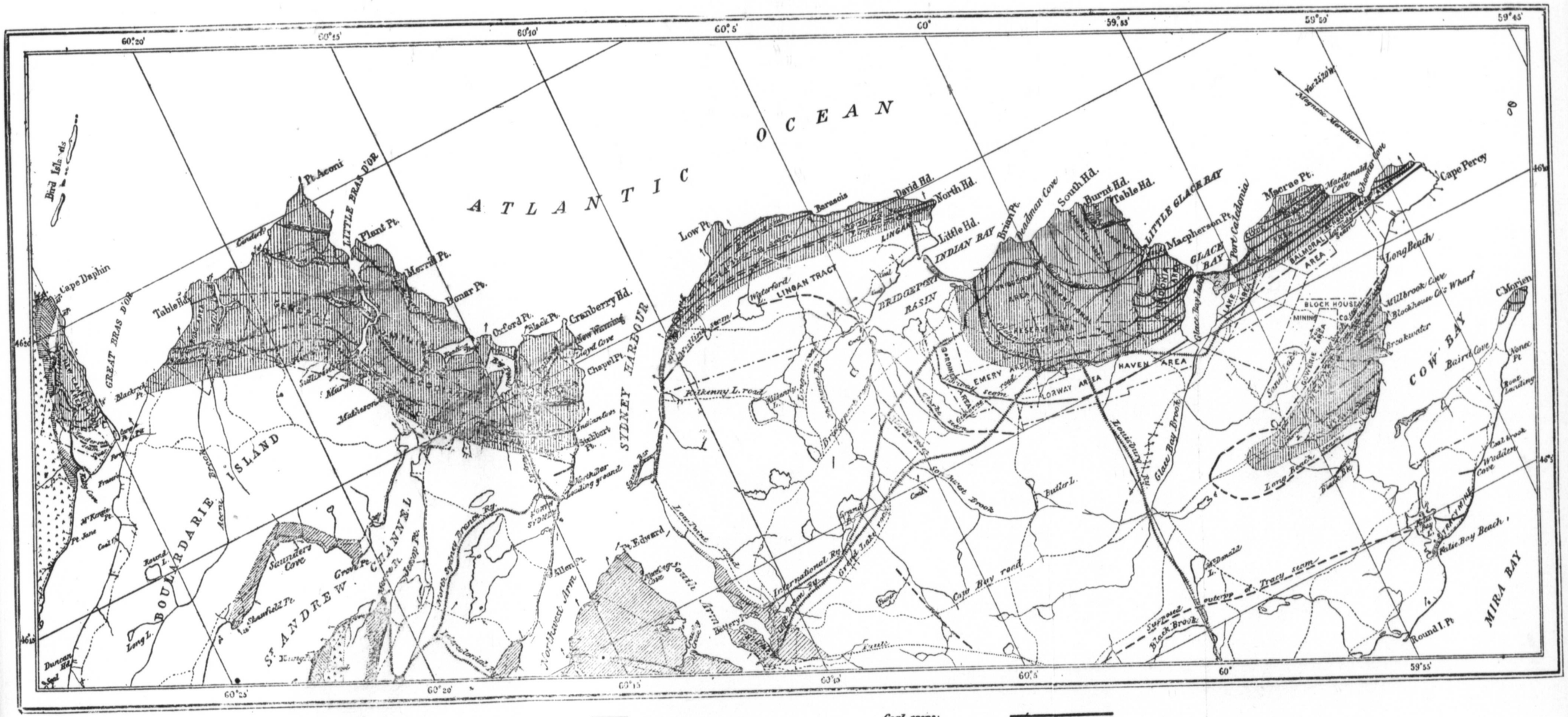

59°55'
59°50'
59°45'
Var. 25.20 W.
Magnetic Meridian
South Hd.
Burnt Hd.
Table Hd.
LITTLE GLACE BAY
Macpherson Pt.
GLACE BAY
Port Caledonia
Macrae Pt.
Macdonald Cove
Cape Percy
46°
LongBeach
BALMORAL AREA
BLOCK HOUSE
MINING
Millbrook Cove
Blockhouse Co. Wharf
C. Marien
Breakwater
COW BAY
Baird Cove
Stone Pt.
Stone Landing
HAVEN AREA
Louisbury Rly.
Glace Bay Brook
Long Beach
Black Bay
Coal Brook
Webster Cove
46°5
Kelso Bay Beach
McDonald's L.
outcrop of Tracy seam
Sydney Black Brook
Round I. Pt.
MIRA BAY
60°
59°55'

Plate V. Illustrating Mr. Hugh Fletcher's Paper,—
"The Sydney Coalfield."



LEGEND

- Coal Measures.
- Millstone Grit.
- Carboniferous Limestone.
- Potsdam
- George River Limestone.
- Laurentian.

- Coal crops:
- Do doubtful:
- Limestone:
- Direction of dip:
- Roads
- Coal area boundaries:

Scale of Statute Miles.

0 ¼ ½ ¾ 1 2 3 4 5 6

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rock sections in cliffs which rise from twenty to one hundred feet above sea level. The coal seams lie in four basins—the Cow Bay, Glace Bay, Sydney Harbor and Bras d'Or basins—separated by three anticlinals. On the east they are lost in the sea, on the west, thrust against the Laurentian rocks of St. Ann's Mountain by a great fault. The carboniferous strata in these basins have been subdivided by Mr. Brown into four distinct formations—the carboniferous conglomerate, carboniferous limestone, millstone grit and productive coal measures.

The first includes the beds of *conglomerate*, usually red, found along the foot of the Coxheath Hills. The *carboniferous limestone*, well exposed at Sydney Point, Point Edward and Kelly Cove, comprises thick beds of red and gray argillaceous shale and micaceous sandstone, beds of black and gray limestone with traces of galena and copper pyrites, and layers of gypsum, here not more than five feet thick and unimportant, but largely worked in other portions of the province. On the shore of Sydney Harbor, a little above the South Bar it underlies the millstone grit and terminates at a fault near the mouth of Freshwater Creek, assumed to be a downthrow to the southwest of about 900 feet. Trunks of trees, fish-remains and shells, indicating brackish water life, are found in a three-and-a-half feet bed of calcareo-bituminous shale near Sydney Point and Point Edward. These rocks with the conglomerate are estimated by Mr. Robb to have a thickness of 4,637 feet. Beneath them lie the igneous and metamorphic rocks of the Coxheath Hills; above them, the millstone grit, separated by a band of siliceous hematite.

The Millstone Grit, about 4,000 feet thick, is well exposed on the roads from Sydney to Cow Bay and Mira Bay on Boulardarie Island, along the shores of Sydney Harbor and elsewhere. In the western portion of the field it consists of an almost unbroken series of beds of gray and rusty coarse sandstone, with great quantities of vegetable fossils, with occasional irregular patches of argillaceous shale and coal; whereas in the east the formation contains thicker and more regular beds of argillaceous shale, with a marked predominance of red shale and sandstone, and seams of coal, one of which at least is of workable dimensions and quality. In this eastern section are the Coal Brook seam of 1 foot 6

inches, the Tracy seam of 4 feet 1 inch, and the Round Island seam of 2 feet, with smaller layers. Among these beds on the section at Mira Bay are exhibited changes both in color and in essential mineral characteristics. A stratum consisting at one place of coarse gray sandstone is frequently found when followed to no great distance, either on the strike or to the dip, to be replaced by red sandstone or by red or gray argillaceous shale. Such replacements are frequent also in the beds of the coal measures. Trunks and roots of prostrate trees are sometimes found converted into black crystaline carbonate of iron. No beds of limestone were observed in the Mira Bay section and carbonaceous shales are extremely rare, and where found consist like most of the coal seams of this formation of very thin beds composed almost entirely of the matted and pyritized leaves of *Cordaites.*

At the North Head of Cow Bay, the lowest rocks exposed by the anticlinal in bold cliffs upwards of one hundred feet high, resemble the red, purple and green shales and sandstones of Mira Bay. Some of the sandstones form conspicuous features in the physical geography of the district, constituting high ridges crowned with large loose blocks. Westward from this point the millstone grit rocks are no where found on the open Atlantic coast until reaching Cape Dauphin. They form the Bird Islands of the west as they form Flint Island at the eastern end of the district. The formation appears to thin to 1800 feet at Kelly Cove, while on Mira Bay it is 5707 feet. On the west side of Sydney Harbor it includes the Ingraham seam, two feet thick; on the east side is the Fraser or Mullins seam 6ft. 4 in. thick, and near McPhee Brook a lenticular layer of argillaceous shale and underclay, nine feet high, constituting a miniature coal basin. To the eastward there are five seams from 1 ft. 7 in. to 2 ft. thick below the Lorway seam; on the Cow Bay road at the intersection of Fitzpatrick Brook, a seam 1 ft. 10 in, thick; while another, the LeCras seam, has been worked on the Mira road by the Messrs. Cossitt and others.

The Coal Measures.—The boundary line between the millstone grit and the so called productive measures, although important in an economic point of view, is a somewhat arbitrary one and may be regarded more as a matter of convenience than as of geological importance. As the upper beds are cut off by

the sea, the entire thickness is nowhere represented. The productive coal measures, as defined by Mr. Brown and Mr. Robb, include argillaceous and arenaceous shales, for the most part gray, red and green marl, sandstone, underclay, limestone, black shales and coal, a thickness of about 1840 feet, of which from forty to fifty feet are coal and fifteen feet limestone, one set of seams running through the district. The coal contains more combustible matter than the Pictou coal and a smaller proportion of ash but a greater amount of sulphur, being at most of the collieries less inclined than at the Pictou and Cumberland mines, and therefore, as stated by Mr. Poole, not subject to the same proportionate waste in working and screening.

Shales constitute more than one-half of the total thickness of the coal measures. The argillaceous shales no doubt originally consisted of fine mud, the darker shades being due to the presence of carbonized vegetable remains; some of the beds contain much pyrite and nearly all are charged with clay ironstone in thin regular layers or in spherical or ellipsoidal nodules or concretions. The shales contain a vast variety of fossil plants, chiefly ferns, their most delicate and fragile fronds and stems being beautifully preserved between the laminæ. Many trunks of erect and prostrate *sigillariæ* with their *stigmaria* roots attached and growing into the coal seams are also found, the largest nearly five feet in diameter, the bark being converted into coaly matter and the interior now consisting of sandstone, carbonate of iron or argillaceous shale. The fluting of the stems is often beautifully preserved and frequently the leaf scars are visible. Occasionally the change of argillaceous shale into arenaceous shale or sandstone is so sudden as to give the beds the appearance of being faulted.

The red and green marls are argillaceous, of considerable thickness, distributed throughout all parts of the carboniferous series, seldom containing fossils.

Numerous beds of sandstone constitute the most prominent, thickest and most persistant members of this series of strata and sometimes form the roof of the coal seams. They are usually of considerable thickness up to forty or fifty feet, coarse and pebbly towards their base and sometimes assume the character of conglomerates, false bedding being prevalent in the

thicker and coarser grained strata which are generally charged with casts of plants and much carbonized vegetable matter in conditions which point to deposition in troubled waters, the trunks, stems and leaves having evidently been drifted from a distance and confusedly mixed together. Many of the sandstone beds are calcareous; a bed of this description at Lloyd Cove near Sydney Mines, furnished specimens of the footprints of a land animal, proving that it was deposited in a flat tidal estuary.

Underclays occur immediately beneath every coal seam, and bed of carbonaceous shale. They are for the most part aluminous and siliceous, form good fireclays and are copiously charged with the roots and innumerable rootlets of *stigmaria ficoides* which constitute the most distinctive feature of these beds; they merge by insensible gradations into the beds upon which they rest and are generally full of ironstone nodules. They vary in thickness from a few inches to eight or ten feet, but their size and richness in vegetable remains, appears to bear no proportion to the size or purity of the accompanying coal seams. The roots spread themselves horizontally in the beds and sometimes intertwine; they are often flattened and converted into sandstone. The rootlets are generally in a carbonized state and penetrate the bed in all directions, but chiefly downwards, as if to prove that they occupy the positions in which they originally grew.

The limestones are dark-gray or black, vary from half an inch to two feet and aggregate about fifteen feet in thickness, are remarkably persistent but disappear or thin out towards the eastern and western extremities of the field. They occupy a definite horizon and are rich in fossils indentical with those found at the Joggins, consisting of *Naiadites, Spirorbis, Cythere,* with scales, teeth, spines and coprolites of ganoid fishes. The fish remains are generally coated with and sometimes entirely replaced by iron pyrites, and the limestone shows cone-in-cone structure.

The black shales are sometimes of the nature of cannel or pass into bituminous limestone charged with fossil shells and plants; more frequently, however, they are soft and laminated, seem to be entirely made up of the matted leaves of *Cordaites* converted into mineral charcoal and may be regarded as coarse coals. Many of the workable coal seams enclose layers or bands

of such shale, and also sometimes pyritous bands which tend to deteriorate the coal.

Taking the average of all the sections measured, the total number of seams in the productive measures is twenty-four, of which six are three feet or upwards in thickness; and the total average thickness of coal may be stated at forty-six feet. The similarity and persistency of the seams over great areas is very remarkable although local variations are frequent. There is, therefore, no great uncertainty in regard to the equivalency of of the various seams at different points. In establishing this there have to be taken into account the quality of the coal, the position and character of the various partings or bands of shaly matter, the mineral and fossil characteristics and the thickness of the strata between the seams, as well as the manner in which the folds and undulations have affected the general structure.

In a few instances the coal seams are split by the gradual thickening of their argillaceous partings. Sometimes seams which are of workable thickness and good quality at one place become unavailable at no great distance. In the Blockhouse seam at Cow Bay and the Victoria seam at Sydney Harbor, curious wedge-shaped masses of rock similar to that overlying the coal interrupt the continuity of the coal, as described by Mr. John Rutherford.

The cleat or cleavage of the coal coincides with the joints of the accompanying sandstones and is most prominent where the strata have been subjected to the greatest pressure. The coal seams are for the most part overlaid by a stratum of argillaceous shale, very frequently characterized by the occurrence of erect stems of *Sigillaria*, often from two to three feet in diameter and in one case nearly five feet, the spreading roots of the trees resting upon the upper surface of the coal. Instead of the usual roof shales, the coal is often followed by sandstone and a bed of sandstone is almost invariably found to overlie the roof shales at no great distance above the coal. Many interesting details in regard to the occurrence of fossil trees in these strata are to be found in Mr. Brown's writings and in Dawson's Acadian Geology.

Subordinate Basins in the Coalfield.—Along the sea coast the three anticlinal and four synclinal folds are well exposed; but the upward slope of the strata from the sea causes the coal

measures in the latter to rapidly run out inland, leaving large portions of the coal seams to be worked beneath the sea, as at the Sydney and Victoria mines.

The Cow Bay Basin.—The seams of this basin have been exposed both by natural and artificial means on both sides of Cow Bay. The average breadth of the basin at the shore, between the outcrops of the lowest seam, does not exceed two miles and one-third and it diminishes gradually inland until it terminates at a point about six miles from the shore, as proved by several crop-pits and boreholes on the various seams. The coal seams of this and the following basins are given in the tabular view. On the South Head some of the lower seams crop out and are cut off by the ocean, thus constituting the eastern extremity of the coalfield as exposed on land. In all the sections at Cow Bay calcareous matter is very sparingly distributed, a remarkable exception to the general rule in this coalfield. On the South Head the coal seams are much more split up by clay and shale bands, yet the total quantity of coal, the approximate distances between the seams and their geographical position in relation to their strike appear to justify the equivalency noted in Mr. Robb's sections. The rocks underlying the Long Beach seam belong to the millstone grit. In the centre of the basin are the Blockhouse and Gowrie mines, on the south side the South Head colliery.

The Glass Bay Basin.—The axis separating this from the Cow Bay basin skirts the northern shore of Cow Bay at Cape Percy or North Head, the opposite dips being visible in the precipitous cliffs. In striking contrast to the Cow Bay basin that of Glace Bay is wide and has uniformly gentle dips on both sides; and includes 610 feet of strata overlying the highest beds of that basin, among which occurs the Hubs seam, the highest workable coal seam in this district. The attitude of all the seams in the Glace Bay basin, extending for a length of about twelve miles, is a striking proof of the general regularity of deposit and absence of faults which characterize this district; but the section shows considerable thinning of the beds between the several coal seams as they are traced westward. The most important cannel coal found in this field lies twenty-five feet beneath the Hub seam, is 1 ft. 2 in. thick, underlaid by 9 inches of ordinary

bituminous coal and by 1 ft. 9 inches of coal, clay and carbonaceous shale in eleven bands; attempts have been made to work it as it contains 30.07 per cent. of volatile combustible matter, 44.42 fixed carbon and 24.68 ash. In the Phelan seam, at a distance of half a mile from the shore, in the main level of the old Bridgeport mine, a shale parting has increased to twenty-eight feet. The Ross seam at and near the Bridgeport shore is only 1 ft. 8 in. in thickness, while at the Emery mine, not quite two miles and a half to the eastward, it averages 5 ft. 3 in.

Situated in the Glace Bay Basin are the Schooner Pond, Ontario, Caledonia, Glace Bay, Emery, Reserve, Lorway, Gardener, International and Bridgeport mines.

The Sydney Harbor Basin.—The next Basin includes the Lingan, Barasois, Low Point and Sydney mines districts, extends from Indian Bay and Bridgeport Basin to Point Aconi and embraces all the coal seams in the field. An anticlinal axis which skirts the north shore of Bridgeport Basin and runs thence westerly, parallel with the North Head anticlinal, to a point, midway between McPhee and McKay brooks on Sydney Harbor, divides this Basin from that of Glace Bay. On the north side of this axis the rocks dip at angles varying from 12 to 16°, at Lingan to 40° at Victoria Mines. From Lingan to Low Point Lighthouse the Strike is nearly parallel to the shore and brings the entire volume of the coal measures upon the cliffs in several fine sections which show 349 feet overlying the highest strata of the Glace Bay Section; and the exposures on Sydney Harbor are equally fine.

The Lingan, Victoria, Sydney and Collins mines lie in this basin.

The Bras d'Or Basin.— West of the Little Bras d'Or, a low broad anticlinal running from Point Aconi to Saunders Cove deflects the strata to the south to form this basin, which includes the Boularderie and Cape Dauphin districts. According to Brown, Hind and others, the Little Bras d'Or runs approximately on the line of a fault, of which, however, as also of a similar supposed fault on the line of the Lingan anticlinal, Mr. Robb could find no evidence.

On the northwest side of Boularderie Island the coal measures are exposed in an unbroken section, extending in the direction of the dip, over a distance of about six miles, from Point Aconi to the millstone grit, which here includes two coal seams not workable. In the Boularderie district the coal has been very little developed. In the Cape Dauphin district only the lower part of the productive measures, probably as high as the horizon of the Sydney Mines main seam, is developed; the principal seam worked at the New Campbellton mine is the continuation of the Blackrock or Number Three seam of the Sydney Mines section, and that underlying, cut in a vertical attitude in the tunnel near the mountain, is the equivalent of the Collins seam of the Little Bras d'Or. The Blackrock and New Campbellton collieries are situated within this district.

Mr. Robb's table showing the equivalency of the principal seams in the various districts and basins is here appended. It will be observed that he assumes the Blockhouse, Harbor, David Head, Victoria and Sydney Mines main seams to be the same and places them on the same horizon in the table. Most of the sections summarized in his report were carefully measured in the cliffs.

TABLE SHOWING THE EQUIVALENCY OF THE PRINCIPAL COAL SEAMS, WITH THE INTERVALS BETWEEN EACH IN THE SEVERAL SECTIONS.

NAMES OF THE DISTRICTS AND BASINS.

COW BAY.

NORTH SIDE.	Strata and Coal.		SOUTH SIDE.	Strata and Coal.	
	Ft.	In.		Ft.	In.
Block House	9	2	Block House	9	2
	319	1		285	8
Seam D	1	0	Seam D	1	0
	130	6		107	0
Seam E	3	2	Seam E	2	6
	118	0		160	7
McAulay	7	9	McAulay	4	11
	215	10		187	9
Spencer?	5	0	Spencer (South Head)	3	9
	338	6		330	11
Long Beach	1	4	Long Beach	3	1
Total thickness coal.	27	5	Total thickness coal.	23	5

GLACE BAY.

EAST SIDE.	Strata and Coal.		BRIDGEPORT.	Strata and Coal.	
	Ft.	In.		Ft.	In.
Hub	9	10	Hub	9	5
	366	3		344	4
Harbor	5	3	Harbor	6	1
	299	3		238	7
Bouthillier	2	0	Bouthillier	4	0
	74	2		92	1
Black Pit	4	9	Black Pit	4	0
	112	9		83	3
Phelan	8	3	Phelan	8	7
	188	3		108	1
Ross	5	6	Emery	1	8
	307	7		279	2
Lorway	4	0	Gardiner	5	9
Total thickness coal.	39	6	Total thickness coal.	39	6

LINGAN TRACT.

Lingan Side.	Strata and Coal.	Sydney Harbor.	Strata and Coal.
	Ft. In.		Ft. In.
Seam A	3 0		
	306 2		
Carr Seams	6 5	Paint	13 4
	190 1		176 3
Barasois	12 1	Crandall, &c	7 11
	379 3		320 3
David Head	8 0	Victoria	6 7
	235 0		308 8
Seam D	3 0	Willie Fraser	3 6
	78 1		83 11
North Head	4 0	Number Three	4 0
	75 11		116 4
Lingan Main	8 0	H. McGilvary	6 3
	95 3		126 6
Seam G	2 6	D. McGilvary	2 2
	340 5		362 9
Seam H	1 0	Seam H	0 10
Total thickness coal.	47 0	Total thickness coal.	44 6

SYDNEY MINES.

Sydney Harbor.	Strata and Coal.	L. Bras d'Or.	Strata and Coal.
	Ft. In.		Ft. In.
Cranberry Head	3 8		
	281 4		
Lloyd Cove	6 4	Lloyd Cove	8 1
	269 1		231 7
Chapel Point	3 9	Seam B	4 2
	322 9		380 7
Sydney Main	6 0	Sydney Main	3 0
	315 10		205 0
Willie Fraser	1 4	Bryant	2 0
	117 0		78 0
Indian Cove	4 8	Edwards	5 5
	87 0	(approx)	100 0
Seam F	1 7	Seam F	2 9
	123 9	(approx)	100 0
Stony	3 0	Collins	5 0
Total thickness coal.	30 4	Total thickness coal.	30 5

BOULARDIE.		CAPE DAUPHIN.	
West Side.	Strata and Coal.	Middle.	Strata and Coal.
	Ft. In.		Ft. In.
Point Aconi	3 2		
	242 0		
Bonar	6 10		
	218 9		
Stubbart	7 6		
	413 3		
Seam C	2 9		
	219 4		
Millpond	3 11	Seam D	1 8
	176 5		237 0
Blackrock	3 0	Four Feet	4 0
	125 8		53 3
Seam F	0 8	Seam F	1 9
	43 9		54 0
Seam G	0 11	Six Feet	6 0
Total thickness coal.	28 9	Total thickness coal.	13 5

DISCUSSION.

(Halifax Meeting, November, 1894.)

Mr. R. H. BROWN — I have a doubt as to whether the Sydney Mine main seam can be regarded as identical with the Ross seam of the Victoria Mine. The Sydney Mine's seam dips North-East at an angle of seven degrees, and has been explored half way across the harbor; whereas, the Ross seam dips very steeply nearly at right angles to this direction. If identical, it would appear that the seams are separated by great dislocation.

Mr. FLETCHER — I admit the possibility of the dislocation; but I think that the evidence given by Mr. Robb of the identity of the two seams is incontrovertible.

Mr. H. S. POOLE — That Mr. Fletcher's paper is an excellent resume, the geology of the Cape Breton coal fields goes

without saying, and that it will furnish for some time to come the standard text book on the subject there can be no doubt. In only one respect would I ask to have it added to, and that is in connection with the palæontology of the field. Students and Summer visitors interested in the subject would desire to have directions how to readily find localties where fossils of the different horizons are likely to be met with, and Mr. Fletcher will add to our obligations by making notes to this effect. College professors and students who take vacations in Nova Scotia and find our province a fertile field for study in many formations so well exposed in coast and river sections will gladly avail themselves of the information. I understand another addition of the large map on a scale of one mile to an inch is likely to be issued by the Survey at Ottawa, and it is expected to show discoveries that have been made since the map was first issued some years ago.

MR. FLETCHER — So much had been done by Mr. Brown on the west coast of Sydney Harbor which offers such fine exposures of the rock which show fossils, and he had described so many in that section in the neighborhood of the coal seams, and, as these seams could be traced through from end to end, it seemed unnecessary to mention every place where fossils could be found. One of the most interesting places is the Carson pit near Sydney. Here ended the limestone formation which contained fossil shells. So much has been published about the different parts of this shore, that a simple reference to localities such as made on the geological maps would be sufficent.

MR. POOLE —If Mr. Fletcher would kindly add a reference to localities where the different fossils could be found, strangers coming in could turn to the paper and find where they could go at once, without turning to geological maps.

MR. FLETCHER — The oversight arose from my following Robb's work. I will sometime try to remedy the defect.

THE CHAIRMAN — I would suggest that Mr. Fletcher amend that and say he will do it immediately.

Gold Mining in Nova Scotia—a Review of Operations in the Various Localities.

By JOHN RUTHERFORD, M. E., Stellarton.

[Read at the Sydney Meeting, July, 1894.]

When it occurred to the writer that he might be able to extract from the records of gold mining in Nova Scotia, something that might be worth while bringing to your notice, he placed before him, in the first instance, as the prominent question to be dealt with, the query—Is gold mining in Nova Scotia worth carrying on? and the more he reflected on this query, the stronger was the feeling that if the idea prevailing in his mind had truth for its basis, the inquiry might not be without advantage. If, on the other hand, an examination of all the circumstances in connection with the practical operations and the position of the auriferous lodes should lead to the conclusion that gold mining in this province is a failure, then a frank avowal of this cannot be considered inimical to the interests of the province. Better far that capital should be placed in less highly remunerative operations, but which have the essentials of durability and steadiness of return, than to explode it with the result only of a flash *et preteria nihil.*

The writer is sensible that in stating the proceeding premise he may be thought to be adventuring boldly, for while to some it may occur that all is not gold that glitters, this inquiry is entered on with the hope that it may be shown that there is more gold than glitters.

It is not intended on this occasion to deal with the subject from a scientific point of view, so far as that bears a geological aspect. The writer is not desirous to arouse a discussion on the formation of gold or the character and position of the matrix, but rather to treat the matter in this sense: Gold has been found here, there, over a widely spread portion of the province; it is there, in

situ, and it is wanted ; how can it best be got and when got, is it worth the candle ?

Now, this how can it be got query is of prime importance. There lies before us a portion of ground containing veins of quartz in which is embedded, sometimes conspicuously, sometimes almost invisible, the precious metal, a metal that in its intrinsic value varies very slightly so that its profitable abstraction depends entirely on the means adopted to bring it into a marketable condition. Progress as regards the skilful application of methods of mining and the scientific treatment of minerals like every other pursuit, is gradual, and we should look therefore with less wonder at the crude adaptation of mechanical appliances in the early mining operations. This remark applies very forcibly to the early stage of gold mining in Nova Scotia ; though with the knowledge that had been gained in California and Australia, it might have been expected that a more rapid application of that experience would have taken place.

The writer in his position of Inspector of Mines, to which he was appointed in 1865, became acquainted with these early operations ; and with regard both to the means of mining and raising to the surface, and the subsequent treatment of the quartz or rock containing the ore, it has frequently occurred to him since, that but for the fact, that sufficient gold was obtained to render the operator easy as to the question whether he was getting all the lode would yield or not, such comparatively simple appliances as were then in vogue seemed to give marvellous results.

From various sources, however—from the general manager, from the underground foreman, and from the intelligent workman's statement of wages made and the show of the lode, he gathered the prevailing opinion in those days that a field of gold of ten dwts. to the ton of quartz crushed, paid. Let this be noted as a starting point; it will be referred to subsequently.

What the writer now proposes to do is this : To briefly, and as summarily as possible state the result of the operations in the different localities, as regards the yield of gold; dividing the inquiry into decennial periods, beginning with the year 1862, to make such remarks as occur to him in the course of the inquiry

and to adduce the opinions of others, competent to form them, on the causes of unsteadiness in the operations which have occasionally occurred, It is hoped that this course, without elaboration, will in its results justify the ultimate opinion arrived at in reply to the inquiry with which the subject is started.

In the report of the Chief Commissioner of Mines, for 1862, the localities named in which gold mining is being carried on are Tangier, Waverley, Oldham, Lawrencetown, Wine Harbour, Sherbrooke, Stormont, Ovens and Renfrew. In the course of the ten years forming the first of the decennial periods embraced in the review, the following localities were also brought into operation, viz., Uniacke, Gold River, Cochran Hill, Fifteen Mile Stream, Gays River, Musquodoboit and Caribou; and it may here be noted that with the exception of the Ovens at Lunenburg and Gold River near Chester, these localities are in the eastern part of the province and extend over a tract of country that may be roughly estimated at 1500 square miles.

Mining was more or less steadily carried on at all these places and the records of yield in the period now referred to—1862–1871, gave the following results:—

Average yield of gold per ton (of 2,000 lbs.) of quartz crushed:

	Oz.	Dwts.	Grs.
Tangier	—	17	10
Wine Harbor	—	14	10
Sherbrooke	1	4	14
Stormont	1	6	12
Renfrew	—	18	7
Oldham	—	17	16
Waverley	—	10	4
Montague	2	4	22
Caribou	—	16	16
Uniacke	—	18	12
Other districts	1	8	14

and an average yield from all localities of 1 oz., 1 dwt., 14 grs.

Now, this must surely be considered a very remunerative yield, and it calls for special attention in connection with the remarks that occur in the reports of the Chief Commissioner of Mines on the varying energy with which mining was carried on,

and the general conduction of the operations. As instances, the following may be quoted. In the report for the year 1865 it is remarked of the Waverley district, "the great productiveness of this district for the past year is due less to any exceptional richness in the auriferous quartz lodes than to the enterprise and energy with which mining operations have there been carried on." In the report for 1867 it is stated, "leads are now operated upon profitably which at the commencement of mining operations could not have been worked except at a loss, and there is no doubt that with the increased experience in mining, and in separating the gold from the ores, many leads, now deemed worthless, will be worked; and though under the present system of manipulation the profits are large, yet it is well known that a large percentage of the gold contained in the quartz is not saved;" and in the report for 1868 the following sentences indicate the character of the operations at that time: "A number of well paying mines have been abandoned at a depth when manual and horse labour could not perform the hoisting and pumping required, the profits having been divided as made and no working capital set aside to meet emergencies and provide necessary machinery. Commencing mines on a small area of ground has always proved detrimental to the gold mining interest, and sinking shafts seems to be a mania. We give as an instance, 30 shafts sunk on one lead, in a distance, of eighteen hundred feet, and 23 shafts in a distance of sixteen hundred and fifty feet on a lead not more fifty feet from the first named. There is also a great want of appliances and skill in saving the fine gold; it is computed by good authority that at least 30 per cent. of this gold is lost in the tailings."

Again in the report for 1869 it is remarked: "In a review of the business of gold mining for the past year it is proper to state that the results have not been as large as anticipated, partly no doubt, owing to the depression of business generally, but largely to the want of skill in management, expensive modes of mining, heavy works engaged in without an adequate object, and the utter absence of any but the most simple appliances for saving pyrites, mercury and fine gold, compared with the appliances used in other quartz mining countries."

Another very trenchant explanation of the cause of suspension of working in some localities is given in the report for 1870. "Speculating," it is said, "has also been very detrimental to the mining interests, as now there are a number of paying mines (judging from returns), that are not working from the want of means to put up necessary machinery, etc., there having been so many worthless properties sold that capitalists are afraid to have anything to do with them."

It may be permitted here to refer to the discontinuance of the personal report of the Chief Commissioner of Mines. Up to the end of the year 1872 this report was a distinct feature in the general report issued from his department, and it frequently contained information of much interest, inasmuch as from his position he was able to give statements explanatory of the difficulties appertaining to the opening of new districts, and to causes of suspension of operations (such as have been referred to), during financial depression; or, until a change of ownership was effected. In most cases coming under the first head, difficulty of access to the various localities has been very considerably lessened, and the transportation of machinery and the necessary supplies of a general character is not now the hindrance that formerly existed.

But apart from this, the writer cannot but think that the Chief Commissioner's review of each year's proceedings with remarks on the special bearing of the various clauses of the Mines Act as circumstances occur in connection therewith, would not by any means, be the least interesting portion of the annual report.

In the report for 1872, the first year of the second decennial period, there is a noteworthy reference to a change of system of working that was prevailing largely at that time, that is, the adoption of the "tribute system," and in connection with this the following extract from the report of the Inspector of Mines for that year, having a bearing on the object of this paper, is submitted.

"Much has been written on the general want of method attending gold mining in Nova Scotia, and sweeping condemnations of the management and want of skill shown while working the mines have been published. Much, doubtless, most justly, and yet somewhat hasty comparisons would seem to have been drawn

between the wide and comparatively easily wrought leads of other districts and the thin leads of this Province enclosed in hard and tough country rocks."

"The great expense attendant on the moving of the quartz has had as much if not more to do with the failures that have hitherto, with but few exceptions, followed all ventures in the gold fields."

"No manner of doubt, however, can be entertained that the treatment of the quartz after extraction is still crude and imperfect, and the results obtained in our mills are far behind those of other countries."

With this premonitory hint of amendment being required, the results in the respective localities during the ten years ending 1881, may now be examined.

Average yield of gold per ton (of 2,000 lbs.) of quartz crushed :

	Oz.	Dwts.	Grs.
Tangier	—	12	5
Wine Harbor.....	—	15	2
Sherbrooke.	—	15	6
Stormont..	1	5	4
Renfrew.....	—	7	21
Oldham.....	1	2	3
Waverley.....	—	13	10
Montague.	2	2	2
Caribou.....	1	—	9
Uniacke.....	—	15	13
Other districts..... ..	—	11	2

and an average yield from all localities of 18 dwts., 4 grs.

It may be here remarked that in the course of the ten years 1871–81, gold was discovered in several localities separated in some cases by a considerable distance, and these are of much interest in this respect, they give a large extension to the field of operations of much importance.

Although the average yield in the last named period shows a falling off in the yield of 3 dwts., 10 grs., still it cannot but be considered a high average.

As it is not the intention of the writer to deal minutely with each particular district in explanation of the cause of this differ-

ence of yield, but rather to treat the subject in the general sense, the production of gold in the next decennial period, viz., 1881-91, will now be given.

Average yield of gold per ton (of 2,000 lbs.) of quartz crushed :

	Oz.	Dwts.	Grs.
Tangier	—	10	12
Wine Harbor	—	11	16
Sherbrooke	—	7	15
Stormont	1	7	15
Renfrew	—	12	17
Oldham	1	8	9
Waverley	—	11	5
Montague	1	8	7
Caribou	—	8	18
Uniacke	—	12	14
Other districts	—	18	16

and an average yield from all localities of 16 dwts. 4 grs.

This statement shows a further decline in the yield of 2 dwts.

The following aggregate statement may now be added, which shows the average yield over the entire period under review, 30 years, in each locality.

Average yield of gold per ton (of 2,000 lbs.) of quartz crushed :

	Oz.	Dwts.	Grs.
Tangier	—	13	9
Wine Harbor	—	13	17
Sherbrooke	—	15	20
Stormont	1	6	10
Renfrew	—	12	23
Oldham	1	2	17
Waverley	—	11	14
Montague	1	18	8
Caribou	—	15	6
Uniacke	—	15	13
Other districts	—	19	11

A general statement of the average annual yield of gold, embracing all localities, for the 30 years 1862-91, is given in the report of the Department of Mines for the year 1891, which shows an average yield over that period of 15 dwts. $7\frac{66}{100}$ grs.

A further extension of gold mining occurred in this last period on which it may be remarked as noteworthy with respect to the localities, not only their geographical position, but also the average yield up to the end of the third decennial period.

In Queen's County, for instance, distant from the western range of operations in the eastern part of the province, about 75 miles, Whiteburn, one of the localities gives an average yield, in the five years ending 1891, of 1 oz. 10 dwts. 12 grs. and Malaga, in the three years '89, '90, '91, gives an average of 16 dwts. 11 grs. In this connection, as indicative of the range westward of the auriferous rocks, mention may be made of the operations at Kentville in Yarmouth Co., about 50 miles farther west. Of this locality, it is stated in the report of the Department of Mines for the year 1885, that 133 tons of quartz yielded 624 ozs. of gold.

In another locality, Rawdon, situated to the north of Renfrew, gives not only expansion to the width of gold country, if the term may be used, but also shows a satisfactory average yield during the five years ending 1891 of 18 dwts. 11 grs.

One more statement may be added to this array of figures, which it is thought, cannot lesson, but, on the contrary, should intensify the value of the proceding statements. An examination of these figures shows that the lowest average yield in the three decennial periods is as follows, the same classification being maintained :—

Minimum average yield of gold per ton (2,000 llbs.) of quartz crushed.

	Oz.	Dwts.	Grs.
Tangier	—	6	22
Wine Harbor	—	6	18
Sherbrooke	—	7	9
Stormont	—	6	6
Renfrew	—	6	3
Oldham	—	10	21
Waverley	—	4	18
Montague	1	—	7
Caribou	—	9	13
Uniacke	—	6	—
Other Districts	—	5	5
And a general minimum average of...	—	8	4

This inquiry may now enter on that stage of the investigation which bears on the other side, *i. e.*, the cost of getting. It is shown in the proceding statements what has been the yield of gold, and it has been mentioned that during the first period of ten years, it was generally admitted that 10 dwts. of gold to the ton of quartz crushed, paid. Attention has been drawn to the inadequate means of extracting and treating the gold; and, in most cases, to a general want of skill in those conducting the operations. It will not be out of place now to adduce some evidence regarding the cost of production in order to place the yield given in the statements at its fair value.

The circumstances of size of lode and its envelop, and the character of the quartz as regards the manner in which the gold is contained therein, have doubtless their corresponding variation in the cost of mining and treating; but as these circumstances prevail more or less in all gold mining localities, it may be permitted to refer to cost of production without special reference to conditions of position.

The writer is unable to give detailed figures in this connection from personal knowledge, and he quotes therefore from published statements which bear the stamp of authority.

One of the earliest references in this connection is made in the Chief Commissioner's report for the year 1869, in which it is stated that a lode at Laurencetown that yielded 16 dwts. per ton, was raised and crushed at a cost of $4.

In other official reports it is stated that one lode at Tangier of mixed quartz and slate could be raised and crushed at a cost of $2.50 per ton; and in another case, a yield of gold of 4½ dwts. "will pay all expenses," (*a*). In another locality the cost is placed at from 8 to 12 dwts. (*b*). These quotations refer chiefly to the first decennial period.

Inasmuch as there is considerable resemblance in all gold mining countries, it cannot be considered unfair to contrast the preceding, statements of cost, due consideration being given to difference in cost of labor, materials, etc., with figures supplied

(a.) Hind's Report on Uniacke, Renfrew and Oldham, 1872, pp. 53-56.
(b.) Hind's Sherbrooke Report, p. 58.

from like sources as have been mentioned, of the cost in other gold fields.

It is stated in the case of two gold mines in Australia, with reference to the cost, as it may be inferred from the payable yield of gold, that at one of them 2 dwts. 21 grs. per ton proved sufficient to pay the proprietors ten per cent.; and at the other the average yield in 1870 was only 4 dwts. 20¾ grs., in connection with which it is remarked that the quantity of gold lost in the early stage of gold mining in Nova Scotia "sufficed," in Australia, "under careful management to give a fair profit to the adventurer." (*c*). And it is added: "These results are due to the practical and intelligent application of the lessons taught by experience; and if this experience is utilized and as intelligently applied in Canada as it has been in Australia, there is no reason why equally satisfactory results should not be achieved."

Further quotations in this connection would but show an equally striking contrast as regards the yield of gold in other countries, which has more than met the cost of production.

There has now been placed before you such a representation of the circumstances of yield of gold and comparative cost of mining and treating as the writer has been able to abstract from authentic records, as regards the yield, and, as he believes, from very reliable sources of information as regards the cost of production. It remains to assert the conclusion to which the inquiry has led. What are the facts that have been adduced? Do they or not permit a positive answer to the query stated at the beginning of this paper, viz., "Is Gold Mining in Nova Scotia worth carrying on?" In every locality in which gold mining has been carried on in Nova Scotia the average yield of gold has been from a minimum of —oz., 8 dwts., 4 grs. to a general average of —oz., 15 dwts., .07 grs. over the extent of country in which the various localities are situated; the area of auriferous rocks covering this extent being estimated as probably over 3000 square miles.

A large field of inquiry is open for tillage in connection with the auriferous rocks of Nova Scotia; numerous very interesting and important features are worthy of study and development, but, as has been stated, it was not the writer's intention to treat

(c.) Selwyn's Report on Gold Fields of Nova Scotia, Geological Survey of Canada, 1870-71, p. 281.

the subject from that point of view. No reference has been made to the number and variety of composition of the lodes in the respective localities, no suggestions have been made respecting the pay streaks and their probably profitable extension downward, no speculative ideas have been ventured with regard to the alluvial auriferous deposits that may exist of which a very competent authority has recorded his opinion that at several localities there appeared "all the conditions required for the occurence of rich alluvial diggings. (*d.*)

Enough, has, it is hoped, been advanced to warrant the assertion that gold mining in Nova Scotia is destined to be an expanding and remunerative industry. The application of higher scientific and mechanical knowledge cannot fail to bring its own reward, and over the seemingly scattered localities, that are at present but the indices of extent of auriferous rocks it may be confidently anticipated that the joint efforts of the enlightened capitalist and the skilled operator will ere long thoroughly establish, as one of the permanent industries, this branch of the valuable mineral resources of Nova Scotia. The writer in conclusion desires to express the very earnest hope and belief that the Mining Society of Nova Scotia will be the means of contributing very materially to the association above referred to.

DISCUSSION.

On the conclusion of the reading of the last named paper, the Chairman said he considered it the most debatable paper of the evening, and called upon Dr. Gilpin to say a few words in regard to the condition of gold mining in Nova Scotia.

DR. GILPIN—Unfortunately, I did not hear all of Mr. Rutherford's paper. There is one point, however, regarding the question of averages to which I would like to draw the attention of the Society and those here interested in the matter, and that is: That the annual average for any particular district may be misleading. For while it may be fairly true for the whole

(d.) Selwyn, ante. p. 16.

province, in a given district a small amount of quartz crushed may yield a very large average, and upon the following year a large amount of quartz may be crushed and give a very small yield. Consequently, the average for that district for a number of years is vitiated. Mr. Rutherford spoke of the yield as being from a maximum of eight pennyweights and upwards. I would only remark that there are a great many gold miners I know of who would be very pleased to have eight pennyweights as a maximum, and go a great deal below that point. In my opinion, the statistics show that the prospect of an increased output from the small rich leads is not very encouraging. In the future the greatest returns must be sought for in the mining and milling of low grade ores and by paying greater attention to the tailings.

THE CHAIRMAN—The paper which Mr. Rutherford has just read, possesses, as I have already remarked, perhaps more debatable points than any other which has been presented this evening. It is too late to permit of a lengthy and detailed discussion, but I would like to call attention to one or two points the discussion of which could be elaborated at a future meeting. The first point has reference to the statement that the early milling was crude and that probably 30 per cent. of the gold in the quartz was lost. In the course of ten years' experience, I have never found a dump of tailings that it would pay to work over, nor which probably contained 30 per cent. of the original value of the quartz. I think this statement of the large early loss of gold should be stamped out, as it would lead to the influx of patent process men who guarantee to take out 100 per cent. of the assay value. The gold ores of Nova Scotia are of such an easy free-milling character, that even with the crude appliances of 30 years ago, it would have been impossible to lose so large a percentage unless in the sulphurets ; and my experience has been that the sulphurets in most of the veins are of too low grade a nature even when concentrated to be payable. The average value of the concentrates or clean sulphurets in Renfrew, Cariboo, Chęzzetcook, Beaver Dam and Waverley, that have come under my notice would not exceed $20 per ton ; and with the prices of chemicals at present ruling in Nova Scotia this grade could not be profitably worked. Another point, and one which I would mention with hearty endorsation, is the reference to the

personal report of the Chief Commissioner in early Mines Reports. The position of the Chief Commissioner permits a reference to many points which could not be individualized in the tables of the reports and to suggestions and criticisms which I am sure have due weight among the miners.

DISCUSSION.

[Halifax Meeting, November, 1894.]

THE CHAIRMAN.—I have been told by one or two members to day, that they would like to say something about this paper.

MR. ANDREWS.—One of the points raised was a comparison between the profits in mining in high and low ores. In my district of Stormont the returns given in this paper for the period of from 1862 to 1871 for the average yield of gold per ton of quartz was 1 oz. 6 dwts. and 12 grs.; from 1871 to 1881, 1 oz. 5 dwts. 4 grs.; from 1881 to 1891, 1 oz. 7 dwts. and 15 grs. He also added an aggregate statement showing the average yield over the entire period of 30 years in each locality. This statement makes the average for Stormont 1 oz. 6 dwts. and 10 grs. Underneath his first quotation of the first ten years he makes the average yield from all localities, 1 oz. 1 dwt. and 14 grs., but continues to say, "now this must surely be considered a very remunerative yield, and it calls for special attention in connection with the remarks that occur in the reports of the Commissioner of Mines on the varying energy with which mining was carried on, &c., &c." I take exception to that. In my district the mines operated since 1891 have been low grade, from 5 to 9 dwt, yet to my own knowledge there has been more money made in mining these low grade ores, than there was in all these years when the high grade ores were being mined. Later on he says: "One of the earliest references in this connection is made in the Chief Commissioner's report for the year 1869 in which it is stated that a lode at Lawrencetown that yielded 16 dwts. per ton was raised and crushed at a cost of $4.00.

"In other official reports it is stated that one lode at Tangier of mixed quartz and slate could be raised and crushed at a cost of $2. 50 per ton." It does not state that it was ever raised for this sum. "And in another case a yield of gold of 4½ dwts. will pay all expenses. In another locality the cost is placed at from. 8 to 12 dwts." Then I see he goes outside of the province. "It is stated in the case of two gold mines in Australia, with reference to the cost, as it may be inferred from the payable yield of gold, that at one of these, 2 dwts. 21 grs. per ton proved sufficient to pay the proprietors ten per cent., and at the other the average yield in 1870 was only 4 dwts. 20¾ grs., in connection with which it is remarked that the quantity of gold lost in the early stages of gold mining in Nova Scotia sufficed in Australia under careful management to give a fair profit to the adventurer." I find in going over some figures to-night we at our own place have done better than that. Since the 9th of August to the first of this month we have paid out $5,504.00 for mining, carrying to mill crushing and placing the gold in the market at Halifax. We have milled 2,372 tons, which make the actual cost delivered in $2.27 per ton.

MR. POOLE.—Does that include office expenses?

MR. ANDREWS.—Yes. It does not include anything for the falling off in value of the machinery.

THE CHAIRMAN.—What was the size of the vein mined during that time?

MR. ANDREWS.—The narrowest part of the vein was seven to nine feet and it runs up to twenty feet. Average seventeen feet. Nine tenths of everything mined was sent to the mill. It was 120 to 125 feet below the surface.

THE CHAIRMAN.—I made some remarks at the time Mr. Rutherford read his paper. Mr. Andrews' statement shows a most promising outlook for the gold mining industry of Nova Scotia at the present time. Mr. Andrews is not the only man who has succeeded in mining low grade ores successfully. There are two or three others in the province, among them the Antigonish mine at Country Harbour. I have one case in mind where the quartz vein is only twelve inches and after allowing for mining, milling, insurance, taxes and 12 per cent. for depreciation the cost is less than $3. Up to the period at which he

has confined his figures that statement at the head of the paper might be open to discussion, but in view of the figures given by Mr. Andrews the answer must be "Yes, it is worth the candle."

I am sorry that Dr. Gilpin is not here. He would bear me out in saying that he has not based his reasoning thoroughly on facts. There are several gentlemen who would say that the figures given by Mr. Rutherford are not conclusive. It is open to assail his argument because his premises are assailable. His criticism regarding the tailings is entirely wrong in my opinion I heard I would be hauled over the coals for what I said as to the value of the sulphurets. I stated that in five districts in my experience the value of these sulphurets would not exceed $20 per ton. I have only tested the tailings in one property in Cariboo. I would like to have additional information thrown on this subject.

MR. STUART.—What depth was this twelve inch vein?

THE CHAIRMAN.—Average depth 300 feet levels. The stopeing was done by hand, drift by air drills. The cost of driving the levels ahead each month is included.

MR. STUART—I would like to ask Mr. Andrews whether his mining was by hand or power drills?

MR. ANDREWS—Hand drills were used in my case..

MR. MASON.—I have seen palpable gold in some tailings. It is impossible to strike an average in tailings. Some of them have run two to three dwts. to the ton.

THE CHAIRMAN.—A point I desire to criticise in Mr. Rutherford's paper is about the thirty per cent. waste. It is a very old story that every year we have from one to twelve men coming into this province who have just the machine to take more gold out of the tailings than nature put in them. If you take Mr. Rutherford's figures of eight dwts. obtained by milling you must assume 33 per cent. to have been lost.

The experience has been that there is no accumulation of tailings which will give $4 to the ton. The average value of his gold is given at 15 dwts. That would make the average value of tailings 7½ dwts. That ought to prevent the patent process man coming in here.

MR. WILLIS.—I was at Oxford three years and I made assays on every mill-run made in that time. The samples were

taken every day once an hour. I tested these tailings in all sorts of ways. I used to concentrate. They gave from two to three per cent. in concentrates. These concentrates were worth seven to eight dollars.

THE CHAIRMAN.—In Oldham the sulphuret assay in bulk averaged about $75 per ton. At the same time in Waverley the average of the sulphurets was about $8 per ton.

Silver Mines of West Kootenay, B. C.

By E. D. Ingall, M. E., Chief of Mining Statistics, Ottawa.

(Read at the Sydney Meeting, July, 1894.)

Until a comparatively recent period the mineral production of the Province of British Columbia was almost entirely confined to coal and gold the latter chiefly obtained by washing the shallow auriferous gravels distributed widely throughout the province.

The discovery and working of veins yielding silver ores was all, with the exception of a few scattering discoveries, subsequent to 1880.

It is not the intention, in this paper, to go into any details as to the history of the silver mines of the province which are so admirably dealt with in the report of Dr. G. M. Dawson on the Mineral Wealth of British Columbia, issued with the Annual Report of the Geological Survey for 1887.

A few items may, however, not be amiss as prefacing the more immediate subject of this paper, viz: the more newly discovered silver veins of the West Kootenay District.

According to Dr. Dawson the largest deposit of galena now known as the Blue Bell Mine and situated on the east shore of Kootenay Lake was discovered as early as 1825 by the botanist Douglas and amongst the earlier discoveries of this class of ores is that in the Coast Range of Mountains at Hope on the Fraser River in 1871. The ore discovered there was described as "argentiferous grey copper" containing lead, copper, antimony and iron.

In 1882 a number of claims were located on discoveries at Stump Lake in Yale District, of veins, carrying ores rich in gold and silver, and from that date to 1889 various camps came into greater or less prominence in that district and in those of East and West Kootenay constituting together the S. E. corner of the Province.

At the time of the writing of Dr. Dawson's report in 1888, argentiferous ores had been reported also from various points in the Northern districts; in Cariboo, Omenica, Cassiar and further north in the Yukon country but none of these have come into any prominence so far, doubtless on account of the numerous drawbacks due to lack of good communications with the outer world.

Before passing then to the subject proper of this paper, it may be well to point out on the map here, the various other districts in the province where veins carrying argentiferous ores have been found and more or less worked.

It is noticeable that at most of these points the ores are mixed carrying much copper sulphurets and are often antimonial and arsenical, differing in this respect from the prevalent ore of the Ainsworth, Hendryx, Slocan and Illecillewaet districts where argentiferous galenas and the products of their decomposition take precedence over all others.

The points to which it is desired to draw special attention in this paper, are the results of studies made by the writer in 1892 when in British Columbia for the Geological Survey.

The time at disposal allowed only of the study of the Illecillewaet, Ainsworth and Slocan. sub-districts of West Kootenay where, however, a large number of claims were visited and examined with a view to getting the general features of the veins.

Illecillewaet — Beginning then with the district tributary to Illecillewaet on the Canadian Pacific Railway we have within a radius of from 5 to 10 miles, a number of claims upon which more or less work has been done, among which are the Lanark and Maple Leaf, with the Isabella, the Jumbo, the Sanquhar, the Cariboo and others all lying north of the C. P. Railway station and all within five miles of it.

Some eight miles north-east of the same place lie the Gold Hill and Copper Hill groups of claims whilst about ten miles south-east from the headquarters of the district at Illecillewaet lie the Fish River group among which are the Dunvegan, Elizabeth, Edinboro and Fishburn's claims. These are reached by a trail of some fifteen miles in length passing over the divide between

the waters tributary to the Illecillewaet River and those of the Fish River which runs southerly into the north-west arm of the Upper Arrow Lake.

All the above mentioned groups excepting those of Gold Hill and Copper Mountain are staked out on fissure veins which cut a formation consisting of shale rocks generally dark in color and often quite black and carrying a large percentage of carbonaceous matter. These are accompanied by grey bands of a calcareous nature and often of considerable width whilst in many places throughout the district the presence of intrusive igneous rocks is evidenced by tongues and dykes of the same cutting the sedimentary rocks and a little east of the Fish River group the main body of one of these intrusive areas is reached.

The enclosing rocks of the Gold Hill and Copper Mountain groups are in general chloritic and talcose schists, with intercolated calcareous belts which, however, are distinctly different in appearance from those of the last mentioned, effecting rather a greenish grey hue with a somewhat rusty weathered surface. The schistose rocks of the series are generally greenish and yellowish grey, so that the general color of this formation contrasts plainly with the darker greys and blacks of the last mentioned.

In the first mentioned or black shale series, the ores are mostly galena, or galena and zincblende mixed, whilst in the schistose formation galena veins are found, but others have also been located carrying rich copper sulphurets assaying well in silver, and said also to carry some gold. At Copper Hill, for instance, is a vein cutting the schists and carrying copper glance and yellow sulphuret in a gangue which is sometimes white translucent quarts, and sometimes seems to be ferruginous dolorite. The ore is said to assay 61% copper, and $20 gold and $8 silver. All the rocks of the district as might be expected in a mountain range, are folded and contorted, and the detail of their distribution would take a long time to work out.

The veins cutting the black shale series, shew very similar characteristics to those described later as occurring in the Slocan district. They carry galena as the chief ore in ribs and masses,

in a gangue which is generally ferruginous. At places much zinc blende is intermixed, especially where larger bodies of ore occur in connection with the *lime belts.*

Some few veins have been located in which the gangue is quartz with galena and pyrites disseminated ; ore in pockets in the vein.

The detailed description of the Slocan district following, serves equally well for this district.

Passing south we come to the well-known Slocan camps, the position and details of which are well shewn on the map.

Late in the fall of 1891, a party of discouraged prospectors were making their way over the mountains towards Ainsworth, and being very short of provisions, were making the best time possible, when, in descending a gully to the east fork of Carpenter Creek, which runs into Slocan Lake, they lighted upon an extensive outcroping of ore. Without loss of time, claims were staked out and specimens secured which, when assayed, gave such encouraging returns as to cause a rush to the district in the following spring, and the consequent discovery of a large number of rich veins, covering an area about ten miles by seventeen, along the valley of the Kaslo river and between its headwaters at Bear Lake and the east shore of Slocan Lake. The rocks of this district present the same general features as those in the vicinity of Illecillewaet.

The bulk of the claims of the district have been staked out on veins cutting rocks of the black, shale series with their associated calcareous bands. They show the same variations in character, being soft and highly graphitic at places, and harder and more compact at others, generally from the proximity of intrusive igneous rocks and are thus often highly altered. showing chistolite, etc. These intrusive rocks are found throughout the district, showing as dykes of various thicknesses. They are light in color, with a preponderance of the acidic mineral constituents, orthoclase felspar and quartz constituting, as a rule, the bulk of their substance. This association of rocks in general, occupy the southern side of the valley of the Kaslo River, and extend some miles to

the south, where they are said to abut on a large area of granite.

On the north side of the valley of the same river, the schistose series of rocks is largely developed, being in many places serpentinous. In this series of rocks a number of veins have been located. They show as fissures varying in thickness from a few inches to two or three feet, carrying the ore which is galena in solid ribs. These ore ribs are generally imbedded in a soft ochery gangue, sometimes of a pasty consistency. The thickness of the ribs varies from a few inches up to a foot or two. Occasionally the walls of the fissure are lined with quartz crystals and the enclosing rock is rusted some few inches in from the walls of the vein.

Veins of solid quartz also occur occasionally, but those seen carried very little mineral. The veins in this schistose series of rocks are apt to be free from some of the irregularities occasionally shown by those in the black shale series. The veins in the shale series present similar features to those already described, as occurring in the same series in the Illecillewaet district. Whilst they frequently run for long distances with the formation, they are also constantly found cutting across it.

Where a vein is found cutting across, or in the proximity of one of the calcareous bands previously mentioned, they are apt to show some interesting features, widening out or forming large pockets of ore in connection with the vein. Some of the big shows of the district have been of this nature and have proved very disappointing, their pockety nature being shown on development. When, however, the parent vein has been located, it has been found to be persistant, which will be found to be true for most of the fissures proper. Where they cut the slates, the veins at places show a considerable width of brecciated vein stone, angular pieces of the enclosing rock being cemented together by quartz and other gangue and ore minerals. The commonest occurence, however, is to find veins of from a few inches to two or three feet in width, carrying galena in solid ribs, nuggets, and boulders in a rusty ochreous and sometimes clayey filling.

The galena varies in grain, from large cube down to that with a fine steely fracture as shewn by these specimens. It is sometimes enriched by the presence of ruby silver and the richer silver minerals scattered through it. What is known as "Carbonated" ore occurs with the galena, but this is not really carbonate of lead, as one might suppose, but is the ochreous gangue material in which the silver occurs disseminated in the metallic or native condition and in the condition of the richer silver minerals, with doubtless some carbonate of lead. The whole probably results from the decomposition of the gangue and of the silver-bearing galena of the vein.

Other minerals are associated with the galena in places and in varying quantities. Of these, zinc-blende is the most prominent ; iron pyrites occurring in fair quantity, and other metallic minerals being only occaional.

The pure galena in solid ribs seems to effect more particularly the narrower veins, cutting the shales, whereas the big developments in the calcareous parts carry generally a large proportion of zinc blende which lessons their value, this mineral being objected to by the smelters, when its percentage is large. Another class of the veins found, show various rich arsenical and antimonial silver minerals in a gangue composed principally of quartz.

Development work on these veins has in a number of cases opened up most promising exposures of ore. In one case a tunnel was seen on a new prospect where for all its length about 75 feet, it was estimated that the ground broken had been from 50 to 60 per cent. pure galena assaying 125 ounces to the ton. Or again, at another place, a prospect pit was seen showing a 2 foot rib of absolutely pure steel galena with ruby silver, the ore assaying 860 ounces to the ton. When one sees such exposures of ore as these, at a number of places in the district as the result of merely preliminary development work by the prospectors themselves, and taking into account the many other veins found in the district, having good, if not quite so extensive, shows of ore, one cannot help feeling that the district has a very hopeful future before it.

These ores are rich in silver as shown by the results of some 50 essays made in the chemical branch of the Geological Survey, of specimens of galena collected by myself which run from 50 ounces to 360 ounces, the majority from the black shale series in the Slocan district averaging perhaps 100 to 125 ounces per ton. Some specimens of so-called "carbonate" gave little or no silver, whilst two specimens of this class of ore from different claims gave 700 ounces and 1630 ounces, respectively. The galena from the veins on the schistose formation seems to average lower in silver than that occurring in the shale formation.

The other districts of West Kootenay now prominent in respect of their silver ores are Ainsworth, Hendryx and Toad Mountain districts, all of which have been well described by Dr. G. M. Dawson, of the Survey, in his report of West Kootenay. The ores of the latter district, however, are more mixed, copper and the richest silver minerals occuring with the galena. They also carry a little gold. Other camps which have come into prominent notice of late are those of Goat River and Trail Creek.

Three smelters have been erected in the district, one at Golden, one at Revelstoke (now washed away by the flood,) and one at Pilot Bay on Kootenay Lake. The latter however, has not been completed owing to some disagreement among the capitalists concerned.

The two former works consisted each of a single water jacket furnace with roaster and appurtenances, but the Pilot Bay works have been projected upon a more extensive scale. The plan includes:—

Concentrator Building	85 x 100
Sampling Works	100 x 108
Roaster	100 x 170
Smelter	58 x 98
Refinery	120 x 245
Assay Office	20 x 80
Boiler House	40 x 48
Blacksmith Shop	20 x 40
Machine Shop	20 x 40
Office	30 x 45
Boarding House	25 x 60

As none of these works have so far been running all the ore produced has been shipped to smelters in the United States at Tacoma and San Francisco.

Pack trail traverse the country and some few wagon roads connect the chief camps with steamer navigation on the lakes and rivers, whereby connection can be made with the Canadian Pacific Railway and the American railway to the south, whilst other projected connecting railways now being built will give a still better chance of success.

To a certain extent the mines are waiting the completion of these better means of communication, which are rendered the more necessary by the present low price of silver, but nothwithstanding this discouraging feature and the existing commercial depression, the amount of discovery and development work prosecuted has been quite considerable, and we can, I think, still feel very hopeful for the future of silver mining in British Columbia.