

Robert Bell

THE JOURNAL
OF THE
Ontario Mining Institute

BEING THE
Proceedings for the Years 1894-5.



VOLUME I.

Edited by the Secretary.

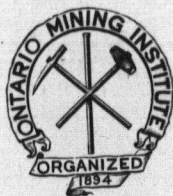
PUBLISHED
AT THE OFFICE OF THE INSTITUTE,
SLATER BUILDING,
OTTAWA, CANADA.

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Mr. Jas. Conmee, M.P.P., Port Arthur,
President, 1894-96.

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PROCEEDINGS
OF THE
ONTARIO MINING INSTITUTE
FOR THE
YEARS 1894-1895.
SPECIAL MEETING.

TORONTO.

TENTH APRIL, 1894.

Convened at the Rossin House at three o'clock in the afternoon.
Mr. James Conmee, M.P.P., Port Arthur in the chair; Mr. G. R. Jones, acting Secretary.

Mr. B. T. A. BELL, Ottawa, being called upon, explained what had been accomplished by mining organization in the Provinces of Quebec and Nova Scotia, and urged the desirability of such an association in Ontario.

THE CHAIRMAN invited those who were desirous of joining such an organization to sign the roll of membership.

The following were enrolled:

Prof. Nicol, School of Mines, Kingston.	R. H. Ahn, Toronto
Prof. Miller, School of Mines, Kingston	John McKellar, Fort William
A. Blue, Director of Mines, Toronto	Peter McKellar, Fort William
T. W. Gibson, Bureau of Mines, Toronto	Thomas Marks, Port Arthur
W. Hamilton Merritt, A.R.S.M., "	Edgar J. Jarvis, Toronto
B. T. A. Bell, Canadian Mining Review, Ottawa.	Dr. Coleman, School of Practical Science, Toronto
G. A. Spotswood, M.E., Kingston	B. J. Townsend, Toronto
Folger Bros., Kingston	J. W. Brown, Toronto
J. B. Carruthers, Kingston	J. F. Latimer, Toronto
J. M. Machar, Kingston	W. T. Newman, Toronto

Arthur,

Ontario Mining Institute.

J. Bawden, Kingston
 T. Birkett, Kingston
 W. A. Allan, Ottawa
 James Connée, M.P.P., Port Arthur
 J. M. Clark, Toronto
 Thos. Shortiss, Toronto
 L. A. Morrison, Toronto
 D. F. Burke, Port Arthur
 Ian Cameron, M.E., Sudbury

Edward Faye, Toronto
 E. S. Townsend, Toronto
 J. T. Laidlaw, Toronto
 M. J. Paterson, Webbwood
 T. D. Ledyard, Toronto
 F. A. Fenton, Toronto
 George T. Marks, Port Arthur
 J. J. Kingsmill, Toronto
 R. W. Prittie, Toronto,

And about half a dozen others.

ELECTION OF OFFICERS.

It having been resolved that the organization should be named the Ontario Mining Institute, and a Constitution and By-Laws having been drawn up, the following were elected officers for the ensuing year:—

President:

JAMES CONNÉE, M.P.P., Port Arthur.

Vice-Presidents:

J. J. Kingsmill, Q.C., Toronto, Archibald Blue, Toronto,
 Prof. W. L. Goodwin, Kingston, W. Hamilton Merritt, A.R.S.M., Toronto.

Treasurer:

T. W. Gibson, Toronto.

Secretary:

B. T. A. Bell, Ottawa.

Council:

Prof. Coleman, Toronto, Peter McKellar, F.G.S.A., Fort William,
 Prof. Nicol, Kingston, J. M. Clark, Toronto,
 William Young, Rat Portage, Ian Cameron, Sudbury,
 T. D. Ledyard, Toronto, A. W. Carscallen, M.P., Marmora,
 Dr. Ames, Toronto.

AMENDMENT TO THE ONTARIO COMPANIES ACT.

The following resolution, moved by J. M. Clarke, seconded by J. J. Kingsmill, Q.C., was adopted:—

"Resolved, That in the opinion of this Institute, an Act should be passed at the present session of the Ontario Legislature placing beyond doubt the power of joint stock companies to issue shares at a discount, the present uncertainty on this point being especially detrimental to the mining industry."

MOTION TO INCORPORATE.

It was moved by Judge Kingsmill, seconded by Mr. Marks, and resolved: "That the Council be directed to consider the question of incorporation, and they are hereby authorized to apply therefor, if after consultation it is thought desirable."

A MINING JOINT STOCK COMPANIES ACT.

It was resolved on motion of Mr. D. F. Burk, Port Arthur, seconded by Mr. T. D. Ledyard: "That a committee comprising Messrs. Conmee, Kingsmill and Marks, together with the mover and seconder, be and are hereby appointed to wait upon the Ontario Government forthwith and ask that a Mining Joint Stock Companies Act be passed, providing that the only penalty attached to the non-payment of calls upon mining stock be the forfeiting of the amounts already paid upon their stock."

MINERAL EXHIBITS AT INTERNATIONAL FAIRS.

Moved by Mr. L. A. Morrison, Toronto, seconded by Mr. John McKellar, Fort William: "That it is the opinion of this Institute that the mineral interests of Canada should be represented at all the great international exhibitions by one who is scientifically and practically acquainted with the great mineral resources of this Dominion."—Carried.

GOVERNMENT AID TO IRON AND STEEL PRODUCTION IN ONTARIO.

On motion of Mr. W. Hamilton Merritt, seconded by Mr. T. Shortiss, the following resolution was adopted: "That it would be in the best interests of the Province were the development of the natural mineral resources substantially assisted by the Provincial Government, particularly in the case of pig iron and steel produced in Ontario, and that also the manufacture of steel rails and nickel-steel in Canada be practically assisted by the Dominion and Provincial Governments."

AID TO METALLURGICAL TREATMENT OF GOLD ORES.

The next resolution introduced occasioned a long and animated discussion, in which nearly all present took part. Here is the resolution:

Moved by Messrs. Latimer and Cooper, "That it would be desirable for the Provincial Government to encourage the development of the refractory gold ores in Ontario, and with this in view to give a prize of not less than \$10,000 for the best process of extracting gold from refrac-

tory ores—that is to say, the process that will produce the largest amount of gold from a specified quantity of ore at a minimum cost and on such a scale as to be a commercial success.”

Mr. B. T. A. BELL vigorously opposed the passing of this resolution, saying that the Institute should not, at its first meeting, commence by asking the Government to bonus the mining industries of the country—and the resolution meant nothing else. He claimed that what the Government should do is to compel those holding mining lands to open them up and work them.

PROF. COLEMAN also opposed the resolution, stating that whoever did discover a better method of treating refractory ores would have his reward from the whole world, provided he patented his method.

MR. CONMEE supported the motion, thinking that everything possible should be done to encourage the industry.

After a discussion lasting for about an hour the motion was lost.

It was decided to hold the next meeting in Toronto during Exhibition week, in September.

After a vote of thanks to the Chairman and acting Secretary and to Mr. Bell, the meeting adjourned.

DEPUTATION TO THE PREMIER.

On Wednesday afternoon, 11th April, a deputation from the Institute was favored with an interview with Sir Oliver Mowat and the Hon. A. S. Hardy, and urged an amendment to the Companies Act whereby mining companies might be permitted to issue shares at a discount; the desirability of aid to the proposed metallurgical laboratory in connection with the Mining School at Kingston was also advocated.

Sir Oliver Mowat promised that the Government would give these matters consideration, and the deputation withdrew.

GENERAL MEETING.

TORONTO.

12TH AND 13TH SEPTEMBER, 1894.

Convened in the Private Bills Committee Room, Parliament Buildings, Toronto, at three o'clock in the afternoon, Mr. James Connée, M.P.P., President, in the chair.

THE SECRETARY having read the minutes of previous meetings, the following were elected members :

ELECTION OF MEMBERS.

R. W. Leonard, C.E., Kingston,	James Pearson, Toronto,
F. Hille, M.E., Port Arthur,	Dr. Burwash, Toronto,
J. N. Glidden, Sudbury,	J. H. Chewitt, B.A. Sc., Toronto,
Jas. McArthur, Sudbury,	H. L. Hime, Toronto,
J. F. Whitson, Toronto,	Alfred Willson, Toronto,
Henry Totten, Toronto,	G. B. Kirkpatrick, Toronto,
A. Slaght, Waterford,	Prof. C. Gordon Richardson, Toronto,
Fred. W. Gray, Guelph,	Aubrey White, Toronto.

REPORTS OF COUNCIL.

THE SECRETARY reported that in accordance with resolution passed at last meeting he had issued a circular letter inviting all in any way interested in mining in Ontario to become members, and that the response had been satisfactory. The membership at date was about 70.

THE TREASURER submitted a statement of the affairs of the Association, showing a balance on hand of \$40.60, with a large number of subscriptions outstanding.

MR. A. BLUE reported that the committee appointed to consider the question of a seal had approved of a design, but as Mr. Merritt, who had it, was out of town, the matter had better stand until next meeting.

THE CANADIAN MINING INSTITUTE.

MR. B. T. A. BELL—At a meeting held in Sydney, Cape Breton, on 12th July last, the Mining Society of Nova Scotia and the General Mining Association of the Province of Quebec resolved to federate into

an organization to be known as the Canadian Mining Institute. A resolution was also adopted inviting the Ontario Mining Institute to join in the federation, and asking that the President and a committee of three members be appointed to act in conjunction with a similar committee of each of the other organizations for the purpose of drafting a suitable constitution.

MR. A. BLUE—What is the object of the federation?

MR. B. T. A. BELL—Mainly the publication of a volume of Transactions, which would contain the papers read before all the societies in the organization. Such a federation would also place the mining men in a stronger position in such matters as Dominion legislation. I have therefore much pleasure in moving that the Ontario Mining Institute is in favor of a federation of existing Canadian mining associations, and that Messrs. J. J. Kingsmill, W. Hamilton Merritt, A. Blue and T. W. Gibson be a committee to confer with the representatives of the Mining Society of Nova Scotia and the General Mining Association of the Province of Quebec.

MR. J. J. KINGSMILL—Is there any association in British Columbia?

MR. B. T. A. BELL—Not yet; but I understand an endeavor is now being made by parties in Vancouver to organize.

MR. B. J. TOWNSEND—I have just returned from British Columbia. Before I left there was some talk of the formation of an association. I second the motion.

THE CHAIRMAN then put the motion, which was carried unanimously.

INCORPORATION POSTPONED.

MR. J. J. KINGSMILL submitted the following:

"The committee appointed to report upon the advisability of incorporation beg leave to report that until after the question of federation is settled it would not be expedient to incorporate."

(Sgd) J. J. KINGSMILL,
J. M. CLARKE.

This was agreed to.

MOTION TO AMEND CONSTITUTION.

MR. J. J. KINGSMILL gave notice of motion to amend Sections 6 of the Constitution and By Laws by providing for the appointment of two auditors and defining their duties.

The meeting then adjourned.

Sessions were also held on Wednesday and Thursday evenings, when the following papers were presented:—

THE NATIONALIZATION OF THE MINERAL DOMAIN
OF ONTARIO.

By MR. J. BAWDEN, Kingston, Ont.

This subject presents itself to the consideration of the people of Ontario divested of much complexity which elsewhere surrounds it, such as the dangers of interference with vested interests, of disturbance to the channels of trade or industry, and of burdens to be undertaken for the expropriation of private property.

The province is the nominal, though not the beneficial, owner of one of the most extensive mineral domains on the face of the globe, has no mining industry or trade that by any possibility can be injuriously affected by the operation of mines by a provincial department, and no vested interests belonging to individuals or to classes who may demur from such standpoint to the assumption by the Government of this new function. It is merely requisite to make the nominal an absolute ownership in order to nationalize our mining property.

It is now proposed to discuss the grounds upon which the Provincial Government have the right to operate mines. It is assumed that it is clothed with the legal right. The expediency of making this right active for the benefit of the people of today and of the centuries to come, will, it is hoped, not be disregarded by reason of any appearance of socialism it may wear, or be condemned without investigation because of any preconception as to what are the proper functions of government.

An advertisement of the Ontario Bureau of Mines published in an American periodical calls attention to the fact that the mineral domain of the province extends 100 miles in width and 1,000 miles in length. It is not stated that ninety-nine per cent. of this area is mineralogically an unknown country; that from the mines already operated hardly the mineral contents of an approximate one per cent. (1,000 square miles) of the territory can be certified. It is not stated that in proportion to the capital invested, mining has been less remunerative in Ontario than

elsewhere—in great part due to lack of scientific knowledge, in part to long winters, magnificent distances, and corresponding cost of supplies and transportation. The history of the Montreal Mining Co. is a record of the folly of selling large tracts to land jobbers, who, by a pull on the Land Department, obtained a patent right to induce the public to invest in chances—in other words to run the lottery business under the name of an investment in mineral property. Happily this state of things has been closed out. But it is to be feared that Government may be induced by sectional clamor to do indirectly what it has declined to do directly. There is no reason why a solvent and honest government should sell any property without knowledge of its value. It is a violation of the great public trust committed to it, to offer valuable mines as premiums for the mere chances of discovery. It is cheap literature from the dust-heaps of exploded political economy, to say that it is not the business of Government to discover mines. It is the duty of Government to know the most that can be practically learned of the resources entrusted to its administration, and it should, therefore, know as fully the value of a mineral range as of a timber limit, or of an area of agricultural land. Its knowledge should be intensive as well as extensive. The difference of cost in obtaining this knowledge as against the present system is no argument against the principle, that the Government of a great province like ours should not facilitate gambling in mining locations.

The operation of mines by the Government would seem to be expedient for the following reasons :—

1. That until it is undertaken there will always be pressure upon the Crown Lands Department to sell more mining land than there is an actual demand for, that is "actual" as opposed to merely "speculative" demand. The function of the Crown Land Department to survey such land and give title will be debauched, as it has been in time gone by, for the purpose of enabling speculators to take advantage of the immoral cupidity of those who are ever ready to invest in hazardous chances ; or for the purpose of enabling the buyers of such tracts to hold them against the anticipated demand, and thus rob future citizens of the equal rights they should have with citizens of today. The amount of money which has been turned from the lines of honest enterprise into this profitless channel is very great, with great consequent loss to the community.

2. It is obvious that the price of Ontario mineral land, ranging from \$2 to \$3 an acre, bears no relation whatever to its value. Where no mineral in paying quantity exists on the location, the price is grossly excessive, and the purchase is generally abandoned, with the result that it is tri-ennially sold for taxes, bought by lawyers and real estate speculators to be again sold, and it thus furnishes a fund for taxes which are never expended on its improvement. The kind of land thus alienated from the Crown domain has, by its patent, not any title to nobility conferred upon it, but on the contrary, each parcel serves the rascally purpose of a lottery ticket, for bringing to the Government or municipalities money to which these bodies have no moral right, and out of the pockets of citizens to whom the Government of the country owes the common duty of protection from fraud. On the other hand, where mineral exists in paying quantities, the low price fixed by the Crown bears no relation to the value of the property. The object of the mine owner is to get the greatest possible output with the least possible expense, and by no method can he add to the original value of the mine, except by that of inducing the public to build railroads and other facilities for improving the value of the minerals. Crown timber land is occasionally sold for ten times the price per acre of mineral land, but even this is a small price in comparison with the value of an iron mine, for example, which within an area of ten acres may turn out one million tons of iron ore, the royalty on which, at a minimum charge of 10 cents a ton, would be \$100,000.

3. Due regard for the development of the mineral wealth of Ontario requires measures for the education and prosperity of a body of skilled miners, who should have fair wages, comfortable dwellings, means of obtaining provisions and clothing at fair prices, and insurance for their families against loss of life and limb. There is nothing under the present condition of mining enterprise which calls for any expenditure on the part of the mine owner likely to benefit the locality of the mine. The hovels of miners in the vicinity of some Canadian mines are a disgrace to our so-called mining enterprise. Food supplies are generally brought in from a distance, and near-by gardening or farming meets with no encouragement. The population is migratory, and employment precarious—dependent quite as much, or more, upon the financial management of the concern as upon the supply of ore. As a consequence, mining villages as they now exist in this country, and in the United States,

furnish a strong argument for the state ownership of mines, if the welfare of the laborer is, as it should be, of more intrinsic value than the dividends of mining companies.

4. The mineral domain of this province cannot be safely given over to iron barons and silver kings, or great syndicates. The "writing on the wall" condemns all such proprietorship. If the mineral industry of the United States has ministered to the upbuilding of great fortunes, to the enrichment of men who buy American senators like hirelings, all this comes, not from the incorrigible corruption of human nature, but from a system of administration of state lands essentially corrupt and vicious.

What are a century or two in the life of a nation? If American enterprise has gained a present empirical success by the disregard of every duty owed from the legislators and administrators of today to the citizens of the future, there are not wanting those among her sons who condemn the gross breaches of trust, the shameless brazen fraud and corruption of state and federal legislatures in dealing with the public lands. It becomes those who would see planted in this country the foundations of a higher civilization and more durable progress than any existing in the United States, to investigate the all-important subject of the best system of administration of the resources of the Crown domain for the benefit of the people of this province.

5. One condition has followed the development of the iron mines of Minnesota and Wisconsin, and in some degree the exploration for minerals in Ontario, which will assuredly affect, as a growing evil, mining enterprises as now conducted in the western and northern districts in this province, and that is, the rapid destruction of the forest. The construction of the Canadian Pacific Railway was attended with no protection of the forest in the public interest, with the inevitable result of the destruction of an enormous area of timber between the Ottawa River and Rat Portage. The residue within ten miles or more of the road is for the most part of little intrinsic value save as a protection to future growth and the possible re-foresting of portions of the burnt area. This gives the small timber which the prospector and miner will destroy by the square league for every camp fire, an extraneous but not inconsiderable value. No act of greater folly could be perpetrated than to allow prospectors to roam over the silent leagues of virgin forest which yet grow like islands in many

of the rocky wastes of Thunder Bay and other districts,—each prospector necessarily the means of spreading fire far and wide, irresponsible and unwatched, unpunished for criminal negligence and tolerated as a necessary, and perhaps, welcome evil, with a degree of fatalism akin to imbecility.

Prof. Coleman's description, in recent issues of the *Globe* newspaper, of his own experience while on a survey for the Government, the recent extensive forest fires in Wisconsin and Minnesota, and the great destruction of timber which has followed "prospecting" operations in Eastern Ontario, are warnings which should not be lightly considered. It must be kept in mind that there is no measure to the calamity we incur by the neglect of safeguards against the destruction of the forest. It is neither impossible nor improbable that the Minnesota horrors of this year may be visited on this province with tenfold fury as the natural consequence of prospectors' camp fires.

6. The scientific and economical extraction of ores under Government management will afford supplies for all metallurgical industries required, or capable of being profitably maintained, in this country, and there is no doubt that ores can in many cases be profitably sold, and yet at prices which will offer bounties to the home metal manufacturer. The extensive use of lead pipe and of other manufactures of lead, afford a good market which should be supplied from native sources, but which is not likely to be so for a long time to come while pig lead cannot be purchased as cheaply here as in the United States. In view of the wide distribution of lead-bearing lodes, some also rich in silver, in various parts of the province, there is ample reason why an effort should be made to develop and mine them. The growing demand for copper for electric purposes, and the presence of the ore in various forms in the Lake Superior district are facts which, under ordinary circumstances, would concur to promote mining enterprise. We are confronted by the fact that powerful corporations control the copper market, and that there never was a time when there existed so little encouragement to the private investor to enter into copper mining enterprise as is the case today. The Provincial Government have it in their power to enter into such enterprises with an entire freedom from risks and expenses from which no individual investor is safe. The cost of promoting companies and raising the capital required is usually one-third, or 33 per cent. The in-

dividual is never safe against the misrepresentation of promoters, whereas, the Government can employ permanently the most careful experts and competent engineers, and in their permanent employment secure a guarantee of fidelity. The Government will have in its domain the most ample choice of location and the uttermost exemption from the influence of self-interest in its operations, and may under these favorable conditions put copper, lead and other ores into the market at prices which will ensure the establishment of great metallurgical industries in this province. Last session, \$25,000 a year for five years was voted to enable the iron smelter to get his ore as cheap as in the United States. This money is as likely to go into the pockets of speculators as into those of the mine owner or smelter. It would keep 25 men employed the year round at the iron mines in Thunder Bay district, and a similar number in Frontenac or Hastings, whose output should be 25,000 tons of ore, or the entire amount of the bounty. Now if the Government could sell a good 50 per cent. ore at \$1 a ton, no better aid could be offered to those who would engage in smelting enterprise.

7. The acquisition of a large yearly revenue, by the development and operation of silver, and especially of gold mines, becomes a necessity in the presence of the ever recurring and justifiable demands upon the Government for money for works of permanent utility, and for our rapidly growing educational requirements. Their operation by individuals or corporations will bring in no such results. In fact it is quite possible and extremely probable that mining companies will, under the present state of things, be organized to work frontier properties whose royalties and other returns will scarce pay the expense of collection together with the necessary provincial expenses, whose machinery will be brought in duty free, whose agricultural supplies will necessarily be brought in from the United States, whose laborers will be chiefly foreigners, whose earnings and savings will benefit the United States alone, where the enriched mine owners will also spend their dividends. With more or less modification, this is likely to be the case with the greater part of the gold mining property in the Rainy River and Thunder Bay districts. I am well aware there are doctrinaires and professors, as well as brokers and commission agents, who will tell us that this state of things will enrich the country and that to hinder it will violate the principles of political economy.

The following draft of a bill for the establishment of a Department of Mines, and with various provisions respecting the management of public mines, as presented as suggestive merely, and not by any means as comprehensive of all the legislation required by the policy proposed :—

BILL.

An Act to establish a Department of Mines for the administration and management of the mineral property of the province.

Her Majesty by and with the consent of the Legislature of the Province of Ontario enacts as follows :

CLAUSES RELATING TO THE DEPARTMENT OF MINES.

1. No lease or sale shall hereafter be made of any mining location or of the right to mine in the public lands.

2. There shall be a Department of Mines under the control of the Commissioner of Mines, who shall be a member of the executive council of Ontario.

3. The Department of Mines shall be composed of the said commissioner and an advisory board of four mining engineers with a financial director, whose duty shall be to employ competent surveyors, explorers, mining captains and workmen for the public mines ; to direct where such mines shall be opened and worked ; to purchase machinery, mining equipment, supplies for miners, erect buildings, and engage in every undertaking requisite for the successful working of any mine ; to operate diamond drills for exploratory purposes ; to conduct any works for the dressing and concentration of ores, and for the reduction of gold and silver, and to sell such ores other than those of gold and silver at such prices as may be fixed by the Lieutenant-Governor in Council.

4. The sale of gold and silver bullion shall be made during the session of parliament upon the report of the commissioner of mines as to the value thereof.

5. The Department shall erect and manage such works for milling, roasting, concentrating, and otherwise treating and smelting gold and silver ores as may be found expedient, having regard in such erection to facilities for private mining undertakings on such terms as may be just.

6. The mining engineers who shall with a financial director compose the said advisory board, shall be appointed by the Lieutenant-

Governor in Council after investigation as to their fitness and special experience, and one such mining engineer shall be appointed to the charge of the following four divisions of mining operations respectively, viz.: Gold mines, silver and lead mines, copper and nickel mines, iron mines.

7. There shall be borrowed on the credit of the province the sum of one million of dollars, which shall with any premium thereon constitute the Ontario mining fund, the repayment of which with interest shall be a charge upon the profits from the provincial mines, to be paid in such manner and at such times as may be ordered by the Lieutenant-Governor in Council.

8. The management and investment of said fund, payments therefrom for all mining works, salaries and wages, and the disposal of accretions from sales and profits shall be under the charge of the financial director of the department, but subject to the control of the commissioner and the engineering members of the advisory board. And the financial director shall prepare a yearly statement of the condition of the mining fund and of the receipts and expenditures of the department for submission to the legislature with the report of the commissioner.

9. Rules for the order of business in the Department of Mines, for the management of expenditures and for the audit of accounts, shall be submitted for the approval of the Lieutenant-Governor in Council, and on such approval shall have the force of statutory enactment.

10. Two per cent. of the mining fund shall be set apart as a reserve for the insurance of miners and workmen while engaged in provincial mines against loss of life, illness or bodily injury, and every miner and workman shall pay out of his wages such weekly percentage as may be found requisite for securing to the family of such miner or workman insurance in case of death, illness or accident.

11. The Department may accept the surrender to the Crown of any land heretofore sold as mineral land on repayment by the Crown of the purchase money paid therefor with cost of survey, and may purchase any mining locations at tax sale. But the expenditure under this provision shall not exceed the sum of \$50,000 yearly.

CLAUSES RELATING TO THE MANAGEMENT OF PROVINCIAL MINES.

12. No quantity in excess of 50,000 tons of iron ore shall be exported in any year, and iron mining operations shall be so conducted

that not more than two years' consumption for the furnaces of Ontario and Quebec shall be kept in stock.

13. No miner who is not a literate person, an adult, a subject of Her Majesty by birth or naturalization, and a resident of Ontario for one year preceding his engagement shall be employed in any of the public mines, but this shall not apply to Indians belonging to any reservation in the province. No youth under 16 years of age shall be employed at any work under or above ground.

14. Miners, while engaged in the public mines, their wives and families, shall be afforded the means of procuring groceries, provisions and necessary clothing at an advance of $2\frac{1}{2}$ per cent. on the cost thereof laid down at the miners' dwellings, and no officer or workman engaged in any public mine shall sell goods on his own account or for other persons, to any miner or other workman in the public mines, on pain of dismissal; but nothing herein contained shall prevent the miners from carrying on a co-operative store for the supply of all kinds of commodities, except ales, wines and spirituous liquors.

15. No license shall be granted for the sale of ales, wines and spirituous liquors in any part of the districts of Thunder Bay, Algoma, Rainy River and Nipissing, not under municipal organization, or in any municipality hereafter to be organized, in which any public mine is operated at the date of such organization.

16. Allotments of land not exceeding forty acres shall be leased in perpetuity to miners and workmen on condition of cultivation and at nominal rentals. Allotments shall be made with due regard to the quantity of land available for the use of the miners and workmen at any mine.

In conclusion, let me emphasize the following matters for consideration:—

1. The enormous waste of capital in the organization of mining enterprises under the present system.
2. The losses incurred by mining enterprises through the lack of skill of mining engineers and miners and through financial stringency and mismanagement.

3. The wretched condition of miners, owing to the precarious and irregular method of conducting mining operations in this province and the lack of insurance provision for loss of life, or bodily injury or sickness.

4. The certain destruction of large areas of timber under the present system.

5. The great revenue which may be gained to the province by well directed mining operations in gold and silver mines, and the necessity for this revenue to meet the growing demands of our educational system and other requirements of advancing civilization.

6. The incalculable importance of affording to smelters and manufacturers of metals a cheap and steady supply of raw material, such as iron, copper, nickel and lead ores, at prices which, while affording a moderate profit to the province, will practically extend a bounty to smelters.

NOTE.—The reporters having published that the foregoing paper advocated the operation of public mines by day labor, and with the object of providing employment rather than of making a profit out of the industry: it is hardly necessary to say that I hold no such opinion, but the explanation is due that by "a moderate profit to the province," I mean not less than ten per cent. Mining profits, frequently large, are generally anticipated by the prospector and broker to such a degree that a 25 per cent. dividend-paying mine would return 50 per cent. but for the price paid for its discovery and the cost of raising working capital. If iron, copper and nickel ores shall be economically mined and offered to smelters at a profit of merely 10 per cent. the result will transcend the influence of tariffs or direct bounties for manufacture. The views of President Cleveland on the value of cheap raw materials to manufacturers have no need of advocacy, as they are self-evident truths. To prevent other misconception, let me add that while the acquisition of a net yearly public revenue of ten millions of dollars from gold, silver and other mines seems to be quite practicable, there will be always less danger of excessive expansion of the mineral industry, and the creation of a too powerful mining interest under the system proposed than under private ownership. Once the Government enters upon the usufructuary owner-

ship of the public mineral domain there will be less danger of the mining interest owning the legislature than now. There is no security given us that the existing legislation relating to mining land will be permanent. Once the public get a taste of the advantages of a large revenue from mines, it is not likely they will destroy its source by turning it over to private ownership.

The following extract from the advertisement above referred to of the Ontario Bureau of Mines, is from the advertising pages of *Mineral Industry*, published by the New York *Engineering and Mining Journal*. Although "further information" to be had from the Department is also advertised, there is nothing to indicate in the advertisement that "sale" and "right of purchase" carry with either only a conditional fee simple:—"Ontario's great mineral fields; an extent of 100,000 square miles. Prospectors, miners and capitalists are invited to the great mineral fields of Ontario, in Canada. The most promising ground on the continent for exploration and investment. The Province of Ontario has a mineral bearing belt 100 miles in breadth by 1,000 miles in length, lying north of the great lakes from the St. Lawrence and Ottawa rivers to the Lake of the Woods. Nickel, iron, antimony, apatite, mica, copper, gold, galena, actinolite, talc, cobalt, silver, zinc, asbestos, plumbago, etc. Thousands of square miles of virgin ground for the prospector in the mineral-bearing formations, more easily reached by lake or railway than any other mineral district of the continent. Important discoveries made every season. Careful and intelligent exploration amply rewarded. The attention of miners and capitalists in America and Europe is invited. Mineral lands are sold by the Government at \$2 to \$3.50 per acre, or leased with right of purchase at from 60 cents to \$1 per acre first year, and 15 to 25 cents for subsequent years. The first year's rental allowed as part of the purchase money."

DISCUSSION.

DR. A. P. COLEMAN remarked that the paper contained the most revolutionary set of ideas he had heard given in a public way for a long time. There were cases in Saxony, Norway and elsewhere, of mines being worked by the State, the object being more to ensure employment for workmen than to make a profit. He was not aware that any of these mines were now earning a dividend. His own inclinations were towards

individualism, while the paper certainly looked a good deal like communism. Communism, however, might not be a bad thing in itself, and the tendency of modern legislation was certainly in that direction. There were some of the ideas in the paper, such as the prevention of private enterprise, which struck him as being objectionable, and he should like time for consideration before expressing a full opinion upon it.

MR. A. BLUE said there undoubtedly was an air of communism about the paper, but he was not sure that it was any the worse because of that. He doubted, however, whether any government could get efficient labor out of the large number of men who would doubtless be employed in the future in the mining industry of Ontario. What government could manage 100,000 or 500,000 men so employed, with any hope of securing proper service? The existence of so vast a body of voters dependent on the good will of the Government would constitute a serious menace to the liberties of the country. Under such circumstances a government would be able to practically perpetuate itself in office by reason of the influence it could bring to bear upon the men in its employ. All the evils of centralization on a gigantic scale would be the result upon the adoption of the plan Mr. Bawden proposed. In his opinion the chief, if not the only, method by which a government can properly aid an industry, is by giving those engaged in it information.

MR. JAMES CONMEE thought it was sound doctrine that the less people were governed the better they were governed. There were certain evils which the paper just read had only disclosed: waste of energy, misdirection of capital, etc., but he did not agree that Mr. Bawden had proposed the only remedy. There were others. He was not prepared to see so much power placed in the hands of any set of men, no matter what their politics might be. They had had Curran bridges—they might have Curran mines. (Laughter.)

MR. B. T. A. BELL suggested that as the paper covered a good deal of ground, it would be better if the discussion upon it was adjourned until next meeting, when members would be more fully prepared.

MR. T. W. GIBSON expressed his preference for individualism as opposed to communism. If the incentive to enterprise, industry and thrift which enlightened self-interest supplied, were taken away, what were they going to substitute? Men engaged in mining, as in any other occupation, in the hope of profit, and all the immense development

which had taken place in the mineral industry of Great Britain, the United States and other countries had been the fruit of striving for gain. He feared that government control and initiative would prove far less effective in securing progress than private effort had been.

It being agreed to adjourn the discussion, Mr. Bawden briefly replied to the objections raised to his paper, after which a vote of thanks was passed to him for the same.

THE UTILITY AND VALUE OF SOME COMMON MINERALS.

By MR. A. BLUE, Toronto.

Five or six years ago a young man came to this city from one of our finished country villages to seek an occupation which might afford larger scope for his energies than the little annex farm at home appeared to promise. He took counsel with one or two friends, and after the merits of a number of projects were discussed the general conclusion was reached that no business was as sure or safe as one which undertook to supply the common and everyday wants of the people. Food, clothing and shelter are necessities of life, and whatever else man in a civilized state may do without he cannot, or will not, dispense with these. Our young man had been a producer of foods on a small scale, and naturally he inclined to keep on in that line of business. But his heart was set on a specialty, and so he decided to establish a dairy farm and supply the city with milk. He reasoned in this way: "Every family in the city wants milk, and wants it every day. Being a cheap and nutritive food, and for children especially an almost complete diet, many people will buy as much as they require, and the poorer classes as much as they can afford. I am therefore sure of customers if I can supply a good, wholesome article, and the cash will come in as the milk goes out." This young man was wise enough to learn his trade in a well managed dairy before starting on his own account; but it was only a matter of a few months, and he began right. To-day he sells in the city the milk of nearly 150 cows, he has one of the cleanest and best equipped dairies in the Province, and he is worth \$25,000.

The story illustrates the wisdom of selecting a business that deals with the steady wants of the people; and while intelligence and diligence cannot be dispensed with in any calling, it is worth a good deal to remember that progress is always easiest along the lines of least resistance. Under some circumstances a business runs itself, to use a common phrase; under others it requires a vast expenditure of force and oil, and often then it fails. But many persons are so constituted that they have no pleasure in what are called the meaner pursuits of life. Nothing has a charm for them but to undertake the difficult or the impossible, wherein to succeed is glory and perchance a fortune, and wherein to fail is loss and disappointment without, it may be, a compensating grain of gathered wisdom.

The two most abundant minerals in this country are clay and lime, and they are likewise among the most useful. They furnish the raw material too for mineral industries of the first importance, in which a large amount of capital and many laborers are employed. Yet in the vulgar opinion clay and lime are not worthy of being called minerals, and the seekers after gold, silver, copper, nickel and iron would scorn to recognize the workers in clay and lime as fellow-miners. I think it will not be hard to show, however, that these very common minerals possess a value not in any degree inferior to the metals, and that they are deserving of much greater attention than they have yet received in this country, at the hands of moneyed men, and men of the best technical training in the mineral industries. But let it be premised that in this paper lime (using the term in its colloquial sense) will be dealt with only as material for the production of cements.

As to the extent and growth of the industries, information is afforded by the census reports of the Dominion Government. But for comparative records we can only go back to 1881; no account was taken of cements in the censuses preceding the one for that year, and the earlier statistics of the brick industry are of no use in showing its growth.

The statistics of the two industries in Canada and the Province of Ontario respectively are given in the following table for the years 1880 and 1890:

	CANADA.		ONTARIO.	
	1880	1890	1880	1890
CEMENT :				
No. establishments. . . .	9	19	3	12
Hands employed	115	243	29	128
Wages paid	\$38,151	\$85,960	\$7,000	\$39,245
Value of product. . . .	91,658	251,175	29,200	153,400
BRICK AND TILE :				
No. establishments . . .	560	697	400	463
Hands employed	4,129	6,737	2,768	3,791
Wages paid	\$608,690	\$1,428,489	\$405,311	\$797,257
Value of product	1,541,892	3,584,713	971,158	2,154,152

The noticeable feature in these statistics is the large share Ontario claims in the progress of the ten years. Ten new cement establishments were added, and all but one are credited to Ontario. The number of hands employed by the industry increased by 128, and all but 29 are returned for Ontario works. The amount paid for wages was greater in 1890 than in 1880 by \$47,809, and two-thirds of it was earned in Ontario. The increase in the value of product was \$159,517, and three-fourths of it belonged to Ontario. The progress of our Province in the manufacture of brick and tile was less conspicuous in the decade, although in number of works, employees, wages and value of output, she exceeds all the other Provinces combined. In the increase of works from 1880 to 1890, her share was 63 out of 137; of workmen employed it was 1,023 out of 2,608; of wages paid for labor it was \$391,946 out of \$819,799, and of value of articles produced it was \$1,182,994 out of \$2,042,821.

But assuming the absolute accuracy of the figures, there is one aspect of them which arrests attention, viz : the relativity of the cost of labor to the value of product in Ontario and the other Provinces. For the whole Dominion in 1880 the ratio of labor to product was 1 : 2.53, and in 1890 it was 1 : 2.50—a proportion which everyone would be

disposed to accept as likely. For Ontario however the ratios of labor to product were 1 : 2.40 and 1 : 2.70 for the former and latter years respectively, while for the other Provinces they were 1 : 2.95 and 1 : 2.27. The use of improved machinery would account for this disparity to some extent, although not wholly. So also would fluctuations in the price or the efficiency of labor. The latter cause can be dismissed as improbable, in view of the proximity of the Provinces; and while the former might flatter our vanity, it would in view of all the circumstances be fatuous to claim for it more than a very modest share of potency in the radical disturbance of ratios. The real cause will probably be found in the different scales of values adopted in different parts of the country, and it is to be regretted that in the census enumerations account was not taken of quantity as well as of value.

In the statistics collected by the Bureau of Mines last year the manufacturers of cement in Ontario gave the value of their product as \$127,415, while the number of workmen they employed was 224, and the amount of wages paid for labor \$60,208. Their product included 74,353 barrels of natural rock and 31,924 barrels of Portland cement. In 1890 there was no Portland cement made in our Province; yet the value of cement manufactured that year according to the census was greater than last year by \$25,985, while the number of workmen employed was less by 96, and the wages paid for labor less by \$20,963. Had we the output for the census year in quantity, the cause of the discrepancy would more clearly appear. The Bureau's returns of brick and tile for 1893 are also much lower in value than those of the census for 1890, but this is no doubt due to the fact that the financial stringency of last year caused many works to close down early in the season, while others were idle the whole year. The number of men employed was 2,874, the amount paid for wages \$531,686, and the value of product \$1,339,873—the ratio of labor to product being 1 : 2.52.

It has been shown that on the basis of values the manufacture of cement in Canada increased from \$91,658 in 1880 to \$251,175 in 1890. The whole of this product was consumed in the country, but it was far from supplying our needs. In the fiscal year 1880-1 we imported hydraulic, Roman and Portland cements to the value of \$53,765, and in 1890-1 to the value of \$313,690. But since the fiscal year 1886-7 the trade tables give us the quantity as well as the value of the cements

imported, and they show that the demand has been largely on the increase. The following table gives our imports of Portland and Roman cements for each of the seven fiscal years 1886-93, the great bulk of which was the Portland variety:

YEAR.	BARRELS.	\$
1886-7	102,750	148,054
1887-8	122,402	177,158
1888-9	122,273	179,406
1889-90	192,322	313,572
1890-1	183,728	304,648
1891-2	187,233	281,553
1892-3	229,492	316,179

The total importation in the seven years was 1,140,200 barrels, valued in the trade tables at \$1,720,570; but to this should be added the \$455,445 of Customs dues paid to the Government, the cost of freight and insurance and the profits of importers, in reckoning the price paid by the consumers—an aggregate of not less than \$3,250,000. In these seven years the increase in quantity was 123 per cent., and in value 113 per cent. But a more striking evidence of the growing demand is afforded by a comparison of the imports of Portland and Roman cements for 1880-81 and 1892-93. In the former year their value was only \$45,646, and in the latter it was \$316,179, being an increase of nearly 600 per cent. in twelve years. This is a rate that perhaps has not been equalled in any other article of Canadian importation. What is the secret of it, and is the demand likely to be maintained?

The answer to these questions may be summed up in a very significant term of very modern usage on this continent, viz., good roads. The setting in of the area of good roads in this country as well as in the United States, does not date back ten years, but in that short period much has been learned on the subject, and the street engineer is now as much of a specialist and quite as useful in his way as the military engineer or the mining engineer. The Roman roads of Europe, which have lasted out the traffic of two thousand years, have taught him the invaluable lesson that the only sure way to make a good road is to lay a good and strong foundation. But instead of using stone material as the Romans did in constructing their great military roads, he has adopted the

concrete used by them in the construction of temples and other public buildings, some of whose walls have been standing 2,400 years. The great dome built by Agrippa, the friend of Augustus, "the immortal monument of the Pantheon," as Gibbon described it—now the church of Santa Maria della Rotonda—is an edifice in concrete, and though ravaged by fire and assulted by the Huns and Goths, it is still intact after more than 1,900 years. Concrete is the street engineer's material for street building, and his chief reliance in the making of it is not Roman or any other kind of natural cement, but the stronger and more durable Portland. In Toronto during the last five years not less than 150,000 barrels of cement have been used in making concrete for street construction, and of this quantity Mr. Rust tells me that not more than 4,000 barrels have been the native hydraulic cement. "Up to the last year or two," he says, "it was all imported Portland cement from Europe." In other towns and cities of the Dominion cement is also being used in steadily increasing quantities in building sewers and streets, and the results are so uniformly good that the material promises to grow steadily in favor. It is almost certain then that for many years yet to come the demand for Portland cement will continue, as experience proves the utility and permanency of the concrete roadbed.

But why should we remain dependent on foreign sources of supply for Portland cement? We have in Ontario abundance of raw material for producing it. In scores of localities beds of white shell marl of large extent and excellent quality are found, some of them at the bottom of lakes in which myriads of fresh water shells yet survive, to add to the thickness of the deposit as one generation follows another, others of them on the sites of lakes long ago filled up with peaty mould or drained by continental elevations. This marl, if unmixed with sand, clay, peat, or other matter of mineral or vegetable origin, is almost pure carbonate of lime, and furnishes the principal material for the manufacture of Portland cement. The necessary proportion of clay is a matter of experiment; but in all cases the purer and more uniform the quality of the marl, the easier it is to get a right mixture. Our manufacturers in Ontario have acquired their experience slowly and dearly.

Mr. Rathbun told me that it cost him five years of testing, with the aid of a chemist, before he was convinced that it would be safe to start his works. Mr. Butchart also told me that it cost his company several

thousands of dollars, a visit to some of the best Portland cement works in England—where he was admitted as a special favor—and the service of two experts in the construction of a suitable plant, before they could produce a commercial article. But the Rathbun Company and the Owen Sound Company have succeeded, and during the last two years they have been producing a Portland cement which satisfies every requirement.

Mr. C. H. Rust, Deputy City Engineer of Toronto, makes this statement concerning it, in a letter which I have just received from him :

"Since 1892 we have used a quantity of Portland cement made by the Rathbun Co. at Napanee mills, and by the Owen Sound Company at Shallow Lake. Both these brands are quite equal to the majority of the imported cements, and no doubt when their facilities for manufacturing are increased nearly all the cement used in this city will be of home manufacture."

The Owen Sound Co. has recently had the misfortune to lose its mill by fire, but it is understood that a new one is in course of erection. The company has a large supply of raw material alongside of the works, suitable clay for mixing being found immediately below the marl, and doubtless the capacity of the new mill will be made to meet the growing requirements of the trade.

The only other Portland cement works in the Province are in Marlbank in the County of Hastings. The site was chosen because of its nearness to a very large deposit of marl; but although English capital was put into the business, and presumably English experience also, the enterprise had to pass through the usual ordeal of disappointment and delay before a successful beginning was made.

The output of those three mills last year was 31,924 barrels, but one of them did not start till late in the season, and another worked only half the year. Had their capacity been six times as great they could hardly have supplied the quantity of Portland cement imported by Canada during the fiscal year 1892-3, and obviously therefore there is ample room for the home manufacture to grow. With raw material so abundant and accessible, and with capital seeking new channels of investment, and labor seeking employment, why should we not produce in the country all the Portland cement that our market requires? An article of uniform quality will always be in request by customers, and

with care on the part of the manufacturer there is no reason why he should not be successful in supplying a distinct brand. But as long as we are dependent on foreign makers we cannot hope to be supplied with cement of uniform quality, for where large orders have to be filled it is the common practice even of large mill owners to buy lots from other manufacturers and so make a prompt shipment. The result is that there are as many brands as makers, and with cements of different qualities, some quick setting and some slow setting, it is hardly possible to make a first-rate concrete. This is a risk which may easily be avoided if orders are placed at home, with the home manufacturer, and the good results obtained from our Ontario cements are no doubt due to the fact that orders are honestly made up, each manufacturer being jealous of his own reputation.

As regards the products of clay, it is not necessary that much should be said. Taking the various articles of common and pressed bricks, terra cotta, tile, sewer pipe, and pottery, the number of men employed in their manufacture in Ontario last year was 3,109, with earnings of \$601,686. The aggregate value of their products was \$1,684,873, or more than one-fourth of all the mineral products of the Province in the same year. This fact alone suffices to prove the importance of our clay industries; yet it is obvious that they are capable of greater development. The manufacture of pressed brick and terra cotta began here only five years ago, and last year, in spite of the collapse in the building trade, the value of the output of six works was \$217,373. It gave employment to 224 workmen, and paid them wages to the amount of \$80,686. The improvements already noticeable in the architecture of our cities as a consequence of the use of pressed brick and terra cotta is bringing this material fast into favor, and it may be said that the earth affords no better building material than a properly burnt brick, and none which so readily lends itself to the production of handsome architectural effects. In the strong and fine-textured shales of our Hudson River and Medina formations, conveniently situated and easily quarried, Ontario is favored above most Provinces and States in America.

The same shales are also found to be suitable for the manufacture of sewer pipe, with proper mixtures, and last year the output of two establishments employed in this industry was \$230,000.

Another clay industry is now on the eve of commencement, and if successfully established it promises to be a great boon to our towns and cities, viz.: the manufacture of vitrified brick for street paving. In Ohio, Illinois, Iowa and other American States this has now grown to be a very important industry, and it is supplying a material for street construction which on all points of merit is not equalled by any other material hitherto employed for the purpose. Many mistakes were committed by the first makers of paving brick, and there is much yet to be learned as to the clays or clay mixtures which give the best results, as well as to the proper degree and duration of heat to produce a hard, tough and impervious brick. But much is already known, and with careful experiments and close observation many works are enabled to produce with regularity a high percentage of paving brick of uniform quality from every charge of a kiln. A number of experiments have recently been made in Toronto, Hamilton and elsewhere in this Province, and although each expert will assure you that he alone knows the secret, and that no one else has the clays for a right mixture but himself, you may rest assured that in a matter of this sort the key and the ward are not so hard to match as the tribe of experts would have you believe. In several instances encouraging progress has been made, especially with the Medina and Hudson River shales.

We may therefore, I think, look with confidence to an early beginning of the production of paving brick in Ontario; and when that time comes we shall be no longer at the mercy of trust concerns like the owners of Pitch Lake asphalt, as illustrated the other day in the case of a contract for paving in the city of Hamilton. When we are producing Portland cement from our own shell marls and clays to the full extent in which it is required for street concrete, and paving brick from our own shales to cover the concrete, we shall be as independent as we ought to be in supplying ourselves with the materials of such everyday requirements as are called for in the building of good roads. In so doing also we shall be utilizing our raw materials of clay and lime, otherwise of no value, finding profitable investment for capital lying idle in the banks, and giving employment to hundreds, if not thousands, of men who for lack of work to do are finding it hard to win their daily bread.

With one suggestion to the professors and instructors in the School of Practical Science, Toronto, and the School of Mining, Kingston, I close. Reference has been made to the experiments conducted by the manufacturers of brick and cement, preliminary to the building of works to commence production on a commercial scale. These experiments demand patience, exactness and scientific method, as well as the use of costly appliances. Why should they not be taken up in our technical schools, where there are professors having the necessary expert knowledge and training, and the appliances for making tests and ascertaining results with unerring accuracy? The importance of the clay industry has been so well recognized by the State Legislature of Ohio that a course of practical and scientific instruction in the art of clay-making and ceramics has been added to the educational work of the State University, and the first term of the department opened yesterday. Work of that character is as much needed in Ontario as in Ohio, and the professors of our scientific schools cannot too soon prepare to enter upon it.

DISCUSSION.

MR. R. W. PRITTE said he had been for a number of years interested in the brick industry, particularly in the manufacture of paving brick. This article was coming largely into use in the States, and he had seen pavements which had been down for 16, 18 and 20 years, with but little repairs. It was giving the utmost satisfaction, and made a superior pavement in every respect, being smooth, lasting, easily cleaned, and affording a good foothold for horses. He was interested in a large vitrified brick factory which had been started at the Humber, near Toronto, last year, and was got partially under way when the financial crash on the other side affected the enterprise and brought it temporarily to a stop. He hoped, however, that the operations would yet be begun. It was the company's intention to put up a plant capable of turning out 50 millions of brick per annum, and employing 400 men.

DR. A. P. COLEMAN, in reference to a remark in Mr. Blue's paper, thought it only fair to say on behalf of the School of Practical Science, that they had begun the work of testing cement, brick and similar materials. If provided with proper appliances, the authorities of the

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School were perfectly willing to engage even more extensively in such work.

MR. J. LATIMER asked if there had been any development in fire-clay.

MR. BLUE—Not in Ontario.

MR. BELL—There are good deposits of fire-clay in Nova Scotia, but they are not made use of.

MR. J. M. CLARKE said it was well known that the manufacture of articles like vitrified brick in Ontario had engaged the attention of outsiders more than of the people of the Province. Outsiders were now investigating the subject with the view of beginning the manufacture of paving brick here.

THE RAINY RIVER GOLD DISTRICT.

By DR. A. P. COLEMAN, Toronto.

Mr. Chairman, I have been unable to write out a paper as I promised to do, owing to the fact that I returned home from the trip I took this summer only yesterday at noon. In fact, I have hardly had time to throw my ideas into consecutive shape, and I must therefore ask your indulgence while I give you some rambling talk on the subject of the western gold fields of Ontario. As Mr. Blue has suggested, such humdrum things as clay and marl have no great attraction for ordinary men, and a brick of gold is looked on with a good deal more interest than even a brick made of the Don valley clay. Partly on this account, and partly because the resources of the Province are of great interest to all of us, it will be worth while for me to give you a little account of the work done this summer, and of the region in which perhaps in the future some important mines will be developed.

The little expedition that was sent out by the Bureau of Mines, consisting of my friend, Dr. Burwash—who was in many ways well fitted for such work, having been assayer and mineralogist for the Province of New Brunswick—myself and three men, set out about the middle of June. We had to make a tremendous round to get at the scene of our

work. Rat Portage, Lake of the Woods, Rainy River—by this circuitous route we were obliged to reach our destination on Rainy Lake. Our object was to examine specially the gold fields of the region, and also incidentally to note anything that appeared to indicate other mineral resources of importance.

The only map of the district we were able to examine is one made by Lawson and published by the Dominion Geological Survey in connection with his report on the Rainy Lake region. It is an admirable map, and I found it in constant use by prospectors, steamboat captains and all others. Even the Americans who came there had to depend upon the Canadian map, which shows part of the American territory as well. I found I could steer my course by this map; all the portages, channels, etc., are marked upon it, and I could practically go into an unknown country without a guide, and make my way by the aid of this map alone. The topographical work of the map is admirably done, and the geological work in the lower part of the region is quite as admirable. I found a few places, however, here and there where blunders had been made in the geology, especially in marking the contours of the various formations.

This whole region consists of two great groups of rocks—Laurentian and Huronian. On the map the Laurentian rocks are colored pink, and the Huronian green. The special rock which is of interest to us is the green one, called by Lawson the Keewatin, in reality a member of the Huronian series, so far as one can judge from its general associations. The other rocks are Laurentian granite, gneiss, and rocks of a similar description. For several reasons this region is one of the most interesting in the world from a geological point of view. I shall give you one. We find the gneissoid Laurentian rocks not generally looked on as eruptive, coming up through the green Huronian schists, which at one time probably formed a great sheet, covering all the rocks beneath. These Laurentian bosses are thus enfolded between the schists, and in consequence wherever you go in that region you find the latter nearly perpendicular, a fact of great importance to the district as a mining one. These green rocks—green on the ground as well as on the map—have proved to be the most interesting from the mineralogical standpoint. They consist of hornblende schists, chlorite schists, and a mixture of these and a number of associated rocks. In many parts these schists

contain veins of quartz, which in the majority of cases are bedded veins. True fissure veins, *i.e.*, those which cross the strike, are rare. As a rule bedded veins are not so continuous or so certain as ore bodies as the other kind.

One of our first efforts was to see the only mine working in the region, the Little American. This is situated on a small island, not larger than the site of these Parliament buildings, in the state of Minnesota, three miles south of the international boundary line. They had reached a depth of only 45 feet when I visited it, but there is a fairly equipped 5-stamp mill at work actually turning out bricks of gold at the present time. The mill, though small is well arranged.

There is no geographical or other reason why the international boundary should mark the limit of gold-bearing rock, and I am convinced that there are as valuable properties, and probably much more valuable ores, north of the line. At the Little American I was shown a brick consisting of about \$500 worth of gold, which was the result of about 48 hours' work and the product of about 30 tons of ore. I was told that the yield is about \$20 of gold per ton, but I think this estimate a little high, and that \$16 or \$17 per ton would be more nearly the truth. There was also on hand about half a ton of concentrates that would run between \$320 and \$350 per ton, which I was informed they intended to ship away for treatment. A large part of the ore is of the free milling kind, notwithstanding that the sulphides come very close to the surface in this region, scoured as it has been by the ice of the glacial period. The decomposed, rotten quartz so common in other districts has been all scraped away. Part of the gold is held in the sulphides and will be refractory. However, \$16 per ton will pay, even if the concentrates be neglected altogether. I believe the Little American has paid from the start. On the strength of this mine a "city" of 300 inhabitants has sprung up. On the Canadian side there is a mine called the Little Canadian, on a still smaller island, which may prove to be a producer like the other, but we could not examine it to any advantage.

A good deal of prospecting has been done. We visited Seine river and Seine bay; along part of the latter a large number of iron locations have been laid out. The ore is magnetite. We examined one or two of these locations; whether they will amount to much in the end or

not, one cannot say, but should a railway pass through the district they may prove of considerable value. A large number of gold properties have been located along Shoal Lake, and one of the most interesting of them is on a spot, which on Lawson's map, is marked "gabbro." I disappointed the gentleman who owns it, Mr. Thomas Wiegand, very deeply by telling him his mine was in granite, for he was in the full belief that it was in gabbro. There the veins are true fissure veins and can be traced for a mile. The largest one is 5 feet wide at some points. A little development work is being done, and I understand the mine is turning out very well. There is probably a continuous body of ore and a valuable property here. It is not very usual to find rich gold-bearing rock in granite, but the granite here must be looked on as an eruptive rock, deriving its gold from the surrounding schists.

Our next expedition was into the Pipestone Lake region, whence we portaged over to the Manitou district. We went north of the country shown on the map, where we found segregation or bedded veins enclosed in the green schists just as below. No claims have yet been taken up here, but there are a number of veins, and probably something of importance may turn up. In the Manitou section a good deal has been done and a few claims worked to the depth of 15 or 20 feet. Some extraordinarily rich specimens come from the upper part of Manitou Lake; whether the deposits will hold out in depth of course one cannot say. There are some true fissure veins 6 or 8 feet wide at points, so that there is plenty of material, and in places it is very rich. Only one mine was being worked at the time of my visit. It had a considerable body of quartz, and carried free gold, as I saw with my own eyes.

I visited the famous Atik-oka iron range, where there is certainly a large body of ore. Some of it will probably prove to be of Bessemer quality, but other portions of it contain sulphur.

The whole trip meant 1,000 miles by canoe, and consumed nearly three months' time. We brought back a large amount of material which we intend to have assayed to ascertain what are the relationships of the gold-bearing veins to the surrounding rocks. We have samples from veins that occur in granite, in gneiss, in various sorts of the green schists, and we wish to settle if we can whether or not there are horizons at which gold is more commonly found. One definite result already arrived at, is that over a region 200 miles long and 50 miles or more wide, every here

and there free gold is found in the rock. I think the majority of the veins will not justify large development work. It is my opinion that a custom-mill in the Rainy Lake region and another in the Manitou country might serve a good purpose and open up a very important field. Many of the mines might be small and would not warrant the erection of a stamp mill, but they might well repay the cost of taking out the ore, if it could be treated at a custom-mill, because it is rich. Some of the mines will probably prove to be large and continuous and will justify expense. The ore in general appears to be free milling, although a considerable quantity is retained in the sulphides and will have to be treated accordingly. One interesting fact is to be noted, wherever you find galena you find free gold. What the relationship between the two is I have not worked out, but this appears to be the case and is borne out by my own observation as well as by the testimony of explorers. Some better mode of access to the region is required. It is very difficult to get into the Manitou district, though that lake is only 30 miles from the C. P. R. Six portages have to be crossed, one of them a mile long. You cannot take mining machinery over that, and some improvement will have to be made before the region can be developed at all. There is probably as great an area of the gold bearing formations north of the C. P. R. line as there is south, and prospectors are just beginning to go in there. It is to be borne in mind that Rainy Lake is a large body of water, and has a coast line almost as long as that of Lake Ontario. This fact very much facilitates travel and exploration. (Applause.)

THE HON. A. S. HARDY ELECTED AN HONORARY MEMBER.

MR. KINGSMILL moved, seconded by Mr. J. M. Clarke, that the Commissioner of Crown Lands, the Hon. A. S. Hardy, be elected an honorary member of the Institute.

THE CHAIRMAN in putting the motion, remarked that since the present Commissioner of Crown Lands had taken office there had been more interest taken in mining by the Government, and a greater advance on previous legislation had been made than at any previous time. The present mining law, though not incapable of improvement was, as he had stated elsewhere, perhaps the best worked out law and the most liberal in its provisions of any on the statute book.

HON. MR. HARDY.—Mr. Chairman, I certainly had no expectation that this honor would be conferred upon me this evening when I ventured to intrude upon you. I can only thank you for the very complimentary resolution that has been moved, and the very kindly manner in which it has been carried. What I am afraid of is, that I shall hardly be able to bring myself within the terms of the by-law, or the conditions under which it may be applied. Perhaps, however, the position which I hold may act as sponsor for me in the matter, for I fear this is the only way in which I can claim to be a fit and proper candidate for honorary membership in your association. I am pleased to be present at this meeting of your institute. I know it is not what is called a mining convention, but it is perhaps built on a more solid foundation, and fitted to discuss matters more carefully and satisfactorily. I am pleased sir, to hear some of the remarks which you yourself made. When you stated that we in Ontario have had more mining legislation during the past five years than for the previous twenty, I accept it as a compliment, not merely to myself but to the officers of the department, and indeed to yourself as well. We have had many pressing invitations from you, sir, to even more active legislation. Perhaps my own connection with mining has been confined too much to legislation. I have been compelled to leave the practical and scientific work of the department to other hands; but in Mr. Blue and his assistants we have a body of men earnest and enthusiastic in pursuit of the duties devolving upon them to whom these interests may very safely be committed.

The Government have put in a consolidated form the entire mining law and regulations, established a Bureau of Mines, imposed working conditions on those who acquire mining lands from the Crown, introduced the leasing system by which land may be obtained on easier terms and at a lower cost, lowered the minimum area of mining locations, and adopted the plan of staking out claims, of which you, Mr. Chairman, were so enthusiastic an advocate. We have endeavored to assist the mining industry by aiding railways on a considerable scale, and are now attempting to help on the work of development by means of a government diamond drill. We have adopted all the methods of assistance that were fairly within our power, even to the extent of establishing summer mining classes, and of making a grant of \$125,000 to encourage the opening up of our iron mines. It would be difficult to ask a legislature

in four or five years to do much more or go much faster. With all the advances we have made in this line there is in the mind of anyone perhaps only one drawback—the imposition of a small royalty on ores. This may be claimed by some to stand in the way of mining development, but perhaps the taxpayers will be strongly inclined to support it.

It will afford the Government pleasure to be of any assistance to you as an Institute. The rooms in these buildings will always be open for your meetings, and any other facilities which we can offer you are at your disposal. Meetings of this kind are one of the means by which our mining industry will be ultimately developed. That it should be so slow of development seems a marvel to some of us. Our lives are passing away, but the mining industry is not making the progress or producing the wealth as rapidly as we would like. It can hardly be expected that the Government will pour out money to bring about the development of the industry, but whatever will increase the desire of mining men and capitalists to go into the mining business may be legitimately expected from the Government; beyond this, and perhaps the opening up of roads and waterways, I do not know that you can expect the Government to go.

The education of the country in mining matters must come from bodies such as this. I am glad to know of its existence, and heartily wish it prosperity. I again thank you for the honor you have done me in making me an honorary member of your Institute. (Loud applause.)

DEEP WATER-WAYS CONVENTION.

ALDERMAN J. E. THOMPSON, on behalf of the Committee of Arrangements, extended a cordial invitation to the Institute to send delegates to the Deep Water-Ways Convention to be held in Toronto on 17th September and following days.

MR. J. J. KINGSMILL, seconded by the Secretary, proposed the following delegates:—Mr. A. Blue, Director of Mines; Dr. Coleman, School of Practical Science; J. Bawden, Kingston; J. J. Kingsmill, T. W. Gibson, R. W. Prittie, J. M. Clarke and T. D. Ledyard, Toronto.

The delegates being approved the Secretary was authorized to issue their credentials.

NEXT PLACE OF MEETING.

PROF. NICOL, in inviting the Institute to Kingston for its next meeting, said he was quite sure the Faculty of the School of Mining would do everything possible to make the meeting a success.

MR. J. BAWDEN having seconded the invitation, the Secretary was authorized to convene the next meeting at Kingston in January, 1895, at such time and place as seemed most suitable by the Kingston members of the Institute.

A vote of thanks to the Chairman having been passed the meeting adjourned.

ORDINARY GENERAL MEETING.

KINGSTON, ONT.

3RD AND 4TH JANUARY, 1895.

The opening session was held in the School of Mining, Kingston, Ont., on Thursday morning, 3rd January, Dr. W. L. Goodwin, Vice-President, in the chair.

The minutes of previous meetings having been read and confirmed, a letter was read from the President, regretting inability to be present at the meeting.

FEDERATION.

THE SECRETARY submitted the report of the Mining Society of Nova Scotia on a scheme for the federation of existing Canadian Mining Associations.

MR. HAMILTON MERRITT also presented the report of the Committee of the Institute, which had been forwarded to the Quebec and Nova Scotia Societies.

After considerable discussion, the report of the Mining Society of Nova Scotia was in the main approved, but the clause anent subscriptions was referred to a sub-committee comprising Prof. Goodwin, Prof. Nicol, Mr. A. Blue, Director of Mines, and the Secretary, to report at a later stage of the proceedings. This committee, after due consideration, recommended the following amendments to the consideration of the Quebec and Nova Scotia Societies:—"That each of the Societies in the Federation shall pay the expense of printing and illustrating its own portion of the proceedings of the Institute, the rate per page not to exceed one dollar and a half." (Or, as an alternative :) "The Societies in the Federation shall each pay an annual subscription towards the expenses of the Institute of such an amount as may be determined upon at each annual meeting, but the contribution from each Society shall at no time exceed in amount the sum of three dollars per capita."

MEETINGS AND STUDENT MEMBERSHIP

THE SECRETARY tabled a notice of motion to amend the Constitution and By-laws so that two meetings of the Institute should be held in each year, instead of three as at present; also, so as to create a student membership at a nominal fee.

LEGISLATION RE MINING ENGINEERS.

MR. HAMILTON MERRITT moved the appointment of a committee comprising Prof. Goodwin, Dr. Coleman and Mr. Merritt, to report upon the advisability and feasibility of legislation for the registration in the Province of duly qualified mining engineers. It was highly desirable, he thought, that where such educational institutions existed in Ontario as the School of Mining and the School of Practical Science, something should be done to prevent or to minimize the practice of quacks in the profession. It seemed to be the rule in Ontario that where people were engaged in an occupation in which life and limb were endangered they should be required to conform to a certain standard of qualification. The matter had been under consideration and had been discussed in Nova Scotia. Personally he thought that mining engineers had as much right to protection as doctors, dentists and lawyers.

MR. B. T. A. BELL thought that the motion might be tabled for discussion as to ways and means at a future meeting. While in sympathy with the principle involved he could not see how legislation would improve matters. He could mention cases in which the biggest frauds had been perpetrated by mining experts who had all the letters of the alphabet behind their names. Some of the ablest and most competent mine managers were men who had never seen a school of mines or taken a degree. A science course would never compensate for the absence of honesty or common sense.

PROF. NICOL, having seconded Mr. Merritt's motion, it was put to the meeting and carried.

NEW MEMBERS.

The following were elected to membership :—

Mr. John Donnelly, Kingston.
Mr. B. H. Klock, Klock's Mills.
Mr. W. G. Kidd, Kingston.
Mr. Wm. Mason, Kingston.
Prof. Dupuis, Kingston.
Mr. Fred. Burroughs, Napanee.

Prof. Carr Harris, Kingston.
Mr. Bruce Carruthers, Kingston.
Mr. T. L. Walker, Kingston.
Mr. J. Newlands, Kingston.
Mr. E. Musgrove, Kingston.

The morning session then adjourned.

SECRETARY'S EXPENSES.

On motion of Mr. W. Hamilton Merritt, Toronto, seconded by Mr. W. G. Miller, the Treasurer was authorized to pay the sum of twenty-five dollars to cover the Secretary's expenses at previous meeting, also his travelling expenses on the present occasion. It was also resolved that in future the matter of this expenditure be left in the hands of the Council.

COMMITTEE RESPECTING PUBLICATIONS.

On motion the following were appointed a committee to wait upon the Hon. A. S. Hardy, Commissioner of Crown Lands, with a view to obtaining a grant towards the expense of publishing the proceedings of the Institute:— J. J. Kingsmill, Q.C., Dr. A. P. Coleman, Mr. A. Blue, W. Hamilton Merritt, and Mr. Jas. Conmee, M.P.P., President.

Addresses were afterwards delivered by D. Goodwin on "Nature's Concentration Works," and by Prof. Nicol on "Borom: its detection in minerals, and uses." During the sessions the following papers were discussed:

THE SILVER MINES OF THUNDER BAY.

By MR. PETER MCKELLAR, F. G. S. A., Fort William, Ont.

A few years ago the silver mines of Thunder Bay were in active operation and much mining development was in progress—now all are closed down. The depression in the value of silver—the advent of the new Mining Law—and, about the same time, a number of the prominent mines had penetrated down into the silicious or poor-bearing stratum of the Animikie rocks—these causes combined, resulted in the complete closing down of all the mines. Of course, in time, some of those will be reopened, not all, as many mines were started without a showing to justify it, as is generally the case in all mining districts. Other new discoveries will undoubtedly be made here, as there are lots of unexplored areas under cover of drifts and alluvial deposits, etc.

It was known to geologists and mining men for many years, that the veins were richer in silver within the argillaceous stratum than within the underlying silicious stratum; but few of the mining men had much knowledge of the thickness of either, and were often disappointed in

their mining operations on this account. As this characteristic is becoming better understood, many of the misdirected efforts of the past may in future be avoided. At Thunder Bay the Animikie group of rocks covers an area of more than a thousand square miles. It consists principally of slaty beds, argillaceous and silicious, lying nearly horizontally upon the denuded upturned edges of the highly inclined Archean strata, which in this locality undoubtedly are largely Huronian schists. The thickness of the Animikie formation along the run of the northern belt of silver mines, or from Silver Harbor to Gun Flint Lake, 80 to 90 miles, will probably average 600 to 1,000 feet; but out towards the coast line it will be much thicker. The silicious or lower stratum, the lower silicious division of Mr. Ingall, is at the base of the Animikie rocks and is about 400 feet thick at the Duncan mine, and nearly 700 at the Beaver mine. It is not likely to exceed the latter thickness much anywhere along the northern silver belt. The carbonaceous clay slaty stratum that overlies the silicious stratum, shows a thickness of about 300 feet; but along the northern silver belt it has been partly or wholly removed by erosion and denudation in places; and in others it is covered with a bed or sheet of trap, which, again to the southward, is overlaid with slaty beds higher in the formation. In the mines along this belt, all the rich deposits of silver were found in the veins within this argillaceous stratum, which in the southward direction dips under higher beds of the formation. It remains to be proven whether or not the argillaceous beds of the higher horizons have the same favorable influence on the deposition of the silver within them, as the lower stratum has. From the past showing it would appear not, as in the great central belt, some ten miles or more in width, which lies immediately to the southward of the northern silver belt, no rich silver lodes have yet been found like those on the latter. This apparent barrenness of the central belt may be accounted for, 1st. If the presence of the silver is due to lateral segregation, that the lower argillaceous stratum is the real silver-bearing stratum of the formation, in which case the veins here would have to be mined down through the over-lying beds to reach the silver-bearing stratum; 2nd. If the infilling is from below, that the northern silver belt seems to lie along a line of weakness, where there are many fissure veins, while along the central belt the veins are comparatively few and may not penetrate down to the metalliferous reservoir to which I will refer further on. The coast

silver belt lies about twenty miles south of the northern silver belt and along the Macfarlane diorite dyke, as Silver Islet, McKellar, Thompson, Spar and Jarvis Islands locations, crossing the strike of the fissure veins. I consider the search for the causes that produced these silver-bearing veins a matter of much importance, that is, to try and find out if the silver in the veins is due to lateral segregation, or if it ascended in the fissures from a deep source, to be deposited subject to the laws of attraction or to the influences of the adjacent rocks. If the infilling is by lateral segregation, it seems to me clear, that in the Animikie group the veins need only be worked down to the lower silicious division, for the underlying Archean strata are exposed in extensive areas, here and there, throughout the Algoma district. They show to be auriferous in many places; yet they do not show to be argentiferous in this respect anywhere, I believe, excepting in the vicinity of the great Lake Superior trough, as at the Gopher and Star mines, Whitefish River, north of Whitefish Lake; the 3 A. mine north of Silver Harbor, Thunder Bay; Syrette location east of Nipigon Bay; the locations at the mouth of the Steel River; and the Little Pic silver mines west of the Little Pic River. These are all in the Archean strata and carry silver ore similar to that of the Animikie veins, and in the case of the 3 A. and Gopher mines, rich ores. If the infilling is from below, as I believe, we may look for these veins in or out of the Animikie to prove valuable for mining to great depths, as the 3 A. mine and Gopher, etc., prove that some of the Archean strata at least, have the influence to cause the precipitation of silver in fissures within them, when present in solution, as well as the argillaceous slates of the Animikie have. The greater showing of silver in the Animikie veins than in the Archean, may be on account of the Animikie area occupying the more favorable position in relation to the metalliferous reservoir below.

There is no doubt the Thunder Bay silver veins are true fissures, as shown by the faulting of the walls. The Silver Mountain vein shows a fault of 60 to 70 feet; the Beaver vein, 15 feet; the Rabbit Mountain much greater; the Duncan mine vein 120 feet, etc.; so that the fissures must penetrate to a great depth. It seems certain that the copper and silver of the native copper mines of Lake Superior, were ejected from great depths with the fluid rocks of the Keweenawan group, and also that the fissures of the silver veins here, resulted from the subsidence in cooling of these great eruptions, and subsequent to the flow of the fluid

rocks. The previous fissures formed were filled with fluid rock and show now as trap dykes in great numbers, especially along and near the coast. It is highly probable that those fissures cut down to the great reservoir from which the eruptive rocks of the Keweenawan were ejected, heated vapors, steam and aqueous solutions would ascend in the fissures, and carry metals and minerals along; and continue the ascension and precipitation of the solution subject to the influences of the adjacent rocks until the fissures were filled as we find them. In the event of the argillaceous beds having a greater influence in depositing the silver, than the interstratified silicious beds of the Animikie have, the veins within the former should show richer in silver than within the latter, as we find them. So also with the underlying Archean strata, it is quite probable that the veins will be rich in silver within some of them and poor within others in a similar way.

The middle of the Lake Superior trough, the portion opposite Thunder Bay, appears to have been the most metalliferous part of the great reservoir, for all the great copper mines are here on the one side and the silver mines on the other. Although the rock formations continue westward for 200 miles or more, the rich mines do not show excepting around the middle portion of the trough.

There are two series of fissure veins here; those of the one the most numerous bear nearly east and west, about parallel with the great trough; those of the other, cross and are prominently developed along the outer coast line, and rarely penetrate far inland. The position of the latter series near the middle of the trough, might be expected to prove richer than the other series of veins. The Silver Islet vein is one of them, and is certainly the richest one known thus far.

If it can be proved satisfactorily that these veins carry the silver in the underlying Archean strata, this locality is likely to prove a valuable deep mining district. I consider it quite probable that it will do so, in view of the natural conditions that bear on the matter, some of which I have in this paper endeavored to show.

In conclusion I may say in regard to the processes of lateral segregation and infilling of veins from below, that these are well known theories. The statement of mineral veins in the Encyclopedia Britannica remarks, "But that this mineral matter came chiefly from below appears almost certain."

DIABASE DYKES IN THE SUDBURY REGION.

MR. T. L. WALKER, M.A. Kingston, Ont.

During the past few years the rocks of this region have received considerable attention. At the time of the construction of the Canadian Pacific Railway in 1884, Professor Bonney * of London visited the district and made a careful microscopic study of the rocks found near the railway lines. His attention was directed chiefly to the metamorphic rocks of the Huronian belt. In 1890 the late Professor G. H. Williams was entrusted by the Canadian Geological Survey with the microscopic study of a collection of Sudbury rocks. This collection had reference principally to the rocks associated with the copper-nickel ores. Baron Von Fouchon † of Vienna spent a few weeks during 1890 studying these rocks in the field, especially with a view to ascertaining the relative ages of the different rocks.

The so-called Sudbury region is composed of a belt of Huronian rocks striking north-east and south-west. The rocks to the south-east and north-west of this belt are chiefly granites and gneisses. The Huronian belt is here made up of hornblende schists, quartzites and slates, while associated with these and possibly of later age are areas of granite and greenstone. These latter rocks generally occur in lenticular areas whose longer axes agree with the strike of the Huronian rocks. The rocks to be considered here are the youngest in the district, and are found generally in dykes of diabase, which frequently have a strike nearly at right angles to the members of the Huronian belt.

One of the best representatives of this dyke series may be seen crossing the railway track several times between Sudbury and Murray Mines. Its course can be easily followed for about three miles. The most eastern exposure is a little more than a mile from Sudbury where it cuts through feldspathic quartzites which are regarded as characteristic Huronian rocks. About a mile farther along the journey to Murray Mines, just near a pit from which clay has been taken for furnace pur-

*Quart. Jour. Geol. Soc., Vol. 44, p. 32.

†Geol. Survey Canada. Report of Progress 1891, F, p. 59.

‡Jahrb. d. k. k. Geol. Reichsanstalt 1892, p. 276.

poses, another good exposure occurs, but at this point the rocks intersected by the dyke are the greenstones with which the nickel ores of the district are commonly associated. A curve in the railway leaves the dyke on the north side, but it may be well seen again, at the village of Murray Mines, just where the colonisation road, after passing east through the village, turns south-eastward to Sudbury. In this instance the rocks intersected are granites which Bell regards as of Laurentian age, but which instead can be shewn to be younger than even the nickel-bearing greenstones which he regards as not older than Huronian. The dyke is again exposed just west of the smelter at Murray Mines. Here the dyke cuts through the greenstone area with which the Murray Mines deposit is connected. All the exposures of diabase along the Canadian Pacific Railway between Sudbury and Murray Mines, are portions of the same dyke. Thus in following up this dyke for a distance of three miles it is seen to be of later age than any of the other rocks of the district. A second diabase dyke crosses the Canadian Pacific Railway one mile east of Worthington station. Its general direction is north-west. A third dyke crosses the railway about one quarter of a mile east of Worthington station and shews about the same general direction as the others. Many other examples occur, some of which are said to have other directions, but all those examined by the writer, have a general north-westerly direction. In width they vary from a few feet to fifty yards.

One thing characteristic of these dykes is the ease with which they are acted upon by hydro-chemical agencies. Near the Village of Murray Mines, the government road passes for some distance between high walls of granite, which have become prominent by the weathering out of the diabase. The nickel bearing greenstones resist the action of atmospheric influences much better, and are generally greenish on weathered surfaces. In this they stand in contrast to the rocks under discussion, which become quite rusty on exposure. Spheroidal weathering is characteristic. When well exposed the diabase seems to be made up of all ball-like masses, varying in size from a few inches to several feet in diameter. Decomposition is seen in the separation of concentric layers. Good exposure of this weathered rock often resemble walls built of cobble stones. With a view to understanding the reason for this concentric weathering, a thin section was made of a ball about three inches in diameter. No radial or tangential arrangement of any of the con-

stituent minerals could be noticed. Mineralogically the centre of the ball did not differ from the portions nearer the surface. If these ball-like forms originated from the molten magma by crystallization beginning at independent centres, which afterwards became the centres of the balls, then we would expect the central portions to contain the more basic minerals. The microscopic examination of the large section did not confirm this anticipation. This structure has been regarded as due to contraction on cooling after solidification. Spheroidal weathering is very frequent in diabase. One of the exposures on the Canadian Pacific Railway, just east of Worthington station, shews phenocrysts of plagioclase from one to two inches long. This porphyritic phase is confined to a margin of from four to six feet along the wall. The rocks intersected show contact action, since, for three yards from the junction with the diabase the slates are broken into rhombohedral fragments. Just behind McGregor's house at Murray Mines a similar action is shown. The granite, along the contact with the diabase, is shattered into layers parallel to the contact. Adjoining the diabase these layers are about one-third of an inch wide; the width of the successive layers gradually increases till a maximum of two-and-a-half inches is reached at about two feet from the contact. A section from one of these layers of granite, showed, under the microscope, that considerable limonite had been developed, and that the feldspar was somewhat kaolinised. Besides, the quartz grains appear to have been shattered by the heat; they are seen in groups having nearly the same orientation as though larger grains had been broken up into several fragments which now form one of the groups of grains with nearly simultaneous extinction. No glassy borders were observed on the diabase, but this may be due to the ease with which the rock decays. In one instance a dyke was examined which showed a trench 10 inches wide and about twice as deep, along the line of contact. This was probably caused by the comparatively rapid decay of a glassy border, but there was no opportunity of obtaining fresh specimens of the dyke quite close to the contact. Near the border the rock is fine-grained, but within a few inches it becomes almost as coarse as at the centre of the dyke.

Mineralogically considered, the plagioclase is the most abundant. It is generally quite fresh, but at times somewhat kaolinized. Idiomorphic much-tinned crystals are characteristics. From a measurement of the

angles of extinction in thin sections it appears to be one of the most basic members, such as labradorite. The relative proportions of lime and soda found in the general analysis of the rock point to its being a feldspar containing very much more lime than soda, such as we have in the case of labradorite. Wandering extinction and zonal structure are very frequently observed. In some of the slides prepared from the dykes near Worthington the feldspar crystals in a few cases contain slender inclusions, probably of glass, arranged with their longer direction parallel to the contact between the successive twinning lamellæ. The twinning is commonly according to the albite law, but a combination of the albite and pericline laws is not infrequent. In one section from the dyke near Murray Mines, twinning was seen combining the albite, pericline and baveno laws. Being the earliest of the silicates to crystallize, we have the ophite structure beautifully developed by the idiomorphic lath-shaped forms of the plagioclase. The quantity of pyroxene varies. In the exposures near Murray mines about one-quarter of the rock is pyroxene, while at other points on the same dyke and also in the dykes near Worthington the pyroxene does not form more than one-eighth. It is noted that where there is most pyroxene there is least olivine and *vice-versa*. The total quantity of olivine and pyroxene is nearly constant—the one increasing as the other decreases. The olivine occurs in pale greenish-yellow grains which are generally somewhat rounded, and are a little younger than the feldspar, but older than the pyroxene. In a few cases the olivine has given rise to serpentine and fine grains of magnetic iron ore. The pyroxene shows no definite outline. Cleavage can be very seldom observed. It is reddish-brown to violet in color and faintly pleochroic. In none of the large number of sections examined could alteration of the pyroxene be seen. The iron ores are in part magnetite and the rest is probably ilmenite. They occur in irregular grains, showing no alterative products, and are generally associated with the olivine. Very slender apatite needles are abundant and intersect all the other minerals. A few scales of strongly pleochroic brown mica, a little chloritic substance, an occasional minute speck of a brassy sulphide and a few particles of quartz complete the list of minerals. Considering the general freshness of the rock it is easiest to regard the quartz as primary.

A careful chemical analysis was made of specimens from an exposure of the dyke on the Canadian Pacific Railway near Murray Mines.

The result of this analysis is shown in column I. Column II. shows an analysis by Mr. W. F. Hildebrand (4) of an olivine gabbro from Pigeon Point, Minnesota. III. is Teall's (5) analysis of diabase from Cauldron Snout, Durham, England.

	I.	II.	III.
	Per Cent.	Per Cent.	Per Cent.
$S_1 O_2$	47.22	49.88	51.22
$Al_2 O_3$	16.52	18.55	14.06
$Fe_2 O_3$	3.32	2.06	4.32
$Fe O$	12.40	8.37	8.73
$Mn O$	.04	.09	.16
$Ca O$	9.61	9.70	8.33
$Mg O$	3.33	5.77	4.42
$K_2 O$	.67	.68	1.25
$Na_2 O$	3.40	2.59	2.55
$H_2 O$	.30	1.04	1.28
$C O_2$ .....	....	....	.19
$Ti O_2$	3.62	1.19	2.42
$P_2 O_5$	.33	.16	.25
$Fe S_2$ .....	....	....	.49
$Ba O$	.01	.02	....
$N_2 O$	.0275	....	....
$Co O$	.0055	....	....
$Cu O$	Trace	....	....
Total	100.803	100.10	99.67
Spec. Grav	3.01	2.97	2.98

The proportion of ferrous oxide is much higher than usual, as is also the titanate acid. This latter doubtless occurs partly in the ilmenite and magnetite, and partly in the augite, giving it its characteristic violet

color. The small amount of oxide of barium was found by working with a large quantity. Mr. Hildebrande has recently shown that the occurrence of this element in rocks is much commoner than formerly supposed. About eighty grams of the rock powder was fused with an arsenical flux and the resulting arsenide buttons were treated for copper, nickel, and cobalt. In this way the quantities of cobalt and nickel could be easily separated and weighed. It has long been known that nickel is a frequent constituent of the heavy ferro-magnesian minerals, especially of pyroxene and olivine, and it is quite probable that in this case the nickel, cobalt and copper occur in these minerals. Whether these metals were primary constituents of the magma or not, it would be difficult to say. They may be derived from the nickel-bearing greenstones, as the diabase dykes cut through them and possibly through some of the nickel deposits associated with the greenstones. It is easier to regard the original diabase magma as containing the heavy metals. No nickel deposits have been found associated with the dykes.

The quantity of nickel contained in this rock may seem to be only trifling, but there is more nickel in one of these dykes than in the best nickel mine in the Sudbury region. Take the dyke which crosses the railway between Sudbury and Murray Mines. This dyke has been traced for three miles, though it is probably much longer, and is at places 150 feet wide. It contains enough nickel to form a band of 2 per cent. nickel ore over two feet wide and as long as the dyke. If it were all concentrated in one mass, the deposit of 2 per cent. ore would be forty-eight feet wide and one-eighth of a mile long. The deposit would have the same depth as the dyke. This would yield 10,560 tons of 2 per cent. ore for every foot in depth, or 1,056,000 tons for the first hundred feet in depth. This would represent 21,120 tons of metallic nickel, or enough to supply the market for ten years. This is for only one dyke, counting only three miles as its length. But this low percentage of nickel is of no value whatever. Nature has not concentrated the nickel here as she did in the greenstone areas. Had the diabase cooled more slowly and contained a considerable quantity of sulphur, then the nickel contents of this rock would doubtless have concentrated in lenticular masses along the wall, so as to be available for mining purposes. These conditions were present, however, in the case of the nickel-bearing greenstones, and consequently we have large masses of nickel ore.

GOLD IN ONTARIO AND ITS ASSOCIATED ROCKS
AND MINERALS.

By DR. A. P. COLEMAN, Toronto.

Since the discovery of the Richardson mine in the Township of Madoc, in 1866, gold has been found at hundreds of points in Ontario, from the Madoc region in the east to the Lake of the Woods in the extreme west. In this distance of 900 miles there is nowhere a gap of more than about 100 miles between known gold deposits, except in the little explored region north-east of Lake Superior, where gold has not been discovered for a stretch of 175 miles. It will be convenient to speak of three gold regions in the province, a south-eastern one in Hastings county, a central one reaching from Wahnapiatae to the Sault, and a western one extending from Lake Shebandowan to the Lake of the Woods. A few isolated discoveries lie outside these areas, and it may be that future finds will connect the three gold regions into a single one including the whole Archaean portion of Ontario.

Unlike most gold regions, Ontario has no placer deposits, a consequence of intense glacial action which has swept away all gold-bearing sands and gravels and so mixed them with barren materials in the immense beds of drift found in the southern portions of the region as to make placer mining hopeless. It is said that colors of gold may be washed from the sands of Toronto Island, and probably traces of placer gold could be obtained at many other points by perseverance in panning, but nowhere in paying quantities. In this respect Ontario resembles Nova Scotia and differs from Quebec with its Chaudiere placers, and still more from British Columbia.

Another important result of ice action has been the more or less complete removal of weathered products from the surface of veins, so that the sulphides which regularly accompany gold-bearing quartz in all parts of the world below water level are here found as a rule only a short distance beneath the surface; implying that no large amount of thoroughly free milling oxidized ore can be obtained from our mines, and that the more refractory sulphide ores must be treated from the very first. The points just mentioned account largely for the slow advance of gold mining in the province.

The gold from our mines is unusually pure, resembling in this respect the gold of Nova Scotia rather than that of British Columbia. Assayers notice that Ontario gold ores, when free from galena or copper pyrites, yield buttons with little more silver than is accounted for as coming from the litharge or test lead employed in the assay. Probably the proportion of silver is generally less than five per cent., though exceptions occur to this rule. Dr. Lawson states that in some gold ores from the Lake of the Woods "silver occurs in the auriferous quartz veins, generally as an accessory mineral, in small quantities, but sometimes, as the assays of the Pine Portage mine show, in greater proportion by weight than the gold "**

Our gold appears in the usual forms as nuggets, scales, etc., and never, so far as I have observed in crystals, though crystals of gold have been reported from the interesting new region of Wahnapiatae. Specimens from that lake in the museum of the School of Practical Science, Toronto, show smooth planes, but apparently only an impress from adjoining quartz crystals.

Of the minerals associated with gold, quartz is by far the most constant, so that miners and explorers are apt to call every gold ore, no matter what its composition, quartz; if, indeed, they do not refer to it as a "quartz," with the idea that a single specimen should be spoken of in the singular, not in the plural. The gangue quartz of Ontario gold ores varies greatly in character. Often as found at the surface it is rusty and porous, "good looking rock," while a short distance below it contains sulphides and is quite different in appearance. The quartz may take on crystal form and be more or less clear and transparent, as in some specimens from Wahnapiatae, or it may be massive or bluish grey, as in the ore from the Ophir mines in Galbraith township, or the Sultana mine near Rat Portage. Some of the latter quartz, which is distinctly schistose and has a crypto-crystalline appearance with thin bands of chlorite or hornblende running through it here and there, might properly be described as quartzite. In other regions the quartz is apt to be fine grained and milky or dull white, as at the Partridge mine near the Atikokan, or the Ledyard mine in Belmont. From the latter locality come some beautiful specimens of white cellular quartz with specks of gold disseminated over the walls of the cells. In the same quartz, Mr. McAreë has

observed small red jaspery concretions.* Sometimes the quartz is stained to a pale red with films of hematite, as at the Rey-Wiegand mine on the Seine river, or green with malachite, as in the McGowan mine near Parry Sound.

In texture, then, the quartz may form crystals or coarse or fine grained crystalline masses, or it may be cryptocrystalline and compact. Its color may vary from pure white to greenish black, or it may be stained red or brown or green with iron or copper compounds. It may be almost transparent or only translucent or quite opaque. It may be true vein quartz or a schistose quartzite. A few other oxides occur in our gold ores, especially the brown hydrous and the red anhydrous oxides of iron in weathered surface ores. Vennor states that gold has been found embedded in the third oxide of iron, magnetite, in the Madoc and Mar-mora district, and that Prof. Bell of Albert College, Belleville, found oxide of tin in a specimen of ore from the same district.† A similar association has been observed at the Vermillion mine in the Sudbury region, where small amounts of cassiterite occur.

Sulphides of one kind or another are almost universal accompaniments of ores of gold that have not been subjected to weathering, the most prominent, of course, being iron pyrites, whose brassy gleam may be seen in most of our gold ores. It displays the usual crystal forms, cubes with striated planes or pentagonal dodecahedra. Crystals almost an inch in diameter are sometimes found in the Belmont ores. The common occurrence of pyrite with gold is no doubt accounted for by the mode of transport and deposit of the metal, sulphate of iron having the power to dissolve small quantities of the metal. Any reducing agent, such as organic matter, destroys the solvent by forming sulphide of iron, the gold being deposited at the same time. This theory satisfactorily accounts for the particles of gold often found embedded in the pyrite. If the particles are above a certain size they are more or less completely liberated by crushing and may be saved by amalgamation. Such sulphide ores are partially or wholly free milling. If the particles are very minute many of them will not be set free by simple crushing, and the ore is refractory. It is worthy of note that some of our ores which have been looked on as highly refractory, so that thousands of dollars have

*Papers of Engineering Society, S. P. S., p. 26, etc.

†Geol. Sur., Can., 1871-72, p. 131.

been spent on chlorination or other plants with which to treat them, have turned out to be almost completely free milling. An excellent example of this is to be found in the Sultana mine, from whose sulphide ores 92½ per cent. of the gold is extracted in the stamp mill, and the small quantity of concentrates obtained hardly pays for treatment.

In the Sultana ore one frequently sees specks of gold embedded in the quartz entirely apart from the iron pyrites. It is clear that this gold cannot have been deposited in the way suggested above. Perhaps this and the nuggets sometimes found in pure white quartz at the neighboring Ophir mine have been carried in the form of a gold silicate, as suggested by Bischoff and other writers.

The cellular white quartz from Belmont doubtless once had its cavities filled with pyrite crystals like those now found below the level of weathering. The sulphide has been oxidized into sulphate and leached out, one stage of the process being perhaps the formation of hydrous sesquioxide of iron and of siderite.

I am not aware that the marcasite variety of iron pyrites has been found in our gold ores, but pyrrhotite, the lower sulphide, is not infrequent in the Lake of the Woods region.

Small amounts of copper pyrites are often found accompanying the iron pyrites in our gold quartz, sometimes largely replacing it, as at Oliver Daunais' Wabigoon mine. The other copper sulphides, bornite or peacock ore, and chalcocite or copper glance, are much less common. In one very interesting deposit found last spring near Parry Sound these two minerals occur in large quantities in the quartz, far outweighing all the other sulphides, and small nuggets of gold may be enclosed in them or lie between the copper ore and the quartz. An assay of some of this bornite free from visible gold gave ½ ounce per ton, with a very small per centage of silver.

Mr. Coste in his report on the Lake of the Woods region mentions the somewhat rare sulphide of copper, covellite, as occurring with iron and copper pyrites, bornite and other sulphides in the gold ores from that part of Ontario.*

The only other sulphides which I have observed or seen mentioned in connection with our gold ores are galena and zincblende. The former is often found at the Lake of the Woods and Rainy Lake and is

*Geol. Sur., Can., 1866-69.

there considered a favorable sign, since it is generally associated with free gold. The cause of this relationship is not easy to understand, for the galena itself does not usually carry any important amount of gold. Zincblende is found in small quantities in mines near Port Arthur and Marmora, but seems to have little influence on the gold contents of the ore. The sulphides of iron and copper seem much more efficient as gold bearers than those of the other metals.

The only compounds of arsenic or antimony found in our gold veins are mispickel and tetrahedrite. The latter mineral has been reported from only one locality, so far as I am aware, the Empire mine in Madoc, where Vennor found it forming small gold-bearing veins with calcite, magnetite and quartz in dolomite.* Mispickel, on the other hand, is rather widely spread in the gold deposits of the Province, being found in small quantities in ores from the Lake of the Woods, and in immense amounts at the Gatling and other mines near Delora in Marmora. The mispickel of Delora occurs sometimes as very pretty rosette-like twined forms or as crystals of prismatic habit, but more commonly in fine or coarse-grained masses. According to Prof. Chapman,† it averages from one or two to seven or eight ounces per ton of gold, and the value of the ore is considerably increased by the large amount of arsenic it contains; but the ore proved so refractory that the expenditure of hundreds of thousands of dollars in elaborate reduction works resulted only in failure.

A quite similar ore was worked, apparently at a profit, many years ago at Goldberg in Silesia, where the arsenic was made a valuable part of the output. It is probable that improvements in method may yet cause these mines to be valuable. In considering the province as a whole one should remember that arsenic in amounts sufficient to make the ore very refractory is confined to this narrow belt of territory. The Belmont mines, a few miles away, show no trace of mispickel.

Tellurium occurs apparently in only one locality in the province, in the sylvanite of the once famous Huronian mines west of Port Arthur.

The other minerals associated with gold in the province are not specially important. Free gold may sometimes be found in the silicates forming the wall of veins. A pretty specimen from Wahnapiatae, now in

*Geol. Sur., Can., 1866-69.

†Minerals and Geology of Central Canada, p. 307.

the museum of the School of Practical Science, Toronto, contains several small nuggets completely enclosed in green chlorite. Vennor refers to occurrence of gold in dolomite and calc-spar,* and describes the wonderfully rich cavity of the Richardson mine in Madoc, where the first gold was discovered in Ontario. The gold was here found in a "reddish brown ferruginous earth in which were scattered fragments of a black carbonaceous matter, the latter showing when broken, small flakes and scales of the metal."† Specimens of free gold from Marmora, in the School of Science collection, are associated with a somewhat weathered siderite. Probably some of the rusty quartz with free gold from this and other parts of the province, results from the decay of siderite or other carbonates rich in iron, rather than from the weathering of sulphides.

Turning now to the rocks in which the gold deposits of the province occur we find that they are all very ancient, most of them Archæan. The south-eastern region, that of Marmora, Madoc, Belmont and other townships, is probably the most ancient, belonging to what Vennor calls the Hastings series, believed by him to be the equivalent of the lower Grenville series of Logan, *i.e.*, to the lower portion of the upper division of the Laurentian. It is possible, however, that these rocks are really a small area of greatly modified Huronian. The remarkable gold bearing deposit of Parry Sound is probably of the same age. All the other important gold districts are Huronian, if we assume that Lawson's Keewatin is in reality of that age.

Dr. Chapman, however, has obtained gold from a vein in Keewatin rocks at the Enterprise mine on Black Bay, Lake Superior; and gold has been found in the Animikie, north and east of Port Arthur,‡ showing that the precious metal does occur in rocks younger than Huronian, probably lower Cambrian.

Lithologically, the rocks in which gold has been found in Ontario, vary greatly. Vennor describes the famous Richardson mine as occurring at the contact of a "chloritic and epidotic gneiss with a silicious ferruginous dolomite." It was in a cavity at this contact that the thousands of dollars' worth of rusty earth thickly spangled with flakes of gold were found, which raised a gold fever the like of which has never been experienced since in the staid province of Ontario. In several other

* Geol. Sur., Can., 1866-69, p. 167.

† *Ibid.*, p. 165.

‡ Min. and Geol. Central Canada, p. 301, etc.

parts of the Hastings series Vennor finds gold in veins running through dolomite, in silicious dolomite or at the contact of mica slate and dolomite. With the dolomites are mentioned various schistose rocks, talcose, micaceous, chloritic and hornblendic. So far as mining experience goes in Hastings, the deposits in connection with dolomites are merely pockets, sometimes rich, but quickly exhausted. Vennor believed that the gold of the region is in close association with the summit of an iron-bearing band.

The only specimens of country rock from the region which I have examined are from the Belmont mine. The specimens, which are greatly weathered, consist of diorite, perhaps originally diabase, and chloritic schist. The latter contains a large amount, almost 50 per cent. of a carbonate, calcite or dolomite. Mr. McAree, who examined the country rock of the Crawford mine in the laboratory of the School of Science, found it to be weathered diorite, with chloritic schist in the walls.*

The gold of the McGowan mine, Parry Sound, is found in a bedded vein resting on a dark diorite-schist and covered with a mica-diorite schist. A few feet above this a bed of dark grey rock turns out to be a gabbro. Mingled with the quartz is a rock consisting of quartz, muscovite, garnet and a little augite, a combination hard to name. Not far off one finds dykes of very coarse-grained pegmatite and a large extent of gneiss, while a bed of impure crystalline limestone occurs a mile to the west. It is somewhat doubtful if this association of rocks should be placed with Vennor's Hastings series, but it differs decidedly from the typical Huronian and from Lawson's Keewatin. As this is a new locality the rocks have been mentioned in some detail.

Passing to the central gold region, the rocks containing the gold deposits about Lake Wahnapiatae have, so far as I am aware, never been carefully examined, though Bell maps them as Huronian with eruptive masses of diabase and diorite, the Huronian being defined as consisting of a variety of crystalline schists and stratified clastics, such as gray-wacke.

The country rock of the Vermilion mine is Huronian, but of just what character I am not aware.

A specimen of the country rock of the Ophir mine in Galbraith township, submitted to me by Mr. Blue, Director of the Bureau of Mines, though greatly weathered, is pretty certainly a diorite.

* Papers of Eng. Soc., S.P.S., p. 26, etc.

Going still further west, we find some gold-bearing veins in the dark Animikie slates, north and west of Port Arthur. No doubt the eruptions of fine-grained diabase which traversed these rocks and covered them with wide-spread beds of lava have had a great influence on the formation and filling of the gold veins, as well as those of silver, in the region.

The Huronian mine, unique in Ontario as containing the rare mineral sylvanite, doubtless occurs, as its name suggests, in the Huronian, but I have not seen any detailed description of the enclosing rocks.

We now come to one of the most recent gold regions of Ontario, that of the Seine river and Rainy lake, where fortunately the geology has been, in many parts, quite carefully worked out by Lawson and his assistants and successors. Lawson's excellent map shows rounded areas of Laurentian gneiss, granite or syenite enclosed in wide meshes of Couchiching gneiss or mica schist, underlying the Keewatin schists, probably of Huronian age. Up to the present gold has never been found, so far as I am aware, except in or near the latter group, which consists of a complicated series of schistose, massive and fragmental rocks. The schists are either basic in character and of some green shade of color, or acid and yellowish or brown. The green schists are probably of volcanic origin and are mixed up with massive fine-grained diabase, the latter being probably solidified lavas, while the schists represent ash-beds. The green schists are sometimes soft and chloritic, at other times hard and hornblendic. The acid series of rocks represents, according to Lawson, a later series of volcanic products resembling quartz, porphyry and related rocks originally, but now turned by metamorphic action into schistose, felsites, etc. Besides the rocks mentioned, distinctly fragmental rocks, such as graywackes and even schist conglomerates occur in large amounts. Of these rocks the softer green schists naturally appear the most promising, and many gold-bearing veins have been located in them, almost always of the bedded variety. Examples of this are found in the well known Little American mine, where a series of lens-shaped quartz veins dip steeply (82° - 85°) to the south, between layers of chloritic and hornblendic schist. Free gold has, however, been found also in bedded veins in schist apparently of the felsitic or acid type, as in the series of locations north of Wild Potato lake, an expansion of the river Seine. The most talked of claims of all in this region, the Ray-Wiegand property and adjoining ones, which are now being developed,

show free gold at many points and assay well, but are of a totally different character. They are distinctly fissure veins, with sharply defined walls, crossing the general trend of the schists of the region. These veins are not in the schists, but in a peculiar quartzose granite, not very far from the contact with the Keewatin schists. Some other bosses of granite, and also of a very coarse-grained gabbro, or perhaps anorthosite, since the white feldspar greatly predominates, lie just to the west on Bad Vermilion lake.

The rocks of the Manitou region to the north are of the same general character, but have not yet been mapped.

On a claim owned by LaCourse, a pockety vein which has provided a great number of handsome specimens, lies in a gneissoid rock that looks very different from the ordinary Keewatin, and may be Couchiching, but I wish to examine thin sections of the specimens taken before speaking positively. Another claim which is now being developed at the north end of the lake, shows bedded veins of quartz with visible gold in Keewatin graywacke.

The massive diabases of the Rainy lake and Manitou contain few quartz veins, and these are apparently not auriferous.

The most westerly gold field of Ontario, that of the Lake of the Woods, has been before the public for a number of years and is fairly well known as compared with the territory just to the east.

The Sultana mine, which produces its brick of gold with great regularity, works a bedded vein in green and gray chloritic and hornblende schist. On the same island or point we find a vein striking in a quite different direction and enclosed in a somewhat coarse syenitic gneiss. This is the Ophir mine, which has produced such wonderfully rich specimens of free gold.

The Bad mine, near Rossland, which also provides specimens rich in free gold, is on a quartz vein lying upon gray syenitic gneiss and having a few feet of fine-grained flesh-colored gneiss or granite just above, followed by the syenitic gneiss again.

Other mines in the same vicinity have been sunk upon bedded veins in green schists of the usual Keewatin type, but nowhere far away from the syenitic gneiss.

In summing up the results of this very brief survey of a very wide field, one may say that the gold of Ontario is generally alloyed with only

a small percentage of silver, and is usually found, as in most other regions, in quartz-containing iron pyrites or other sulphides, or the oxides resulting from their decomposition. Much of it is free milling; and very refractory ores, such as tellurides or arsenic compounds, occur in only two localities. In the western part of the province the presence of galena or copper pyrites is believed to indicate rich ore.

In the majority of cases the gold-bearing veins are of a bedded character, especially those in highly schistose rock. In the eastern part of the province the enclosing rocks are rarely more or less pure dolomites, but are often diorites, diabases or gabbros, or schistose modifications of these rocks, and belong probably to the upper Laurentian. In the western region the chief country rock is the green Keewatin schist of the Huronian, rarely the brownish felsitic variety, and in these rocks the veins are bedded. Gold-bearing veins in this region occur chiefly near the contact of the schists with granite or syenitic gneiss. At a few points true fissure veins with much free gold occur in the granite or syenitic gneiss, but, so far as known, close to the contact with the green schists.

THE GLENDOWER IRON DEPOSIT.

By W. G. MILLER, B.A., Kingston.

It was thought that a few notes on the Glendower iron deposit might be of interest to the members of the Institute as it is the first property on which the new Government diamond drill has been put to work; and moreover, the deposit, in itself, has some features which are worthy of study.

The Glendower mine is situated in the township of Bedford, in the county of Frontenac, four miles east of Bedford station on the Kingston and Pembroke Railway, with which it is connected by a switch.

Much has been written on Ontario iron deposits by Logan, Hunt, Harrington and others. Our iron deposits have probably been studied in as great detail as have any of our economic deposits. Since, however, so few of them have been worked out or, in other words, have had

their ore exhausted, most of the theories concerning their nature and origin have been formed, we might say, *above ground*. So that we may hope to understand them better after more underground work has been done.

Many theories have been proposed to account for the origin of these deposits, and as the deposit with which we have to deal consists of magnetic iron ore, I shall, with your permission, give a short review of the chief theories which have been suggested to account for deposits of this nature, although I am aware that most of you are well acquainted with them. Afterwards I shall give a short description of the Glendower deposit, and we will try to determine which of these theories is the most applicable to it.

The chief theories, then, as to the origin of magnetite deposits are :

1st. The theory which received the support of Hutton about one hundred years ago.

Hutton believed that the iron ores which we now find among metamorphic rocks were of igneous origin, *i.e.*, that the ore had been emptied into crevices or fissures in the rocks in the molten state. His theory has now become practically obsolete as regards most iron deposits, and the tendency of opinion, at the present time, is towards the chemico-sedimentary theories. It is, however, believed by some that our titaniferous iron ores have had an igneous origin.

2nd. Another theory closely connected with that of Hutton is that in which it is supposed that iron ores have originated, for the most part, as the excessive basic portions of igneous rocks. There are such occurrences in Greenland and elsewhere, although seldom, if ever, pure enough or abundant enough to be worked.

3rd. It has been held that many of these deposits have originated as beach sands. This theory was proposed by a Canadian, Dr. Harrington, of Montreal, in 1873, and it has since received the support of many eminent geologists.

4th. In somewhat the same way as under the last example we find magnetic sands concentrated as river bars and collected together in lake expanses or still bodies of water along rivers. Hence it has been held that deposits, which we now find among metamorphic rocks, have originated in this way.

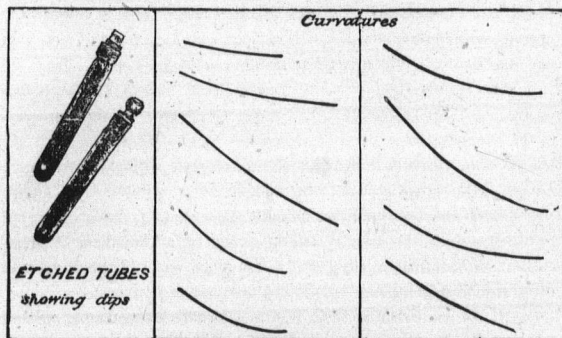
5th. As replaced limestone beds—in which it is supposed that the

iron may have replaced calcium carbonate or have existed in the form of siderite, and have been finally metamorphosed into magnetite.

6th. As submarine chemical precipitates, a theory which has been proposed by the Winchells for some of the iron ores—chiefly hæmatite—of Minnesota. The igneous rocks associated with these ores lead to the conclusion that the enclosing rocks have been formed by submarine volcanoes. Deposits of iron and silica, which are interbedded, are thought to have originated from the heated, overlying water. During last summer, however, Spurr has shown that these ores originated from the solution or leaching out of the iron in beds of green sand or glauconite.

7th. As metamorphosed limonite beds. This theory has met with quite general acceptance, and it is believed by some observers that many of the iron deposits in this vicinity have originated in this way. The limestone and gneisses or schists which form the country rock are believed to represent sedimentary materials which was laid down contemporaneously with the limonite.

8th. There is the method of formation of deposits by segregation or as segregated veins. This theory is viewed with favor by many re-



(Modified after Channing.)
Curvature of Diamond Drill Holes.

liable observers. By this method the iron oxide is conceived to concentrate from a state of dissemination in the walls, by slow secretion in solution, to form the ore bodies along certain favorable beds. "The

nature of the action is well illustrated on a small scale by the well known disks of pyrites and calcite that form in clays and shales." This theory cannot of course be applied to magnetite deposits in general, but it is probably true in certain cases. Where it applies we should expect to find hornblende and other ferruginous minerals in association with the ore, since it would be only from the more basic rocks that the iron would be leached out, and it is also likely that the ore would be fairly well crystallized.

Many deposits are, of course, commonly spoken of as veins, although they are quite different in structure.

Besides the theories which I have mentioned, there are some ten or twelve others which have been proposed, some of which seem to be applicable in certain cases, but they are of less general interest.

It is difficult to say which of these theories can be applied to the Glendower ore body. This deposit lies in metamorphic rocks which have a strike about N. E. and S. W. and dip at an angle of over 80°, the rocks on the upper side of the deposit being crystalline limestone, while that on the lower has been described as hornblende schist. The ore itself is a coarse magnetite, and in places is well crystallized and exhibits a well defined parting. Mixed with the ore there is considerable hornblende in large pieces. The deposit can be traced for over half a mile and, where the ore was mined, it is said to have a breadth of from twenty to forty feet. It was worked to a depth of about one hundred and eighty feet, and a curious feature of the ore is that down for some distance from the surface of the ground it is quite free from sulphur, but after reaching a certain depth it was found to contain a considerable percentage of this impurity. The object of drilling at the present time is to test the deposit at a greater depth and see if the ore again becomes free from it. It is said that the shaft was sunk to a depth of one hundred and twenty or one hundred and thirty feet before the sulphuretted ore was met with.

It was claimed that in a former boring, made some years ago, the ore was found to become free from sulphur at a greater depth, and this raises an interesting question as to how the one part of the ore contains sulphur, while the mineral both above and below the sulphuretted band is comparatively pure.

*Report Roy. Com. Min. Res. Ont., 1890.

Having now briefly described the deposit, let us see if any of the theories of origin which I have mentioned will satisfactorily account for the characters which it possesses.

Hutton's theory, or that which considers the ore to have been formed as a dyke, certainly cannot be applied to it, as the rocks on the sides of the deposit show no evidence of metamorphic effects, which would have been brought about had the molten mass been protruded between them.

There is no evidence that the ore is the more basic part of an igneous mass of rock.

Certain features of the deposit also preclude the idea that it has originated as beach sands or as river bars.

The deposit shows no characters which would lead us to suppose that it had originated as a submarine deposit.

The magnetite may have been produced through the metamorphism of limonite beds, although the form which the layer of sulphuretted ore takes in the deposit does not seem to point to this mode of origin. The sulphur layer is in a direction transverse to the dip of the deposit, while if the deposit had had a rudimentary origin we would expect this layer to lie in the direction of the dip.

I have not met with any description of bodies of ore of this nature which contain sulphuretted bands in this form. An interesting paper is, however, to be found in the Transactions of the American Institute of Mining Engineers, Vol. XVII., by D. H. Browne, on the "Distribution of Phosphorous at the Luddington Mine." In this paper the author shows that the bands of bessemer and non-bessemer ore alternate and that they lie in the direction of the dip of the rocks.

From some characters of the hornblende rock on the lower side of the Glendower deposit, it seems possible that the ore may have been derived from this rock by a process of leaching or segregation in solution.

The components of the rock in portions of the drill core examined microscopically are essentially pyroxene, which in some of the thin sections examined is seen to be almost completely altered into hornblende, while in others it is quite fresh, and scapolite, with, in places, a considerable amount of calcite.

Large pieces of hornblende are found scattered through the ore, a

fact which seems to point to the presence of hornblende in the source from which the iron was derived.

The ore, if we accept the view that it has been formed by segregation in solution was formed in a line of weakness between the limestone on one side and the hornblende rock on the other, and the iron was dissolved out of the latter by water, more or less heated, percolating through it. Along the line of weakness there would be more chance for the matter carried in solution to become oxidized and the result would be that the iron which had been dissolved out and put into solution by carbonic acid or other acids or alkalis, would be precipitated in the opening and take the place, to a certain extent, of the calcium carbonate which would be dissolved in its stead. This latter material would be carried through by the percolating water and deposited, on the solution becoming concentrated, in the adjoining rocks, where there was little or no oxidation taking place. Thus it is that we find the hornblende rock filled with granules of this secondary calcite.

It seems to me, taking all the characters of the ore body into consideration, that the magnetite has originated by this process of segregation from the adjoining rock, although the question needs more careful study than I have been able to give it. This theory will account for the position the sulphuretted band is said to occupy.

It has been held by most authorities that the magnetite deposits in our Archæan rocks have had a sedimentary origin and have been formed at the same time as the metamorphic rocks which enclose them. J. D. Dana has summed up the opinion of these authorities in the following words:—"Geologists who have studied the widest range of Archæan iron regions—believing that they are alike in mode of origin—have reached the general conclusion that the ore and schists of all ære conformable in bedding, and hence they are metamorphic sedimentary deposits."

However, we have a means now, in the petrographical microscope, of examining into these questions more deeply than our predecessors, and it is likely that more light will be thrown on the problem. It was claimed, as mentioned above, that some of the iron ores of Minnesota had originated as submarine precipitates, but Spurr, on making a microscopic examination of the ores and their enclosing rocks, proved that the ore has been formed by a leaching out of the iron from beds of glauconite.

Since it is likely that many owners of mining locations in Ontario will make use of the diamond drill, which has been so liberally placed at their service by the Government, to test their properties, it may be well to mention an important paper, on diamond drilling, which is published in the Proceedings of the Lake Superior Institute of Mining Engineers, for 1893, by J. Parke Channing. Most people seem to think that diamond drill holes must be straight, but this writer from careful experiment and observation, has proved that in many cases they have a considerable curvature and that the direction which the drill tends to take is towards the horizontal. Mr. Channing has, as yet, not been able to determine whether there is a side curvature as well as the upward one. His paper is well worthy a careful perusal by anyone interested in drilling, and knowing the results which he has arrived at, much trouble and uncertainty will often be saved. He determined the amount of the curvature by letting down small glass tubes which were partly filled with hydrofluoric acid, to different depths in the holes. At the end of about two hours the tubes were pulled up and the etching produced on them by the acid showed the direction which the holes took at the points where the tubes had rested.

A FEW NOTES ON MERCHANTABLE MICA IN THE LAURENTIAN.

By WM. HAMILTON MERRITT, F.G.S., Assoc. R.S.M.S., &c.

Mica mining may properly be said to be in its infancy, and until quite recently had nowhere arrived at the dignity of mining, the operation consisting for the most part in making irregular surface pits where mica crystals were discovered at the surface.

This condition was chiefly due to the fact that the consumption of the mineral was very small. Electricity has, however, brought about a much larger demand for mica, and it is expected that mica mining will assume considerable importance in the near future.

Last year, up to Dec. 1st, \$26,257 is given by the Customs Department as the value of shipments to the United States and Europe—chiefly the former

During the past summer I had occasion to visit some of the mica deposits in the Kingston district in Ontario, and near Ottawa and in the Saguenay district in the Province of Quebec.



Fig. 1—Section of Smith and Lacey Mine, Sydenham, Ont.

It has occurred to me that it might possibly prove of interest to record a few notes on the occurrence of some of the deposits, for I think it is a subject well worthy of investigation, and all the information relating to it should be collected by our Institute. In fact I do not know of any economic mineral substance in which there is a larger field for investigation than that of mica deposits.

Dr. R. W. Ells has given a very interesting and valuable communication on "Mica Deposits in the Laurentian of the Ottawa District,"* to

*Journal Am. Chem. Soc., Feb. 1894.

the Geological Society of America. He gives six principal modes of occurrence for mica in that district.

It may be open to question whether a specific number of conditions can properly be laid down at present. Without doubt the deposits examined by Dr. Ells occurred as he described, but it may be possible that he would have expanded the number of conditions if more deposits had come under his attention. With reference to my own general observations, I may say that, as you probably all know, and as explained by the title of my paper, the mica bearing formations of Eastern Canada occur in the Laurentian.

Nearly all of these old crystalline rocks carry more or less mica, but only in certain belts, and in limited areas in these belts is mica found in large enough crystals to be of commercial value.

The mica occurs in two classes of rocks:

1. *In granite*—the mica being associated with quartz and felspar, and generally present as muscovite, or white mica. Other minerals, such as tourmaline, garnet, phosphate and common emerald, are very often found in a crystalline form associated with this class of deposit.

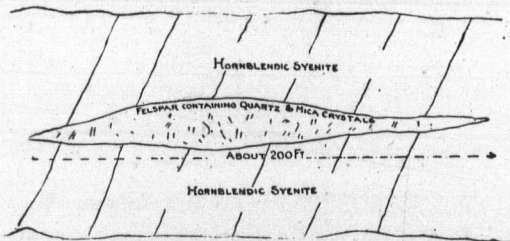


Fig. 11.—Lenticular Mass or Vein of Felspar with Mica Crystals, Murray Bay Mine, Que.

It is evidently where the crystallization of the rocks has been slowest that we find the merchantable mica, for the other components of the rock accompanying it are also more or less equally well developed, and we not only find larger crystals of mica, but the crystals of the other minerals composing the rock are of a correspondingly increased size. It is therefore advisable to note the general crystalline character of the rock

masses where mica crystals appear at the surface and mining operations are contemplated.

2. *Associated with Hornblendic or Pyroxenic Rocks*—chiefly hornblendic syenite, often gneissic, but in cases graduating from a pyroxenic syenite to a diorite or gabbro. In this latter class of deposit the mica is either found associated with hornblende or pyroxene and apatite, or in veins or irregular masses of calc-spar or felspar (with more or less quartz) cutting hornblendic or pyroxenic syenite. The mica is chiefly phlogopite or amber mica, and sometimes biotite or black mica is found.

It is remarked that where the hornblende contains a larger quantity of iron (typical black hornblende) the mica is darker, and when the mica is associated with the lighter colored actinolite it is found to be amber colored or almost white.

Working of Mica—Before proceeding to illustrate the above mentioned general classification of deposits by a few examples, I shall give a note or two about the working of mica.

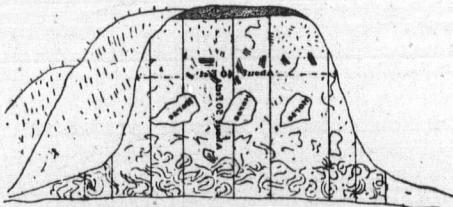


Fig. III.—Face of Cliff—Mica-bearing Ridge—Hall Mine, Saguenay District, Que.

It may correctly be inferred from the above remarks that the occurrence of the larger (or merchantable) crystals, is somewhat irregular and precarious, and such is found to be the case. Indeed, in most formations the crystals are much twisted, broken by joints, with embedded crystals of quartz or calcspar in them, and sometimes spotted with iron or manganese stain, or minute crystals of tourmaline or magnetite.

It is perhaps more difficult to put a price upon the cost of mining mica than upon any other mineral, though it be conceded that all mineral occurrences vary greatly in the cost of their yield.

Mica mining being quite in its infancy, the most economical manner of attacking and mining the mica remains yet to be determined. It will, however, probably be in the direction of cheapening the excavation of the rock containing it, by operating on a large scale where the formation warrants it. Most of the mining has been done up to the present in Canada by merely making pits where crystals were found of any size.

When the mica is associated with apatite, as is very often the case, that mineral yields a good price, and the felspar, which is in other cases largely developed in association with the mica, has been exported, but the extensive use of this mineral at remunerative prices to the producer, remains for further developments.

From instances observed, it may be said that in exceptionally favorable cases 20 tons of rock may yield a ton of merchantable uncut mica, and it in turn gives a very good result if from 4 to 10 tons yield one ton of cut mica. In one case in a yield of 23 per cent. of cut mica, 7 per cent. was No. 1, and 16 per cent. was No. 2. Sizes running from 6 x 7 in. down to $1\frac{1}{2}$ x $2\frac{1}{2}$ in., the smaller sizes being much the most numerous.

It is a somewhat strange coincidence that 23 per cent. is the exact yield of a well known Indian mine, as given in a very interesting article on Indian mica in THE CANADIAN MINING REVIEW.

One deposit yielded from $1\frac{1}{2}$ to 7 tons a week of uncut mica, for six men employed.

The cost of getting the rock carrying the mica may vary from 50 cents to \$2 per ton, and almost any shot in most mica deposits may bring an altered condition for the time being.

The cutting of the mica may be said to cost from \$50 to \$100 per ton of cut mica produced, depending upon the size and quality of the mica crystals.

The resulting cut mica furnishing a varying quantity of first or second class mica, and the price obtained for the product increases immensely in proportion to the sizes of the sheets, and whether the mica is pure white or dark amber color.

There are a variety of uses for the waste mica produced in the cutting and the demand for this is constantly increasing, but the enormous quantity of defective crystals produced in mining may be said to be of no value.

The following are examples of the occurrence of mica:—

1. In Bedford Tp., Frontenac Co., Ontario—Mica crystals are associated with apatite in a hornblende belt, occurring in a syenitic gneiss. Mica, dark amber-colored phlogopite.

2. In same locality as No. 1—(a) Mica is largely developed in a light-colored gneissic syenite band, varying from compact to highly crystalline, and where the large crystals are developed it has been mined in connection with phosphate, which occurs with it. (b) At one place the formation is cut with a distinct calc-spar vein, 5 to 8 ft. wide, and large mica crystals occur in this with light-colored hornblende masses. The mica is light amber-colored phlogopite.

3. In Loughborough Tp., Frontenac Co., Ont.—A strong belt of a quartz syenite carries mica crystals. Largely crystalline quartz and felspar, with patches of light-colored hornblende, contains mica crystals chiefly associated with the latter mineral. The mica is light amber-colored phlogopite.

4. In same Tp. and Co. as last—A belt of quartz syenite in large crystals carries mica. The quartz, felspar and light actinolite crystals are largely developed. The mica is light amber-colored phlogopite.

5. In Portland Tp., Frontenac Co., Ont.—Crystalline syenite, with light-colored, almost white, amber mica.

6. Hichinbrooke Tp., Frontenac Co., Ont.—A diorite (spotted), quartzose in places, and varying in color from grey to blackish-colored, with dark hornblende, contains mica with phosphate and magnetic iron. Mica is black biotite.

7. Loughborough Tp., Frontenac Co., Ont.—A belt of hornblende rock contains a zone of large hornblende and mica crystals occurring with apatite. Mica is dark amber-colored and has been found in crystals 7 feet square.

8. North Burgess Tp., Ont.—A hornblende rock which has decomposed to a green steatitic rock, about 50 yards wide, occurs between a quartzose gneiss and a felsitic gneiss and is mica-bearing. The mica is light-colored amber phlogopite.

9. Hungerford Tp., Hastings Co., Ont.—A granitic gneiss contains mica and tourmaline crystals. Mica is white muscovite, but at times spotted with minute tourmaline crystals.

10. North Burgess Tp., Lanark Co., Ont.—Strong belts of highly micaceous hornblende rock contain dark amber-colored crystals of mica with apatite. The crystals are often of a good size and in great abundance, but are much twisted for the most part.

11. Hull Tp., Ottawa Co., P.Q.—A dark-colored augite (diallage) syenite is cut with strong veins of calc-spar up to 15 feet wide. The veins carry mica crystals. Mica is dark amber-colored and somewhat spotted.

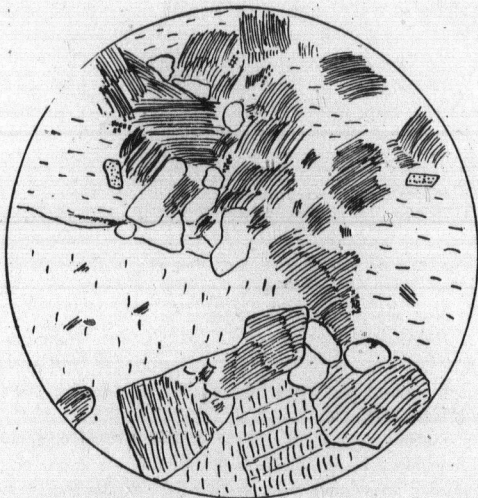


Fig. IV.—Rock Section, Augite (diallage) Syenite, from Hull Tp., Ottawa Co., P. Q.

12. Murray Bay District, North Shore River St. Lawrence, P.Q.—A lenticular mass, or possibly a vein, of felspar, with quartz horizontally cuts a dark hornblende gneissic syenite, which dips almost vertically.

The felspar mass has been opened for nearly 200 feet and shows a thickness of from 15 to 20 feet at the widest place, running down to a few feet. The mica is scattered in bunches of crystals. The felspar

and quartz assume the character of graphite granite occasionally and more commonly that of pegmatite. Large quantities of pure felspar are obtained. The mica is found both as white muscovite of excellent quality and also as phlogopite of an amber shade, a peculiar transition occurring very abruptly.

13. Saguenay Co., Que.—A granite ridge has the quartz, felspar and mica largely developed in crystalline form. The general character of the ridge is in the main quartzose with development of felspar and mica crystals, and more rarely crystals of tourmaline, garnet and phosphate. The ridge appears to have a stratification which is nearly vertical. On the flanks of the ridge a gneissic form appears with hornblende and some calc-spar, but the main body of the ridge consists of quartz, felspar and mica, the former largely predominating, some in the form of "rose-quartz." The crystallization is large in certain irregular zones where mica is mined. Large horse-like masses of greyish fine-grained rock come in here and there, with the larger crystallized rock occurring between them. The whole body of the ridge carries small mica crystals. The mica is muscovite, white and strong. The mica crystals are often impaired with quartz crystals lying imbedded in them, sometimes partly cutting through the mica crystal or entirely piercing it.

The Institute adjourned on Friday morning, 4th January, having held four sessions. In the afternoon the members were present at the formal opening of the mining laboratory in connection with the School of Mining—the first of its kind in Canada—and witnessed the operations of the plant, which includes a small steam stamp mill, Frue vanners, and other appliances for the reduction of ores and minerals.

In the evening the members were entertained to a dinner at the Frontenac Hotel, a numerous and distinguished company being present. A number of toasts were given and the proceedings were thoroughly enjoyable.

SECOND ANNUAL MEETING.

School of Practical Science,
TORONTO.

10TH AND 11TH APRIL, 1895.

The second annual general meeting of the members of the Institute was held in the School of Practical Science, Toronto, on Wednesday afternoon, 10th April, Mr. W. Hamilton Merritt, M.E., A.R.S.M., in the absence of the President, in the chair.

After the Secretary had read the minutes of previous meeting, the following were elected :

NEW MEMBERS.

Mr. J. Burley Smith, M.E., Glen Almond.
Mr. Frank Darling (Canadian General Electric Co.), Toronto.
Mr. Herbert C. Hammond (Osler & Hammond), Toronto.
Mr. W. E. Boisted (School of Practical Science), Toronto.
Mr. J. W. Shields (School of Practical Science), Toronto.
Mr. G. R. Mickle, M.E., Sudbury.
Mr. W. A. Parks (Biological Building), Toronto.

AMENDMENTS TO CONSTITUTION AND BY-LAWS.

On motion of the Secretary, the following amendments were adopted.

Section III. Par. 3—"The Institute shall consist of Active, Associate, Honorary and Student Members."

Par. 4—"That the paragraph be changed to read, "Active Members," instead of "Members," as formerly.

That a new paragraph be added as follows :—"Student members shall be persons who are qualifying themselves for the profession of mining, metallurgical, mechanical or electrical engineering, or other branches of engineering, and such persons may continue student members until they attain the age of twenty-five years. They shall have notice of and the privilege of attending all meetings and excursions, and shall have all the privileges of the Institute, except voting. Student members shall pay an annual fee of one dollar.

Section V: That the membership fee be three dollars instead of two dollars.

Section VIII. That a general meeting, for reading and discussion of papers, be held once in each year, instead of twice as formerly.

TREASURER'S REPORT.

Mr. T. W. Gibson submitted his annual report, showing a balance on hand of \$14.50, with assets and liabilities about even:

The report was adopted.

SECRETARY'S REPORT.

The SECRETARY—A year ago today our Institute was organized, with a membership of 37. It has grown to 79, or an increase of 42 during the year. Meetings have been held as follows:—

Rossin House, Toronto, 10th April, 1894, one session; Private Bills Committee Room, Toronto, 12th and 13th September, 1894, four sessions; School of Mining, Kingston, 3rd and 4th January, 1895, four sessions.

Ten papers had been contributed to the proceedings as follows:

The Utility and Value of some Common Minerals, by Mr. A. Blue, Director of Mines.

The Nationalization of the Mineral Domain of Ontario, by Mr. J. Bawden, Kingston.

The Rainy River Gold District, by Dr. A. P. Coleman, Toronto.

Nature's Concentration Works, by Dr. W. L. Goodwin, Kingston.

Gold in Ontario and its Associated Rocks and Minerals, by Dr. A. P. Coleman, Toronto.

Boron: Its Detection in Minerals and Uses, by Prof. W. Nicol, M.E., Kingston.

Notes on the Merchantable Mica of the Laurentian, by Mr. W. Hamilton Merritt, A.R.S.M., Toronto.

Notes on the Glendower Iron Deposits, by Mr. W. G. Millar, M.A., Kingston.

Notes on the Silver Deposits of Thunder Bay, by Mr. Peter McKellar, F.G.S.A., Fort William.

Notes on the Diabase Dykes of the Sudbury District, Ont., by Mr. T. L. Walker, M.A., Kingston.

Typical Ontario Rocks (illustrated by lantern microscopic views), by Mr. W. G. Millar, B.A., Kingston.

The other feature of the year's operations was the scheme of federating the various mining organizations, which had been considered and approved by the Institute, and had been finally adopted on a basis satisfactory to the other societies.

ELECTION OF OFFICERS.

President.

Mr. James Conmee, M.P.P., Port Arthur.

Vice-Presidents :

Mr. James McArthur (Canadian Copper Co.), Sudbury.

Mr. Ian Cameron (Dominion Mineral Co.), Sudbury.

Mr. Peter McKellar, F.G.S.A., Fort William.

Mr. J. J. Kingsmill, Q.C., Toronto.

Treasurer :

Mr. T. W. Gibson (Bureau of Mines), Toronto.

Secretary :

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

Council :

Mr. A. Blue, Director of Mines, Toronto.

Dr. A. P. Coleman (School of Practical Science), Toronto.

Dr. W. L. Goodwin (School of Mining), Kingston.

Prof. Wm. Nicol (School of Mining), Kingston.

Mr. F. Hille, M.E., Port Arthur.

Mr. R. W. Leonard, C.E., Kingston.

Mr. J. F. Latimer, Toronto.

Mr. W. Hamilton Merritt, M.E., Toronto.

Mr. T. D. Ledyard (Ledyard Gold Mines), Toronto.

Mr. Thos. Shortiss, Toronto.

The following papers were read at this and the other sessions of the Institute:

A RECENT TRIP TO THE RAINY RIVER GOLD FIELDS.

By MR. F. HILLE, M.E., Port Arthur.

I have to ask your pardon, gentlemen, for changing the theme of my paper, also for not making this paper as complete as I wished it to be written, on account of my present very limited time, which is also the reason why I could not take the pleasure of reading this paper *in persona*, but had to accept the kind offer of my friend, Mr. Burk, to read it for me instead. Indeed, I have to ask your indulgence further, for choosing this subject for my present paper, because you have heard lately so much about the Rainy river district in particular, and about gold in general, that you might consider it too much of a claim laid upon

your patience in listening to that theme again and again. Now I shall try to throw as much new light upon this subject as is at my disposal at present.

Although the Seine river, the principal scene of the present gold excitement in the Rainy river district, is not a new acquaintance of mine from only a week ago when I visited it last. I trusted its waters at different times, in different seasons, to carry me to its various borders, but this time, although not the most favorable season for exploration and examination, I looked over some places along its shores which were partly new to me. The most interesting spot was again the lower, but northerly part of Shoal lake and Bad Vermillion lake, not only on account of the frequent occurrence of the precious metal gold, in the veins of the different rocks, but also on account of the geological condition prevailing there. Dr. Lawson, in his excellent report on the Rainy river district, dwelt repeatedly on the possible forming of these rocks and, in a very sagacious deduction, came to the conclusion that they constituted the products of a highly active volcano of Keewatin age. Undoubtedly they are, and I might add, of perhaps "post" Keewatin age, for the reason that these rocks are massive and compact and that the green schists, made up of the tuffs and ash-beds, are seen overlapping the Keewatin highly tinted and foliated slates. These rocks must have been produced therefore in a comparatively quiet period. The granite at Bad Vermillion lake forms the remainder of the lava in the former vent of the volcano, while the gabbro surrounding the granite its first extravasation. Next overlying the former, as the second ejectamenta, an altered granite (?) called protogin, and on top of this rock the above-mentioned chloritic rock which, at the shore of Shoal lake, is mixed with pebbles and boulders, now called conglomerates. The protogin forms on location A. L. 104, the highest point on the north side of Shoal lake, with the exception of the graniteboss on the south side of Bad Vermillion lake, about two miles farther west. Dr. Lawson could not have seen very well the exposure of this rock unless he had penetrated the dense pine forest for half a mile on one side and one and a half miles on the other side from the shore. It is therefore excusable when he thought the green schists formed the contact with the gabbro, as we cannot expect that a geologist should explore every square foot of the region he is going over.

Allow me, gentlemen, to dwell a little longer on these rocks and especially on the protogin. The field appearance of the gabbro at the surface is that of a limestone owing to the decomposition of the anorthosite, and that of the protogin as a massive, greyish-green, coarsely crystallized rock, which on unaltered pieces shows by a microscopic examination to be composed of much translucent quartz with dark spots as enclosures, some feldspar and a good deal talc or chlorite. If the latter is a metamorphic product after biotite, the microscope might give us information about it, but I consider this of less importance than the question, "what was the cause, what the agency, that altered this rock to what it is now? Pressure? Well, that might have been the primary cause, and formed a favorable condition for the secondary, that is, for a chemical agency. Hot saline water in a highly eruptive locality suggests itself as the simplest explanation. Now again, the action of such waters on rocks of different kinds was, especially in the later Archaean times, undoubtedly not a rare occurrence; but a rare occurrence must have been the forming of a rock of exactly the same composition, and also rare the happening that all circumstances in altering and changing this rock were found to be the same, acted the same and formed the same results. Because we find this rock in only a few localities, and in this province, yes, I might say on this northern continent, so far as I am aware, only upon a few places in the Rainy river district, and there, following in almost a straight east-north-east line, the water-courses of the Seine Atti-Kokan, and appearing as far east as Ossinawee lake, not in a continuous belt, but in wide intervals, as isolated little knolls. It is accidentally that we have found this rock so far only upon the above-named places, because our travels through the country are principally done along the water-courses? Or offered our earth's crust at that time especially weak spots, or a weak line in the neighborhood, or along the shore of an Archaean sea, whose beach-pebbles and boulders are found cemented together now, by the lava and ashes, that it was possible to form a group of volcanoes whose ejectamenta are alike! Accepted this has been so, accepted further that the above-mentioned circumstances had prevailed, that hot mineral waters had acted upon the rock, then we have to accept also the theory that these waters not only changed this rock, but have been also the agency which has dissolved the minerals out of it, existing therein and infiltrated, and deposited them in the fissures of this rock. Wherever we

find this protogin here in our western country, the veins have exactly the same appearance, the vein matter is the same, consisting of quartz, blende, copper and iron pyrites and galena, and almost in every instance gold free and combined, and also the slickenside is made up of the chloride or talc of the rock. Now I will not say that lateral secretion was the exclusive cause of the filling of the veins, although it is easier to accept, when one considers that the different minerals appear in vertical lines in the veins, and commence often on both walls with the same mineral, changing toward the middle in equal sequence. I observed another peculiar feature, that is, in the forming of the veins or fissures, they seem to radiate from one common centre, which is caused, perhaps, by the magma being longest hot and viscid there where it was thickest, and cooled and contracted, therefore, more slowly than towards its thinning sides.

Now, when we consider that this protogin is of eruptive origin and comparatively little altered by dynamic forces (perhaps with the exception of a little "rough shaking at times" which might have produced and opened some of the fissures still more), unlike those which prevailed in Keewatin times and formed the rock of that period to what they can be seen now to exist, as often sharply foliated and highly tilted slates, while this protogin still showing its compact and massive structure, then it is to be assumed that most of the veins therein should be of a "true character." If so, and if we consider further the often very rich mineralization of the veins, then, gentlemen, I am somewhat justified to have dwelt upon and kept your attention so long upon the occurrence of this rock, because it will play an important role in our gold-mining camps as a rich and permanent producer of that yellow, much desired metal, gold.

To do justice also to the neighbors of this rock, to the slates much developed in the western part of the Rainy Lake and River district, we find in them sometimes very good and very likely also permanent veins, especially where they form the contact between the different series of the Huronian and these and the Laurentian rocks, but a large percentage of the veins in the slates show a bedded, or to use a more current expression, a gashy form. So much is certain that there are few gold-mining camps where the gold is so generally distributed in the numerous veins over so large an area as in the Rainy River district. This area extends east to the Shebandowan Lake region and as far known, as far as

50 miles north of the Canadian Pacific Railway from where I received samples of ore last fall identical with those coming from the more southern and western district.

On my recent trip through the Seine river country, I observed the building of the several concentrating mills on locations where the veins are neither developed, nor the people have any idea of what character their ore is or will be, and if the machines bought are suited for it or not. Judging from my experience in testing the different ores over a period of six years, I have to say that a number of these machines are not adapted to our ores here, because they neither work economically nor profitably. Allow me to prove my assertion. As I remarked before, a large percentage of our ores consist of quartz, blende, copper and iron pyrites and galena, also, after taking them out of the workings, out of a certain amount of the country rock, chloritic, talcous and cerisitic in character, and further some gold combined and free. The latter usually more so at the surface than farther below where the atmospheric influence ceases, yet in a great number of veins the gold will be found there exclusively combined with the pyrites, and also the other sulphurets greatly increased, therefore the ore will be distinctly refractory. Further, we have to consider that there are no reduction works in the immediate neighborhood, the nearest are in Omaha and Newark, that the communications in that country are very primitive yet, therefore the freight will absorb a large amount of the value of the ores or concentrates.

The machines generally used here are stamps, amalgamating tables and Frue vanners, or vanners of a similar type. Now we know that the stamp is not an ideal grinder, that it produces a large amount of fine muddy slimes, and the more so in disintegrating our ores here. The consequence is that these slimes are settling so tenaciously upon the common amalgamating table, and even on the Frue vanners, that there is often a great loss of leafy hammered gold particles as well as valuable concentrates. Furthermore, instead of separating the components of the ore, we receive them in our old method mixed together, thereby experiencing not only loss of zinc, lead and copper, by making a present to the smelting works, but also have to pay perhaps an extra cost for treating our high grade zincous concentrates, and increasing our shipping expenses enormously. Because instead of shipping the gold value (let us say from 30 tons of ore) in only one ton to the reduction works, we

are sending it in five or even more tons. Expressed in figures : instead of having \$40 shipping expenses we have \$200, besides the expense for treatment, loss of the byproducts zinc, lead and copper, and also the expenses for mining and milling. Only a very rich mine can afford such extravagance, but surely not the most of the mines which will be opened in that country. Therefore, I consider it deplorable, that people commence already building mills, before they have a mine and before they know what they have in their mine, because the end result is usually a failure of the individual mine and a condemnation or drawback in the development of a mining camp.

On the other hand in using the right methods in milling our ores, we could make them pay very well, even if the ore is refractory. Yes I might say this refractory ore will pay in many instances, for the expenses in extracting the gold, by saving the byproducts and making use of them ourselves.

I said above that there are many bedded veins in that country which show quite an appreciable amount of gold. The nature of these veins would not justify the owners to erect mills for their own use, but it would be possible for them to realize something for their ore, if they could send it to a neighboring custom mill. Such a mill situated at Sturgeon Falls with a splendid water power all the year round, would have a central situation for some time to come, as the trend of the prospectors is eastward up the Seine. But any individual or company who would build a custom mill there would find out later on he would have made a good investment.

But what a boon would it be for the people being, and going into that country, if the Ontario and Rainy River Railroad were built. Every one of us who has had experience in travelling in winter through this country surely realizes what a good invention a railroad is, but realizes also what a drawback the non-existence of such an institution is, in regard to a rapid development and prosperity of any newly opened region, and especially farming and mining camps. See the existence of the farmers on Rainy river, living on the richest soil that nature can produce, and knowing what treasures they could earn from it if they had a market. The same is the case with the miners, they are sitting on their treasures and don't know how to carry them into the market.

I thank you very much, gentlemen, for your kind attention.

DISCUSSION.

DR. A. P. COLEMAN said that Mr. Hille's was a very interesting paper, and, in general, it ran along the lines that he had himself found to be correct last summer. Mr. Hille had used the word "protogene," which was, perhaps, not familiar to some of those present. It signified a variety of granite in which the mica or hornblende had been changed into a talcose or chloritic mineral. The granites of which the writer had spoken, especially under the head of "protogene" were very interesting, because they form the country rock of the richest and most continuous vein that had been found in the district. They were true fissure veins. The fact that they radiate from large masses of rock generally called gabbro, but which is in reality anorthosite, leads to the conclusion that they are the result of volcanic disturbance at the time when these rocks were the basal or lower portions of what at the surface was given off as lava or volcanic ash. The Rainy lake region had been examined since Dr. Lawson's time and since his own visit by two members of the Geological Survey staff of Minnesota, Messrs. Winchell and Grant, who have described it very fairly. Strange to say, they exactly reverse Lawson's account of the relationship of the rocks. Lawson supposes that the gabbro was the earlier of the two, and the granite a later eruption, while the two gentlemen named have taken the view that the granite was the earlier and the gabbro a later eruption. The evidence, so far as he (Dr. Coleman) had examined it, went to show that the later observers were correct. The gabbro does not show signs of having been subjected to any violent force, whereas the granite undoubtedly has. You find no veins in the gabbro, but you do find very well marked veins, and on a large scale, in the granite. An eruption of the gabbro burst the previously consolidated granites, and gave rise to the fissures that were afterwards filled by segregation or in some other way. The ore is somewhat refractory in its character. Mr. Hille has mentioned the chief sulphides that occur in it, and there is no doubt that in most cases the gold is carried away very largely by the pyrites, and also to some extent by the other minerals. However, he could not agree with Mr. Hille's suggestion that some other mill than the stamp mill would be more suitable for treating the ore. It was his conviction that the great blunder in Ontario has usually been in getting some other mill than the stamp mill. His idea was that you ought to get a mill that really will work ;

but hitherto the method seems to have been to get the mill that least is known about. The results of this kind of management can be seen in the neighborhood of Rat Portage. He did not mean to say that those other mills would not work well in other regions or under special conditions, in our own districts, but up to the present they have not worked well. He said: "Take the mill that has been proved to work." The first thing, however, that should be done in any mine was to prove that you have gold. He had strong objections to taking in a mill of any kind until a depth of a couple of hundred feet had been reached, and it had been proven that there was enough gold-bearing quartz to pay for the mill. Up to the present only stamp mills had been introduced into the Seine river district. This, he thought, was wise. Most of them are small. One is a 10 stamp mill in the Shoal lake region, and two others are 5 stamp mills.

MR. J. F. LATIMER inquired if the ores of the Rainy lake region carried much sulphide.

DR. COLEMAN—Yes, in several sections.

MR. LATIMER—Any arsenic?

DR. COLEMAN—A little, not very much. Not enough to be any serious drawback. I may say that there is no district except that near Shoal lake, where granite is the country rock; otherwise, the geological conditions are pretty uniform.

MR. LATIMER—There are a few veins on Lake of the Woods, in granite.

DR. COLEMAN—They are rather, I believe, in gneiss. The Bad mine, for instance, is between two layers that are probably both gneiss.

DETERMINING THE VALUE OF GOLD ORES IN THE FIELD.

By R. W. LEONARD, M. C. Soc. C. E., M. Am. Inst. M. E., Kingston.

At this time when there is a renewed interest in Ontario gold fields, it is of peculiar interest to prospectors and owners of gold locations to be able to arrive at a fair estimate of the value and character of their

ores, and to determine on the method to be adopted for milling or otherwise extracting the value.

The ordinary method of taking hand specimens to an assayer gives results of little value except to indicate whether it is worth while to further explore the property.

A mill test of one, or preferably, several tons is of course "the proof of the pudding," and—if properly carried out—gives all information that can be desired about the character and value of the ore sent to the mill. The School of Mines in connection with Queen's College, Kingston, is now happily possessed of a three-stamp mill for testing purposes, which will no doubt be of great value to mine owners.

There are, however, many discoveries made in districts so remote from railway or water communication, or even from travelled wagon roads, that the cost of sending out a lot of ore for a mill test is so excessive as to cause the owners to hesitate before incurring such an expense.

It is to determine, at a reasonable expense at the mine, the gold contents of such ores and the value that can be extracted by amalgamation, that the writer proposes the following method, which he has used and has checked with the ordinary assays and found very satisfactory.

A quantity of the ore judged sufficient to give a fair average value (say one ton) as broken to egg size on a close board floor (or preferably on an iron sheet), and carefully quartered (sweepings and all). The quarter is again broken smaller and again quartered. The part selected is then coarsely crushed in an iron mortar and sampled. A quantity of the same judged (by size of the shows of gold, if any, and the supposed value of the ore) sufficient for fair assay is now weighed and ground fine in successive lots in a mortar with water and a *small amount* of mercury until the whole weighed sample has been treated—using the same mercury for each lot. The whole weighed sample is now panned down to separate the amalgam and the concentrates from the tailings. The concentrates are dried and weighed and the *whole of the mercury used* is retorted in a small, smooth cast-iron retort. When all the mercury has been driven off, the retort is opened and a small quantity of test lead is melted in the bottom of the retort to collect all the particles of gold left from the retorted mercury. The lead is then poured into a mould and the litharge and scrapings of the retort are reduced on charcoal with the blow-pipe, and the resulting lead added to the first. The lead is now

refined and cupelled with the blow-pipe in the ordinary way and the resulting button of gold and silver is weighed, parted and weighed again as by the ordinary methods.

The dried concentrates (which are much more uniform in value than the free milling ore) can now be assayed by the blow-pipe, or a small quantity can be sent to an assayer if the prospector is not sufficiently expert with the blow-pipe. If the concentrates are sufficiently rich to be worth saving for further treatment the value can readily be obtained by the blow-pipe.

The above method will give more information and a more accurate assay than a fire assay as usually conducted, because it shows what proportion of the gold can be saved by amalgamation and what value remains in the concentrates, and because it is easy to treat in this way a very much larger sample than is treated in the ordinary assay.

The writer does not propose the above as anything novel—on the contrary, it rather reverts to original principles—and some portions of the process will no doubt be familiar to many members of this Institute; still the writer believes there are very few who realize how correct and how valuable is the knowledge of an ore obtained by this method; and while he does not propose it as a substitute for a mill test of a large quantity where a mill test is feasible, it is a better assay than any other that he knows of and can be carried out at a trifling cost at the mine with apparatus that a man can very easily carry.

The writer has carried out several experiments in comparing this method of assay with both the fire assay and with mill tests of large quantities, and in each case the results have been most satisfactory. These results are embodied in a paper contributed by the author to the proceedings of the American Institute of Mining Engineers.

GUNPOWDER AND NITROGLYCERINE.

By W. HODGSON ELLIS, Toronto.

An explosive is a body which can, by a chemical reaction, suddenly develop a quantity of gas, large compared with the volume of the body before the reaction.

There are two ideas contained in this definition.

1st. An increase in volume due to chemical reaction.

2nd. The increase is sudden. The force of an explosion is measured not in foot pounds merely, but in foot pounds per second.

To illustrate, consider an analogous case. A cubic foot of water will yield about 1,700 cubic feet of steam. If this change takes place slowly as in a steam boiler under ordinary conditions, the expansion can be made to work, which can be regulated at pleasure—to grind flour, for instance.

If the change takes place instantaneously the boiler is shattered. This is an explosion, although water is not an explosive according to our definition; for the steam is formed from the water, not by a chemical action, but by a physical change merely.

Now, one explosive differs from another not only as to the nature of the chemical action which brings about the explosion, but also as to the rate at which this change takes place; and in studying the effects of a given explosive we have to attend to two things:—(1) The volume of gas which a given volume of the explosive yields; and (2) the rate at which this gas is developed.

Thirty years ago there was practically only one explosive—gunpowder (though many explosive substances were known). Today we have a fresh one patented every week, and it appears to be worth while considering to what causes the differences in the properties and efficiency of these bodies is due, and how far a knowledge of their chemical constitution can throw light on their behaviour, and upon their suitability for different purposes.

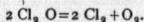
There are two kinds of explosives:

1. Mixtures of two or more bodies which can be made to combine together, forming compounds which, under the conditions of the experiment, occupy a greater volume than the mixture.

2. Compounds which can be decomposed, yielding products which occupy more space than the compound.

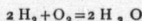
As an example of the first class we will take a mixture of oxygen and hydrogen. As an example of the second class we will take chlorine monoxide, Cl_2O . Let us consider the second case first.

The equation representing the reaction is:



From this equation it follows that two volumes of chlorine monoxide yield two volumes of chlorine and one of oxygen, measured under the same conditions of temperature and pressure; that is, two volumes become three volumes, temperature and pressure remaining constant. But temperature does not remain constant. The decomposition of chlorine monoxide is attended by a disengagement of heat, and the heat so evolved is sufficient to raise the products of decomposition (supposing their specific heat to remain constant) from 0° to 1709° C. At this temperature 3 volumes of gas will become 22 volumes. This is therefore the space which two volumes of the original compound would occupy if it were free to expand. Hence 1 volume would become 11 volumes, or the gases produced by the decomposition would occupy 11 times the original volume of the compound. If now the reaction takes place in a closed space which prevents the gas from expanding at all, then the pressure increases in proportion to the volume the gas would occupy if free. So that in this case the pressure will be 11 atmospheres.

Let us now consider the first case. The reaction



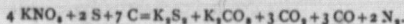
is exactly the reverse of the one we have just been considering, and in it 3 volumes become 2 volumes—i.e., if the temperature remained constant and the steam remained uncondensed, there would be a diminution in volume instead of an increase. But the temperature does not remain constant. In this reaction also heat is evolved and the quantity of heat is enough to raise the steam nearly 9,000° C. (if its specific heat remained the same). At this temperature 2 volumes would become 66. Hence the original 3 volumes would become 66, and 1 volume 22 volumes. That is, if the reaction took place in a closed space the pressure would be 22 atmospheres, or just double the former.

The importance of the part played by the heat disengaged in an explosive reaction is well brought out by these two examples.

To the first of the two classes that we have been considering belongs gunpowder. To the second nitro-glycerine.

It has been shown by the analyses of Bunsen, Karolyi and Abel and Noble, that the reactions which occur when gunpowder is fired vary with the composition of the powder and the conditions of the experiment, and that the equation representing the explosion of military or sporting powder is a very complex one. In the case of blasting powder, however,

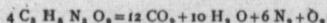
of the composition of that examined by Sir F. Abel and Captain Noble, in their classical researches on the composition of fired gunpowder, we may deduce from their results the following equation :



From this equation it follows that 552 grammes of gunpowder will yield $8 \times 22,327 \text{ cc.} = 178,616 \text{ cc.}$ of gas, measured at 0°C and 760 mm. bar. Hence 1 gramme will yield 323 cc. But since the heat evolved by the explosion of one gramme of gunpowder is about 500 calories, and since the specific heat of the products of the explosion may be roughly put at about $\frac{3}{4}$, the calculated temperature of explosion will be 2000°C . and the 323 cc. will expand to 2,689 cc. One gramme of gunpowder occupies about 1 cc. The sulphide and carbonate of potassium are liquid at this temperature and occupy about $\frac{1}{2}$ cc. Hence the pressure will be over 5,000 atmospheres or 40 tons to the square inch. Abel and Noble have found experimentally 42 tons to the square inch.

Saltpetre contains as much oxygen as 3,000 times its bulk of air, and gunpowder is merely a contrivance for burning carbon by means of this enormously compressed oxygen and forming carbon dioxide and carbon monoxide gases, while the nitrogen of the saltpetre is liberated at the same time.

The explosion of nitro-glycerine may be represented by the equation



from which it follows that 1 gramme gives 713 cc., and 1 cc. (= 1.6 grammes) gives 1,141 cc., which is expanded by the heat evolved at least eight times, (Berthelot) probably more than this.

But the nature of this reaction is totally different from that which takes place in the explosion of gunpowder. That is a combustion propagated from particle to particle at a comparatively slow rate. The explosion of nitro-glycerine on the other hand is a detonation, a breaking up of the molecules propagated with a velocity comparable to that of sound—exceeding 5,000 feet per second.

Six cubic inches of nitro-glycerine gives about a cubic yard of gas, requiring about $\frac{1}{1000}$ of a second for its formation, (Lewis). A square yard of surface carries an atmospheric pressure of 9 tons, and this has to be lifted in the $\frac{1}{1000}$ of a second—i.e., more than one million foot tons per second. Figures such as these amply account for the well known shattering effect of nitro-glycerine, and for its destructive effects when

tamped only by the superincumbent atmospheric air—effects which are commonly alluded to as the tendency of nitro-glycerine to “strike down.”

It is a most important property of nitro-glycerine that this enormously energetic fashion is not the only way in which decomposition takes place. On being heated it first volatilizes slowly without decomposition. If the temperature is raised to its boiling point, which is somewhere near 180°C (350° Fahrenheit) it is converted into vapour with much rapidity and the vaporization is attended by partial decomposition. It may be set on fire and will burn quietly away because the heat is carried away by the gaseous products before it has time to be communicated to the rest of the nitro-glycerine. But if the temperature of any of the nitro-glycerine be raised to a little above this temperature (180°C — 350°F) the decomposition takes on the character of detonation and is propagated as such through the whole mass and even to neighboring masses.

The importance of these facts in the practical employment of nitro-glycerine, and especially in the thawing of dynamite cartridges need only be alluded to.

UNDERGROUND PHOTOGRAPHY.

By MR. G. R. MICKLE, Sudbury.

Underground photography is a subject which has received a considerable amount of attention during the last few years. Mr. Burrow, of Cornwall, deserves especial credit for the patience he has exercised in his efforts to take good photos underground, and he has been rewarded by obtaining some excellent photographs. For obtaining sufficient light he found after a great number of experiments, that it was necessary to use two lime lights in addition to flash-lights, but even with all these appliances for giving light, only a small number of his trials were successful (about $\frac{1}{2}$).

We will show some slides obtained from photographs which we took in some of the nickel mines near Sudbury. In taking these photos

we used magnesium powder only, as the use of lime-lights would be so troublesome and expensive as to be out of the question for most people. We made altogether about 70 trials, using different plates and lights, and obtained about 7 or 8 good photos, and about the same number of passable ones, the rest were total failures. The chief difficulty appeared to be to obtain enough light to illuminate the large spaces; in addition to this the air was saturated with moisture and foggy, and generally smoky, either from the miners' lamps or blasting powder. We soon found that it was useless to attempt taking any photos where the miners had been working for any time, the only time at which anything could be done was early on Monday morning before the men went to work. Even then the air was too foggy some days to get good results. It was, moreover, possible to take only one photo in the same stope on the same day, (unless the ventilation is very good) as the smoke from the large quantity of magnesium powder used soon obscured everything. In all our trials the same camera was used, viz.: a 5 x 7 in. Hawkeye folding camera. We got good results with Stanley plates sent, No. 50, and Cramer crown.

We tried small flash lamps and magnesium ribbon, but found they were altogether inadequate, and it was not till we used two continuous blast flash lamps holding 120 grains of magnesium powder each, that we got any satisfaction at all; the powder in the lamp is blown through a flame of burning alcohol, and the blast lasts about half a minute. One lamp was generally held behind the camera and another off to one side, but of course not directly in view of the camera; by this means we were able to show a man in one case 150 ft. from the camera, one light being let off near the man, but sheltered from the camera behind a rock. As the results of our experiments so far, it appears to be necessary in order to secure good results, to select a day on which the air is not foggy or smoky in the mine, to use only the most sensitive plates, to have some background which will reflect the light more or less, and not to face the camera towards very large stopes, if the stopes are more than about 50 ft. wide it does not appear to be possible to show the opposite wall clearly, and if there are any miners in the picture, they should not have their lamps in their hats as the flame only makes a blur and spoils their faces.

When these conditions are observed very fair results can be obtained by use of magnesium powder only.

TESTING GOLD ORE.

By W. HAMILTON MERRITT, M.E., Toronto.

It may be said in a general way that gold-bearing quartz is found in many places from the extreme east to the extreme west of the immense Province of Ontario. It is being milled in three places: in one mill in the Marmora district, in another in the Sault Ste. Marie district and in a third mill in the Lake of the Woods district. Whether enough ground had previously been opened up and tested before erecting the mills I am not in a position to state. "Dame Rumor" hath it, however, that in all these cases the mills are hampered by not having an adequate supply of ore on account of the mines not having been previously opened up. We may hope that this is not correct. There have been, I much regret to say, only too many cases in our province where mills have been put up previous to solving the important preliminary problems as to the real character and the available extent of pay ore. One difficulty which met the Ontario developer was that there was no testing plant in existence in Canada where he could have a quantity of ore treated, and he was compelled to erect a plant himself to find out what he really had, or send his ore to New York or still further. That difficulty now no longer exists, for there is a small stamp mill and concentrating plant at the Kingston School of Mining, where anyone can have a ton or more put through and the yield in free gold and concentrates determined.

Now for a few words about the determination of the value of a gold ore. I allude to the value of the contents of the ore itself outside of the considerations of size of vein, its situation, cost of mining, supplies, labor, etc., all of which have such an important bearing upon the ultimate value of the ore. The ultimate value of the ore also largely depends upon the cost of treating it, and this should be had in view from the start, especially in the case of our Ontario gold ores. As a rule most people take a piece of the ore to an assayer and get a result to the ton of ore. Let us say it is a gold ore, and suppose a return of \$8 to the ton is given. They then calculate very easily that mining will cost \$3, milling \$1.50, management, etc., \$1; total cost \$5.50, which gives a profit of \$2.50 per ton. Then so many thousands of tons treated give so many thousands of dollars profit as easily as one and one make two.

But, through the abominable perversity of things in general, after working away for some time, the result does not seem to come out as it should, and disheartened shareholders say that there is no gold and shut down the mine and mill.

There are many explanations why it has been a failure. Some of them may be :

(1) The dead work of opening the mine, putting up a mill and management may have used up all the money and they are unable to cope with the first difficulty which presents itself.

(2) The vein may have narrowed or pay-shoots be few and far between, therefore mining has come much higher than the price estimated.

(3) No milling test had previously been made and the run of the ore comes far short of the hand samples assayed, a very common cause of disaster.

(4) The free milling portion of the vein is only superficial, and it becomes refractory a very short distance below the surface, therefore the pulp will require to be concentrated and the gold extracted by smelting or chlorination, which will considerably increase the cost of production. This would have been discovered by first doing development work, and having some test runs made of the ore from different places.

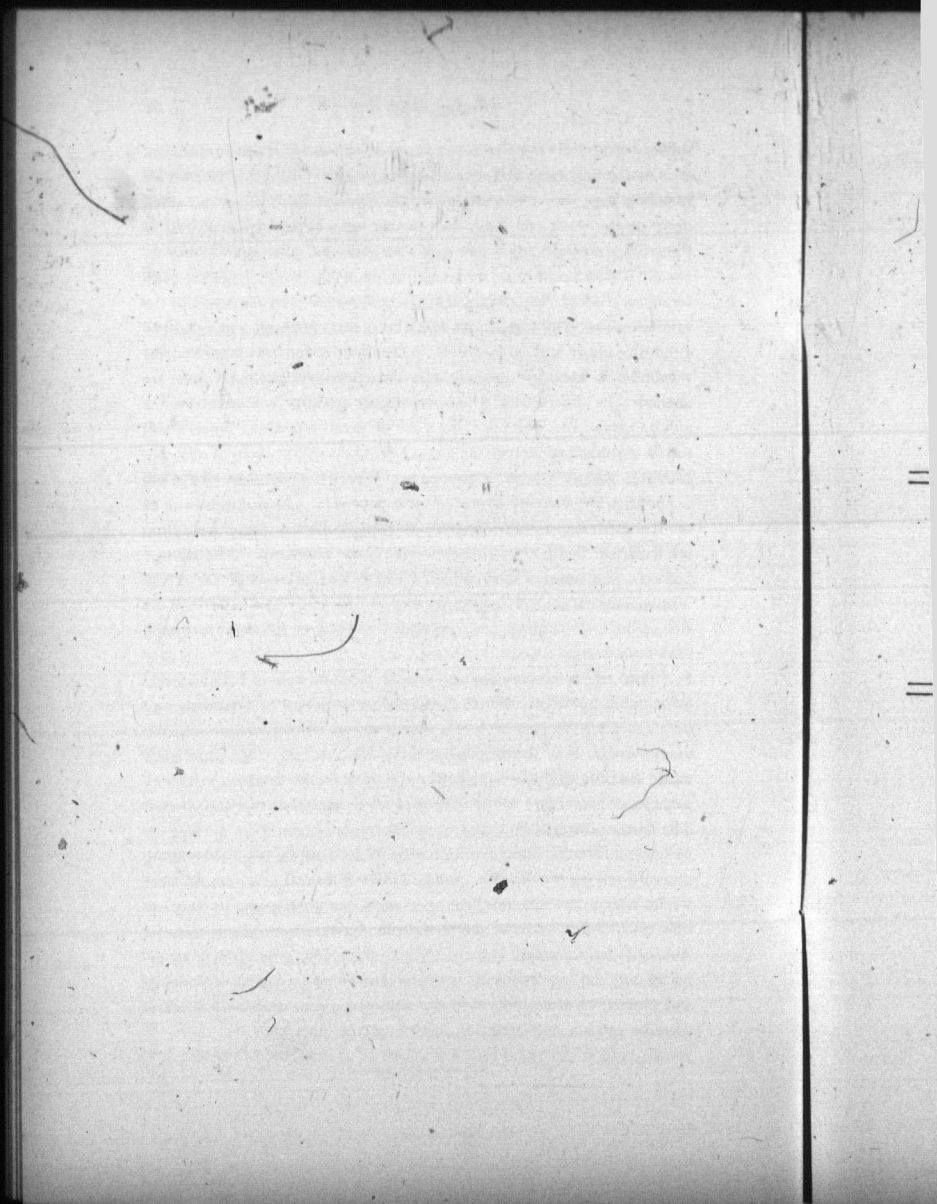
(5) Among a number of other causes of failure to get expected results, such as overbuilding, extravagance, ignorance, dishonesty, etc., I shall merely add that the manner of crushing may not be suitable to the ore, and that, on one hand, the gold may be slimed and not caught, or the size of the screen and height of discharge may allow the ore to be delivered before the values have been liberated. Both of these latter contingencies are carefully checked by the procedure adopted at the stamp mill at the School of Mining at Kingston, and valuable suggestions can be given in this connection when a test run is made of the ore in the mining laboratory.

Although it is universally conceded that there is no test like a milling test for a gold ore, yet sometimes it is either impossible or not necessary. An assay of a mere hand specimen is, if not actually useless for practical purposes, to be accepted only with the greatest caution, and should merely serve as a basis for further investigation. A large quantity of a gold ore should always be taken, not less than half a ton; then it

should be carefully sampled down to get a fair average for determination.

At the School of Mining at Kingston special arrangements exist for sampling large lots. The ore is first put through the crusher, quartered down on the sheet-iron floor, then further reduced by being run two or three times through adjustable rolls and quartered after each reduction. Finally it is reduced to a powder by means of the sample grinder, quartering on oil-cloth being again resorted to between each reduction by the grinder. The resulting sample taken is generally about seven pounds. From this about half a pound is quartered out for fire assay, and the remainder is kept for panning and amalgamation assays, if these are needed. In the case of a new ore, whose qualities are unknown, the amalgamation and panning assays are of great importance when a mill test is not made of the ore. Coupled with these a fire assay of the concentrates will, of course, be necessary. Where the character of the ore is known a fire assay of it is all that is necessary. In making a run of ore it should be carefully sampled by being collected every hour from the feeder, so that a check is kept on the result of the mill. The tailings, however, give even a more valuable check, and in tests of ore at the Mining Laboratory at Kingston they are caught every half hour. As the slimes from the tailings are evaporated nothing is allowed to escape examination.

With reference to sampling a vein or ledge for testing I shall merely make one suggestion. Where the sampling is not on a large scale, say such as testing the face of a drift being driven on the vein, it is sometimes thought that the drillings give the best average. My experience would lead me to doubt this, for the jar of the drill tends to make any particles of gold settle to the bottom, and, therefore, escape the scraper. The fairest average of a vein is undoubtedly obtained by picking or wedging across the whole face in several places and mixing the resulting ore. In getting ore from any mineral vein or deposit as a sample, what we are after is not mineralogical specimens, but an attempt to find out how many dollars can be obtained from a certain quantity of material which has been opened to view. How much more ground may be expected to yield similar results is a problem which geological knowledge and experience sometimes help the mining engineer to solve, but oftentimes he can see no further into rock than any other man.



APPENDIX.

OFFICERS AND COUNCIL, 1894-95.

President:

James Conmee, M.P.P., Port Arthur.

Vice-Presidents:

J. J. Kingsmill, Q.C., Toronto.

Archibald Blue, Toronto.

Prof. W. L. Goodwin, Kingston.

W. Hamilton Merritt, A.R.S.M., Toronto.

Treasurer:

T. W. Gibson, Toronto.

Secretary:

B. T. A. Bell, Ottawa.

Council:

Prof. Coleman, Toronto.

Peter McKellar, F.G.S.A., Fort William.

Prof. Nicol, Kingston.

J. M. Clark, Toronto.

William Young, Rat Portage.

Ian Cameron, Sudbury.

T. D. Ledyard, Toronto.

A. W. Carscallen, M.P., Marmora.

Dr. Ames, Toronto.

OFFICERS AND COUNCIL, 1895-96.

President :

Mr. James Conmee, M.P.P., Port Arthur.

Vice-Presidents :

Mr. James McArthur, Sudbury.

Mr. Ian Cameron, Sudbury.

Mr. Peter McKellar, F.G.S.A., Fort William.

Mr. J. J. Kingsmill, Q.C., Toronto.

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Mr. A. Blue, Toronto.

Dr. A. P. Coleman, Toronto.

Dr. W. L. Goodwin, Kingston.

Prof. Wm. Nicol, Kingston.

Mr. F. Hille, M.E., Port Arthur.

Mr. R. W. Leonard, C.E., Kingston.

Mr. J. F. Latimer, Toronto.

Mr. W. Hamilton Merritt, M.E., Toronto.

Mr. T. D. Ledyard, Toronto.

Mr. Thos. Shortiss, Toronto.

CONSTITUTION AND BY-LAWS

(As Amended to Date.)

SECTION I.—Name.

1. The Organization shall be called the ONTARIO MINING INSTITUTE.

SECTION II.—Object.

2. The object of the Institute will be to mutually benefit and protect its members by facilitating the interchange of knowledge and ideas, and by taking concerted action upon all matters affecting or relating to the mining industries of the Province of Ontario and generally to promote the said industries by proper means.

SECTION III.—Membership.

3. The Institute shall consist of Active Members, Associate Members, Honorary Members, and Student Members.

4. Active members shall be persons engaged in the direction and operation of mines and quarries in the Province of Ontario, mine and mill owners, parties interested in the ownership of mines, mining engineers, mine managers, superintendents, explorers or prospectors and metallurgists.

5. Associate members shall be persons not eligible in the foregoing clause, but such persons whom the Institute shall deem worthy of admission. All associates shall enjoy full rights and privileges of membership.

6. Honorary members shall be persons eminent in the profession, or history of the industry of the Province.

7. Student members shall be persons who are qualifying themselves for the profession of mining, metallurgical or mechanical engineering, or other branch of engineering, and such persons may continue student members, until they attain the age of twenty-five years. They shall have notice of, and the privilege of attending all meetings and excursions, and shall have all the privileges of the Association, except voting.

SECTION IV.—Election of Members.

8. A recommendation for admission according to Form "A" in the Appendix, shall be forwarded to the Secretary, and by him laid before the Council, who shall have power to elect or reject by a majority vote. The recommendation shall be in writing, and signed by not fewer than two members of the Institute in good standing.

SECTION V.—Fees.

9. The membership fee shall be three dollars, or such amount as may be determined from time to time by the Council, payable annually in advance at the Annual General Meeting of the Institute, but any member or associate member being one year in arrear of his annual subscription shall cease to be a member.

SECTION VI.—Office Bearers.

10. The office bearers of the Institute shall consist of:—1st, a President; 2nd, four Vice-Presidents; 3rd, a Secretary; 4th, a Treasurer; and nine members in good standing, who shall act with the office-bearers as a General Council.

11. 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 a year.

12. All Past Presidents of the Institute shall be elected Honorary Presidents.

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

SECTION VII.—Duties of Officers.

14. The President shall be Chairman at all meetings at which he shall be present, and in his absence one of the Vice-Presidents. In the absence of a Vice-President the members shall elect a chairman for that meeting.

15. The Treasurer shall hold in trust the uninvested funds of the Institute, which shall be deposited in the name of the Institute at a bank approved by the Council; he shall receive all moneys and shall pay all accounts that are properly certified as correct by the Council, and shall present from time to time a statement of the Institute's accounts.

16. The Secretary shall attend all meetings, shall take minutes of the proceedings, shall be responsible for the safe custody of all papers, books and other property, and under the direction of the Council shall conduct the general business of the Institute.

SECTION VIII.—Meetings.

17. The Annual General Meeting for the election of office-bearers, the transaction of the business of the Institute, and the reading and discussion of papers, shall be held in the City of Toronto on the first Wednesday in March in each year.

18. A General Meeting for the reading and discussion of papers and for the transaction of business shall be held once 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 Institute.

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

20. Special meetings may be called by the President or a majority of the members of the Council at any time, notice of which, stating the nature of the business, shall be mailed by the Secretary to each member of the Institute.

SECTION IX.—Consulting Officers.

21. The Council shall have power to appoint such consulting officers as may be thought desirable from time to time and may vote them suitable remuneration.

SECTION X.—Dissolution.

22. The Institute shall not be broken up unless by the vote of two-thirds of the members present at any general meeting convened for the purpose of considering the dissolution, and after confirmation by a similar vote, at a subsequent meeting to be held not less than three or more than six months after the first, and notice of this last meeting shall be duly advertised as the Council or a general meeting may direct.

SECTION XI.—Amendments to Constitution and By-Laws.

23. The foregoing Constitution and By-Laws may be amended by a two-thirds vote of any meeting, but notice of motion for such amendment must be given at least four weeks previous to the discussion of the same, of which notice the Secretary shall duly inform every member.

APPENDIX TO CONSTITUTION AND BY-LAWS.

FORM A.

Mr. being desirous of becoming a member of the ONTARIO MINING INSTITUTE, we, the undersigned, from our personal knowledge, do hereby recommend him for election.

Names of two members,

Date.....

FORM B.

I, the undersigned, being elected a member of the ONTARIO MINING INSTITUTE, do hereby agree that I will be governed by the regulations of the said Institute, as they are now formed, or as they may be hereafter altered; that I will advance the interests of the Institute as far as may be in my power; provided that whenever I shall signify to the Secretary in writing that I am desirous of withdrawing my name therefrom I shall (after the payment of any arrears which may be due by me at that period) be free from this obligation.

(Signed)

Date

THE ONTARIO MINING INSTITUTE.

Treasurer's Statement for Year Ending April 11, 1895.

Dr.

To 56 Membership Fees received at \$2 \$112 00

Cr.

By Disbursements as follows:

Printing—Paynter & Abbott.....	\$ 8 00	
Estate Mortimer & Co.....	21 15	
		29 15
Postage—B. T. A. Bell, Secretary.....	28 50	
Travelling Expenses—B. T. A. Bell, Secretary..	35 00	
Wood Cut of Seal for Institute, and Electro—		
Rolph Smith & Co.....	4 85	
Balance on hand.....	14 50	
		<u>\$112 00</u>

*Assets.*Unpaid Membership Fees, 1894-5, 22 at \$2 \$ 44 00*Liabilities*

"Canadian Mining Review," Engravings.....	\$ 6 25	
B. T. A. Bell, balance Travelling Expenses.....	14 50	
T. J. Shanks, reporting Kingston meeting.....	25 00	
		<u>\$48 75</u>

THOS. W. GIBSON,

Treasurer.

TORONTO, 11th April, 1895.

Adopted,

WM. HAMILTON MERRITT,

Chairman.

LIST OF MEMBERS

ONTARIO MINING INSTITUTE.

1	Allan, W. A.	Victoria Chambers.	Ottawa.
2	Ahn, R. H. ....	.....	Rat Portage.
3	Burroughs, Fred. ....	.....	Napanee.
4	Bell, B. T. A.	Slater Building.	Ottawa.
5	Birkett, T.	Kingston Loco. & Eng. Co.	Kingston.
6	Bawden, J.	Clarence Street	"
7	Blue, A.	Director, Bureau of Mines	Toronto.
8	Burk, D. F. ....	.....	Port Arthur.
9	Brown, J. W.	9 Toronto Street.	Toronto.
10	Boustead, W. E.	School of Practical Science	"
11	Burwash, Dr.	695 Spadina Avenue.	"
12	Carruthers, J. B. ....	.....	Kingston.
13	Conmee, Jas., M.P.P. ....	.....	Port Arthur.
14	Clark, J. M.	Barrister.	Toronto.
15	Coleman, Dr. A. P.	School of Practical Science	"
16	Cheesworth, J. W. ....	.....	"
17	Cameron, Ian.	Dominion Mineral Co.	Sudbury.
18	Carscallen, A. W., M.P. ....	.....	Marmora.
19	Cooper, W. Jas.	15 Imperial Bank Building	Toronto.
20	Chewett, J. H.	83 York Street.	"
21	Donnelly, John. ....	.....	Kingston.
22	Darling, F.	Canadian Gen'l Electric Co.	Toronto.
23	Dupuis, Prof. ....	.....	Kingston.
24	Eames, R. H.	372 King Street West.	Toronto.
25	Folger Bros. ....	.....	Kingston.
26	Faye, Edward. ....	.....	Toronto.
27	Fenton, Fred. A.	203 Church Street.	"
28	Goodwin, Prof. W. L.	School of Mining.	Kingston.
29	Glidden, J. N.	Copper Cliff.	Sudbury.
30	Gray, Fred. W. ....	.....	Guelph.
31	Gibson, T. W.	Bureau of Mines.	Toronto.
32	Hille, F. ....	.....	Port Arthur.
33	Hammond, Herbert C.	Messrs. Osler & Hammond	Toronto.
34	Hine, W. L.	15 Toronto Street.	"
35	Harris, Prof. Carr. ....	.....	Kingston.
36	Jarvis, Edgar J. ....	.....	Toronto.
37	Kent Bros.	Bankers.	Kingston.
38	Kingsmill, Judge.	19 Wellington Street West	Toronto.
39	Kirkpatrick, G. B.	Dept. Crown Lands.	"

40	Klock, Robert A.	Klock's Mills	Ont.
41	Latimer, J. F.	13 St. Patrick Street	Toronto.
42	Laidlaw, J. Turnbull	78 St. Alban's Street	"
43	Ledyard, T. D.	57 Colborne Street	"
44	Leonard, R. W., C. E.		Kingston.
45	Laughlin, J. T.	35 Adelaide Street East	Toronto.
46	McKellar, John		Fort William.
47	McKellar, Peter		"
48	McArthur, Jas.	Canadian Copper Co.	Sudbury.
49	McAree, John, D.L.S.		Toronto.
50	Miller, Prof.	School of Mining	Kingston.
51	Merritt, W. Hamilton	15 Toronto Street	Toronto.
52	Mickle, G. R., M.E.		Sudbury, Ont.
53	Morrison, L. A.		Toronto.
54	Marks, Thos.		Port Arthur.
55	Marks, Geo. T.		"
56	Morgan, C.		Toronto.
57	Minnes, Jas.	Messrs. MacNee & Minnes	Kingston.
58	Mason, Wm.	School of Mining	"
59	Musgrove, E.		"
60	Nicol, Prof.	School of Mining	"
61	Newman, W. Thos.	73 Oxford Street	Toronto.
62	Newlands, J. W.		Kingston.
63	Prittie, R. W.	409 Dovercourt Road	Toronto.
64	Pyne, Dr. A. R.	261 Gerard Street East	"
65	Parks, W. A.	The University	"
66	Pearson, Jas.	1 Toronto Street	"
67	Richardson, Prof. C. Gordon	57 Colborne Street	"
68	Spotswood, G. A.		Kingston.
69	Shortiss, Thos.	9 Toronto Street	Toronto.
70	Shields, J. W.	School of Practical Science	"
71	Slaght, A.	Inspector of Mines	Waterford.
72	Smith, J. Burley, M. E.		Rat Portage.
73	Townsend, B. J.		Toronto.
74	Townsend, E. S.		"
75	Totten, Henry	Treasury Department	"
76	Webber, John	464 Spadina Avenue	"
77	Willson, Alfred	Canada Company	"
78	Whitson, J. W.	Dept. Crown Lands	"
79	White, A.	Assistant Commissioner of Crown Lands	"
80	Walker, T. L.		Kingston.
81	Young, William		Rat Portage.