The Canadian Mining Review

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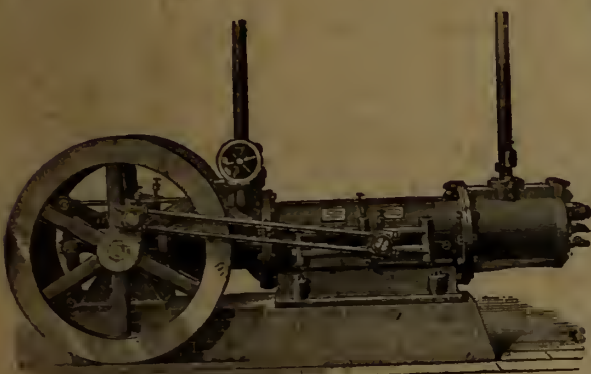

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The Canadian Mining Review

Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Victoria Chambers, Ottawa.

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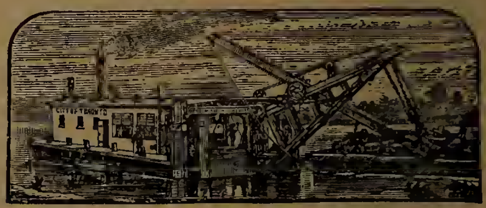

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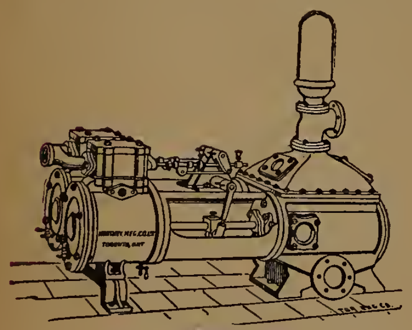

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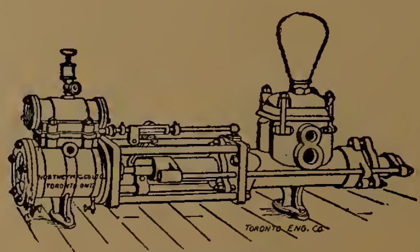

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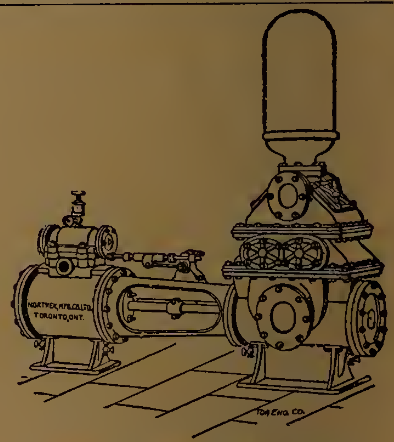

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THE UNITED MINING SOCIETY OF NOVA SCOTIA,

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Vol. XIII. JANUARY, 1894. No. 1

Mining Machinery.

From an article in a recent number of the *Canadian Manufacturer* it would appear that manufacturers of mining machinery want to destroy the industry which is their sole market, flattering themselves that they can derive support like the fabled sloth from the suction of their own paws.

The present wail of these spoilt and petted manufacturers is that mining machinery of a class or kind not manufactured in Canada has been and may be imported free of duty according to an Act passed by a Government which they must acknowledge is distinctly protective in its policy.

The Act in question was passed in order to give some measure of protection to the promising industry of mining—not protection from the honest tonic of competition, which is the life and soul of progress in trade, but protection from the short-sighted greed of one class of manufacturers who ask their fostering government to legislate for them only, and compel another and much more important native industry to use antiquated, illadapted machinery at exhorbitant prices merely because it is manufactured here.

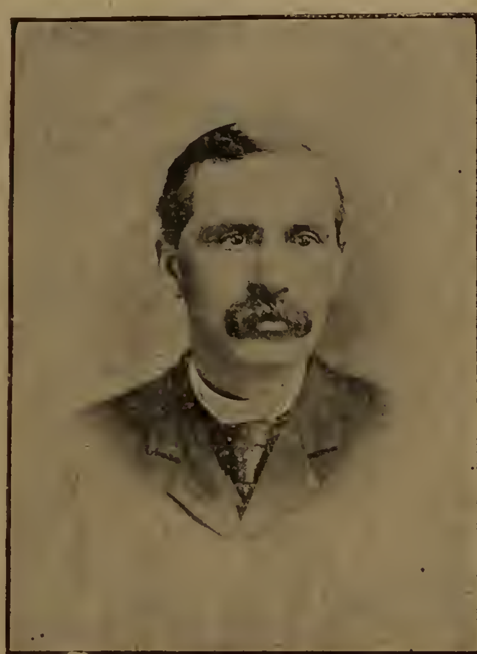
There are none so blind to facts as those whose vision is obscured by self-interest, and it would appear that this particular class has been so pampered and spoilt that it cannot recognize the equal rights of another native industry and does not look upon mining, which brings more foreign capital into the country, employs more labor, and results more than any other in general prosperity to the fortunate district in which it is located, as a Canadian industry at all.

And this great industry, this robust, masterful son of a new country, which asks for so little, is to be denied its equal rights, is to be handicapped forsooth that one of its feeble, rickety brethren, represented by the manufacturer of one pump, one stone breaker, or one rock drill may flourish without effort and without the wholesome spur of competition, which they evidently need, to bring them up to the level of merit of the high class manufacturers of other countries where mining machinery is manufactured up to date to meet the ever changing requirements of a progressive industry.

Countries where miners do not make shift to use a Blake-Marsden crusher when a pulveriser is what they want, or a Northey pump for a deep coal pit instead of the specially designed colliery pumps like that of the Jeansville Iron Company of Pennsylvania, which they may consider will suit their purpose better.

Is the mining industry to be denied the right of its own judgment and free choice, in favor of a specially protected industry? If so the whole trade system of the Dominion is a farce and in the abstract goes far to show the inherent economic weakness of a protective policy, the bolstering up of one class at the expense of another, as long as the latter will submit to it.

Our miners are not to use the machinery they think most economical and most suitable to their requirements; they must be taught that it is advisable for them to use only one or two kinds, it is expedient and proper that they be denied selection from the inventive genius and workmanship of the world, in order that one or two Canadian manufacturers may exist on the secured profits of a few protected machines. One can imagine to what an absurd extent this system might reach if unopposed.



Mr. John Blue, Eustis Mining Co., Capelton, President General Mining Association of Quebec, 1894.

An experienced miner coming to a new country after being accustomed to the modern mining machinery of more advanced countries, in stating his wants to the local manufacturer would be told: "My dear sir, your past experience is a mistake, you don't know what you want here, a Clarkson-Stanfield concentrator may be all very well in its way but we don't make it, it is a new-fangled, modern idea unsuited to this country where protection makes it inexpedient and unnecessary to make many changes and impovements, what you want is a good old-fashioned Rand drill or a Northey pump, or a good substantial steam hoist; they may be rather expensive articles because the import duty imposed to protect us from the pernicious influence of modern thought and the improvements of the rest of the mining world, makes it more expensive to manufacture them here, and we really are too busy reaping easy profits to be bothered with a first-class machine like the one you ask for; we can of course make you a separator if you must have one because we are engineers and can therefore make all kinds of machinery as we have taken care to point out to the Department of Customs. It will take some time to do this, however, as we have not given much special attention to separators and it will be costly and may not be quite successful at first, therefore do you not think you had better take something else instead?"

Seriously, let us look at the matter in a matter of fact light and see if according to their own statement the manufacturers have anything to complain of.

Miners in Canada find it more convenient to buy machinery made here if it is what they want, because it can be inspected before purchase and manufacturers cannot complain of want of custom hitherto. What the miners, however, claim as their right is that they shall have that class or kind of machinery which they want, and which is not manufactured in this country, duty free.

As to any technical difficulty in determining the "class or kind" manufacturers have certainly nothing to grumble about.

It is well known that the General Mining Association of Quebec has since its formation always encouraged the membership of manufacturers, and it cannot be denied that they are already well represented and have had a powerful voice in its deliberations on all subjects.

At the quarterly meeting held in Montreal on the 7th April, 1893—Capt. Adams presiding—when the importation of mining machinery was thoroughly discussed, there were present many representatives of the mining machinery industry noticeably, Mr. F. A. Halsey, of the Canadian Rand Drill Co., Sherbrooke; Mr. John M. Jenckes, Jenckes Machine Co., Sherbrooke; Mr. Gillman, of the Ingersoll Rock Drill Co., Montreal; and others. It was moved by Mr. B. T. A. Bell, secretary of the Association, and seconded by Mr. John Penhale:

"That a special committee representing the mineral operators of the province, consisting of Mr. John Blue, Mr. J. Burley Smith, Mr. Geo. R. Smith, Mr. S. P. Franchot, and himself, with *an equal number of gentlemen representing the manufacturing interests of mining machinery in Canada*, be appointed to frame a statement of mining machinery not manufactured in Canada. and that the said statement be submitted to the various Canadian Mining Associations for approval, before being finally submitted to the Department for official reference."

This joint committee of machinery manufacturers and mineral operators met at Sherbrooke on the 12th May, 1893. There were present: F. A. Halsey, J. M. Jenckes, J. S. Mitchell,

J. Burley Smith, L. A. Klein, John Blue, F. P. Buck, B. T. A. Bell, B. Rising.

"After discussion, the secretary submitted an elaborate statement, showing the various classes and kinds of machinery known to be made in Canada, together with those which were known not to be made and which were being imported. *He stated that a circular had been addressed to every machinery manufacturer in the Dominion,* asking them to furnish particulars of their manufactures, and that an invitation had been sent to each to send representatives to this meeting. The information given in response to these circulars had been embodied in the statement which he thought was fairly complete. Messrs. Halsey and Jenckes, mining machinery manufacturers of Sherbrooke, made objection to furnishing the department with any statement showing machinery that was not manufactured, claiming that a statement of what was made would serve the purpose equally well. After discussion this was agreed to. The committee then proceeded to discuss the statement of machinery made, which, after some alteration was adopted, and the secretary was authorized to forward it to the Mining Society of Nova Scotia for its endorsation prior to the meeting of the Association on July 5th, 1893."

Now the writer in the *Canadian Manufactnrer* complains—"that such list has been prepared, and has been submitted to the Government, and that it has been drawn up entirely in the interest of users of mining machinery with a view to making the construction of the law which has hitherto been quite general, absolutely so."

This is most unreasonable as it is shown by the foregoing that the manufacturers on the appointed committee repudiated the list of machinery not manufactured, and substituted that of machinery manufactured in Canada, and the accepted list is the one which they preferred and agreed to in committee, and indicates clearly that the manufacturers do not want to meet the miners in the same liberal spirit shown by the latter, and that they would tax all the mining machinery if they could, and that, unrestrained, their short-sighted cupidity would do its best to destroy the industry by which they live.

No reasonable man would deny the usefulness of a Rand drill, a Northey pump, or the acknowledged excellence of the Ingersoll-Sergeant coal cutting machine; but all these have their limit of utility, and if miners consider some other kinds and makes are an improvement, are more modern, or have advantages not possessed by those made in Canada and are practically necessary to enable them to compete with the mines of other countries, and they are not made here, then they have an undoubted right to import them free of duty according to the recent Act of the Dominion Government, which desires to foster all her industries and not one particular class only.

Gypsum Production in Nova Scotia during the year 1893.

This industry appears to have kept in the even tenor of its way, and there is little to note beyond the depression due to the dullness of the principal market, the United States.

The output to the close of the year is, so far as information can be obtained at the time of writing, in round numbers 160,000 tons. This does not include about 5,000 tons used locally for house work and for fertilizers. The export is principally to the United States. The district having a practical monopoly of the export trade is that of Windsor. A few miles from the town on tide water is a large quarry controlled by the Messrs. Dimock, of Windsor. This quarry is connected by a railway with the wharf, and is very favorably situated for working. Other smaller quarries are found at Walton, Cheverie, Newport, Hantsport, etc., in this vicinity.

During the past season a small quarry has been opened at Parrsboro', on the Bay of Fundy and a few hundred tons shipped to the States.

There is a mill near Truro which supplies a considerable local trade in fertilisers.

In Pictou and Antigonish counties a very limited amount is used locally. Passing to Cape Breton the quarry at Lennox Passage returns about 6,000 tons shipped, it is stated, principally to New York.

The Victoria Gypsum Company near Baddeck mine a very superior grade of plaster. Their shipments are in the vicinity of 20,000 tons. Small lots were shipped from Port Hood. At Mabou quite extensive operations have been carried on by the Mabou Gypsum and Coal Company. The returns for the first nine months of 1893, show shipments of 11,700 tons of plaster, and of 27,000 bags of fertilizer. Good shipping wharves have been built here and it is anticipated that there is a good opening for the purpose of manufacturing gypsum fertilizers.

As is well known the quantity of gypsum in Nova Scotia is simply inexhaustible. The finer and whiter qualities are abundant, and preferred for shipping. The other soft varieties are equally good for agricultural purposes and are more commonly met with. It is surprising that the beneficial qualities of gypsum as a vehicle both for manufactured fertilizers, as well as for constant use in stables, etc., for compost is not more widely recognized. Its capabilities for retaining liquid and volatile constituents of manures are unsurpassed, and it is in itself directly beneficial to many soils. In France these uses are well understood and acted on. The production of gypsum in England is limited and is stated to be decreasing annually. The prices there per ton are such as might under favorable conditions of freight permit of shipments from Cape Breton.

The Iron Industry of Nova Scotia, 1893.

During the past season the business of this industry has been advancing steadily and surely. At Londonderry work was continued as usual. Explorations in the immense territory controlled by this company have shown extensions of the ore deposits, calculated to ensure ore supplies for some time to come. The Torbrook ore has continued to give satisfaction. There has also been the usual amount of spathic ore calcined, and the Brookfield limestone quarry has been worked for flux.

Late in the fall the Pictou Charcoal Iron Company resumed work, having secured the additional capital required to fairly launch their enterprise. There is no doubt that the brand of this company will soon have a well recognized value, as their appliances and material are calculated for the production of a first-class charcoal pig. The prospecting work of this company has resulted in the location of a valuable deposit of brown hematite on the head waters of Sutherland's River, in a locality not generally considered likely to contain this ore.

The New Glasgow Iron, Coal and Railway Company may now be said to be in good running order. The difficulties inherent in starting a blast furnace in a new district appear to have been overcome. The question of fuel, ore, flux, mixtures, etc., appear to have been solved, and for some time past the furnace has been running on pig for the New Glasgow Steel Works, and it is proposed to also give considerable time to the production of foundry pig. It is anticipated that there will be ample employment for the furnace. It is specially pleasing to learn that the supplies for the steel works can be procured locally. The mines and railway of the company are now completed and in good working order. The company's railway runs from Hopewell to Sunny Brae, a distance of 12 miles. It is to be hoped that no distant day will see the extension of this road some 35 miles to Sheet Harbor, on the Atlantic coast. This admirable haven open all winter would afford a ready and short outlet for Pictou coal, iron ore, etc.

Some exploration work was done on the Bartlett and Holmes areas, in Pictou County, and the results have been confirmatory of the high opinion expressed by Sir William Dawson and others of the deposits of specular, limonite, etc., covered by these properties.

At Arisaig, Antigonish County, explorations carried on during the past few years have shown that there are numerous bodies of iron ore well adapted for mining, from their size and accessibility. A few hundred tons were mined by the New Glasgow Iron, Coal and Railway Company and tested at their Ferrona furnace, and found to be quite satisfactory.

This district is close to shipping and railway, and will be an important iron ore producer in the future.

At Torbrook, Annapolis County, the only mining operations are those of the Torbrook Iron Company. Here the regular production has been continued and the mine has been placed in effective condition. The vein continues about six feet in width, of uniform quality and free from faults. Some explorations in the district lying south and south-west of Torbrook show that the extent of territory underlaid by iron ore is much larger than has hitherto been believed to be the case. As this locality is near shipping facilities, and well provided with railways it should benefit by any change in the United States tariff, placing iron ore on the free list. The following figures will show the amount of iron ore raised, and the pig made in Nova Scotia during 1893:—

	Tons.
Iron ore raised	89,000
Pig iron made	41,000

The Montagu Mine Disaster.

The sad accident at Montagu Mines, near Halifax, N.S., which is mentioned in our Mining Notes, and whereby four miners lost their lives, is worthy of more than passing comment.

The direct cause of the disaster was undoubtedly a lack of correct information as to the extent of the old underground workings. The property came into the hands of the Symon-Kaye syndicate, a London corporation managed by Mr. Alfred Woodhouse, in the summer of 1892. At that time, and for some time previous, the property had been idle, and neither plans nor information were on fyle or accessible as to the extent or character of previous workings. We believe we are correct in saying that Mr. L. J. Boyd had made a map for the promoters' use which purported to show these workings, but as they were filled with water this map evidently could only have been based on hearsay, and therefore was quite unsuitable as a guide for future workings.

Shortly after obtaining possession the local management started to sink a new shaft about 190 feet west of an old one, called the Cooper shaft (our figures are from the evidence given at the Coroner's inquest), and ultimately a depth of something over 100 feet was reached.

Some four months ago good quartz was struck in this shaft, and since then work has been pushed more vigorously. Levels running east and west, at a depth of one hundred feet, were driven, and a back stope started from the roof of the east level. It was in this stope, as we understand, that the best quartz was to be seen, and the stope was carried up to a height of over 30 feet from the level at the time of the accident. It was in this stope also that the fatal shot was fired at 8 a.m. on the morning of Dec. 28th. From Boyd's plan it would appear that over 60 feet of solid rock intervened between the stope and the old workings carried west from the Cooper shaft; as a matter of fact there could not have been over 3 feet, as the hole fired was only 18 inches deep, breaking both ways and flooding the new workings to a height of 28 feet in three minutes time.

The question at once arises who—if any one—was responsible for the accident? and were proper precautions taken?

While it has been said in some of the Halifax papers that there is no provision in the Nova Scotia statutes for the fyling of correct underground plans of gold mines, we think differently. Sections 19 and 22, and sub-section 9 of Section 25, Chapter VIII., cover this accident *with this exception*, that Sections 19 and 22 are applicable only in case twelve persons or more "*have ordinarily been employed below ground*," but Section 25 has no limitation as to number of employees, and is therefore applicable.

That part of Sections 29 and 22 which applies is as follows:—

Sec. 19. When any mine is abandoned, the owner of such mine at the time of such abandonment shall, within three months after such abandonment, send to the office of the Commissioner an accurate plan on a scale of not less than two chains to one inch, showing the boundaries of the workings of such mine up to the time of the abandonment.

Sec. 22. The owner, agent or manager of every mine of coal, &c., &c., shall keep in the office at the mine an accurate plan of the workings of such mine, * * also the owner, agent or manager of *all other mines* in which more than twelve persons are ordinarily employed below ground, * * on or before the 1st day of April of each year, shall furnish to the Inspector a correct plan or tracing of the workings up to the 1st day of January then last past.

The question that first arises, therefore, is whether the owner or owners at the time the Cooper shaft workings were made, "ordinarily employed twelve men below ground"—if they did, by the sections above quoted, they are responsible; if they did not, then these sections cannot apply, but the Commissioner should see to it that they are amended so as to apply in future to all cases.

It is obviously impossible and unfair to expect of the Inspector (who in his dual capacity of Deputy Commissioner and Inspector is probably the hardest worked man in the Government's service), that he should look after all the small workings going on intermittently here and there, and procure and place on fyle maps of all such workings. These maps should be made by the lessees, and on them should fall the responsibility of neglecting to furnish them, as is the case with coal lessees.

But when we come to sub-section 9 of Section 25 we have no limitations, it is one of the "General Rules" which are to be observed in every mine. The Section reads as follows:—

(9.) Where a place is likely to contain a dangerous accumulation of water the working approaching such place shall not exceed eight feet in width or height, and there shall be constantly kept at a sufficient distance, not being less than five yards in advance, *at least one bore hole* near the centre of the working, and sufficient flank bore holes on each side.

From the evidence given at the inquest it was shown by the foreman (Savage), that water had been coming in heavier than usual for a week before the accident, and that on the morning of the accident it was running in faster than usual, and that 24 hours previous a hole that was fired shifted the course of the water from the foot wall seam to the hole.

From the published accounts in the Halifax papers, it is evident that some of the workmen were afraid of the danger impending, and that more than one miner quit work because of apprehension of the mine being flooded.

Under these circumstances it would certainly appear that there was knowledge of "a dangerous accumulation of water," and as the manager, Mr. Woodhouse, had been in this country "two years and three months," he should have known of this statute and have given orders for the necessary bore hole to have been carried in all faces working towards the old ground.

We do not hesitate to say that good mining practice, without the statute referred to, would always keep a long bore hole ahead in approaching ground that was known to be worked out full of water.

We are reminded also by the Halifax *Herald* that Mr. Woodhouse came to Nova Scotia with quite a flourish as to his previous experience and great ability. While we do not say that Mr. Woodhouse's neglect was directly or indirectly the cause of this disaster, we do say that the course he pursued was not that which an experienced or capable mining engineer would have followed.

The lesson of the disaster, not alone for Nova Scotia, but for all the other Provinces of the Dominion, is to look to their statutes regulating mining, and see to it that there is embodied there regulations making the periodical correction of all maps of underground workings obligatory under heavy penalties. Also making it obligatory on every mine owner to furnish such maps of his property, and on the mine's officials to properly record such maps that they may be available to subsequent owners.

The gold fields of Nova Scotia have had many desultory and isolated openings made, and the main districts have been more or less continuously worked for over 30 years, therefore it is practically impossible to obtain plans of all the underground workings. But it is not impossible to collect data regarding most of the work that has been done, and one way to make this available was shown in a paper recently read by Mr. John E. Hardman, before the Mining Society of Nova Scotia, on "Government Aid to Mining." Such maps as are suggested in that paper would record the best available data, and would furnish a foundation to which each subsequent year would add its story. The cost to the government would not be great, but whatever the cost this disaster demands that no time should be lost in collecting and recording in some way or another all the data that can now be gleaned by disinterested parties from the men who formerly worked in these mines. Many of these men are getting old, others are leaving the country, and in a few years' time none of them will be available to tell his story.

EN PASSANT.

Owing to an unusual pressure on our columns, our usual yearly review of the progress of gold and coal mining in Nova Scotia has been laid over until the February issue.

Mr. Robert Archibald, M.E., has been appointed manager of the Joggins mines of the Canada Coal and Railway Company at Joggins, N.S. Mr. Archilbald is an experienced colliery manager. He comes from the Carron Company of Falkirk, Scotland.

Mr. Wm. Blakemore, M.E., of Cardiff, a Past President of the National Association of Colliery Managers, has received the appointment of assistant to Mr. David McKeen, M.P., Resident Manager of the Dominion Coal Company at Glace Bay, C.B.

Mr. John Blue, of the Eustis Mining Company, Capelton, the new President of the General Mining Association of the Province of Quebec, is one of our most successful and highly esteemed mining men in the Province of Quebec. A Scotchman by birth and training, he has been for many years engaged in exploiting the enormous body of copper pyrites at Capelton. The Eustis mine may safely be said to be the banner mine of the province, the ore deposit extending laterally for over two miles, and in depth on the slope of the vein to over 2,000 ft., while at the lowest point, at last report, the ore body is as strong and as solid as ever and has every appearance of continuing so for an indefinite depth. Since it was first opened the Eustis mine has produced about half a million tons of ore and in all liklihood it will produce as much more and probably be a long way from being worked out then. The portrait of the new President published in this issue is from a photograph by Presby, Sherbrooke, Que.

Mr. Ian Cameron, manager of the Dominion Mineral Company, Sudbury, another Scotchman, by the way, has gone to the old country for a brief holiday.

CORRESPONDENCE.

Free Mining Machinery.

To the Editor of the Review:

SIR,—In the December number of the *Canadian Manufacturer* appears an article under the heading of "Mining Machinery," the manifest object of which is to boom the Northey pump, although the writer would have it appear as applying to all mining machinery. There are so many mis-statements of facts, and particularly in reference to the action of the mining associations in asking the Government to be more explicit in the wording of the Act that some reply becomes necessary.

In the first place the mining associations referred to are the General Mining Association of the Province of Quebec and the Mining Society of Nova Scotia. During the past year both of these associations have united in their efforts to have uniform rulings at all ports of entry in regard to the importation of mining machinery, and with that end in view have endeavored to make up lists of such machinery as is entitled to free entry under item 983, and also have urged a better working of the language of the Schedule that there might be no ambiguity and no chance for misinterpretation.

As to the Mining Society of Nova Scotia, I speak whereof I know when I say that all the leading makers of mining machinery in that province are members of that society, most of them attend the meetings regularly, and most of them were represented upon the committees which have had this matter in hand and which framed the lists which, with the concurrence of the Quebec Association, was forwarded to the Hon. Minister of Customs.

These manufacturers do not oppose the free importation of such mining machinery as is not made in Canada; on the contrary, it is safe to assert that some such importations have brought them increased business, from the duplication of some machines and the renewal of wearing parts in others.

The mining associations of the country have always kept the interests of the home manufacturers in view, and some of the best plants in Canada to-day are fitted with Canadian machinery wherever that machinery can be supplied, and such plants contain of American manufacture only such machines as are not, and at the present time cannot be, made here.

One might go further, and show the illogical nature of this article in the *Manufacturer*, as for example: "If a foreign manufacturer establishes a branch of his works in Canada, or a Canadian manufacturer engages in such an enterprise, then he is handicapped by this free foreign competition," which means (if it means *anything*) that if the Worthington Co. come to Canada and make the Worthington pump here, they then will be handicapped by "free foreign competition," though just how the Worthington pump is to come in free, if it is made here, the Northey pump man doesn't explain!

DURHAM.

HALIFAX, January 28, 1894.

FOURTH ANNUAL GENERAL MEETING

OF THE

General Mining Association

Of the Province of Quebec.

The Fourth Annual General Meeting of the General Mining Association of the Province of Quebec, was held in the new club room Windsor Hotel, Montreal, on Wednesday and Thursday 11th and 12th January. The attendance being one of the largest since the organisation of the Association.

The following, among others, were present:—

John Blue, Eustis Mining Co., Eustis, Que.
George R. Smith, Bell's Asbestos Co., Thetford Mines.
Capt. R. C. Adams, Anglo-Canadian Phosphate Co., Montreal.
H. J. Williams, Beaver Asbestos Co., Thetford Mines.
Dr. F. D. Adams, McGill University, Montreal.
E. D. Ingall, Geological Survey, Ottawa.
E. A. Barlow, Geological Survey, Ottawa.
Prof. W. A. Carlyle, McGill University, Montreal.
George E. Drummond, Canada Iron Furnace Co., Montreal.
T. J. Drummond, Canada Iron Furnace Co., Montreal.
J. .T McCall, Drummond, McCall & Co., Montreal.
John J. Drummond, Canada Iron Furnace Co., Radnor.
John J. Penhale, United Asbestos Co., Black Lake.
W. T. Costigan, Cyclone Pulverizer Co., Montreal.
E. B. Haycock, Star Gold Mine, Ottawa.
F. P. Buck, Dominion Lime Co., Sherbrooke.
Col. Lucke, Beaver Asbestos Co., Sherbrooke.
F. A. Halsey, Canadian Rand Drill Co., Sherbrooke.
J. D. Sword, Ingersoll Rock Drill Co., Montreal.
J. Burley Smith, British Phosphate Co., Glen Almond.
Daniel Smith, Hamilton Powder Co., Brownsburg.
Dwight Brainerd, Hamilton Powder Co., Montreal.
J. T. Donald, M.A., Montreal.
A Dick, Joggins Mines, N.S.
Graham Fraser, New Glasgow Iron, Coal and Railway Co., Ferrona, N S.
John F. Stairs, M.P., New Glasgow Iron, Coal and Railway Co., Halifax.
A. W. Stevenson, C.A., Montreal.
W. S. Gardner, Machinery Supply Co., Montreal.
Fritz Cirkel, M.E., Ottawa.
B. T. A. Bell, Editor CANADIAN MINING REVIEW, Ottawa.
James King, M.L.A., King Bros., Quebec.
Hon. E. J. Flynn, Commissioner of Crown Lands, Quebec.
And the following mining students at McGill: Messrs. Cole, Lambert, Whiteside, Archibald, Van Barrieveld, Hart, Givillaun, Featherstone, Wilkins, Askwith, Rutherford, Webb, Adams and Green.
A. Leofred, M.E., Quebec.

In the absence of the Hon. George Irvine, Q.C., President, Capt. R. C. Adams, Montreal, presided.

The Secretary read the minutes of the last Quarterly General Meeting, together with those of recent meetings of the Council, which were confirmed.

New Members.

The following were elected members of the Association:

J. D. Sword, M.E., Montreal.
W. E. C. Eustis, Boston.
A. W. Morris, M.L.A., Montreal.

Financial Statement.

MR. A. W. STEVENSON, C.A., submitted the financial statement for the year which showed the total receipts to have been $2,406.42 and the expenditure $2,269.55, leaving a balance in hand of $136.87.

THE SECRETARY briefly referred to the marked increase in the membership during the past year, the interest that had been taken in the various meetings and excursions, particularly the proceedings of the International Mining Convention, held at Montreal during the week beginning 21st February, when the Association welcomed as its guests the American Institute of Mining Engineers, the Mining Society of Nova Scotia and the Ontario Mining Association. The many papers which had been submitted had been of an exceedingly valuable character, and had done much, not only to extend their own knowledge, but also he hoped to attract the attention of the people and capitalists at large to the field for investment in mining open to them in their province and througtout the Dominion.

The Late Mr. W. Hall Irwin.

On motion of the Secretary the following resolution was adopted:

"The members of the Association having learned with profound sorrow of the untimely death of Mr. W. Hall Irwin, a valued and highly esteemed member of the Council; Be it resolved: That a minute be entered in the proceedings of this Annual General Meeting recording the sense of loss sustained by the Association and the mining industry of the Province, the welfare and interests of which he had done so much to promote and further by his integrity, energy and enterprise."

Amendments to Constitution.

The following amendments and additions to the Constitution were adopted:—

Section 10. "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."

Section 12. "All officers and members of Council shall retire annually, but shall be elegible for re-election."

Section VII. "When the proposed Candidate is elected, the Secretary shall give him notice thereof according to Form "B," but his name shall not be added to the list of members of the Association until he shall have signed the Form C in the appendix."

Section XVI. "General meetings for the reading and discussion of papers and for the transaction of business shall be held once in every four months in each year, at such time and place as the Council may determine.

Affiliation of Mining Students.

THE SECRETARY stated that at one of their Council Meetings the question of affiliating the McGill Mining Society, which was an organisation of the mining students attending the lectures at McGill University, had been discussed, and Mr. Carlyle had written to say that the matter had been favorably entertained by the students. On motion in was decided to refer the matter to a meeting of Council to determine upon a basis for such affiliation.

A Canadian Mining Association.

THE SECRETARY stated there was a very favorable disposition among many of the members towards the incorporation of the existing mining organisations into one strong body, which while representing the Provinces would be thoroughly representative of the mining interests of the Dominion. Certain prominent members of the Mining Society of Nova Scotia were also strongly in favor of such an amalgamation.

THE CHAIRMAN—The idea is a capital one and I think that we should make a move towards carrying it out.

MR. F. A. HALSEY was heartily in sympathy with such a move. The Council, he thought, might draw up a proposition and submit it at their meeting on Thursday, it could then be left in the hands of a sub-committee to enter into negotiations.

On motion the matter was referred to Council to report.

Election of Officers and Council.

The meeting then proceeded to elect officers and Council, the various ballots resulting as follows:—

President:

John Blue, Eustis Mining Co., Capelton.

Vice-Presidents:

J. Burley Smith, British Phosphate Co., Glen Almond.
George E. Drummond, Canada Iron Furnace Co., Montreal.
F. P. Buck, Dominion Lime Co., Sherbrooke.
Col. Lucke, Beaver Asbestos Co., Sherbrooke.

Council:

James King, M.L.A., King Bros., Quebec.
Capt. R. C. Adams, Anglo-Canadian Phosphate Co., Montreal.

F. A. Halsey, Canadian Rand Drill Co., Sherbrooke.
S. P. Franchot, Emerald Mining Co., Buckingham.
Hector McRae, Electric Mining Co., Ottawa.
R. T. Hopper, Anglo-Canadian Asbestos Co., Montreal.
J. J. Penhale, United Asbestos Co., Black Lake.
George R. Smith, Bell's Asbestos Co., Thetford Mines.
Fritz Cirkel, M.E., Ottawa.

Treasurer :

Mr. A. W. Stevenson, C.A., 17 St. John St., Montreal.

Secretary :

Mr. B. T. A. Bell, 17 Victoria Chambers, Ottawa.

To Meet in Quebec.

After discussion it was unanimously resolved to hold the next meeting in the city of Quebec during the first week in June.

The meeting then adjourned.

EVENING SESSION.

The members reassembled at eight o'clock, Mr. John Blue, President, in the chair. The club room was crowded, there not being seating accommodation for all present. The first paper was :

The Diamond Prospecting Drill in Mining Canadian Phosphate and other Irregular Deposits.

By J. Burley Smith, Glen Almond, Que.

It is generally held that the diamond drill is not of the same utility in prospecting and determining the position of irregular deposits as it is in minerals of more regular occurrence.

This is more from the fact of the great results achieved in determining accurately the area, extent and depth of regular deposits scientifically located, than failure to discover the position of acknowledged uncertain deposits.

However great the service rendered with regard to regular deposits, it will be remembered that the value of the diamond drill as a prospecting tool became first properly appreciated from the remarkable discoveries made through its use in the great hematite deposits of North Lancashire and Cumberland, England.

Deposits, which from their apparent fitfulness and irregularity had been worked only on a small scale, and as mere surface pockets occurring here and there over a considerable area of ground, and abandoned when apparently exhausted, until the boring operations of a few enterprising proprietors taught the lesson that, although the character of the ore seemed irregular, similar deposits occurred at much greater depths, and of much greater magnitude, the irregularity, scientifically considered, being but another form of regularity and the peculiar order in which these deposits were to be looked for.

Subsequently, and chiefly owing to the use of the prospecting drill, these mines have been worked to a very great depth, and much more extensively, turning out annually many hundreds of thousands of tons.

And the great number of successful results of recent years in such deposits, in all parts of the world, appears to indicate that the diamond drill is of even greater utility in prospecting these than in the more regular minerals referred to.

The very irregularity which makes some kinds of mining so uncertain shows the necessity of traversing and searching the zone of occurrence in many directions by some method much more rapid and less costly than by shafts and tunnels, and a tool like the diamond drill, capable of drilling from 20 to 40 feet per day and bringing out cores of the material passed through, seems to fulfil, in a great measure, these required conditions.

Through its use, prospecting of a mineral property can be exhaustively and reliably carried out in a few months, and cross sections delineated, showing the unmber and size of the deposits, from the plotted profiles of which the quantity of ore contained may be approximately calculated, showing if the quantity discovered is large and near enough to bear the greater expense of sinking a shaft or driving tunnels to reach it.

Thus, by the expenditure of a few thousand dollars in the prospecting machinery and the cost of the necessary boring operations, the owner of a property is able figuratively to cut his property into slices and see what is inside. The accuracy of which depending, of course, on the number of cuts made.

And, instead of risking a large sum in the purchase of a costly permanent plant and machinery to begin active mining operations for a mineral only doubtfully believed to exist, it may be ascertained by a properly arranged system of borings (practically constituting an approximately accurate underground survey showing the extent and location of detached and irregular deposits) whether it is advisable to lay out money in plant at all, or how much, and even if it is advisable to mine a property or not.

If valuable the very best machinery can be laid down without hesitation or risk for the most economic method of sinking or driving to and winning the mineral when reached.

At the same time an approximate knowledge of the quantity, making it feasible to determine in advance all the questions of transport and annual yield, the laying down of tramways and and the transport generally and the use of available water or other gratuitous power to the best advantage.

Negotiations for sale or purchase would also be much simplified from the fact of the real value of the mining estate being established, the cores of mineral and country rock, with the accompanying chart and sections being the best evidence of the character of the property.

In mining phosphate of lime in Canada the prospecting drill is certain to prove of the greatest possible service.

It is now pretty clearly demonstrated by those eminent Canadian geologists who have earnestly investigated the phenomena of occurrence of this peculiar mineral, that it is found, with rare exceptions, in detached masses or pockets sometimes resembling veins, in masses of pyroxene which originally considered as interbedded portions of the structure of the Laurentian rocks, are now generally acknowledged to be intrusive dykes, probably connected with the basic eruptions of Archean date.

Very recent observations made in the actual mining of phosphate corroborate in a remarkable way these conclusions, and give at once a basis from which to start in searching for the mineral.

The question of irregularlty and uncertainly of the phosphates are not disposed of, but the occurrence and form of the pyroxene are shown to be not irregular and it may be easily recognized.

It is well known that these pyroxene zones, belts or bands, or whatever name they are distinguished by, are readily found and their boundaries clearly defined.

Granting this it will be seen that the field of operations for the diamond drill prospector is not unduly large, and that a comparatively few carefully selected bore-holes will show if the zone is rich in phosphate or not, the character of the deposit, rich or poor, generally prevailing throughout, and if it is desirable to make further and more conclusive tests, or proceed to another field without loss of time or money.

If a number of vertical borings, placed at fixed intervals with their situation carefully recorded on plan are made and a proper register kept, together with the drill cores brought to the surface, a number of accurate profiles may be constructed, showing a faithful section of the ground tested and whatever it contains. And if parallel lines of borings be made at a convenient distance it will be seen that the area of these respective profiles multiplied by the parallel distances apart will give approximately the quantity of material lying between, whether of unproductive ground or a deposit of mineral.

My own experience in diamond boring in phosphate deposits has been confined so far entirely to underground work, *i.e.* in testing the ground in search of deposits lost track of, or cut out, or new ones believed to exist, but I am able to testify to the success attending those borings made and profiles taken which proved the existence of several valuable deposits ; in one case fully corroborated by the extension of a drift to it. And knowing the distance exactly, and the kind of rock intervening, we were able to let the driving of this by contract and on very reasonable terms.

I regret from the fact of our boring operations being yet incomplete, that I am not at liberty to give full figures and details, but hope on some future occasion to return to the subject and publish a full account of this work, which has proved valuable and interesting to me, and may be of use to other phosphate miners.

I will therefore conclude with some description of the machine in use at our mines, which has given the greatest satisfaction, absolutely costing nothing in repairs during the six months we have had it in daily use.

The diamond drill we have in use is the Bullock drill and of the prospecting type, it is capable of boring holes up to a depth of 1,200 feet, in hard rocks such as gneiss or diorite it will bore at the rate of about 20 feet per day of ten hours, and in phosphate, one foot in three minutes, and it requires about four horse power to drive it efficiently. It bores holes of $1\frac{3}{4}$ in. in dia. bringing up a core $1\frac{3}{16}$ in. dia

The motive power is supplied by a pair of light and compact trunk engines, fitted with slide valves of novel construction, which permit the using of the smallest possible part, and reducing the clearance to a minimum, thus effecting a large saving in the use of compressed air.

It is light and portable and can be used with equal convenience on the surface or underground, and will bore in almost any direction.

It is unnecessary to give further particulars here and I will therefore refer enquirers for more to the catalogue of the makers.

Finally, however, I desire to express the opinion that the diamond drill is equally useful in prospecting for mica, graphite and all minerals of more or less irregular occurrence.

As a mining tool in every day operations it is of the greatest value—in testing ground ahead, in sinking, driving or stoping, and it is not infrequently used in boring blast holes as well.

Discussion.

The paper was ably discussed by Messrs. George R. Smith, Capt R. C. Adams, W. A. Carlyle, F. A. Halsey, E. D. Ingall, and the Chairman.

Mine Tunnels and Tunnel Timbering.

By Mr. W. A. Carlyle, Montreal.

Location—In the selection of the site for the tunnel-entry care is taken to choose a place (1) as easy as possible of access by trail or road, (2) but chiefly at the lowest point, so that the greatest possible area of the ore deposit may be worked over-head after the tunnel reaches it, and at the same time be drained naturally of water, all geological data having been sought out by surface examination and test-pits. Good and sufficient dumping ground is also provided for, care being taken by survey if at all doubtful, that the tunnel will be on the right territory and that the waste rock on the dump will not fall so as to trouble other property or block public roads, or by any possible means incur litigation or impede future mining operations.

Often in the early life of a claim to develop the character and value of the ore-body, a tunnel is run at a point high up so as not to be at first of too great length and cost, but afterwards a longer tunnel is driven in at a much lower level after the upper one has proved the claim to be good, and enrich d the none to plentiful supplies in the company coffers. Again a tunnel may sometimes be profitably driven as from the other side of the hill or mountain, so that its mouth will be in a most advantageous position for connection with an aerial wire-rope tramway, by which arrangement although the first cost will be more, the cost of transport of ore from the stope to mill or railroad will be so lessened as to quickly repay the extra initial outlay. For this reason it may be wiser to use a tunnel instead of a shaft, even if the latter is much the more preferable for the mining of a deposit, and when work must be done below the tunnel level. This is now rendered very easy by sinking inclines and placing at their head rapid and powerful hoists operated by electricity or compressed air, and if water is encountered, pumps can now be got that will do beyond peradventure, most efficient work with either of these sources of power.

In all cases the tunnel must be run right straight for the vein, and for this it may be well to call in the aid of the surveyor whose directions should be then closely followed, for if even a slight deviation is made, say to work along softer ground, one's course is quickly lost under ground and a queerly shaped tunnel is the result. This direction is easily kept by lining in the miners with plugs driven into the centre of the roof and plumb-bobs suspended from them, or using stout screw-eyes in the caps of the timbering.

Dimensions— In metal mining tunnels $4\frac{1}{2}$ x 7 ft. for single track, and 8 x 7 ft. for double will be amply large when no timbers are used, but with timbers 4 x $6\frac{2}{3}$ ft. in the clear for single, and $7\frac{2}{3}$ x $6\frac{2}{3}$ ft. for double will permit the easy haulage of much material, but still be none too large. In a small cheap prospecting tunnel $3\frac{1}{2}$ x 6 ft. will suffice.

Grade—The best average grade in good work is 6 in. per 100 ft., giving a rapid fall for water and equalizing the work of taking out fulls and returning the empties. A 1 per cent. grade common in levels, with a good track will permit a trammer to ride out but he will have a heavy push back especially with iron and timbers. Miners left alone will quickly work in a steep grade, they will never run level, and in good work the grade is easily kept by using a 16 x 20 feet straight-edge cut to the proper inclination and a spirit level, laid along the mudsills, and checked with level and rod every 100 or 200 feet, for 6 in. per 100 feet too much grade in a 1000 feet means 5 feet less of stoping ground.

Equipment—In developing a claim by tunnelling the least amount of equipment is required. If the work is to be done with the very least outlay of money a small stout shed or blacksmith shop is erected over or near by the entry and fitted up with forge, anvil, bench, vises and sufficient appliances to keep all the mining tools in good condition such as drills, hammers, shovels and picks, and also with such supplies necessary for repairing the cars. Often all the blacksmith work is done by one of the miners working part-time in the shop, but if one man is needed just for this work, during spare hours he may be engaged in building more cars using bot-wheels, or else in cutting out mine timber setts. In more extensive work where machine drills are used, a simple and not expensive engine house is built, say 40 x 40 feet, divided into (1) the compressor room in which are a 4 x 6 drill compressor, the receiver and two steam pumps, one for boiler feed the other for supplying cold water to the compressor, (2) coal bunkers, (3) a small store room, and (4) the rest of the building has a sufficient boiler, a large bench with vises, tools and fittings for repairing the air drills, etc., and also a small hand drill. Around near the boilers are benches and hooks for the miners' use, warmed in winter by the exhaust steam. At a very large tunnel-working in Colorado often to be referred to, and in which the writer worked, the cost of such an engine house thus supplied was $8,700, while another $1000 was spent on two other buildings, a well equipped blacksmith shop and a timber shed on either side of the track near the tunnel which was double tracked and driven 6,000 feet at a cost of $125,000, with such an equipment, the first 3940 feet taking exactly two years to accomplish, being delayed by hundreds of feet of tremendously difficult and dangerous ground.

If two drills are being used a third should be kept in the shop, also a good supply of track-iron, piping, sharp drills, etc, trying to anticipate always any wants that otherwise might delay work. If good water power is available excellent machines are now made by the using of which power, the cost of this kind of work can be greatly reduced.

As to houses and eating quarters for the men, I think company money should not be spent on these as good men can nearly always be got who are willing to work and also to build their own houses or shanties. Even the manager or superintendent should be content with humble quarters if in a new region, until the mine warrants more expense.

Ventilation—When the tunnel is run a short distance some means of conveying fresh air to the face must be provided:—(1) By hand blower set up at entry and pipes 4 x 5 inches diameter; (2) by a tight wooden box, 1 foot square, running into the face and having its outer end running up the hill to create a draught; (3) by some regular form of blower or exhaust fan, as the Root or Baker, driven by water or a small steam engine, using piping 8 x 12 inches diameter, spiral, welded and tight joints; (4) by discharging compressed air at intervals as found so successful in the large Pratolino tunnel, Italy, 3,600 metres long; (5) or by perhaps the best and cheapest method of all, *i.e.*, using pipes 8 x 14 inches diameter, with tight joints, running nearly to the face, introduce in the pipe near the tunnel-mouth a Korting exhaust (made in Philadelphia) which is about 3 feet long and the same diameter as the pipe. To this conduct through a ½ inch pipe live steam of 60 to 80 lbs. pressure, or as usually used, compressed air, which is allowed to blow off in the exhaust in a direction towards the mouth, a vacuum tends to form quickly behind the jet and at once a strong current of air begins to flow along the pipe from the heading and it is surprising how great is the efficiency of this cheap and simple exhaust ventilator. I have often seen in this big tunnel, with the air hose for two drills open to supply more fresh air, an 8 inch pipe thus have the air fresh and good in twenty minutes after the firing of 25 holes loaded heavily with dynamite. Of course as the tunnel gets long, the air along it may get sluggish and poor except near the heading, and as soon as possible natural ventilation should be secured through another connection with the surface, or the decay of the timbering will be very much more rapid. In using the drills the exhaust air from them is aiding very materially but this is not enough in itself after the work is 800 or 900 feet long.

Drainage—In cheap work, even in very good work, if a large flow of water has not been anticipated, water when struck is allowed to flow out over the floor, planks being laid between the rails to keep the men's feet dry, but this is a wet, dirty way, especially near the entry in winter time. Much better is it, remembering that water is almost a certainty, to prepare to confine it in a trench or small box along the side, or if a large flow may be expected, to put in water boxes from the first under the centre of the mud-sill (Figs. 4-7) at very little extra cost, such a box 12 x 16 inches, with ½ % fall, safely carrying 2,000 gallons per minute. I have seen a torrent pouring from a tunnel when it was then necessary to make the timber sett higher to permit the putting in for the tracking of a second sill 12 x 14 inches, above the mud-sill, just such as is seen in the Sutro tunnel of the Comstock.

Illumination—Around where the miners are at work, as at the face, the paraffine candle is by far the best illuminant, as it can be put anywhere and does not vitiate much air as do the foul-smelling, dirty coal oil lamps or torches that must be used in very wet places. The electric light is of course most efficient for permanent lighting, all wires being well insulated and the lamps usually with a wire mask, but *no* key for turning on and off the current. These protected incandescents can be used at the face, but are not as convenient as the candle in a miner's stick.

Explosives—In tunnelling only some form of dynamite or giant is the explosive used, giant No. 1 or 75 % nitro-glycerine being used in the centre cutting holes, where a concentrated effort is required in blowing out this central wedge of rock, while in the following or side holes when greatest effect is gained by spreading the energy of the blast over more space, giant No. 2, or 36 to 45 % strong is used, lower grades being discarded in all such work. These explosives, bought at a cheaper rate when in a considerable quantity, are best stored in a small vault or room excavated from one side of the tunnel near the entry, well boarded up and floored so as to be perfectly dry, with double doors, one locked, and good ventilation. Here it will be safest from any harm, as fire, lightning or mischief and liable to freeze only a little. The boss should prepare the cartridges, knowing just about the number of sticks needed, and then take them in at loading time when he sees that this important part is properly executed. In small work the miners usually carry in the necessary powder stuck down in their boot-leg and fire the holes as soon as ready.

In thawing out giant, which by the way should not be kept too long in stock, or over 1½ years, some simple arrangement is easy if there is a steam engine where a small box can be heated by the exhaust or live steam, but if a large amount is being used daily, it may be better to have a small house 6 x 6 ft., with racks for holding the stacks and trays of sawdust beneath, all heated by steam, and with a good supply of powder thus kept ready the cartridges can be safely made on a broad shelf opposite a window, without running the chances of danger always liable if this work is done, say, in the engine room. With a small Brunton fuse nippers cartridge loading is done much better and quicker, as with the nippers the fuse is cut square off and compressed so that it slips easily and snugly into the fulminate end of the cap, which is then fastened tightly on by an incircling squeeze from another part of the same tool.

Firing—If the tunnel is being driven by hand drilling, the shots are always exploded by simply snuffing or igniting the fuses with the candle, but with air drills the battery is much used, first firing the centre cutting holes and then the remainder, although if the timbering is kept close up to the face, this method is found to be harder on it, and for very good reasons many superintendents prefer lighting the charges by hand, making the fuses of the centre, or over, or undercutting holes shorter, so as to fire first and give the other shots their maximum efficiency. In this large tunnel where the driving was hard and fast, the battery was used for some time, but returning to hand firing it was found more satisfactory, as the preparations for shooting were quickly made, the rotation of shots was nearly controlled, the timbering not nearly as badly hammered up, and the number of missed shots small. These missed shots were easily set off by carefully cleaning out the hole nearly to the charge by the man who loaded it, and then inserting a small cartridge of a new fuse and half a stick that seldom failed to detonate the original charge, the ventilating exhaust described quickly drawing off the hot, smoky air, thus delaying work but a little. Such shots must be very carefully watched, especially if a large number has been exploded, for should the drill strike one that has been overlooked a bad explosion will ensue. One of the superintendents of this tunnel, afterwards in another mine, was caught in just this way while going his rounds, and on stepping up to the machine just as it struck the charge the man had neglected to notice had not exploded.

Mining—Tunnelling is begun by making a good entrance, if in rock, by putting in a strong well-cut set of timbers and a good door or gate; if in wash, by clearing away at once all loose stuff and timbering or walling up the approach to the opening to prevent caving in of the banks after heavy rains or in spring. For the first 100 feet or so wheelbarrows may be used for taking out the waste which at first is disposed of in levelling up outside and preparing for the tracks to the dump. Timbering will be needed until well into the rock, and usually close lagging, as water working through the wash would otherwise bring much soft stuff into the tunnel, besides the timbers are best kept close up to the face to forestall much unnecessary excavation, and to bar against the accidents liable in this often dangerous material.

The putting in of good solid tracking from the first will soon repay the extra cost, as it is surprising how the progress is increased by the use of good cars and tracks, when the maximum work can be got out of the trammers and the horses or mules, and vexatious and expensive delays caused by cars leaving the rails reduced to a minimum. The rails of at least 16 lbs. per yard, but preferably 24 lbs., are laid on the mud-sills or on stout ties 4 feet apar. and ballasted between with waste to make a good footway, or else planks are spiked down between the rails that have an 18 or 20 inch guage carefully set. In this big tunnel 36 lb. steel rails made a firm steady track over which with ½ % grade a 900 lb. mule easily pulls in a train of 12 or 15 heavy steel cars or trots out with the same loaded with 12 to 20 tons of rock or ore, a brake being necessary to control when going out.

Steel cars holding ¾ to 1½ tons of rock and with the wheels running loose on the axles are generally used but if much wet gritty stuff is being carried out that dripping down quickly cuts the axle bearings. This rapid and very harmful deterioration can be checked by putting on self-oiling wheels that are now made in a simple manner to protect such bearings. As the bottom of the car box is the first place to wear out from the constant fall of rock and this is an awkward place to patch or renew, the blacksmith should fit in the new car a false bottom of 1 inch pine and $\frac{3}{16}$ inch boiler plate bolted to the floor of the car which will protect the car itself and can be quickly replaced when worn out. Such details greatly lengthen the life and also reduce the cost of the rolling stock besides decidedly improving the efficiency. In a double track tunnel it is very convenient to use near the face a temporary switch and single track of light iron that can be lifted up and carried ahead, by which an empty coming in on its track can be run on this single track in the centre, much more easily shovelled into and worked about and when filled, be pushed upon the other track to wait until the whole train is ready. On the outside a simple device will save a man's time or the unnecessary stopping of the train when under full way and the otherwise great liability of the cars leaving the track at this point, and this is an automatic or simple spring switch where the two tracks merge into the one to the dump, that allows the car coming out to pass on to the dump-track, but returning the switch is always and only open to the in-going truck. As to the motive power when the tunnel gets long or over 1,000 feet, the trammers should give way to a horse or mule that will soon become accustomed to working in the darkness with perhaps only a lighted candle at the curves. In a completed tunnel not over 1,600 feet in length and a grade of not less than 1 % haulage is made very easy by putting at the inner end where it connects with the deposit, a 10 or 12 h.p. motor that will quickly pull in a train of empties that runs out full, dragging the steel cable and is checked at the entry by the motorman at the motor at the inner end.

The majority of tunnels are, perforce, driven by hand drilling and good progress thus made. Comparative tables as to the cost of driving by hand or machine are not available, but in the west with even the very high price for labor it is well understood that the advantage gained in the use of air drills is in *time* but not in *cost*, therefore I think one should hesitate before installing such a plant, to count the cost and to decide whether the work had better be rushed with all speed and whether the compressor and drills can be put to real use after mining commences. In some camps compressed air becomes a perfect fad and every superintendent thinks himself behind the times if not using it. In a single track work 100 to 180 feet per month by hand drilling is quite possible if the rock is not extremely hard, but with air drills the rate should be from 250 to 330 feet, 300 feet being good driving. In the big tunnel mentioned with 2 drills working in shale and afterwards hard dolomite, and breaking as much rock as the shovellers could well handle, the men were allowed pay as for two extra shifts if 300 feet was the month's advance, and it was astonishing to see the way they made the rocks fly and resented any delays, the result being that 320 to 330 feet was repeatedly the month's progress, while the star record for one month in softer dolomite, was 379 feet or 12½ feet per day.

If a head of 40 to 100 feet of water from a flume is available the compression of air is greatly cheapened by operating the compressors with Pelton water wheels. The electric percussion drills now in the market have not as yet proved a decided success, but in time technical defects will surely be remedied.

In hand drilling the placing of the holes depends greatly upon the character of the rock, although this influences but a little machine drilling, in which two vertical rows of holes are drilled toward one another in the centre for breaking out the central wedge, and then parallel rows of somewhat deeper holes and such squaring up holes as are required. Again 3 or 4 converging holes near the centre especially in small tunnels, will suffice to make a good centre cut, and concentric rows of holes will complete the work, but all machine men have their hobbies and a really good man will make much faster progress than one who knows how to handle the drill but not select the position for the holes. It might be said here that greater effect is secured by firing these centre cutting holes by electricity, but the others are fully efficient when snuffed.

Timbering—It is seldom that the rock in the tunnel will stand long without support excepting some classes of granite syenite, gneiss or firm limestone or sandstone, and as the primary object of timbering is to *prevent*, not *check*, the movement of the ground, it is generally best to timber up at once if the rock is at all liable to be weak, as so often the rock under strong tension will collapse without any warning or immediately after examination, and timbering will then be far more expensive in the end.

Spruce, pine and hemlock are mostly available for such service in our American mining and then they are best if the trees have been killed but not damaged by fire and stand straight, dry and strong, as the green wet stuff is very heavy to handle under ground. Such timber cut above altitudes of 7,000 or 8,000 feet was found in Colorado to be much inferior in strength to that from lower down, being less resinous and brashy.

Some sketches have been made to show the styles of timbering mostly used in American tunnels, those requiring the fewest cuts and simplest framing while preserving the maximum strength.

Fig. No. 1. shows a cheap sett consisting of cap and posts of round timber and poles split or unsplit for logging.

Fig. No. 2. is a full set of round timbers better framed with or without collar braces.

Fig. No. 3. shows a sett for single-track with different kinds of joints, and of timber sawn on two or four sides.

In putting in the timbers every sett is made perfectly firm with wedges and blocks on top and sides, and in logging up if the ground is not very wet and loose, the logging is spread out, not put close together, by leaving out every other piece and filling in between with bits of rock, and to make the most of the logging's strength it is put in with the *round* side next to the timbers.

Figs. Nos. 4 and 5. show the sett used in the double-track tunnel mentioned, with collar braces and water box. Before framing, the sticks were squared on two sides by two French Canadian axemen, at a cost no more than that of the timber squared at the mill, as was afterwards used in the arched setts. This form and size of sett was found to stand very heavy ground even when spiling had to be used, but finally it was supplanted by the arch sett, (Figs. Nos. 6 and 7.) when the pressure became excessive and as it was better adapted to spiling. This sett was designed to give ample room for working, but in the least possible space and with the simplest form of of framing. It withstood tremendous pressure when the cost of progress for some time was $600 per foot, and only in one place where crossing a bad water course, were extra intermediate setts needed besides those with four-foot centres.

For the framing, good drawings were given the carpenter, who then made very accurate templets, by which the different pieces were quickly marked and cut so that each set always fitted together perfectly. If a sett ever did show signs of collapse another was at once put in beside it, and where the tunnel had passed through some porphyry that afterwards swelled and forced the timbers all out of shape, the only relief was gained by every little while working away the rock behind the timbers until this swelling ceased.

When bad running ground is met with, the greatest care is imperative lest the men be suddenly overwhelmed or hundreds of feet of the tunnel filled up in a few minutes. The timbering being right up to the heading that threatens to burst in, this is prevented by slipping in the breast boards or horizontal planks across the face between the last sett and the rock, then over the cap and behind the posts are driven out the chisel pointed spikes, 3 in. x 6 in., 7 ft. long, as far as they will there go. Next begin at the face by working around the top breast-board until it can be pushed ahead 6 to 12 in. and held there by props against the sett, and then the other planks down to the bottom. As soon as possible the "false sett" is put in place to prevent the spiling from closing in too soon, and I believe the best, handiest and cheapest form of false sett is that used by Mr. D. W. Brunton in this tunnel. When in the wash very difficult ground had been traversed by spiling, but the old method of keeping the heading open until a new sett could be put in, by holding the spiling out by any possible prop or scheme, used a great amount of timber and allowed an immense deal of sand and mud to enter the tunnel. With this new device the work was wonderfully simplified and much better controlled. Two strong posts notched at the foot to crowfoot into the corners of the windsill and posts, supporting on their top rods a length of 5 in. gas pipe bent to a shape to correspond with the timbering used, were fastened to the cap of the last sett by turn buckles and rods passing through near their heads. This last sett was tied back to the next sett with turn buckles and rods passing through holes near the four collar braces. Now, when the breast boards had been gradually and laboriously worked forward far enough, and held by stays that could not obstruct the new sett, this was now set up, the bridging put on to keep the spiling from pressing down directly on the timbers, and reserve a space through which the new spiles should pass, and then by loosening the turn buckles the false sett was lowered until the enclosing shield of spiles rested on this new timber and four more feet were won. If a great flow of water and sand under great pressure is experienced about all one can do is to let it drain until it lessens or stops, as will be the probable result. One detail in this kind of work must never be forgotten—100 feet or so back from the face, and perhaps again at 200 feet, is kept a supply of planks of proper length so that should the breast suddenly give way, the miners running back can at once build up a dam or bulkhead by laying these planks across the tunnel against the timbers. This is generally done in the dark, the sudden in-burst extinguishing the lights, and the treacherous sands may pour in as fast as the men can run. In a larger tunnel in the same place through neglect of this precaution, 600 feet of the tunnel was thus filled up and temporarily lost, necessitating much (what might have been avoidable) expense in its recovery.

Notes on the (White) Mica Deposits and Mines of the Saguenay Region.

By J. Obalski, Inspector of Mines, Quebec.

This district, from a mining point of view, is an entirely new one, the first working having been commenced in the fall of 1892.

Sometime prior to this date, it was known that mica existed at certain places, but no attempt was made to work it. Recently, however, the increased demand for mica, by reason of its extensive use in the generation of electricity and its accompanying requirements, caused prospectors to take the field, and certainly the results have proved satisfactory and gratifying.

The locality most prominent in this district at present, is in the Township of Bergeronnes, Saguenay County, and situated about twenty to thirty miles below the village of Tadousac, and at a distance of about ten miles from the shores of the St. Lawrence.

In addition to the discoveries made in above mentioned locality, indications have been found in the adjoining Townships of Tadousac and Escoumains, also in the valley of the River "Aux Canards," on the other side of the Saguenay River.

The formation belongs to that of the Lower Laurentian, the country rock being mainly feldspathic and dioritic gneiss frequently crossed by trap dykes, easily discernible on the formation bordering the Saguenay River.

The character of the country is, generally speaking, barren, and is as yet unsurveyed and belongs to the Crown; the facilities for transportation, although one would think differently at first, are in reality good, by following the valleys of the streams running to the St. Lawrence.

Numerous veins of quartz and course granite traverse the country rock, and in some instances are of great magnitude, we will only consider the latter kind. The elements, quartz, feldspar and mica, are well separated and in some places] large enough to warrant the name of mica mines being applied to them. The general direction of the veins is N.E., the dipping, as well as the forms of same, being variable.

While prospecting this district I met with several of these veins, not less than fifteen in number, well defined and worthy of consideration, but they do not all merit the title of mica mines; sometimes the mica being too small, or the veins themselves too narrow to admit of being profitably worked.

I will now give some details concerning the two most important properties and which have been developed with a marked degree of success. The kind of mica found in this district is uniformly of the white (muscovite) variety, and of a brownish color when in thick crystals, whereas the same variety in the Ottawa Region is invariably green under the same circumstances. It is remarkably clear, free from spots, is elastic and the cleavage is excellent. I have not any minute test of this mica, but have seen by the correspondence of the operators that it is highly appreciated and the demand is much in advance of the production, up to the present time. The mica is used for stove and also for electrical purposes.

The McGie Mine—This mine is the property of Daniel McGie, Esq., and others, of Quebec. It is situated in the Township of Bergeronnes (block G), twelve miles from Escoumains Bay. It comprises an area of 58 acres. The vein, about a quarter of a mile long, which crosses the property in a N.E. direction, is crooked, and the dip is on an average about 40° N.W., and crosses the stratification of gneiss county rock. This mine, the pioneer property of the district, was opened in October, 1892, and was worked during the summer season with a force of not exceeding ten men.

At the southern extremity of the property the vein is 15 ft. to 25 ft. wide, and was operated on a length of 140 ft. by means of an open trench 15 ft. deep and a shaft 25 ft. deep. About 15 tons of undressed mica have been taken out, from which 15% of dressed or cut mica has been obtained and marketed. The largest pieces produced cut 7 x 10 in., and the average may be considered as 3 x 4 in. In addition to the above, I may say that roads have been constructed and the necessary buildings erected. From the south to the other extremity of the mine, the vein gradually widens and expands until a width of 55 ft. is reached, showing numerous crystals and as yet untouched.

The feldspar (orthoclase) is found, as usual, in large quantities, and appears to be of an excellent quality. Crystals of black tourmaline, garnet and emerald (beryl) are found, the latter sometimes 3 in. in diameter.

Beaver Lake Mine (Bergeronnes, Block H)—This mine is the property of P. P. Hall, Esq., and others, of Quebec. It is situated at the head of the Little Bergeronnes river, in proximity to Lac-aux-Sables, and about 11 miles from the shipping point on the St. Lawrence, of which distance 6 miles is preferably traversed by water in crossing said lake. The area comprised is 100 acres; the veins run N.E. on a length of one mile, with a vertical dip; about one half the length of the vein has been prospected, showing same to carry a width of from 100 to 300 ft. as per the latest reports. While inspecting this property I measured one exposure 140 ft. wide and several others of 100 ft. in width, with numerous crystals in sight. An exceptionally fine view of the vein is obtainable from the base of a cliff 50 ft. high by 142 ft. wide, including a strip of barren rock about 20 ft. wide. Here and there a large number of crystals of merchantable mica may be observed, disseminated all through the vein, in some instances capable of cutting 4 and 5 x 6 in. The mine is as yet unworked, prospecting work only having been done so far, but the appearance leaves no doubt as to its value.

These two properties are the only ones in a workable condition at present, but numerous other places have been held under prospecting license, and the results although not so encouraging, have firmly established the fact that several other veins of similar character exist, some of them not workable but others favorably situated and which in all probability will be developed next season.

Labor in this district is plentiful at current prices, but the men are not accustomed to mining work, nevertheless with a practical man as superintendent they soon become skilled. The original prospectors had no knowledge of mining to speak of and especially as regards mica. It is necessary to erect buildings at the mines, as the hands have to be housed there. Cost of transportation from the two working mines at present would not be more than 15c. per 100 lbs. from the mine to the shipping point on the St. Lawrence, and from there to Quebec by schooner say 10c. per 100 lbs. or $5.00 per ton to Quebec, including the handling. If the mica were selected and dressed at or near the mines, the above figures as applying to cut mica are very moderate.

I must again repeat that the district is as yet unsurveyed and the prospecting was done by people very slightly experienced in such work.

I cannot give any better or more illustrative idea of this country than by comparing it with the Ottawa phosphate region, the important mineral here being of course white mica, and the principal veins, quartz and coarse granite.

In conclusion I would remark that if there is a future in store for the white mica industry, there is here a large field for research and investigation, and which may well repay practical and intelligent prospecting.

In addition to above notes I would mention that while mica, in workable deposits, has been located at Lake Manowan, near the head of the Peribonca river, 250 miles north of Lake St. John; at Watsheshos on the Gulf of St. Lawrence, about 400 miles below Tadousac; and also at Lake Pieds de Monts, 17 miles north of Murray Bay. These properties, I must observe, however, to avoid confusion, are not in the same district, although of the same character and containing the same variety of mica, viz: muscovite.

Discussion.

Capt. R. C. ADAMS—I do not know that I can say anything about this interesting paper, but if I am allowed I might say something in regard to the mica industry. It has interested we phosphate miners very much because we have found mica in connection with the phosphate and until the last two years have been in the habit of cursing it and throwing it away; but now that the product is extensively used in electrical practice we have turned back to the old abandoned pits and have gone to work to extract the mica and we think now that the case is just reversed, whereas when we were mining phosphate the mica came in, now that we are mining mica the phosphate comes in, and if I go to a pit with a fine vein of mica it often gives place to phosphate which formerly I would rather have seen. We find the occurrences of mica so irregular that it is hardly profitable to mine except when one gets large sizes and many miners have abandoned its production, but if phosphate prices advance I think the properties that have phosphate and mica together will be profitably worked. The prices quoted may at first sight seem high, but when you come to have your mica culled over by the purchaser's experts and find that four-fifths goes with the pile valued at $25 per ton, whereas only a small remainder goes into the one hundred dollar pile, you will find that your average price is low. The first lot of mica that I sold averaged $80 per ton and encouraged by that I went on and got out a large quantity which, after being culled over by the buyer, averaged $35 per ton. I resolved to make one more effort and obtained a large quantity of mica and after two or three months' effort to sell it, finally succeeded in working up the figure to double the former price. I shipped a sample ton lot of this to the States, and to my surprise it was seized on the ground of undervaluation, although it was valued at double the price I had ever sold at before. I went to New York State and found the Inspector, who produced the retail price list of the dealers who buy from the miners and he declared that to be the market price at which the goods should be invoiced. Nothing would convince him to the contrary. My mica was seized and the valuation raised and I was told that I had made myself liable to a fine of $250 for not invoicing it at the retail price. From experience I have found it most profitable to sell the product in the rough and let the dealer cut it and retail it to the consumer.

Mr. J. BURLEY SMITH—The merchants in London, England, complain of the want of regularity in prices on this side. It seemed as if nobody knew exactly the value of the article and producers were all trying to get as high a price as possible.

The CHAIRMAN here called upon the Hon. E. J. Flynn, Commissioner of Crown Lands for a few remarks.

Hon. E. J. FLYNN—I must thank you very kindly for the very hearty welcome you were good enough to extend to me on entering the room to-night to witness your good work. I am pleased indeed to have this opportunity and I must congratulate you. I feel that I am in the best of company here, in the company of gentlemen that are imparting practical knowledge and I put myself in the category of those who are acquiring knowledge. Of course I am a public man and I must say I have not got much time to acquire that very useful knowledge, but it is my duty as a member of the Administration to encourage as much as possible this good work. It has given me great pleasure to note the progress of the good work that is being accomplished by your Association. You have just heard of the mica mines on the lower shore of the St. Lawrence, and I can fully corroborate the statements made by Mr. Obalski, having received from other sources ample confirmation of the extent and value of these mica deposits. I would like to see a greater number invest capital in these mica mines. You will pardon me if I refrain from any further remarks at this time as I hope to be with you again to-morrow. It has given me great pleasure to have made your acquaintance and I congratulate you with all my heart upon the good work you are doing. Allow me to thank you again. (Loud applause.)

Mr. B. T. A. BELL—I am sure every member of the Association appreciates to the full the trouble the Hon. the Commissioner of Crown Lands has taken to be present at this meeting and the pleasure his company has given us. His presence among us may be taken as a sure indication that the Government is disposed to meet us fairly and o do everything in its power to promote the development of the mining industry of this province. We must not forget also that it is to the Hon. Mr. Flynn we are indebted for the complete repeal of the Mercier Mining Act. (Applause.)

After a vote of thanks to Messrs. Smith, Carlyle and Obalski for their papers, the meeting adjourned until Thursday afternoon.

MEETING ON THURSDAY.

The members reassembled in the club room on Thursday afternoon at three o'clock. There was again a large attendance. Owing to the absence of the president, who had to leave town, Mr. George E. Drummond, Vice-President, occupied the chair.

Visit of Belgian and other Experts.

Mr. B. T. A. BELL—Before proceeding with the business of the meeting I desire to make a statement respecting a motion that was submitted yesterday by Mr. Leofred. We were told that the Belgian, French and other foreign governments had determined to appoint a commission to enquire into the mineral resources of the Dominion and we were asked to endorse it. We passed a resolution to that effect. Since then, however, it has transpired that the proposition is simply being promoted by certain individuals to obtain large sums of money from the Dominion and Provincial Governments to *invite and defray* the expenses of a commission which is to spend a number of years in this country in the work of acquiring knowledge, and, as it would seem to be largely of the nature of an individual enterprise, I think that as an association we are unanimous in our desire to withdraw any countenance that may have been granted to such a scheme. There could be no objection in asking the Government to co-operate with a commission that was being sent here by any country, but as this bears on its face a strong suspicion of a scheme to put money in the pockets of the promoters, I desire to move that we erase from our minutes the resolution adopted entirely under a misapprehension at yesterday's meeting.

MR. T. J. DRUMMOND—I have much pleasure in seconding the motion. From what we have learned the matter is one which this Association cannot countenance. We were certainly misled by Mr. Leofred's statement that these foreign governments were to send such a commission at their own expense.

MR. B. T. A. BELL—I distinctly asked Mr. Leofred the question when he submitted his motion and I think it was adopted purely on his assurance that the foreign governments were sending the experts at their own expense. Personally, so far as I can gather, the whole affair is a pretty healthy scheme to put money in the pockets of the promoters.

MR. T. J. DRUMMOND—Our Government can aid the mining industry much better by advertising the resources of this country in more legitimate ways than this.

MR. F. CIRKEL—I certainly never heard of the German Government making any such proposition. If it had I should have heard or read of it in the German papers.

THE CHAIRMAN—The motion was passed, as Mr. Bell says, entirely under misapprehension. Is it the sense of the meeting that it be rescinded?

The motion was then put and carried unanimously.

On the Igneous Origin of Certain Ore Deposits.

By DR. FRANK D. ADAMS, McGill University, Montreal.

The numerous and elaborate investigations into the nature and origin of ore deposits which have been carried out in recent years have led to the somewhat startling conclusion that certain of the deposits in question are of igneous origin. In stating that they are of igneous origin it is not meant merely that heat was in some way connected with their genesis, but that using the term as it is employed by geologists, that these deposits have cooled down and solidified from a molten condition like the other igneous rocks with which they are associated. The most important investigations into this class of ore deposits are those of Professor J. H. L. Vogt, of the University of Christiania, the results of these, however, having been published principally in the Swedish language are not so well known as they deserve to be, and as a valuable resume of his investigations has just been given by Prof. Vogt in the Zeitschrift Für Praktische Geologie, (numbers 1, 4 and 7, 1893) it has been thought that a brief presentation of the facts known concerning these deposits might be appropriately brought before the Mining Association at this time, especially in view of the fact that although this class is a comparatively small class of ore deposits it seems to be one especially well represented in Canada.

In order to present this subject in as clear a manner as possible, it will be advisable first to say a few words on some recent investigations into the nature of igneous rocks in general and the processes at work during the cooling of molten magmas, by the solidification of which igneous rocks are produced.

Recent researches have shown more and more clearly that a fused mass of rock is very similar to any ordinary solution of salt or sugar in water or any other solvent. As the fused mass slowly cools one mineral after another crystallizes out, a definite order being always observed. The mineral containing the largest amount of base, such as iron, lime or magnesia first separates out, then a series of other minerals containing less base, until finally there remains only a comparatively acid portion of the magma which may be considered as the solvent of the others, corresponding to the water of the saline solution above mentioned, which solvent may eventually crystallize itself. Thus for example in the case of a granite, we find that the various ores, magnetite, titanic, iron ore, pyrite, etc., first separate out, then the mica or hornblende, then the feldspars and finally the quartz. The ores together with the mica and hornblende may thus be considered as having been originally held in solution in the molten feldspars and quartz. Now it is known as the result of elaborate experiments on various saline solutions, that if a solution of any salt be heated and allowed to cool gradually the salt tends to concentrate in the cooler portions of the solution. It is also found that in concentrated saline solutions there is a certain tendency for the lower part of the fluid to become richer in salt than the upper portion, that is for the salt to settle down toward the bottom. In the case of certain alloys also, as is well known, it is often impossible to obtain a homogeneous mass on casting owing to the persistent way in which certain constituents of the alloy will concentrate toward the top or bottom of the bar or casting during cooling. Even in pig iron it is found that the amount of sulphur and phosphorus will vary considerably in the different portions of the same pig for similar reasons. This phenomenon in the case of alloys has long been known as liquidation.

In molten rock also a similar tendency to separate into portions differing in composition is clearly shown to exist by our geological studies of erruptive magmas, this tendency resulting in the separation of certain more basic parts of the magma from others which are less basic—that is to say the dissolved or basic material concentrates in certain places and this gives rise to a lack of uniformity in the mass—part of it being richer in certain minerals than other parts. In all probability differential cooling and the action of gravity are not the only factors which tend to bring about these remarkable phenomena in rocks, many other factors some of which we do not even suspect as yet, probably also working in the same direction. But whatever the causes may eventually prove to be which are most potent in bringing about these remarkable irregularities in molten rock masses, the fact remains that in cooling such masses do fall apart into portions differing in composition.

Now it stands to reason that since these changes are brought about by movements in the molten mass, the more fluid the mass is, the more favorable will be the conditions for such irregularities to develop themselves, and hence as basic magmas both naturally and artificially are more fluid than acid magmas, it is in basic magmas that such irregularities will be most strikingly seen. As actual examples of this process we may take for instance the basic borders which we find in connection with so many granite masses, where during cooling the more basic part of the magma has concentrated itself toward the sides of the mass. The dark spots and patches which disfigure so many granites are in many cases at least, portions of such basic parts which have been separated by subsequent movements in the magma. As a granite where this is excellently seen the Garabal Hill granite of Scotch highlands may be cited, or the celebrated Brocken massif of the Harz Mountains, in which a gradual passage from granite to gabbro can be clearly traced. Many similar examples nearer home might be cited, as for instance the igneous core of Mount Royal and many of its associated dykes in which remarkable variations of composition may be observed.

It is a universally recognized fact that ore deposits usually occur in connection with igneous rocks, that is with rocks which have solidified from a molten condition. Of these ore deposits however, two classes have as Prof. Vogt points out, a particularly intimate relation to such rocks, namely:

1st. Titanic iron ores.
2nd. Sulphide ores containing nickel.

These deposits not only occur in connection with the igneous rock but actually appear to form part of it, the ore occurring distributed through the rock and the heavy bodies of ore, merging gradually into it in many places, so that it is impossible to tell where the rock begins and the ore body ends. The ore body in fact seems to be merely a portion of the igneous mass in which the ore, which is one constituent of the normal rock, is concentrated sufficiently to form workable deposits.

Titanic Iron Ores.—One of the most celebrated deposits of this class is that occurring at Taberg in Smaland, in Sweden, and which has long been recognized as merely a local variety of the great intrusive mass of rock belonging to the Gabbro family and known in Sweden as olivine hyperite. This rock, which is poor in iron ore, can be observed step by step to pass over into the ore body, which has been extensively worked and consists of a mixture of titaniferous iron ore and olivine, the ore forming about 50 per cent of the rock.

A sketch of this occurrence taken from Prof. Vogt's paper and showing the concentration of the iron ore in the central portion of the mass is given in Figure 1.

Another large deposit of iron ore at Cumberland, Rhode Island, occurs in a presisely similar manner as part of a gabbro mass and was for years extensively worked, but had to be finally abandoned on account of the large amount of titanic acid which it contained. In Brazil, Derby has also described the occurrence of large bodies of iron ore which gradually pass over into a mass of pyroxenite, of which they form part. Similar deposits of titaniferous iron ore of large extent have recently been recognized by Winchel in Minnesota, and by Kemp in the Adirondacks. In the latter case where the body of iron ore is about 20 feet in thickness, the great mass of gabbro of which it forms a part is closely related in petrographical character and probably in age, to the great areas of gabbro of anorthosite which in Canada occur in a number of places in our Laurentian country, occupying in some places hundreds, and in other places thousands of square miles.

These Canadian rocks also contain in many places large deposits of iron ore which are invariably rich in titanic acid, a fact which has made itself very patent in the failure which has followed all attempts to work them. Of these one of the best known is the great body of titanic iron ore near Baie St. Paul on the Lower St. Lawrence, where, in a great of mass of gabbro or anorthosite solid bodies of the iron ore 90 feet in thickness occur which have been traced for a mile or more. An attempt to work this made years ago, resulted in the loss of about £80,000 sterling. Other deposits of considerable size are known in the district north of Montreal, near St. Hypolite and St. Julienne, as well as at several other points in the so-called Norian gabbro area. In these as before the iron ore occurs as a constituent of the gabbro but is locally concentrated so as to be very abundant at these points. Another extensive deposit, although less widely known occurs on the River Saguenay, between Chicoutimi and Lake St. John. Here on the north shore of the river there is a group of hills composed of the titanic iron ore which occurs in another great gabbro mass having an area of not less than 5,800 square miles. This iron ore, which is also titaniferous, occurs principally in three bands, the most easterly of which is about 75 yards wide. The accompanying view has been reproduced from a photograph of this hill taken from near the shore of the Saguenay. It is thus evident that we have in these great deposits of titaniferous iron ore, true eruptive or igneous masses which are merely local and extremely basic varieties of the gabbro in which they occur, due to the concentration in certain parts of the mass, from some of the cases before mentioned of the most basic constituents of the rock. It will also be seen that these peculiar deposits are not confined to one locality, but are found under similar conditions in widely separated parts of the world.

When it is once recognized that these deposits have the origin here described a solution is afforded to what has hitherto been a puzzling fact, namely, that all the iron ores occurring in the so-called Norian series in the Laurentians, which is composed exclusively of eruptive anorthosite or gabbro, are rich in titanic acid, while in the same district deposits of magnetite free from titanic acid will be found in the associated gneisses.

Vogt notices that, in the cases which he mentions, these iron ores occur toward the central portions of the igneous masses rather than toward their margins, while in the case of the sulphide ores forming the other class of these deposits the reverse is the case. This does not however, appear to be by any means invariably the case in the similar deposits of titanic iron ore in Canada.

The igneous origin of many of these deposits of titaniferous iron ore has long been recognised, but Prof. Vogt proceeds to show that certain great deposits of sulphide ores have in all probability a similar origin.

SULPHIDE ORES CONTAINING NICKEL.

He first shows that the nickel ores of the world fall into three principal classes.

1. Ores containing arsenic and antimony, with or without bismuth.
2. Sulphureted ores without arsenic, that is to say, nickeliferous pyrrhotite or pyrite, millerite, polydymite, etc.
3. Silicated nickel ores.

Of these, No. 1 occur principally in veins, as for instance in various places in Saxony and at Mine Lamotte and Bonne Terre in Montana.

No 2, which is the class of which this paper treats, occur in basic intrusive rocks being apparently formed by a differentiation of the magmas and local concentration of the ore. Of these the celebrated Norwegian deposits as well as those of Varallo in Italy and of Sudbury in Canada are examples.

No 3, occur as veins in serpentine, which results from the alteration of basic eruptive rocks, the ore being leached out during the process of decomposition and accumulated in the veins by lateral secretion as in the case of the great nickel deposits of New Caledonia, which are now the principal competitors of our Canadian nickel deposits.

Dismissing the first and third classes of deposits as having quite a different origin and confining our attention to the second class, the first striking fact to be noticed concerning them is that they are so simple and uniform in character in all parts of the world that a mineralogical description of one set of deposits would serve for all. The principal minerals which they contain are pyrrhotite or magnetic iron pyrites, a sulphide of iron which almost invariably holds a little nickel and cobalt, but which in these deposits usually contain 2 to 5 per cent. of these metals. Pyrite containing nickel and cobalt is also present, usually in smaller amount than the pyrrhotite, and having a better crystalline form owing to the fact that it is crystallized at first. This mineral usually contains proportionately more cobalt and less nickel than the pyrrhotite. With these in a few deposits minerals richer in nickel have been observed, three of these have been certainly recognised and possibly others may be yet discovered. Of these pentlandite (Fe, Ni) S has been recognised at two Norwegian localities and in considerable quantities by Mr. D. H. Browne, at the Copper Cliff and Evans mines and at the Worthington mine, in the Sudbury district. (*Eng. and Min. Jour.*, Dec. 2nd, 1893). Polydymite ($Ni_4\ Fe\ S_6$) occurs at the Vermillion mine in the Sudbury district, while Millerite also occurs in certain of the Sudbury deposits, as well as at the Lancaster Gap mine in Pennsylvania. Copper, pyrite, usually present in considerable amount, and titanic iron ore, complete the simple list of minerals found in these deposits. Other metallic minerals are present only as the rarest exceptions and in very small amount, among these the most noteworthy being sperrylite, an arsenide of platinum ($Pt\ Ao_2$), discovered in the ore of the Vermillion mine above mentioned and not known to occur anywhere else in the world.

This remarkable group of ores therefore contains nickel, cobalt, copper and iron, united with sulphur and some titanic acid, while lead, zinc, silver, arsenic, antimony, bismuth and tin are absent or occur only in traces. Moreover, a remarkable fact in connection with this class of deposits is that—as Prof. Vogt shows—if the average of large quantities of ore such as the output of a mine be taken, there is a certain ratio between the richness of the pyrrhotite in nickel and the per centage of copper contained in the deposit. Thus in the Norwegian deposits he states that in those workings which produce an ore containing from 75 to 80 parts of copper to 100 parts of nickel and cobalt, the pure pyrrhotite holds about 2.5 per cent. of nickel and cobalt, while as the copper sinks the per cent. of nickel and cobalt in the pyrrhotite rises until when but 20 to 25 parts of copper to 100 parts of nickel and cobalt are present in the ore, the pyrrhotites holds over 7 per cent. of the latter metals.

NOTE.—The illustrations in Dr. Adams' and Prof. Carlyle's papers were not completed in time for puplication.

this connection a recent statement by Mr. D. H. Brown (*loc. cit.*) is of interest, namely that in the case of the Copper Cliff Mine, which, as the name indicates, was opened up and worked for copper before the ore was known to contain any nickel, on sinking, a decrease in the amount of copper has been followed by an increase in the richness of the pyrrhotite in nickel, the very large body of ore struck in the 7th level and which is almost entirely free from copper pyrites, consisting of a pyrrhotite averaging about 10 per cent. of nickel.

The following table will show this relation in the case of a number of the Scandinavian deposits and it would be a matter of great interest if it could be ascertained that a similar relation exists in the case of our Canadian deposits. As Prof. Vogt points out, in order to obtain averages for large deposits, it is best to draw the results from the analyses of the mattes obtained by smelting the ores of the several deposits, copper and nickel being concentrated in almost exactly the same proportion. It has been found in the case of the Scandinavian deposits that although the proportion between pyrrhotite and copper pyrite may vary considerably from day to day, the average for a considerable run is pretty constant.

RATIO OF NICKEL TO COPPER IN SOME OF THE MOST IMPORTANT NORWEGIAN AND SWEDISH MINES.

Name of mine.	Content of copper corresponding to 100 parts of nickel.	Percentage of nickel and cobalt in the pure pyrrhotite.
Graagalten mine..	75-80	About 2·5
Klefra mine	55	" 2·75-3·0
Erteli mine..	45-50	" 3·0
Bamle district.....	35-40	" 3·5 -4·0
Flaad mine.......	37	" 4·5
Senjen mine	35-40 (about)	" 3·5 -4·0
Dyrhang mine....	30-35	" 3·8 -4·2
Beiern mine......	20-25 (about)	" 7·0

Prof. Vogt also draws attention to the fact that the average proportion of nickel to copper in the Norwegian ores is about 100 to 40 or 50, and that in the Piedmontese occurrences about the same proportion holds good, while in Canada where the associated igneous rocks are of a somewhat different character, there is often relatively more copper, 100 parts nickel to 100 or even 150 of copper being found in some deposits, while in others the ordinary Norwegian proportion still holds good.

In Norway there are some 40 gabbro masses with which deposits of nickeliferous pyrrhotite are associated, these being the largest nickel deposits in Europe. The gabbro, which is undoubtedly an igneous rock, is composed of plagioclase, feldspar and a rhombic pyroxene, thus belonging to the variety of gabbro known as Norite. These masses of gabbro occur in the Archean schists, generally intruded between the layers or beds but often cutting across them. The Norite of all the masses shows a remarkable tendency to differentiation so that one and the same mass, in different parts of its extent, will vary greatly in relative proportion of the constituent minerals.

The pyrrhotite, pyrite and copper pyrite are regular constituents of the Norite occurring in small quantities all through the various masses but like the other constituents being found more abundantly in certain places, so that a gradual passage can often be observed from the normal Norite through a pyrrhotite Norite to masses of pure ore. Sometimes on the other hand the ore occurs in masses sharply separated from the Norite. These segregations of ore are in the great majority of cases situated at or near the edge of the Norite masses and Vogt regards them as strictly comparable to the basic borders or edges so often observed about granites and other igneous rocks as before mentioned, in which the basic portions are sometimes marked by similar gradual passages and in some cases by sharp transitions. These sharp transitions are easily explicable when one considers that any part of the magma having once separated itself from the rest, being possessed of a decidedly different specific gravity and perhaps of a different degree of fluidity, would, if the whole mass were caused to move, keep itself separated by a comparatively sharp line from the rest of the molten mass.

Furthermore Vogt states—and this is a point which has a very practical bearing with those who are interested in our deposits—that in Norway although it is of course impossible to establish a mathematical ratio between the area of the gabbro mass and the quantity of ore in the associated ore deposits, nevertheless experience has shown that the deposits associated with the small gabbro masses are always unimportant and that all the larger ore bodies are found in connection with the larger gabbro areas, as might be expected if his explanation of the origin of the ore is a correct one.

The nickel deposits of Varallo in Piedmont, Italy, which were worked from 1860 to 1870, are very similar in almost every respect to those just described from Norway, occurring like them in Norite near the contact with the country rocks. A similar association of nickeliferous pyrrhotite with a rock of the gabbro family also occurs at the Lancashire gap mine in Pennsylvania and at Schweiderich in Bohemia.

The great nickel bearing sulphide deposits of the Sudbury district—the largest and most important deposits of this kind known to exist—in mineralogical composition and mode of occurrence are remarkably similar to those just described in the several localities above mentioned.

The work of Mr. Barlow and Dr. Bell of the Geological Survey in the Sudbury district and the excellent geological map of the district which they have prepared present these remarkable resemblances in a striking manner. As in Norway, there are here a large number of igneous masses—some 60 in the 3,500 square miles embraced by the geological map above mentioned—composed of a rock which although it has been commonly called diorite, has proved in most of the cases where it has been carefully examined to be a gabbro more or less altered with the development of secondary hornblende, that is to say substantially the same rock as in Norway and elsewhere. These diorites cut through the clastic rocks of Huronian age, to whose strike they in most cases conform in a general way, but like these latter are in places cut by granites of later age. The ore, as has been mentioned, is a nickeliferous pyrrhotite associated in some cases with polydymite, pentlandite or millerite and mixed with copper pyrite. It occurs disseminated through this gabbro or diorite, sometimes in sufficient abundance to form deposits which can be worked, the large workable deposits usually being formed by a concentration of these ores near the edges of the gabbro masses or at the contact of these with the Huronian rocks or with the granites, but never extending into these to any considerable distance from the gabbro.

Such deposits have no well defined wall but merge into the gabbro, the wall so far as the miner is concerned being the limit of profitable working due to the fading away of the ore body into the gabbro, so that in underground work an abundant sprinkling of ore through the gabbro serves as an indication of the proximity of heavy ore bodies.

Furthermore, as in Norway, there seems to be in these deposits a certain relation between the size of the deposit and the area of the gabbro mass in which it occurs, since all the extensive mining operations are carried on in deposits associated with large gabbro masses, while in connection with many of the smaller masses, smaller deposits as yet unworked and in many cases unworkable are known to exist. It is also, as has been mentioned, not unlikely that a relation between the percentage of nickel in the pyrrhotite and the amount of copper present in the several deposits similar to that which has been noted in the Norwegian deposits may exist in these Canadian deposits as well. In fact these Canadian deposits resemble those of Norway and all others of the class having similar geological relations wherever they occur throughout the world, in a most remarkable manner, the points of resemblance being so numerous and so striking as to preclude mere chance coincidence.

The facts in the case of these Sudbury deposits point to these also having originated in the elements of the pyrrhotite and copper pyrite, originally disseminated through the molten rocks, having during the process of cooling seggregated themselves together in certain parts of the magma, especially toward the sides, just as certain other constituents have a tendency to do in igneous rocks of various kinds, especially in basic rocks such as these gabbro, and even in these very gabbro masses themselves.

This presented itself to Mr. Barlow, who has made the most careful study of these deposits as the only tenable view concerning their origin, even before Prof. Vogt published the result of his elaborate studies in Norway. "The ores and associated rock" Mr. Barlow writes," were in all probability simultaneously introduced in a molten condition, the patches of pyritous matter aggregating themselves together in obedience to the law of mutual attraction." (Ann. Rep. Div. of Mineral Statistics, Geological Survey of Canada, 1889-90, p. 128.) One fact in the case of the Canadian deposits which might at first sight seem to oppose this view of their origin, is the frequent occurrence of the ore along or near the contact of the diorite with granite, which judging from contact phenomena, is more recent than the diorite and consequently would have been intruded after the ore deposits were formed and consequently cannot be considered as the wall rock of the molten diorite toward which the seggregation would take place. But it must be remembered that in such a district of hard and massive diorites and softer stratified rocks, any shattering which would precede the intrusions of the granite would probably tend to develop lines of fracture along the contact of these two rocks and thus afford a ready passage for the granite magma in these directions. The contact of the diorite and the granite would thus mark approximately, in many cases at least, the contact of the diorite with the Huronian rocks through which it was intruded.

Concerning these sulphide ores containing nickel therefore, Prof. Vogt sums up as follows:—

1. These deposits, which are numerous and occur in widely separated countries, are always found in connection with some basic igneous rock allied to gabbro and since this is invariably the case we must conclude that the deposits stand in some genetic relation to this igneous rock.

2. Since we can frequently trace a gradual passage from the workable deposits into the igneous rock by a progressive increase in the amount of ore in the rock, we must conclude that the ore masses were not in any way introduced into the rock subsequent to cooling but were separated out of the molten magma during the solidification of the rock. This conclusion is also borne out by the remarkable simplicity and uniformity of chemical and mineralogical composition of these deposits throughout the world, by the relation between the size of the ore deposit and the area of the gabbro mass in which it occurs, as well as by the absence in these deposits of lead, zinc, arsenic, antimony, bismuth, etc., and of those minerals which are especially characteristic of the so called pneumatolitic action.

3. Owing to the fact that, as Fournet has shown, the metals copper, nickel, cobalt, iron, tin, zinc, lead, silver, antimony and arsenic have in general a decreasing affinity for sulphur in the order named, the small percentage of copper, nickel and cobalt present in the original magma united with sulphur and becomes thus concentrated in any sulphide of iron which separates, while any tin, zinc, lead, silver, antimony or arsenic present in the magma is not so concentrated.

4. From what we know of the amount of copper, nickel and cobalt contained in these rocks themselves we are justified in concluding that these metals are always present in the original magma in amount quite sufficient to supply material for all the deposits in question, if only the concentration can be effected, and in this connection it would also follow that there must be a certain ratio between the size of the eruptive mass and the extent of the ore deposit.

5. The copper of the deposit always appears as copper pyrite. The nickel becomes concentrated in pyrrhotite or appears in the form of millerite, pentlandite, or polydymite, all minerals comparatively poor in sulphur, while the cobalt on the other hand is concentrated in the pyrite which is much richer in sulphur.

6. In the Canadian nickel bearing sulphide deposits, platinum in the form of sperrylite is sometimes found, which would seem to be analogous to the occurrence of native platinum and osmiridium metals, contained in the more or less serpentinized, basic olivine bearing rocks in the Urals and elsewhere to be mentioned further on.

7. Titaniferous magnetite or Ilminite almost always occurs in small amount in the nickel bearing sulphide deposits, indicating a genetic relation and to a certain extent a transition between these sulphide secretions and the deposits of titaniferous iron ore mentioned in the beginning of this paper as having a similar origin.

8. The nickel bearing sulphide deposits occur in almost all cases about the edges of their several igneous masses, a fact which, as has been mentioned, is susceptible of explanation in that the sulphides, following Soret's principal, become concentrated toward the cooling surfaces of the mass.

Another remarkable fact tending to the same conclusion and showing the importance of geological studies in connection with ore deposits, is that although in the several widely separated countries the pyrrhotite deposits associated in the manner above described with the gabbros are so rich in nickel, the celebrated Fahlbands of Norway which are bedded or apparently bedded deposits consisting of heavy impregnations of pyrrhotite, pyrite, copper pyrites, etc., but occurring in gneisses or schists of various kinds contain hardly any nickel, hundreds of analyses showing the nickel and cobalt contents to range from .25 to .50 of one per cent., and what is still more remarkable the same is true of the similar Fahlbands so often associated with our Laurentian limestones in Canada, so far as these have been examined. In these the pyrrhotite and pyrite is present in large amount and is often associated with copper pyrite but only a very small quantity of nickel and cobalt, usually not amounting to more than a trace, is present. (Adams, Frank D., Preliminary Report on the Geology of Central Ontario, Geological Survey of Canada, 1894, in press.)

METALLIC SEGGREGATIONS FROM IGNEOUS ROCKS.

Some few cases of the seggregation of metals in a free state are known to occur in igneous rocks. These deserve much more careful and extensive study than has yet been bestowed on them in view of the light which they promise to throw on the origin of ore deposits such as these which have just been considered.

These are of two classes :

1st. Iron-nickel alloys.

2nd. Platinum and osmiridium metals.

The celebrated occurrences of native iron holding about 2 per cent. of nickel, discovered by Nordenskjold in basalt and at Uifak and Assuk in Greenland, are now believed to have resulted in the reducing action of the carbonaceous material in the rock through which the basalt was erupted, but these occurrences nevertheless afford an example of the concentration of nickel, which must originally have been disseminated in small amount throughout the molten basalt, in the iron which has been reduced in the way above described, a more recently noted and even more remarkable occurrence is the Awaruite of New Zealand which is composed of 67·93 per cent. of nickel, ·70 per cent. of cobalt and 31·02 per cent. of iron and is found in a very basic igneous rock belonging to the class Peridotites. (G. H. F. Ulrich, Quart. Jour. Geol. Soc., Nov., 1890.)

In the various parts of the world where platinum occurs in alluvial sands it has been found from time to time intimately associated with serpentine and chromic iron ore, thus indicating as its probable source some Perodotite or Olivine rock, and Murtchison long ago mentioned its occurrence in the serpentine rocks of the Urals. ("Russia in Europe," p. 484.) Some ten years ago, however, this probability became a certainty for on the western slope of the Ural mountains platinum was found in grains disseminated through an olivine gabbro, which there formed the bed rock on which the platinum bearing gravels rest. Recently, at a locality on the eastern slope of the same mountain chain platinum associated with chromic iron ore has been found so abundantly disseminated through an olivine rock that this latter can be actually worked with profit, as much as 93 to 110 grains of platinum to the ton of rock being found. (R. Helmhacker, Zeit. Fürprak, Geol. Feb., 1893, and Can. Record of Science, April,

1893. *See also* Eng. and Mining Journal, Dec. 22, 1893.)

It is thus evident that the platinum of commerce also occurs originally as a seggregation from basic igneous rocks.

The uniform character and constant association of chromic iron ore wherever deposits of this mineral are found with serpentine, which rock is a decomposition product of basic eruptive rocks rich in olivine, points very strongly to the probability of this mineral also being a product of the differentiation of basic igneous magmas during cooling, but its solidification and alteration to serpentine. Our knowledge of these deposits, however, is not as yet sufficiently extensive, not sufficiently exact to enable any definite conclusions to be reached on this most interesting subject.

Although therefore these mineral deposits which present evidence of having originated in the differentiation of igneous masses during cooling, form a comparatively small class of deposits, they are full of interest, especially for us in Canada where so many of these deposits occur, and this brief presentation of some of the principal facts concerning them has been given in the hope that the Mining Engineers of our Dominion, many of whom are engaged in the working deposits of this class, having these facts in view may be induced to make a careful study of these deposits with a view of extending or perhaps correcting our knowledge concerning them.

The Manufacture of Iron and the Canadian Iron Industry—A Plea for Protection.

By Mr. George E. Drummond, Montreal.

" There is a tide in the affairs of men,
Which, taken at the flood, leads on to fortune;
Omitted, all the voyage of their life
Is bound in shallows, and in miseries.
On such a full sea are we now afloat;
And we must take the current when it serves,
Or lose our ventures."

These lines apply with peculiar force to Canada, in the present stage of her iron industry.

Events are transpiring from day to day in the neighboring Republic, which demonstrate that the iron industry of that great country has now reached such magnificent proportions, under the wise protective policy so well maintained for the past forty years, that American iron masters are able to compete on equal terms with the world.

History repeats itself. As with England at the middle of this century, so now with the United States. Her iron industry has reached that stage when the Government of the country can consider the question of a reduction in its protective tariff, with comparative safety to the industry itself.

Here in Canada, the iron industry, still in the pioneer stage, although under Government encouragement showing an increase in actual output of nearly 100% in the past two years, broadening out day by day, making a place for itself in the home market, and in the face of many difficulties, displacing gradually the products of American and British furnaces, finds itself at the most critical stage of its existence, threatened by a premature demand for a reduction in the current protective duties, which, if acceded to by the Government, will surely prevent further progress, if indeed it does not altogether annihilate the industry, by exposing it before it is yet established, to the hostile competition of foreign producers, particularly to the competition of American furnacemen, who have of late been the chief, if not the only competitors for our most important territory, viz: the markets of Western Canada.

To produce pig iron, the basis of all subsequent stages of the iron industry, a very heavy initial expenditure has to be made in the prospecting, securing, and development of mines, woodlands, limestone quarries, railways, shipping docks, etc., necessary to ensure a constant supply of raw material.

The establishment of the plant itself demands a heavier outlay, in proportion to the value of the product, than is required for the production of any other staple. It is the experience of almost every iron master, that in the early period of iron making, in all countries, the work is more or less of an experimental nature, and as it must be carried on upon a large scale, and if unsuccessful the investment becomes worthless, the risk of ruin to the first adventurers is great.

It has necessarily resulted from these causes, that to start an iron industry on an important scale, in any country, however favorable its apparent natural conditions, State aid, either by direct bounty, by a heavy protective duty, or by both combined, has been found necessary, and it is in those countries where this has been *effectually done*, which are to-day the large producers of iron, not only supplying their own wants, but also those of other countries.

To deal with this question intelligently, it is well for Canadians to review, as briefly as the importance of the issues will permit, the history of the establishment and successful development of the iron industry in other countries, and particularly note the broad liberal policy of protection under which Great Britain and the United States alike built up the greatest and most successful iron industries of modern times.

The importance of the issues will perhaps in some measure excuse the lengthy references to the methods adopted by our competitors to bring about the successful development of their iron industries, and some description of the splendid equipment they now possess in furnace plant, shipping docks, and other accessories necessary to economical working, will perhaps not be out of place.

John Stuart Mill says: "To draw inferences is the great business of life."

In the light of what has been accomplished by wise administration in other countries, particularly in Great Britain and the United States, Canada may be guided as to the best and surest course for an early development of the great mineral wealth with which God has blessed her.

Iron is perhaps the Almighty's greatest metallurgical gift to man. Its use can be traced to the very earliest ages. Biblical and secular history abound with mention of the use of iron by the forerunners of our race. Tubal-Cain, born in the seventh generation from Adam, is described in the IV. Chapter of Gennsis as "an instructor of every artifice in brass and iron."

In the time of Moses, the Egyptians seem to have been engaged in the manufacture of iron, as referred to in the IV. Chapter of Deuteronomy, 20th verse. "But the Lord hath taken you and brought you forth out of the iron furnace, even out of Egypt." This expression again occurs in I. Kings, 8 and 51.

Swank, in his admirable "Iron in all Ages," says:—"The Egyptians, whose existence as a nation probably dates from the second generation after Noah, and whose civilization is the most ancient of which we have any knowledge, were at an early period familiar with the use and manufacture of iron. Iron tools are mentioned by Herodotus as having been used in the construction of the pyramids. In the sepulchres of Thebes and Memphis, cities of such great antiquity that their origin is lost, butchers are represented as using tools which antiquarians decided had been made of iron and steel. Iron sickles are also pictured in the tombs of Memphis and Thebes, and various articles of iron have been found, which are preserved by the New York Historical Society, and are probably three thousand years old.

Herodotus in the fifth century before Christ speaks of the Chalybians as "a people of iron workers."

The Persians and their northern neighbors the Medes, made iron and steel long before the Christian era, and so did the Parthians and other Cythian tribes.

Ages ago Damascus, the capital of Syria, manufactured its famous swords from Indian and Persian steel.

It may be assumed as susceptible of abundant proof that the knowledge of iron, if not of its manufacture, was common to the people of Africa long previous to the Christian era. The decay of the iron industry of these ancient countries probably contributed towards the ruin of the empires of the east, and as Swank says: "With the fading away of Asiatic and African civilization and magnificence the manufacture and use of iron in Asia and Africa ceased to advance."

Following the march of civilization, the iron industry took root in the west, and has contributed in a very great measure to the wealth of the two most powerful industrial nations of modern times, Great Britain and the United States.

Great Britain—The history of the British iron industry dates back to the days of the Roman occupation, as evidenced by the fact that in Kent, Sussex, Gloucester, Yorkshire, and many other parts of England large quantities of iron cinder, as old as the Roman era, have been discovered. This has been further proved by the finding of Roman coins, pottery and altars in connection with the cinder.

From the days of the Romans down to the middle of the 17th Century, the furnaces and forges of England were operated altogether with charcoal as a fuel. Aided by the protection to native iron inaugurated by Edward III. during his reign from 1327 to 1377, the iron industry made very good progress.

In the 14th Century, the ironsmiths of England had brought the trade to a fine art, aiding thereby to establish the present industrial pre-eminence of England; locks, keys, hinges and bolts, produced during that period having never since been equalled in beauty of design.

In 1615 it is said that there were 800 furnaces, forges, or other mills making iron with charcoal, of which Dudley a few years later estimated that about 300 were furnaces, the weekly product of which was about 15 tons each.

The charcoal iron industry seems to have reached its height towards the close of the reign of Elizabeth, when the trade became so prosperous that instead of importing iron as she had hitherto done, England began to export it in considerable quantities, in the shape of iron ordnance. The extent of the operations however, began to exhaust the forests of England about the beginning of the 17th century, and the British Parliament had to give its serious attention to the question.

In 1740 the production of pig iron in Great Britain was only 17,350 tons, her iron industry at this time having been almost destroyed by the decreasing supply of charcoal.

About 1750 mineral coal, in its natural state or in the form of coke, came into notice as a substitute for charcoal. The iron trade of England and Wales at once revived, while that of Scotland may be said to have been actually created by this new fuel.

Great improvements were introduced in the furnace plants of Great Britain, and the industry from that date forward advanced steadily.

In 1787 the British Government adopted a strong protective tariff for their iron industries, the duty on pig iron being placed in that year at 67 2 per ton, with higher rates for manufactnred iron. This duty on pig iron was later on increased in 1819, and again in 1825, and the protective tariff in this department was maintained down to the year 1845.

The effect of the introduction of mineral coal, and of the protective duties levied on foreign iron was most beneficial. The industry at once showed strength, and from that date continued to grow rapidly, until in 1796 there were 104 furnaces in England and Wales producing 108,793 tons of iron, and in Scotland 17 furnaces producing 16,086 tons.

In 1820 the total production had reached 400,000 tons, in 1825, 581,367 tons; in 1840, 1,396,400 tons; and in 1854, 3,069,838 tons; this quantity being then estimated as fully one-half of the world's production of pig iron.

In 1889 Great Britain's production of pig iron had reached 9,321,563 tons of 2,000 lbs. This with a population estimated at thirty-eight millions, gives the enormous production of 495 lbs. per head. Of this output Great Britain herself consumes 250 lbs. per capita.

In considering the progress made it is well to remember the various Acts of Parliament enforced from time to time by England to protect her national iron industry, by preventing the emigration of her skilled artisans to other countries, by guarding against the sale of her inventions to competitors, and by the imposition of Customs duties upon foreign products.

For instance while the growing scarcity of wood for the supply of charcoal convinced the Government and people of England as early as 1750, (before mineral fuel had come into use) that it would be to their advantage to allow the free admission of iron in its rudest form from the American colonies, and that as a matter of fact they passed an Act in that year setting forth that it would be of great advantage not only to the Colonies, but also to the Kingdom, that the manufacturers of England should be supplied with pig and bar iron from the Colonies free of duty, yet they so fully believed in protecting their own home industries, that the same Act that made the rudest forms of iron free of duty (because England was unable to produce the material herself) contained the following clause,—

"That pig and bar iron made in His Majesty's colonies in America *may be further manufactured in this kingdom*, be it further enacted........that from and after the twenty-fourth day of June, one thousand seven hundred and fifty, no mill or other engine for slitting or rolling of iron, or any plating forge to work with a tilt hammer, or any furnace for making steel, shall be erected, or after such erection continued in any of His Majesty's colonies in America, and if any person or persons shall erect or cause to be erected, or after such erection continue, or cause to be continued, in any of the said colonies, any such mill, engine, forge, or furnace, every person or persons so offending shall for every such mill, engine, forge, or furnace, forfeit the sum of two hundred pounds of lawful money of Great Britain, and it is hereby further enacted........that every such mill, engine, forge, so erected, or continued contrary to the directions of this Act, *shall be deemed a common nuisance, etc., etc.*"

By the Act in question Great Britain undoubtedly encouraged the production of pig and bar iron in America, by exempting them from duties to which like commodities were subject when imported from any other country, but she did this simply because she had not until that date found a fuel substitute for charcoal. A glance at the Act however, will moreover, show that she imposed an absolute prohibition upon the erection of steel furnaces and slit mills in any of her American colonies.

Various other restrictive Acts of Parliament were passed in 1781, 1782, 1785 and 1795, to prevent the the exportation to foreign countries of machinery and tools used in the manufacture of iron and steel, and to prevent skilled machanics from leaving England.

For example an Act in 1785, 25 Geo. III., c. 67.

"To prevent, under severe penalties, the enticing of artificers or workmen in the iron and steel manufactures out of the kingdom, and the exportation of any tools used in these branches to any place beyond the seas."

The penalty provided in this Act read,—

"If any person or persons shall contract with, entice, persuade, or endeavor to seduce, or encourage, any artificer or workman concerned or employed, or who shall have worked at, or been employed in the iron or steel manufactures in this kingdom, or in making or preparing any tools or utensils for such manufactory, to go out of Great Britain to any parts beyond the seas (except to Ireland) and shall be convicted thereof..........shall for every artificer so contracted with, enticed, persuaded, encouraged or seduced, or attempted so to be, forfeit and pay the sum of five hundred pounds of lawful money of Great Britain, and shall be committed to the common gaol........there to remain without bail or mainprize for the space of twelve calendar months, and until such forfeiture shall be paid, and in case of a subsequent offence of the same kind, the person or persons so again offending shall upon a like conviction, forfeit and pay for every person so contracted with, enticed, persuaded, encouraged or seduced, or attempted so to be, the sum of one thousand pounds............and shall be committed to the common gaol for as aforesaid there to remain without bail or mainprize for and during the term of two years, and until such forfeiture shall be paid."

In addition to these restrictive measures, a glance at the protection afforded to the British manufacturers of iron from 1782 to the close of 1825, will demonstrate to Canadians the fact that England owes her greatness in the iron industry very largely indeed to the protection granted to her native industries in the early years of the trade.

Quoting from Scrivener's History of the Iron Trade:—"From 1782 to 1795 the duty on foreign bars was £2 16s. 2d. per ton. It rose to £3 4s. 7d. in 1797. From 1798 to 1802 it was £3 15s. 5d. In two years it had got to £4 17s. 1d. and from 1806 to 1808 it stood at £5 7s. 5¾d. In the three years between 1809 and 1812 it was £5 9s. 10d.

and in the five years ending with 1818 it had been £6 9s. 10d.

"At this date a distinction was made in the interests of British shipping, for whilst thenceforward till the close of 1825 the duty on foreign bars was £6 10s. if imported in British ships, it was £7 18s. 6d. if imported in foreign. Nor was this all, iron slit, or hammered into rods, or iron drawn down, or hammered, less than three-quarters of an inch square, was made to pay a duty at the rate of £20 per ton, wrought iron, not otherwise enumerated, was taxed with a payment of £50 for every £100 worth imported, and steel, or manufactures of steel, were similarly loaded with a 50 per cent. duty."

Mr. James Mavor, the present professor of political science in the University of Toronto, quoting from Conrad's Handworterbuch der Staats Wissenchafter, vol. III, page 45, and also from various other authorities, gives the following data in regard to the duties imposed at various times by Great Britain in the interest of her iron industry.

"The duty imposed on pig iron in 1787 was 67 2 per ton. Duty increased 1819 to 130/ per ton on pig iron. Duty raised 1825 by 10, per ton. Duty altered 1842, 25 per cent. *ad valorem* on pig iron. Duty abolished 1845.

"Duty on manufactured iron altered 1845, 15 per cent. on manufactured iron and steel, this subsequently reduced to 10 per cent. Duty on iron wholly abolished 1860."

Among other measures quoted by this authority are special rates for carrying coals to iron works, embodied in the earlier railway Acts.

The period of protection by high customs duties extended from 1787 until 1860, giving to the iron industry protection of a permanent character for upwards of 73 years.

The restrictive measures cited, although they were in many cases harsh, undoubtedly resulted in building up an industry of great value not only to Great Britain, but to the world at large.

United States—Great as has been the progress made in the iron industries of Great Britain, still more marvellous has been that of the United States, especially when we consider that the development of the American iron industry has been made very largely within the past forty years, and a full consideration of the facts will show that this rapid growth has been due almost altogerher to the fact that during that forty years the Government of the United States has stood firmly by the policy of protection to the native industry, and that the greatest progress was undoubtedly made when the protection was at its highest point.

The first attempt to establish iron works in the United States was made in 1619, the works being located at Falling Creek, a tributary from the James River, in Virginia. This was unsuccessful, but during the 18th century Virginia became quite prominent in the manufacture of iron.

In 1643 an iron works was started in the Province of Massachusetts Bay, which claims to be the first successful iron works established in America. Several other forges were erected at various points throughout New England, in all cases the fuel used being charcoal.

In the State of New York the first iron works would seem to have been erected in 1740 on Ancrum Creek, Columbia county, close to the Hudson river. This furnace was contemporary with our own St. Maurice forge erected A.D. 1752.

In 1800 the celebrated Champlain iron district was developed and in 1801 the first iron works in the district were built. As in New England, so in New York and throughout the United States, charcoal was the only fuel used at this period.

New Jersey saw her first iron furnace in 1676, and Pennsylvania, the greatest producer of all the States, witnessed the inauguration of the iron industry under the able administration of William Penn in 1716, the iron produced by one Thomas Rutter Smith, who lived not far from Germantown, being said to have proved equal to the best Swede iron.s

In 1728 there were four furnaces in blast in Pennsylvania and from that date forward the iron industry of the State was assured.

Space prevents a more minute description of the difficulties experienced and overcome by the pioneer furnacemen of the United States.

Coming down to more modern days, the following statistics, dated from 1854 to 1890, will serve to show the magnificent development of the American iron industry, under the protective tariff shown in the list.

PRODUCTION OF PIG IRON IN THE UNITED STATES FROM 1854 TO 1890.

Net tons of 2,000 pounds.

Calendar Year.	Anthracite & mixed anthracite and coke.	Charcoal.	Coke and raw bituminous.	Total.	Duty on pig iron of all kinds.
					per cent.
1854..	339,435	342,298	54,485	736,218	30
1855..	381,866	339,922	62,390	784,178	30
1856 .	443,113	370,470	69,554	883,137	30
1857..	390,385	330,321	77,451	798,157	30
1858..	361,430	285,313	58,531	705,094	24
1859..	471,745	284,041	84,841	840,627	24
1860..	519,211	278,331	122,228	919,770	24
1861..	409,229	195,278	127,037	731,544	24
					per ton.
1862..	470,315	186,660	130,687	787,662	$6 00
1863 .	577,638	212,005	157,961	947,604	6 00
1864..	684,018	241,853	210,125	1135,996	6 00
1865..	479,558	262,342	189,682	931,582	9 00
					per ton.
1866..	749,367	332,580	268,396	1350,343	9 00
1867..	798,638	344,341	318,647	1461,626	9 00
1868..	893,000	370,000	340,000	1603,000	9 00
1869..	971,150	392,150	553,341	1916,641	9 00
1870..	930,000	365,000	570,000	1865,000	9 00
1871..	956,608	385,000	570,000	1911,608	7 00
1872..	1369,812	500,587	984,159	2854,558	7 00
1873 .	1312,754	577,620	977,904	2868,278	6 30
1874..	1202,144	576,557	910,712	2689,413	6 30
1875..	908,046	410,990	947,545	2266,581	7 00
1876..	794,578	308,649	990,009	2093,236	7 00
1877..	934,797	317,843	1061,945	2314,585	7 00
1878..	1092,870	293,399	1191,092	2577,361	7 00
1879..	1273,024	358,873	1438,978	3070,875	7 00
1880..	1807,651	537,558	1950,205	4295,414	7 00
1881..	1734,462	638,838	2268,264	4641,564	7 00
1882..	2042,138	697,906	2438,078	5178,122	7 00
1883..	1885,596	571,726	2689,650	5146,972	7 00
1884..	1586,453	458,418	2544,742	4589,613	6 27
1885.	1454,390	399,844	2675,635	4529,869	6 72
1886 .	2099,597	459,557	3806,174	6365,328	6 72
1887..	2338,389	578,183	4270,635	7187,206	6 72
1888.	1925,729	598,789	4743,989	7268,507	6 72
1899..	1920,354	644,300	5951,425	8516,079	6 72
1890..	2448,781	703,522	7154,725	10307,028	6 72

In an able article, "From Mine to Furnace," Mr. John Birkinbine, Past President American Institute Mining Engineers, recently said:—

"The following remarks concerning the progress of the pig iron industry, and a prophecy as to its future, appeared in vol. XV of the tenth census, that of 1880, which is presented here to show how much more rapidly the industry has developed than was then anticipated would be the case eight years ago, when it was written.

"In 1866 the United States had reached the production of Great Britain in 1835, that is to say, she was then thirty-one years behind the latter country. In 1884 she was about twenty-one years behind England, and at the same rate of increase for both countries the United States will be about 15 years behind England in the year 1900, and will reach and pass her in 1950. The production of pig iron of each country for that year, as determined from the equation of their respective curves, being a little over thirty million tons."

The facts are that in 1890 the United States passed and has since that time led, Great Britain as a producer of pig iron.

In a paper read at a meeting of the American Institute of Mining Engineers, in October, 1890, by its then President, Hon. Abram S. Hewitt, he showed a comparative rate of interest in population and and pig iron production in the United States for six decades, and brought out the striking conclusion that the production of pig iron has always increased more rapidly than the population, and that the ratio is an increasing one.

Between 1830 and 1860 the production of iron increased twice as fast as the population. Between 1860 and 1890 it increased four times as rapidly, in reality over four times, thus proving that the national wealth continues to grow from decade to decade, at a rate of accelleration of which the world affords no previous example.

Inasmuch as during all this time the United States have imported iron in addition to their native production, it follows that the consumption per capita has also increased more rapidly than the population.

In 1855, according to careful calculations made by Mr. Birkinbine, the United States was consuming iron at the rate of 117 lbs. per head, whereas in 1890 the consumption had increased to rather more than 300 lbs. per head, the whole of which, for the first time in the history of the country, was being produced within American borders.

Mr. Birkinbine, in speaking of the present and future of the iron industry, deplores the fact that part of the development has been brought about by real estate speculations, which he rightly conjectures will exert a restricting influence in the near future. He is, however, of the opinion that:

"If political action does not disturb the industry, or if labor troubles do not seriously interfere with the development, there seems to be no reason for expecting that the pig iron industry will remain dormant, but we may rather look for a yearly steady growth, which at the expiration of 25 years will probably make the annual requirements of the United States in pig iron, or its equivalent, amount to between twenty and twenty-five million gross tons."

These figures Mr. Birkinbine states are the result of a careful study of statistics, taken in connection with an intimate knowledge of the present state of development, and a personal acquaintance with the possibilities of various portions of the country. He says:

"There will be times of depression like the present, preceded and followed by others of unusual activity, but we may confidently look forward to a material advance, perhaps greater than estimated, but certainly much more pronounced than was believed possible ten years ago.

Iron Ore.—The following figures taken from the "Report of Mineral Industries of the United States," at the 11th census, 1890, will give some idea of the magnitude of the iron industry of the United States.

In 1889 the production of iron ore in the United States including red hematite, magnetite, brown hematite and carbonate, amounted to 14,518,041 gross tons, of a total value of $33,351,978.

The total capital invested in the ore mines in the same year is given as $109,766,199. This is all expended within the country on the native ores.

In addition to this iron ore was imported in the same year from foreign countries to the extent of 853,573 tons, valued at $1,852,392.

With reference to foreign ore imported into the United States, Mr. Birkinbine in his "Production of Iron Ore," 1892, says:—

"While the United States has large deposits of iron ore of all kinds, widely distributed throughout the various states and territories, still the low rates of wages in foreign countries, and cheap water transportation rates, have admitted considerable quantities of iron ore into this country, in spite of a specific duty of 75c. per ton, which is collected on all iron imported. In the year ending December 31st, 1892, iron ore to the amount of 806,585 long tons, valued at $1,795,644 or $2.23 per ton, was thus imported. All of this iron however is consumed near the ports of entry, and much of the ore entering the port of Baltimore is unloaded direct from the vessels to the stock piles. This is also the case with one Pennsylvannia furnace.

"All the iron ore imported from Cuba is taken from the mines operated by American companies. Until 1892 but one company was mining and shipping ore from Cuba, but last year a second enterprise was represented by actual shipments, and 1893 is expected to add at least one more active corporation to the list of Cuban mines."

It is significant, in looking over the list of imports for 1889, to find that whereas Cuba supplied 243,255 tons, of a value of $535,524. the Provinces of Quebec, Ontario, Manitoba and the North-West Territories combined, supplied (be it remembered under equal conditions as to the tariff) only 4091 tons, of a total value of $10,697.

Again in 1892, statistics show that whereas Cuba supplied 307,115 tons, valued at $618,222, Quebec, Ontario, Manitoba and the North-West Territories supplied only 8,606 tons, and British Columbia 2,749, a total value for all Canada of 11,355 tons. valued at $27,340.

Spain was the largest supplier of ore in 1889, sending 298,568 tons, of a value of $621,481.

These statistics prove that up to the present time Canadians have found it impossible to compete successfully against the negro labor of Cuba, and the cheap labor of Spain, in supplying ore to the American market. The questions Canadians have to ask is whether under uniform free trade Canada can hope to improve her position as against her Cuban and Spanish competitors. This seems highly improbable. All the facts point to one conclusion, viz., that Canadians must turn their attention to smelting their own ore for the home market.

Equipment and Shipping Facilities.—The equpment of the American mines and furnaces surpasses in excellence that of any of the European nations, and the facilities they possess for cheap transportation of ore from mine to furnace is unrivalled. The shipping docks at Marquette, L'Anse and St. Ignace, Michigan, are worthy of special notice.

These docks have been constructed at a heavy cost by the railways which penetrate the interior, for the special purpose of facilitating the handling of Lake Superior ores at the minimum of cost, and they furnish a very striking example of the foresight and enterprise of American railroad men, who perhaps more than any other class, realize the national importance of the iron industry.

These terminal facilities consist of shipping docks, with elevated railroad tracks from 35 to 47.5 feet above water level. By means of drop bottoms the ore is dumped from the cars into pockets, thence to be discharged at will by means of iron chutes let down into the vessel's hold. By this system the ore is rarely, if ever, handled from the time it leaves the mine until it reaches lower lake ports.

The total investment for docks, specially equipped for handling and shipping iron ore, is placed, by so good an authority as Mr. Birkinbine, at approximately $4,000,000 in the year 1889.

Receiving Docks.—Of equal importance is the system of receiving docks, specially erected for the purpose of handling ore to blast furnaces, or at points from which railroads radiate to blast furnaces.

These docks are of various types, generally furnished with swing boom derricks operated by steam power. By means of these derricks iron buckets are lowered into the holds of the vessels. After being filled with ore by the navvies, the buckets are raised again and swung to the point where the ore is to be deposited, or if for distant points, into hoppers, thence to be discharged into cars. The buckets dump automatically at the point desired, and return to the hold without detaching from the machinery.

It is estimated that the capital invested for receiving docks fully equals that mentioned for shipping docks, and that one such receiving dock alone costs, equipped, fully $800,000.

The investment, although large, is well spent, for by means of these facilities it has been found possible to handle quantities of ore which could not have been moved in any other way, while the cost of such handling has been reduced to a minimum.

Mr. Birkinbine gives the following data as to the cost of handling ore by the new system of receiving docks.

"The expense of shovelling ore into buckets in the holds of vessels varies from 10 to 15 cents per long ton, the rate being controlled by stevedores, while with the improved apparatus at some of the docks, this ore in buckets is lifted from the vessel, carried back 350 feet and dumped, at a total cost, including labor, wear and tear, interest, fuel accounts reported, of from 1 to 1.5 cts. per ton.

"With 21 men in the hold of a vessel, carrying 2,000 long tons of iron ore, the entire cargo has been stocked in 17 hours. Other instances are mentioned where with 28 men, 2,200 long tons were similarly handled in 15 hours, and 2,100 long tons were handled by 18 men in 17 hours.

"In using these improved apparatus in loading from stock piles to railroad cars, it is not uncommon to have a gang of men shovelling into buckets, and loading the ore on cars at the rate of 8 or 9 tons per man per hour."

In addition to these unrivalled facilities for economical handling of raw material, the American furnaceman works under most advantageous circumstances with regard to the large output of his furnace.

As an example, one of the furnaces in connection with the Edgar Thompson Steel Works, of Pennsylvania, recently produced the remarkable output for a single day of 623 tons of iron. In a week one furnace stack in connection with this company produced 3,203 gross tons, and in a month one stack produced 12,800 gross tons. That is in one month, one of these furnaces produced fully as much as twenty-five years ago would have been turned out in a year, from the best and largest of the American blast furnaces.

With such splendid facilities for economical working, with ample capital, and many other benefits accruing from a long continued policy of protection, the American iron industry stands to-day in a perfectly safe position, the trade (aside from the ordinary periods of depression common to all industries), bound to increase in volume, the whole future of the industry linked with the life of the nation.

CONTINENTAL STATES.

Following the example of Great Britain and the United States, France, Belgium, Germany, and other continental States, established, and still maintain, high protective duties with most beneficial results in many branches of the iron industry. Germany's case is especially worthy of mention.

On the 14th May, 1892, Bismarck, in a speech before the German Reichstag, said,—

"The success of the United States in material development is the most illustrious of modern times. The American nation has not only successfully born and suppressed the most gigantic and expensive war in all history, but immediately afterwards disbanded its army, found employment for all its soldiers and marines, paid off most of its debt, gave labor to all the unemployed of Europe, as fast as they could arrive within the territory, and still by a system of taxation so indirect as not to be perceived, much less felt. *Because it is my deliberate judgment that the prosperity of America is mostly due to its system of protective laws, I urge that Germany has now reached that point where it is necessary to imitate the tariff system of the United States.*"

Bismarck gave to Germany a protective policy with something of a permanent character, and the result has been the building up of a great national industry in that country.

In 1834 Germany and Luxemburg, included in the Zollverein, produced only 110,000 metric tons (2204 lbs.) of pig iron.

In 1881 Germany and the Grand Duchy of Luxemburg produced 2,914,009 metric tons (2204 lbs.) In 1890 the production had increased to 4,637,239 metric tons. This increase in pig iron has been accompanied by an enormous increase in the output of coal and lignite. As an illustration showing Germany's progress in the manufacture of basic steel, in 1890 England produced 503,400 tons of basic steel, Germany, Luxemburg and Austria, produced 1,695,472 tons.

IRON RESOURCES OF CANADA.

Canada's "natural fitness" for the successful establishment of the iron industry is beyond question.

The earnest work performed by the Geological Survey of Canada, and by private prospectors, has well established the fact that throughout a very large portion of her vast territory (three and a half millions of square miles in extent) Canada is rich in iron ores of almost every variety known to metallurgy.

Commencing at the Atlantic seaboard, Canada can claim in Cape Breton—extensive deposits of brown hematite, magnetite and spathic ores, lying side by side with coal fields of great magnitude.

Nova Scotia—The limonite, specular and spathic clay ironstone and hematite of Pictou County, specular ore in Guysboro County. At Londonderry an immense vein of ankerite, holding brown hematite.

Between Truro and Windsor numerous deposits of brown hematite, often highly manganiferous.

A range of ferriferous strata extending from Digby to Windsor embracing red hematite and magnetites of Nictaux and Clementsport. Throughout the whole of this district mineral fuel and fluxes occur in close proximity to the iron mines, affording exceptional facilities for economic furnace practice.

New Brunswick—Magnetic and bog ores, with coal fields at Grand Lake and elsewhere, and a plentiful supply of hard wood for charcoal purposes.

Quebec—The bog and lake ores of this Province are probably the most extensive of a like nature in the world. The ore bearing area extends from the borders of Ontario in the west, to Gaspé in the east, and on the other hand from the eastern townships to the Laurentian range of mountains, embracing the historical Three Rivers ore district.

Good deposits of magnetic ores are found at various points throughout the province, especially in the vicinity of Sherbrooke, Leeds, Sutton, St. Jerome and in Pontiac county.

An almost inexhaustible growth of hard wood, suitable for the manufacture of charcoal is everywhere found side by side with the iron deposits. Limestone for flux is most abundant throughout the province.

Ontario—Vast deposits of ore exist throughout Ontario from the Ottawa Valley to the head of Lake Superior. The ore is of many varities, magnetic, red hematite, limonite, specular, and occasionally bog ores, all more or less rich in metallic iron.

At the recent World's Fair in Chicago, Ontario exhibited no less than 120 samples of iron ore taken from her various mines; all these samples averaging 60 per cent. and over in metallic iron, and many of them exceptionally free from impurities. Most notable among the localities sending exhibits were the Ottawa Valley, including Lanark, and the Kingston and Pembroke district, Madoc and and other points in the county of Hastings; Haliburton, Coehill, and other locations in the county of Peterboro; East Algoma, Thunder Bay district, including the Atik-Okan range.

In the matter of fuel, Ontario, like her sister province, Quebec, possesses extensive forests of hard wood, admirably suited for the production of charcoal. She is also rich in fluxes.

Manitoba—Deposits of magnetic and bog ores on Lake Winnipeg, with an abundant growth of hard wood suitable for charcoal in the vicinity of the mines.

British Columbia—While the work of exploration has necessarily been limited, yet the magnetic ore deposits at Texada Island, and Cherry Creek Bluff are already fairly well proved by actual work. The ore from these mines has found a market at Tacoma, Wash., U.S.

British Columbia is very rich in both coal and wood, the outputs of her collieries at Nanaimo, Wellington and Comox showing a steady increase in tonnage.

While in the actual work of proving and developing her mines, Canada has up to the present accomplished comparatively little, yet the careful preliminary explorations already referred to have made it most evident that in raw materials nature has unquestionably endowed Canada with everything necessary to success.

CANADIAN MARKET.

Satisfied as to the possession of raw materials, the next most important question for Canadians, is the market for the finished product. All facts and figures go to prove that for many years to come Canada's natural market for iron products lies within her own borders, side by side with her mines and forests.

According to the best authorities, Canada uses to-day upwards of 250 lbs. of the products of iron per capita. This on a population of say five millions, means, roughly speaking, an annual consumption of 600,000 net tons.

In his report of the Bureau of Mines of Ontario for 1892, Mr. Arch. Blue estimates the consumption to equal (after making all due allowance for waste in converting pig iron into finished iron and steel) say, 604,252 tons for 1891-2. To better realize the accuracy of these figures, it must be remembered for instance that Canada possesses to-day not less than 15,000 miles of railway, standing high among the nations in this particular regard. When her 15,000 miles of railway line is laid with standard 72 lb. rails (the rail of the future) she will have at 113 tons per mile, in round figures, 1,500,000 tons of steel rails. The average life of a rail is 15 years, therefore renewals are being made continually, and as a matter of fact the Dominion is using in this department alone, 100,000 tons of the product of iron annually.

During the past year one of our great trans-continental lines alone imported 36,000 tons of steel rails. The Canadian railway companies if they follow the example of their American rivals, will heartily support the production of steel rails from Canadian ore by Canadian labor. The revenue to be obtained from the carriage of raw materials to the furnace, and of the finished product to the market, as well as through an increased passenger traffic, will more than compensate for the extra price they will be called upon to pay for rail equipment during the first few years of the industry.

All the rails used in Canada to-day are of foreign make.

As a further illustration, the rolling mills at Montreal, Hamilton, Swansea, New Glasgow, N.S., and elsewhere, are producing annually, at a fair estimate, 80,000 tons of the products of iron. Unfortunately the raw material for this output is very largely foreign, although there is no good reason why within the next few years every ton of this should not be supplied by Canadian labor from Candian ore.

Our iron founders use annually about 80,000 tons of pig ron in casting such as stoves, agricultural implements, and machinery of all classes, one-half only of the material used in this class of work being the production of Canadian furnaces.

Aside from these leading lines the country consumes each year a large quantity of such products as band and hoop iron, special quality bar iron, steel boiler plates, steel sheets, sheet iron, chain cables, slabs, blooms, bridge and structural iron, railway fish plates, rolled beams, nail and spike rods, wire, locomotive tires, iron and steel for ships, steel ingots, bars, and other forms of iron too numerous to mention, but almost wholly the product of foreign labor.

In railways and shipping Canada pretty well holds her own, proportionately to population, with either Great Britain or the United States.

Possessed of the necessary raw materials, and reasonably protecting her own home market, there is no reason why she should not, in proportion to her population, hold an equally prominent position in her iron industries.

The history of the Canadian iron industry dates back to the establishment of the St. Maurice forges by the French Government about the year 1737. This was followed at various periods by the erection of iron works at Batiscan, L'Islet, Hull, Baie St. Paul and Mosiac, in the Province of Quebec.

Furnace Falls, Normandale, Marmora, Madoc and Houghton, in the Province of Ontario.

Woodstock, in New Brunswick.

Moose River, Nictaux and Bloomfield, in Nova Scotia.

In course of time each and every one of these enterprises had to succumb to the competition of foreign iron, then admitted free of duty into Canada.

In addition to the difficulty of competing with the more advanced industries of other countries, Canadian pioneer furnacemen labored under many grave disadvantages. The records in every instance speak of small outputs, lack of capital, lack of shipping facilities, mismanagement—good and sufficient reasons in any country, or in any branch of industry, for ultimate failure.

In not a single case has it been shown that lack of raw materials necessitated the closing down of a Canadian furnace. It is true that an almost absolute want of proper shipping facilities in these earlier days, made it troublesome and costly to procure raw materials, and deliver them at the furnace, but this difficulty has long since been removed by the easy shipping facilities afforded through the network of railways now in operation all over the country, not to speak of the perfect waterways and splendid system of canals now possessed by the Dominion.

Passing over the pioneer stage, we come to perhaps the most important epoch in the history of the iron industry in Canada, viz., the introduction of the protective tariff on iron, which came into force in 1887. The tariff as then framed, and still in force, was based upon the American tariff of import duties on iron and steel, and their products, in the proportion of about two-thirds of the said American tariff, and unquestionably the Dominion Government designed the tariff with a view to protecting native Canadian labor a.ainst the cheaper labor of Europe, and the better equipment of the United States. It was evidently the intention of the Government in doing this to afford, at least approximately, an equal ratio of protection to labor, in whatever branch of the industry it was employed, as this is the system upon which the American tariff is undoubtedly based, and the only system possible of complete success.

Unfortunately the Dominion Government made one mistake, viz., the admission of wrought scrap iron, as the raw material for the manufacture of bar iron, at a less rate of duty than puddled bars, blooms and billets, with which it came into competition. This exception is, as Sir Charles Tupper once said, the "one blot" on the tariff, for it has ever since deprived Canadian furnacemen of a home market for their forge iron, a class of iron which in the order of things they must necessarily produce from time to time, and which should be used by Canadian rolling mill men as their raw material for bar iron, either in the shape of puddled bars, or soft steel billets as the trade may demand.

The admission of scrap iron at a low rate of duty has resulted in two evils. First—It has retarded the progress of the manufacture of pig iron from Canadian ores, inasmuch as the iron masters cannot afford to produce puddled bars or steel billets at competitive prices with cheap wrought scrap. Secondly—It has caused the Canadian rolling mill proprietors to make investments in special plant for the manipulation of scrap, and brought a condition of affairs in the rolling mill business that would be greatly disturbed by any sudden change in the tariff with regard to the admission of wrought scrap.

It is the plain duty of the Government to rectify the mistake it has made, but to do so with due regard to the vested interests of all sections of the industry.

This may be done in several ways, for instance, by naming a definite date, say within from three to five years, when wrought scrap, the present raw material for Canadian bar iron, shall be placed at the same rate of duty as puddled bars, or steel billets, with which it comes into competition, and that in the meantime a sufficient bounty be granted, either to the rolling mill companies on such iron and steel as they may produce from the products of Canadian blast furnaces, or to the blast furnace companies direct, as an inducement to them to produce steel billets and puddled bars, so that they may shortly be in a position to supply the mills (at a reasonable living profit to themselves), with all the raw material necessary for the manufacture of bars and other finished iron.

It is not improbable but that a comprehensive arrangement on some such lines would result in the rolling mill companies considering the question of going into blast furnace work on their own account, with most beneficial results to the whole Dominion, or they may adopt the course of erecting plant for the manufacture of steel billets and puddled bars from the Canadian pig iron.

In the face of many difficulties the pig iron industry has continued to make creditable progress since 1887, and especially has this been the case within the past two years.

At the close of the calendar year 1891, the total production of pig iron in Canada was only 23,891 tons. Within eighteen months, that is to say, at the close of the fiscal year 1892, the output had increased to about 51,000 tons for twelve months, a gain of upwards of 95 per cent. 60,000 tons will be a fair estimate of the output to the close of the present fiscal year.

The following will show the furnaces now in blast, with capacity and output :—

LONDONDERRY IRON CO.,

Londonderry, N.S.

Description of Plant, with Capacity.

36,000 acres of freehold land.
Ore mines yield from 50,000 to 70,000 gross tons.
Limestone mines yield from 12,000 to 15,000 gross tons.
Railways, about 12 miles, company's own property.
Two blast furnaces, capacity about 40,000 gross tons.
One rolling mill (silent) " " 8,000 "
One pipe foundry " " " 5,000 "
Number of men employed, about 350.
Maximum number which has been employed when running all departments full, 807.

Make of pig iron (1892)	- 28,052	net tons.
Ore charged (partly bought)	64,430	"
Coke " - - -	41,006	"
Coal " (all bought)	- 1,740	"
Flux - - - -	14,907	"

The Londonderry Co. purchase from outside sources a very large proportion of their ore and coke. It is therefore altogether fair to credit them with the hands employed in the production of this material, in all some 450 men. This gives a total of 800 employees connected directly and indirectly with the operations of the Londonderry Co.

NEW GLASGOW IRON, COAL AND RAILWAY CO.,

Ferrona, Pictou Co., N.S.

Ore mines, limonite and hematite, yielding 60,000 to 75,000 tons per annum.
Coal mines; limestone quarries.
Railways, the property of the company, about 13 miles in length, connecting the furnace with the mines.
One blast furnace, 65 ft. high, bosh 15 ft. 6 in., hearth 9 ft. 6 in., capacity, 100 tons per day.
Battery of coppe kilns.
Number of men employed, 425.
Iron produced in 1893, for nine months campaign, 22,500 net tons.

Ore, about	50,000	net tons.
Coke,	30,000	"
Flux,	13,000	"

The company purchase all the coal required for the operations of the furnace. Last year they bought, washed and consumed 90,000 tons of coal. It is only fair to credit the industry with the men steadily employed in the fuel department, viz., 150 men and 50 boys, giving a total average of 625 employees in connection with the Ferrona works.

Allied with this company, and as an important consumer of its forge iron, is the Nova Scotia Steel and Forge Co., Ltd., of New Glasgow, N.S. The following description will show the great importance of this steel industry.

The plant consists of:—
Two Siemens melting furnaces, 20 tons capacity each.
Three gas heating furnaces.
Five reverberatory heating furnaces.
26 in. reversing cogging mill, with train of live rolls.
Heavy vertical hot billet shears, with live rolls.
One 20 in. plate mill.
One 16 in. bar mill.
One 12 in. bar mill.
One 9 in. guide mill.
Ten pairs shears, 40 tons and smaller.
One 5 ton steam hammer, with 15 ton hydraulic crane.
Four smaller steam hammers.
Machine shop 175 ft. x 75 ft., with 30 ton travelling crane commanding whole shop, equipped with 24 in. slotter, 6 drills (one a 9 ft. radial, 5 in. spindle), 9 lathes, one of which will take in 50 in. over carriage, and 8 in. x 10 in. in the gap, will take 37 ft. between centres, small shapers, etc. Power is supplied by some 50 steam and 10 hydraulic cylinders. Entire works are lighted by arc and incandescent light plant.

Output, 100 tons of steel ingots per day, all of which is worked up into bars, sheets, axles and other forgings.

Over 97,000 axles of this company's make were supplied to Canadian railways.

This company employed in 1893 an average of 425 men at the works, and expended in wages to this staff $185,471.00. Aside from this they should be credited with the labor necessary to mine and raise the average quantity of ore required per day, in all one hundred men, giving a total of 550 men connected with the Nova Scotia Steel and Forge Co., Ltd.

The company consumed 36,000 tons of coal in 1893.

It may be mentioned also that they paid in 1893 for freights, inwards and outwards, $86,667.61.

THE PICTOU CHARCOAL IRON CO., LTD.

Bridgeville, N.S.

Ore mines, brown hematite and limonite, in the immediate vicinity of the furnace.

Wood supply, the company controls 8,500 acres of hard wood lands, yielding principally yellow birch, beech and maple. This land is situated 15 miles from the furnace.

One blast furnace, 55 ft. high, 11 ft. bosh, built of red brick; capacity, 5,000 tons charcoal per annum.

Charcoal kilns, 19 beehive kilns, capacity 50 cords each.

This company has barely commenced operations. So far only 700 tons of iron have been produced. Working full blast, however, it will give employment to 300 men in the woods, mines and at the furnace.

JOHN McDOUGALL & CO.

Drummondville, Que.

Ores, bog ores secured within a radius of 12 miles of Drummondville.

Charcoal fuel, soft wood, principally balsam and spruce secured in practically the same district as the ores.

Two furnace stacks, both built of stone, 35 ft. high; capacity, about 6 tons per day each.

Two hundred men employed.

At present the whole of the output is used in the manufacture of car wheels at the company's works in Montreal. The campaign is therefore largely regulated by the requirements of the car wheel department.

THE CANADA IRON FURNACE CO., LTD.

Radnor Forges, Champlain Co., P.Q.

Ores, bog and lake. The company control 100,000 acres of ore-bearing lands in the districts of St. Maurice, Three Rivers, Vaudreuil, Joliette, St. Ambrose de Kildare, Point du Lac, Gentilly and Beaconcoeur, including the important deposits of lake ores at Lac-a-la-Tortue and Lac-au-Sable, which the company hold in fee simple. Also magnetic iron mines at Sherbrooke, St. Jerome and other points in the province of Quebec.

Wood supply, freehold and royalty rights on hard wood lands extending throughout the country north of Radnor Forges. The supply of wood is practically inexhaustible.

The company's location at Grandes Piles, securing to them the "key" of the St. Maurice River, and the control of most valuable hard wood lands on either bank of the river for seventy miles of the navigable waters of the St. Maurice. The wood is principally hard maple, birch and beech.

Charcoal kilns, a battery of 11 kilns on the furnace property at Radnor Forges, capacity 55 cords each; a battery of 14 kilns at Grandes Piles, capacity 55 cords each. Charcoal also made in pits in the Swedish manner.

Limestone quarry, the company own what is perhaps the most important limestone quarry in the Three Rivers district. This lies within 50 yards of the furnace.

Railways, a railway line from Piles Branch, Canadian Pacific Railway, to the furnace. This together with switches is three miles in extent, all the property of the company.

Car wheel foundry located at Three Rivers.

Furnace, iron shell, height 40 ft., bosh 9 ft. diameter. Crucible and bosh from mantle down is encased and protected with a Russell Wheel and Foundry Co. water jacket. The furnace is complete with all modern accessories. Hot blast stove, Drummond pattern. Steam and water power. New Weimer blowing engine, also complete auxiliary plant blowing engines, steam and force pumps ready for use at any moment should the permanent plant become disabled. Capacity 40 tons per day of high class charcoal iron, specially adapted for the manufacture of chilled car wheels.

This iron stands an average breaking strain of 63,000 lbs. per square inch, the test being on standard bars 1 x 12 inch.

During 1893 the company produced 7,423 net tons of charcoal pig iron. They made all their own raw material, not alone for the production of the quantity of iron named, but also for sufficient stock to provide for a largely increased output during the present year, 1894.

The average number of men employed is 650, with about 400 horses.

During the winter months when the company require to cut all the hard wood necessary for the year's production of charcoal and when they take delivery of a great deal of the ore made during the summer months, they often find it necessary to employ a staff of upwards of 860 men, with about 550 horses. Of this large staff of men at least three-quarters are drawn from the ranks of the farmers or habitants, and the operations are carried on by them over a very large territory.

IMPORTANCE OF THE CANADIAN IRON INDUSTRY.

Politicians will do well to notice that each and every one of the Canadian blast furnaces are located in rural districts, and that in a very peculiar degree the pig iron industry is one closely identified with the interests of the farmer.

The coke furnaces of Nova Scotia draw a large proportion of their employees at mines and furnaces from the farming class. In many instances farmers take work in the mines, while other members of their families look after their agricultural interests.

The charcoal iron furnace especially may well be classed as a farmers' industry. For example, in the case of the Canada Iron Furnace Co. already cited, out of a staff of 850 men employed at the present time, 700 at least of the employees are farmers or habitants, who work for the company during the winter months and in their slack seasons between seed time and harvest.

These men find that the arduous work of clearing their land is no longer profitable, as it has been in the past, but that on the contrary they are now able to derive a very good living from the earliest days of settlement, by supplying wood to the charcoal kilns.

Another ready source of employment is the raising of ore on portions of their own and neighboring land, which would otherwise be wholly unproductive.

The successful re-establishment of this charcoal iron industry at Radnor Forges has greatly improved the condition of the farmers of the historical Three Rivers district. They now find ready and profitable employment on their own land at all seasons, a steady market for their farm products, and ample work for their horses.

During the present season the Canada Iron Furnace Co. are using in their camps and ore fields upwards of 500 horses, 80 per cent. of which are the property of farmers.

This close identity of interest between the farmer and the manufacturer is also characteristic of the work done at Drummondville, in the Province of Quebec, and will no doubt prove equally true with regard to the operations of the Pictou Charcoal Iron Co., at Bridgeville, N.S.

It will be largely in the interests of the farmers of Ontario and Quebec if the charcoal iron industry is allowed to grow and prosper. What has been possible in the case of Sweden is equally possible with the Provinces of Ontario and Quebec, where the raw materials and market lie side by side.

In 1890 Sweden had in blast 154 charcoal iron furnaces, producing 456,102 metric tons, an industry of which that nation may well be proud.

The utilization of the hard and soft woods of our forests, at present waste material, would be of incalculable benefit to the provinces of Ontario and Quebec, and above all to the agriculturists of these provinces.

Next to the farming class, the railways would perhaps be the greatest gainers by the establishment of an iron industry.

In that case of the Government railway, the Intercolonial, it is safe to say that the combined operations of the Londonderry Iron Co., the New Glasgow Iron, Coal and Railway Co., and the Nova Scotia Steel and Forge Co. furnish one-fifth of all the freight business of the railway in question.

The Piles Branch of the Canadian Pacific Railway, on which the works of the Canada Iron Furnace Co. are located, is perhaps the best paying piece of line possessed by that great trans-continental road, and this is very largely due to the fact that every pound of raw material inwards to the furnace and finished product outwards to the market contribute to the revenue of the railway company.

It is plain that any policy that would serve to cripple these iron industries *will be severely felt by the railways. Perhaps the greatest difficulty that has stood* in the way of the advancement of the Canadian iron industry up to the present time has been the uncertainty of the tariff, and political cries of "Commercial Union," "Unrestricted Reciprocity," "Free Trade" and "Revenue Tariff," have served to frighten capitalists, so that Canadian iron masters have found it very difficult to obtain investors for the carrying forward of the work on a proper basis. When the difficulties are all considered, it is remarkable that the industry has reached even its present stage.

The United States at the present time presents an example of what uncertainty regarding tariff changes will do. During the past six months business has been completely demoralized in the iron trade of the Republic by the fear of a possible change in the duties. This in face of the fact that both parties in Congress are known to be more or less protectionist in theory and practice, the difference being only one of degree, whereas in Canada politicians are most extreme in their views, and the battle against protection to native industries has been waged in and out of Parliament during all the term that the so-called National Policy has been in existence.

With such a nucleus as the existing establishments afford, with unlimited supplies of raw material, and possessing the best of all markets—a home market—the Canadian iron industry cannot fail to expand rapidly and safely, probably as in the case of the United States much more rapidly than the population, if only the Government of Canada will establish confidence in the minds of capitalists by, in some manner, giving a degree of permanency to the present protective tariff. Minor details will from time to time require adjustment, but the broad principle of protection to an industry for which nature has so eminently fitted the Dominion, must be endorsed by both Government and Opposition, giving a fair period of time in which to secure a full development of the industry, so that it may meet on something like equal terms, the opposition of its powerful competitors in the United States and Great Britain. Without this the industry will be restricted, and in times of depression such as the present, the iron masters of the United States will simply unload their bankrupt stocks into Canada, with the end that a healthy Canadian industry will be an utter impossibility.

It is a notable fact that during the past four years the increased outputs of the Canadian furnaces has led to a decreased cost of production per ton of iron, and Canadian makers have now forced foreign agents to lower their prices fully $3 per ton from prices asked four years ago. A well maintained tariff for some years to come will have exactly the same tendency as it had in Great Britain and the United States, viz., to strengthen and expand the native industry to the point where Canadians can control the entire trade of the country, and yet sell to the consumer at as low a price as any foreign competitor can do in his own country.

LOCATION.

The question of the proper location of coke and charcoal furnaces will be settled by the natural fitness of each province. Nova Scotia, possessing as she does a great wealth of mineral fuel, must continue for some years to come to produce the coke iron required by the country. It may be urged that she is far removed from her best market, viz., Ontario. However, Nova Scotia is in quite as good a position in this respect, and ought to be in regard to freight rates, as her present greatest competitors, viz., the furnaces of the Southern United States. Within the past two years Nova Scotia has made great progress in the erection of modern plants and improved appliances. She must continue on this course, for the time is past when iron can be successfully produced without improved appliances both in construction and modern methods of operation. The blast furnace must meet the consumers' wants in quality of iron, and technical knowledge and *administrative* ability must be joined together in Canada just as in the United States, to secure the increased output and the high quality of iron which the times demand. Quebec and Ontario afford a splendid field for the development of the charcoal iron industry, and this department will become more and more important as the forests of the neighboring republic and Sweden are depleted.

It is hardly feasible under *existing circumstances* to successfully establish coke furnaces in either Ontario or Quebec, inasmuch as these provinces would have to depend upon importing their supply of mineral fuel from the United States. Such an industry would be of little value to the provinces or the Dominion inasmuch as by far the largest proportion of labor required in the manufacture of iron is that connected with the mines, both coal and iron. Certainly the Government would not be warranted in granting a bounty for the establishment of an industry contributing, as largely as this would, to the labor of our most important competitor, the United States.

There is a reasonable hope that in due time Nova Scotian coal will be profitably coked at Montreal and other centres of population by the utilization of by products.

When that time comes Ontario and Quebec will be in a position to operate blast furnaces economically with mineral fuel, the product of Nova Scotian mines, thereby adding another link to strengthen the confederation of the Canadian provinces.

For the immediate future the charcoal iron industry offers the best and surest field of operation and investment to the provinces of Ontario and Quebec.

A full and unbiassed investigation into all the facts concerning the successful establishment of the iron industry in other countries, and of the circumstonces attending the work already done in Canada, leads to the following conclusions:

First—That the Canadian iron industry has greater and more just claims to the good will and support of the government and people of Canada than perhaps any other of the great industries of the country. In tobacco, sugar and cotton splendid progress has been made, yet these industries, whilst of unquestionable benefit to the country, all contribute more or less to the labor of foreign countries, by using raw materials of foreign growth, for which nature has not fitted Canada. The iron industry is altogether different, being purely Canadian from *raw material to finished product*. Nature has richly endowed Canada with everything that goes to make success in this special line of enterprise. It rests with the government and people of the Dominion to foster the industry to a perfect development.

Second—The Dominion Parliament must immediately adopt a course that will give confidence to investors, by demonstrating that the protective tariff and bounty will be well maintained for some time to come. The Government must rectify judiciously any errors that may have arisen, and must seek at least approximately *to grant a uniform protection to labor, in whatever branch of the industry it may be employed*, be it at the mines, furnace, rolling mill, iron foundry or machine shop.

Third—The Provincial Governments must take steps immediately to encourage by every reasonable concession the development of the iron industries now within their respective borders.

In Quebec and Ontario every facility should be granted by the Provincial Governments in the way of privileges for the clearing of hard and soft woods from Crown lands. This course will not only strengthen and build up the charcoal iron industry, but will bring about a rapid settlement of Government lands.

Hitherto settlers have avoided the forest lands of the east, in favor of the more easily cultivated prairies of the west. Establish the charcoal iron industry in Quebec and Ontario, and the settler will find a sure and profitable return for labor expended in clearing the wood, and the inducement will make the bushlands of these provinces more attractive than the prairies of the west.

The section of the different provincial mining laws, providing for a proper expenditure in the development of mining locations within a given time, should be strictly enforced, and if possible the obligations made even more stringent than at present, so as to ensure a fair amount of work being done promptly, and prevent as much as possible the "locking up" of valuable mines by speculators.

Where the owners of locations are too poor to carry on the work of development in a proper manner then the Provincial Government should do so by some equitable arrangement with the owner. For this purpose the Provincial Legislature should vote in each year's supplies a reasonable sum of money. This would serve to bring about a business-like development of some very valuable mines that now lie dormant, and must in time bring a very profitable return to the Government by the settlement of Crown lands.

Further it would tend to prove to capitalists that the ore supplies are all that they are claimed to be, and ample for all requirements.

The Provincial Governments require to deal with the whole question in a business-like manner strictly enforcing laws that will tend to an early development, but at the same time they must be heartily in accord with the Dominion Government in granting every legitimate encouragement and facility that will tend to build up so valuable an industry.

Fourth—Canadian bankers, capitalists, and men of affairs generally will do well to give the native industry more attention in the future than they have in the past. An industry that is peculiarly Canadian in every branch, drawing all its wealth from Canadian soil, is surely worthy of their legitimate support. The fact that the earlier iron industries of this country failed to succeed under the most adverse circumstances, is no reason why, under existing conditions, undeniably more favorable, the industry cannot be made a thorough success, not alone affording a great field for a safe investment of capital, but indirectly benefiting other existing Canadian industries and interests, aiding towards increased population and national wealth.

Let the Canadian Government and people go steadily onward and by every energy and sympathy build up great national industries and interests, neither doubting themselves nor their resources, but rather cultivating in every department of trade and commerce and in the hearts of the people that national pride in national products so characteristic of Englishmen and Americans. Following such a course Canada must soon develop not only in her iron industry but in every department of national life.

Ore Sampling.

By J. T. Donald, M.A., Montreal.

Worcester defines a sample as "that which is taken out af a large quantity as a fair representation of the whole." Webster says a sample "is a part of anything presented for inspection as evidence of the quality of the whole."

Ore sampling may therefore be defined as any process which will enable us to obtain from a large quantity a fair representation of the whole. To fairly sample a pile of ore is really no simple matter, although there are many engaged in mining who think that all that is necessary is to pick up one or more pieces from the pile at random, and call this a sample.

For instance, sometime ago a gentleman brought me a lump of phosphate weighing about a half a pound as a sample of a pile of about 200 tons. He said he considered it a fair sample, although the pile contained some better and some worse, and requested that it be analyzed. A few months later the ore was sold, and the purchaser had the pile properly sampled; the results of analyses in the two cases, it is needless to say, showed a marked difference.

On another occasion, a company engaged in mining a certain ore determined to send samples to Canadian and English chemists. The party who was detailed to draw the samples went to the pile, selected a few lumps of ore and laid them aside as one sample; he then collected another few lumps of similar size and considered the latter as a duplicate of the first. In due time the certificates of analyses of these samples, by English and Canadian chemists, were laid side by side, and as might be expected were far from agreeing closely. The company who owned the ore blamed the chemists, and the chemists, of course, declared that the fault lay with the samples, and as a chemist I am bound to say I quite agree with the view that the sampler was the party at fault.

As a matter of fact, I may be permitted to say that one of the greatest difficulties with which the analyst has to contend is defective methods of sampling. It is no uncommon thing for a chemist to hear a miner say you analysed for me a sample of phosphate, and when the cargo was sampled and analysed in Hamburg it went much lower than you made it. It must be borne in mind that it is most unfair to hold an analyst responsible for anything except the accuracy of work on the actual sample on which he has worked. If a miner instructs a chemist to sample and analyse a pile, then it is another matter.

The time was when chemists working on duplicate samples did not always obtain closely concordant results, for the reason that different methods were employed by different chemists. This condition of affairs is a thing of the past, and now throughout Europe and this continent uniform methods of analyses are employed in the valuation of the more important ores of commerce, with the exception of copper, which in America is determined by the electrolytic method, whilst in Britain the old Cornish assay flourishes.

The ideal method of ore sampling is to crush the whole parcel, and then let it fall in a steady stream through a machine which, working automatically, diverts at fixed intervals, and for a fixed length of time, a portion of the stream of falling ore. For instance, a stream of ore may be allowed to fall vertically for two minutes, then that which falls during the third minute is thrown automatically away from that which fell during the first two minutes, then for another two minutes the ore falls vertically, then again for one minute the stream is deflected, and so on. In this way the whole parcel of ore is divided into two lots, one containing two-thirds of the original parcel, the other one-third. The latter part is then taken and put through the same machine, exactly as was the original lot, and similarly divided. The lot deflected from the main body in this second process now constitutes one-ninth of the original parcel. It may be put through the process a third time if desired; and in the latter case, the deflected part will represent one twenty-seventh of the original parcel. This portion is next spread out and quartered, and an equal quantity taken from each quarter. This portion is again quartered and a portion taken from each, and so on until a sufficiently small quantity has been obtained, and this last is considered a sample. I think no one will deny that a sample thus obtained will undoubtedly fairly represent the whole.

The method outlined is that which is in use in the large copper ore and matte sampling works in New York; but, of course, it cannot be carried out in the case of quantities of ore which have to be sampled at the mine or any point except the sampling works. Nevertheless, all sampling should aim to approach as closely as circumstances will permit to this ideal method.

To see how closely this ideal method may be approached, let us suppose the case of a quantity of phosphate in bins, and it is required to draw a sample for analysis, the sampler acting for both buyer and seller.

If not fairly level, it is advantageous to first level the pile, and then to place stakes at points, say ten feet apart. Next, workmen, at these marked points, dig down through the ore until the bottom of the pile is reached, and in digging the contents of say each fifth shovel is thrown into a box and carried off to a level floor; when the bottom of the pile has been reached at every staked point, the portion that has been carried off is broken into fragments not larger than an egg, thoroughly mixed, then spread out and quartered, and the selected portion is again crushed, so that now it will contain no lumps larger than an almond. This portion is then mixed and quartered, and so on until a sufficiently small sample is obtained, this may be a quantity that will fill an ordinary pickle bottle.

If ground ore in bags is to be sampled, it will suffice to take a portion from the middle and bottom of every fifth bag, the whole lot thus drawn should be mixed and quartered as already explained.

Closely related to ore sampling is ore grading, which prevails to a certain extent in all mining regions. There is, however, one distinctively Canadian ore which nominally is graded, but in which the grading is of but little importance, for the reason that there is no uniformity in grading, and since it is an ore whose value cannot be determined by analysis, grading is all the more necessary. I refer to asbestos. It is well known that No. 1 grade of some producers is no better than the No. 2 of others, and a purchaser buying No. 1 ore is by no means certain of the character of the ore he will receive. Such a state of affairs is a blot on the asbestos industry, and should be removed. In the case of wheat and flour, for instance, standards are chosen by parties appointed for the purpose, and these are accepted by the trade as standards. Why cannot the same thing be done for asbestos? It should not be difficult for producers to agree upon standards, and to grade their ore accordingly.

Certainly closer attention to sampling and grading ore on the part of miners would tend to an increase of good will between buyers and sellers, and would in the end be directly profitable to the miner.

The Annual Dinner.

Wi' merry sangs, an' frien'ly cracks,
I wat they did na weary;
An' unco' tales and funny jokes—
Their sports were cheap and cheery,
Till butter'd sow'ns wi' fragrant lunt
Set a' their gabs a-steerin'
Syne, wi' a s'cial glass o' strunt
They parted aff careerin',
Fu' blythe that night.

About forty members and their friends sat down to dinner in the Windsor Hotel on Thursday evening. In the absence of the president, who had been called home during the afternoon, Mr. George E. Drummond (Canada Iron Furnace Co.), vice-president, occupied the chair, having on his right His Worship the Hon. A. Desjardins, Mayor of Montreal, and on his left the Hon. E. J. Flynn, Commissioner of Crown Lands for the Province. Among other notables at the head of the table we noticed Mr. John F. Stairs, M.P., Halifax; Mr. Graham Fraser, managing director of the New Glasgow Iron, Coal and Railway Co., Ferrona, N.S., and Mr. James King, M.P.P., Quebec. The tables were tastefully arranged in the form of a horseshoe, and the menu and service was everything that could be desired. Unfortunately, through a misunderstanding, the company was deprived of the services of the orchestra, which had been engaged to play during dinner, but whatever deficiencies may have been at first experienced in this regard were amply compensated for by the musical efforts of individual members, notably by Mr. Fritz Cirkel, M.E., whose brilliant execution at the piano, accompanied by a fine variety of vocal selections, contributed much to the pleasures and success of the evening.

The Chairman intimated apologies from the following: Hon. T. Mayne Daly, Minister of the Interior; Hon. A. S. Hardy, Commissioner of Crown Lands, Toronto; Mr. Arch. Blue, Director of Mines, Toronto; Hon. George Irvine, Q.C., Quebec; Mr. W. W. Ogilvie, President of the Board of Trade, Montreal; Sir J. W. Dawson, Montreal; Dr. A. R. C. Selwyn, C.M.G., Ottawa; Mr. H. S. Poole, President Mining Society of Nova Scotia, Halifax: and others. The toast of the Queen was then given and loyally honored.

Capt. R. C. Adams—I have very much pleasure in moving that we drink a bumper to "Our Guests." I feel that we are very fortunate in having as our guests to-night gentlemen in power—representing governments—because this Association was formed primarily on the principle of the Irishman who, when he landed on an island, at once inquired: "Is there a government here?" and on being informed that there was, exclaimed "Then I am agin it." (Laughter.) The General Mining Association was formed primarily to be "agin" the Government. We found that laws were being passed which oppressed our industries, although instead of being in the position of many people who were constantly running to Ottawa and Quebec soliciting and securing special favors for their industries, we were demanding nothing at all further than to be let alone. Not only was our mining industry receiving no protection, but taxes were being suggested which threatened its existence; so we organized to secure the repeal of these bad mining laws, and, gentlemen, we are glad to say we have succeeded. (Applause.) We have succeeded in having these obnoxious laws repealed. The good efforts of the Hon. George Irvine, our late esteemed president, who formulated the objections to the Mercier law and pressed them upon the Government, were entirely successful. (Applause.)

It is, I take it, a sure sign of our success that we have so many representatives of the Government with us to-night. We are delighted to be honored with their company. We have the Hon. Mr. Flynn, the Commissioner of Crown Lands, to whom we must all go in the first instance to get our land. We consider him really as the Father of the whole mining industry in Quebec, and we feel it especially appropriate that he of all others should be with us. (Applause.) We hope that he will gain enthusiasm in regard to our Association and our industry, and if there is any bare possibility of the system under which he is working being improved, we trust it will be exercised in our favor. We certainly have no complaints to make at present. (Applause.) I think we have shown our appreciation of the political party which he belongs to, which I believe is popularly called in Quebec the *Bleu* party, by electing as our President Mr. John Blue. (Laughter.) It was felt that we must have some one who was really "True Blue." (Applause.)

Then, too, we have with us our old friend the Hon. A. Desjardins, the honored representative of our city, who so gracefully and admirably fills the position of its mayor. (Applause.) Without making any comparison with the past, we may say how thoroughly we appreciate having a "gentleman" in the civic chair.

These were perhaps "hard times" for some of the mineral industries—phosphate, asbestos, silver—but I am often comforted in such times by remembering the words of a good old business man, who said that "blue times" was the time for action—that in hard times men make their greatest success, because then they have to find out what new methods they can adopt and what new devices they shall undertake. In his able paper last night, Mr. Smith gave us one of those instances by his use of the diamond drill to get at the minerals, showing how hard times induce men to undertake new economies in place of the old worn out methods; so, gentlemen, I feel that while we congratulate our guests we might also take courage ourselves and resolve that we are not going to let our mineral interests go down, but that we will adopt wiser methods and better economies, and try to let this old Province of Quebec still raise her head and take rank as foremost in the Dominion in the production of minerals, an industry which next to agriculture is at the bottom and foundation of the nation's growth. I hope we shall take encouragement from this conference with each other, and get to work anew to do what we can to make the coming year a year of progress and prosperity. Before I sit down I will tell you a little bit of witticism that I heard out west, which came into my mind in connection with the mention of the color blue. I was in British Columbia this summer, and there was a man named Brown in a mining camp who had been engaged in the manufacture of charcoal, and therefore had earned the name of Charcoal Brown. One day a stranger came to the camp and said, "Boys, do you know of anybody here by the name of Black." One of the men said, "No, there is nobody here named Black, but there is a man named Charcoal Brown; that is the nearest we can come to it," Some of us here are not quite as *bleu* in politics as we might be, and are even tinged with *rouge*, but the nearest we can come to it is to be true blue in our loyalty to the mining industry. I have much pleasure in giving you the toast of "Our Guests."

MAYOR THE HON. A. DESJARDINS—I have to thank Capt. Adams for his kind reference to myself and you gentlemen for the heartiness with which you have received this toast. A mayor is a short lived individual. I feel this particularly to-night, for although a year has passed, it seems only as yesterday when I made my first public appearance as Mayor in your company, when we assembled in this place to welcome the American Institute of Mining Engineers and the other mining men who came to Montreal under the auspices of your Association, with my friend Mr. Bell, always active, always energetic, always ready. (Applause.) Well, gentlemen, I heartily welcome you again to Montreal. Your conventions, your meetings, your lectures and those periodicals which are published under your control are excellent advertisements abroad of the wealth and possibilities we have in our country. You have done much to make that wealth known elsewhere and I sincerely wish you continued success and prosperity in your undertakings. (Applause.)

HON. E. J. FLYNN—I feel exceedingly pleased to have the honor this evening to meet at this table so many distinguished representatives of the mining industry of the Province of Quebec. I thank you Mr. Chairman and you Capt. Adams for the kind reference to myself and my work. I regret very much that last year, when your Secretary kindly tendered me an invitation to be present as your guest and also to take part in the mining convention, that through the performance of my public duties, I was prevented from being with you. I saw in the papers the result of your deliberations and what took place and I am now consoled by the thought that I can peruse attentively the very interesting papers which were read an that occasion in the very interesting *Journal* of your proceedings recently published, and which is now about to be distributed throughout the Province of Quebec and the Dominion (Hear, hear.) When I left Quebec yesterday to attend your dinner I did not expect to have had the opportunity of uniting business with pleasure, but I have been more than pleased to have been present at your sessions yesterday and this afternoon. I must say that the papers which have been read were of the most valuable and interesting character and I avail myself of this opportunity to tender here publicly my most sincere thanks and my congratulations. I will be allowed to do so, I presume, in my capacity of Commissioner of Crown Lands. The good work you have been doing, as His Worship the Mayor has said, is an advertisement of the mining resources of the province. What we require is capital to develop these resources. The Government of the day has passed what I think you will admit to be liberal legislation in the General Mining Act of 1892. Those that wish to invest their money in the Province of Quebec can secure titles and their rights will be respected. (Applause.) There is not the slightest danger that they can be disturbed in their possession. If they wish to commence by prospecting, they can obtain a prospector's or exploring license. If they wish to work a mine on purchase they can do so, and then become absolute owners, provided they work the mine within a given period. We allow, practically speaking, a sufficient quantity of land to be sold to any given applicant, but we desire to prescribe as much as possible monopoly or pure speculation. (Applause.) In spite of many obstacles and difficulties there has been considerable progress made in mining and in the mining legislation of the province. When in 1878 and 1879 I was called upon to exercise the functions of Commissioner of Crown Lands, all we held then in the shape of legislation was simply a by-law containing four or five clauses of the Act of 1879 in reference to phosphate lands. We had also what was known as "The Gold Mining Act of 1864," which referred specially and exclusively to the Chaudiere Valley. Beyond this legislation we had nothing and it became my duty then, in 1880, to frame the law which has been known as "The General Mining Act of 1880." In 1882 I ceased to be Commissioner of Crown Lands and in the interval between 1882 and 1892 another piece of legislation was introduced, to which I, of course, do not wish to refer. (Laughter.) In 1892 the present law, "The General Mining Act of 1892," was framed, and I think we may consider it to be a distinct improvement on the past legislation. (Hear, hear.) I am ready to admit that there may be features in that law which are not altogether modern and which might be improved, but in the main its features are in harmony with the times and with the views of your Association. One of the features to which I wish to refer briefly and in a word is the inspection of mines. Up to that date the inspector of mines was a person generally a lawyer (laughter) without the slightest knowledge of mining or the mineral industries. Now the inspector of mines must be a mining engineer of five years standing, having a diploma and a practical experience in mining work. (Applause.) The province has been divided into two great divisions, but there has so far only been one inspector—Mr. Obalski. The province so far has not received enough revenue to warrant me in recommending an additional inspector, but I believe, however, since I have had the opportunity of hearing you refer to the different topics under discussion at your meetings that probably, within a short time, it will be my duty to recommend the appointment of another inspector. The Commissioner then ably reviewed the progress that had been made in mining, mentioning particularly the phosphate deposits of the Ottawa Valley, the iron making industries of Radnor and Grande Piles, the asbestos, copper, slate and building material production of the Eastern townships, and the new discoveries of oil fields in the Gaspe district.

I believe from a national point of view your work is extremely useful and you deserve all the encouragement that can be shown to you. You have been kind enough to say that I was one of the best friends of your Association. I believe Mr. Chairman that you have been too kind in these remarks, but believe me I am thoroughly imbued with the importance of the work of your Association. You are materially aiding the mineral resources of the province, you are inducing foreign capital to come here, and you are entitled to all encouragement. Now Mr. Chairman if it is in the power of the Commissioner of Crown Lands, if it will be possible for him to help your Association, I give the assurance in the presence of the members at this table, that you may rely implicitly upon me. (Loud cheers.)

If I am not interfering on the order of the toasts, perhaps you will permit me to propose here, in my capacity of Commissioner of Crown Lands and therefore General Director of Mines, having as it were under my control in a measure even your Association, (cheers) the toast of "The General Mining Association of the Province of Quebec," and to say that I hope it will be long lived and continue in the good work that you have commenced and are carrying on and for which you are deserving of the thanks of the good citizens of the province. (Loud applause.) The toast having been drunk with enthusiasm, the chairman called upon Mr. B. T. A. Bell to respond.

MR. B. T. A. BELL—Mr. Chairman, Mr. Mayor and gentlemen: I am sure it has been very gratifying to all our members to listen to the excellent address and the kindly words of encouragement from our esteemed Commissioner of Crown Lands, and it gives me great pleasure to acknowledge the toast which he has so gracefully proposed. While it may be true that the secretary of any Association may be regarded as the mainspring of its operations, the pivot, if I may call it, upon which its success depends, is unquestionably the treasurer, and as his well known oratorical powers can more fittingly express the sentiments of the occasion, I have much pleasure in asking Mr. Stevenson to reply.

MR. A. W. STEVENSON—It is very kind of the secretary to speak so pleasantly of my work but my duties are not very onerous. Our Association, in its efforts to extend the knowledge of its members, to distribute information respecting the resources of the province, and particularly to protect the industry from pernicious legislation, has been distinctly successful. The present Government of which the Hon. Mr. Flynn is a member and whose presence we so heartily welcome in our midst, has shown by its recent enactments that it recognizes our rights, which was more than could be said for its predecessor in office, whose mining law was nothing short of common robbery. (Cheers.) Our Association desires to go on doing its duty by the mining industry of the province in a fearless manner, not as supplicants for special favors at the expense of its neighbors, only seeking fair play, and I can tell Mr. Flynn that if as an Association we should ever have to seek for some assistance in our efforts to promote knowledge, it will be a case of necessity, and he can readily grant the request. (Applause.)

Mr. George R. Smith at this stage favored the company with the song of the Association, "Drill ye Tarriers, Drill," the company joining heartily in the chorus.

MR. B. T. A. BELL—We have been honored to-night by the company of two gentlemen who represent very worthily the mining interests of the sister province of Nova Scotia, Mr. John F. Stairs, M.P., and Mr. Graham Fraser. These gentlemen are to be congratulated on the well merited success of their endeavours to establish the iron industry of that province on a basis that is distinctly creditable to the country. Their establishment at Ferrona is probably the largest of the kind in the Dominion and it has been equipped with a plant second to none on the continent. I would therefore ask you to drink success to the mining industries of Nova Scotia.

MR. JOHN F. STAIRS, M.P., in acknowledging the toast, referred to the known wealth of Nova Scotia in her minerals and the steady advancement that had taken place in recent years in the development of the coal, gold, iron, gypsum and other mineral industries of the province.

MR. GRAHAM FRASER—I am very glad to be here but I am very sorry I cannot make a speech—none of our family were every known to make speeches. An uncle of mine, a good Presbyterian, died not very long ago, and his pastor told me at the funeral that he was a very practical man. He could never be induced to pray at prayer meeting. On one occasion the pastor had asked him to pray, and after the meeting my uncle took the minister to one side and said, "Now, look here, I do not want you to ask me to pray in public; there are a lot of fellows around here who do not give anything to the church, let them do the praying." (Laughter.) I could not prepare a speech if I tried to, but I may say that in the way of the iron industry, your chairman read a paper this afternoon that gave more facts and statistics than I could give you now. We have a furnace that turns out about 85 tons of pig per day, and that has been running now for a year. Our steel works are the growth of an industry that commenced on a very small scale twenty-one years ago. Two of us started steam forging, and the business gradually grew until a number of years ago it was turned into a joint stock enterprise called the Nova Scotia Steel and Forge Company. At the present time we employ about 450 men regularly, and at the iron works, of which Mr. Stairs is president, about 400 more. I am very glad to be here, and I cannot do anything further than thank you for the reception you have given me. (Applause.)

Mr. E. D. Ingall and Mr. F. Cirkel here contributed an excellent duet on the flageolet and piano.

MR. J. BURLEY SMITH, in a few appropriate remarks, completed the toast list by giving "The Geological and Natural History Survey," to which Mr. E. D. Ingall, M.E., Chief of the Division of Mineral Statistics, fittingly replied.

The toast of "the Ladies" called Mr. James King, M.P.P., and Mr. W. T. Costigan to their feet, and it need hardly be said that both did ample justice to the subject.

A hearty "Auld Lang Syne" and the National Anthem terminated the proceedings.

Asbestos Mining in South Africa—A London syndicate, styled the Cape Asbestos Company (Ltd.), has been registered in London with a capital of £55,000, in £1 shares, to purchase any asbestos or other mines, quarries, workings, rocks, or lands supposed to contain asbestos or other minerals, in South Africa, Canada, Italy, or elsewhere, to take over and work the Farms Koegas, Hounslow, Schalkdrift; to acquire certain mining rights over the Farm Schalkprets, all situate in the district of Hay, Griqualand, Cape of Good Hope; and to carry on the business of mining and working for asbestos.

Good News for Ontario !

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The Successful New Process for the Treatment of Refractory Gold Ores at Marmora Ont. Described.

The Walker-Carter process, for the treatment of refractory gold ores, which was introduced about one year ago by the Hastings Mining and Reduction Company, has fulfilled all the claims made for it by its owners. A mill with a capacity of from seven to ten tons was erected in the village of Marmora last spring, and has been in constant and successful operation for the past six months. About 600 tons of ore have been successfully treated, and an average of 85 per cent. of the assay value of the gold recovered, besides which the arsenic in the Mispickel is entirely recovered in a commercial form, as arsenious acid. As this is the first complete plant erected in connection with this process, a description of the operation may be of interest.

The ore is first crushed, then dried and ground to a fine pulp. It is then conveyed to the hopper of the roasting furnace, which is one of the chief features of the invention. The ore is caused to travel over an extended heating surface, entering at the coolest part and coming out at the hottest part of the furnace.

The roaster consists of a series of horizontal retorts, to which the heat is applied externally. Each retort contains a rake shaft with a series of rakes of a peculiar shape, which are moved to and fro in a semicircle, and serve to push the ore from one end of the retort to the other. The ore then slides from the upper retort to the lower, and undergoes the same treatment as before until it leaves the furnace.

On leaving the roaster, the ore is found to be entirely free from sulphur and arsenic.

The arsenic leaves the retorts as arsenious acid, together with the sulphurous fumes, and are caused to pass through specially constructed condensers, where the arsenious acid is condensed, the sulphurous acid being allowed to escape through a chimney. The ore is then conveyed to the amalgamator, where the mercury is applied in a state of vapor. It is then put through a water cooled tube, and falls into the pans, where the amalgam is recovered in the usual way. At present the tailings are allowed to escape, but it is intended, as soon as a concentrating plant is erected, to recover the oxide of iron, which is of considerable value as a paint. The arsenious acid recovered will more than pay for the whole cost of treatment.

The process is continuous, involves no hand labor, and requires comparatively little attention.

Plants are being erected in various parts of the United States for treating sulphurets and for recovering flour gold.

The Hastings Mining & Reduction Co. operate under a license from Messrs. Kitson and Graham, of Philadelphia, Pa., and Alexander Keith, of Toronto, which is confined to Hastings county. The patents for the rest of Canada are owned by Arthur Kitson, of Philadelphia, and Alexander Keith, of Toronto.

The following is a report of the process made by the well known America Mining Engineer, Mr. Harvey Beckwith, formerly of the Comstock Mines, and Mr. Wm. H. Murdock, of Hidalgo, Mexico.

It is claimed that this is the only known process for the successful treatment of the Mispickel and surplur ores carrying gold, and for ores carrying flour gold.

Report of Harvey Beckwilh, Esq., M.E., upon the Hastings Mining and Reduction Co.'s process for treating refractory gold ores.

SIR,—Left this city on 10th of October, arriving at Mamora, Ontario, on Thursday, October 12th. The object of my visit was to examine the Walker-Carter process and mill located on the Crow river, near the above named town. I found the mill in operation, and was informed it had been in continuous operation for nearly five months last past.

This mill consists of an old fashioned Blake crusher, set to crush fine, discharging the crushed ore on to a plate dryer. The dried ore is elevated into a storage hopper, which supplies, automatically, an old style Griffen pulverizer, which supplies the roaster with pulp of fairly good quality. This pulverizer discharges its pulp on a screw conveyor, which discharges into an elevator, the elevator discharging on to a screen revolving in the hopper, which supplies the ore roaster or oxidizing furnace.

The roasted or oxidized ore is discharged from the furnace on a cooling floor, from which it is elevated into the hopper that supplies the amalgamator.

This amalgamator discharges the pulp containing the amalgum into the first amalgam collecting pan, which flows into the second pan, the second pan into the third, and the third pan into the settler, which is constantly discharging the finish or end of the treatment. From the foregoing statement, it will be seen that the ore under treatment goes through six different operations, namely: crushing, drying, pulverizing, roasting, amalgamating and panning and settling.

It might be well to state here that the ore being treated is of a most refractory class, and that heretofore all systems to extract its values profitably, have failed until this mill was built and put in operation.

These ores are commonly known as "mispickel" arsenical pyrites. They carry gold, and hence may be called auriferous mispickel; auriferous arsenical pyrites. They consist of the sulphides of arsenic and iron, with quartz and some magnesian limestone as gangue. To successfully treat these ores, it is not only necessary to recover a good percentage of the gold, but also *condense* the arsenious gasses set free in the roasting furnace. Condensing these gases is successfully accomplished, but I was not permitted to examine how this was done.

The Roaster or Oxidizing Furnace.—I carefully examined the same and its operations, and must say that the ore was discharged perfectly roasted. I could not detect any sulphor or arsenic present. The gold was liberated, and shoved well into the pan. The furnace works automatically aud continuously, feeding itself, stirring conveying and discharging the ore. Upon inquiring, I was informed the furnace run right along and was no trouble to manage. The consumption of fuel for 24 hours is ¾ of a cord of hardwood, or 1½ cords of dried slabs.

The Amalgamator—This machine also works automatically and continuously, as also the pans and settler connected with it. The roasted ore containing the gold is fed into this machine for the supply hopper above it.

Attached to the side of the hopper of the amalgamator is a small hopper holding quicksilver, which is fed into ore as it passes into the machine, and so managed as to feed a certain number of pounds of quicksilver to a ton of ore.

In the lower part of the machine there is an ordinary fire-place, where sufficient quantity of heat is generated to *insure* the vaporization of the quicksilver. To prevent the escape of the quicksilver fumes, the cold air above is utilized, and a water jacket condenser serves the same purpose at the discharge end. The machine is very simple, and seems to work perfectly, the gold liberated being amalgamated. In my judgment, the percentage of gold saved is governed by the *fineness* of the pulp. As shown at this mill, it is a very cheap and simple system for recovering gold.

After adjusting the amalgamator, and the water supply for pans and settlers, they run themselves and are no further trouble. I am imformed that the percentage of gold saved averages 90 per cent. of the value contained in these ores, and that the loss of quicksilver comes within an ounce per ton of ore treated. The arsenic saved and condensed as the oxide of arsenic is valuable.

COST OF OPERATING MILL.

4 men at $1.25 per day	$5 00
1 man at $2.00 per day	2 00
Rental and power per day	2 00
Fuel, 1½ cords of slabs	2 00
Oil and lights	1 00
Superintendent	3 00
	$15 00

Present capacity of mill about five tons in 24 hours.

So soon as additional condensers are set up, the capacity of the mill will be about ten tons in 24 hours.

Conclusions—After careful investigation, I state that this "process" is a success. Owing to its simplicity, ordinary people can successfully operate it after a month or two of instruction by a competent person.

Its adaptability, and the field of its usefulness in treating base gold ores will, in my opinion, be great.

In my judgment it will easily and economically treat all classes of auriferous sulphides or gold, in association with the sulphurets of iron and copper.

As to gold very finely divided, such as "float," "flake" and "flour" gold, the system of *dry* amalgamation, as carried out by the amalgamator above described, seems to me, will easily save it. The cost of reduction is greatly lessened, because the whole operation is automatic.

From the foregoing, I can say I do not know of any process or system of extracting gold from its ores that can compete with the method, and therefore most heartily and sincerely recommend it.

(Signed) HARVEY BECKWITH, M.E.

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Having recently visited and carefully examined and tested the results produced by the Walker-Carter gold mill located at Marmora, Hastings County, Ontario, Canada, in treating the very base, and refractory gold ores of that section, namely, arsenical pyrites.

I endorse unreservedly the report herewith attached of Mr. Harvey Beckwith, M.E., made by him recently on this mill and process, as being conservative and fully within the results produced, as I believe, for the past five months.

While the perfect oxidization of these ores, and the subsequent amalgamation of their gold contents to a high per cent., is unprecedented so far as my knowledge goes, the condensation of the poisonous arsenical gases from the roasting and the utilization of them as the commercial oxide of arsenic is something never before accomplished in a continuous operation.

Another point strongly attracted my attention, and that was that the men running this mill had never had any previous experience, but had been taught by one of the inventors in a couple of months.

(Signed) W. B. MURDOCH,
Murdoch Tunnels, Hidalgo, Mexico.

MINING NOTES.

[FROM OUR OWN CORRESPONDENTS.]

Nova Scotia.

Caribou.

The mines and property of the Truro Gold Mining Co. were sold at sheriff's sale, on the premises at Caribou, on the 16th of the month to George W. Stuart, acting for the company. It is said that the property will be re-opened next summer, and the shaft sunk to the pay chute.

Isaacs Harbor.

The protracted litigation over the Hurricane Island mine continues to keep this district dull. The work at the North Star mine continues, but the results are not as large as during the summer.

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The Richardson mine continues to keep up its record, and is now regarded as one of the standbyes of the province. In places the vein has had a width of 20 feet, and maintains an average width of 10 to 12 feet. During the year ten additional stamps were added to the mill, and further additions to the mill plant are contemplated in the spring.

Montagu.

On the morning of the 28th of December the worst disaster in the history of gold mining in Nova Scotia occurred in the mines of the Symon-Kaye Syndicate of this district. A pair of men were at work in a stope rising from the back of the 100 ft. level east at a point about 80 ft. east of the shaft; at eight o'clock they fired their hole, warning the men at work driving in the levels. The shot blew a hole in the wall intervening between the new workinge and the old, letting in all the water above that point, flooding the mine and drowning the two men driving the level west, one of the men driving east and the man mucking quartz. Four other men at work in the same shaft escaped.

The coroner's jury returned a verdict of accidental drowning, but recommended that the legislature furnish the inspector of mines with sufficient means to procure plans of all underground workings.

[We comment on this accident elsewhere.—ED.)

South Uniacke.

The Thompson-Quirk mine has reached a depth of about 260 feet, and the vein is reported as rich as ever, but to have separated into two or three parts.

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A local syndicate or company has been organized in Halifax to take over the mining areas lying immediately east of the Thompson-Quirk property. The syndicate will sink a shaft near the dividing line to cut the Thompson roll, the distance to be sunk being estimated at about 350 feet. Mr. A. A. Hayward, one of the vendors, is in charge of the work, which has already been commenced.

Renfrew.

The advertised sale of the C. H. North properties did not come off on the 27th December. Instead, an arrangement has been made by a syndicate (composed of Evan Thompson, Charles Thompson and D. A. Macdonald) to pay off the indebtedness, aggregating about $5,000, and take over the mine and appurtenances, Mr. North to have nine months in which to redeem the property. Further conditions and stipulations are in the agreement, and if carried out this district will once again come to the front as a producer.

Waverley.

For the first time in twenty-five years the product of this district has reached the 2,000 oz. mark. Since 1868 there has been no year when the product was in excess of 2,000 ozs., and since 1877 the annual production has been less than 500 ozs. The total for 1893 has been entirely the product of the West Waverley Gold Co., Ltd., and amounts to 2,108 ozs.

Quebec.

Templeton.

It is reported from a reliable source that the Amsterdam mine (De Nederlandsche Phosphaat Maatschappij) will entirely abandon their phosphate mines in this district which are equipped with a large machinery plant, boarding and dwelling houses.

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The Wallingfordt property is turning out large quantities of good sized crystals daily. The veins, eight feet wide, continue in regular width to the depth and in the horizontal. Eight men are steadily employed in the mine; five men are trimming mica for a Boston electrical concern. This mine is considered by experts to be the richest mica mine in the township of Templeton up to date.

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Mr. A. Pullan, from Montreal, is working the Perkins property, lot 18 in the 8th range. The mica deposits so far discovered are reported to be very promising. Five men are employed.

Mr. Hotchkiss is working with nine men on the south half of lot 14. Considerable quantities of mica have been taken out of different veins, but no particulars are to hand.

Negotiations are pending with English people re sale of the Ferguson lot 4 in the 9th range. This property shows four large deposits of mica, which were worked with success in the summer of 1892.

Eastern Townships.

We learn that work has been resumed at the Albert copper mines, Capleton.

Ontario.

Lake Nipissing.

The white mica mine of Mr. John Mackay, Lot No. 9, 1st Concession, Township of Calvin, is meeting with great success in the depth. The original vein of a coarse granite had on the surface a width of about 5 ft.; this vein has been followed by a shaft to 20 ft. depth, and it was found that it widens out gradually to a width of 14 ft., the horizontal extensions being of regular character. The crystals are of a greenish color, containing occasionally dark spots, probably tourmaline, but it has been observed that towards the depth these spots seem to disappear. Further development work will show whether this will be verified. The daily average output amounts to 150 lbs. of perfect crystals. This mica is now being trimmed, and averages 20 to 25% of 2 x 2 up to 3 x 5 and over.

Sudbury District.

We are pleased to learn that the Drury Nickel Company commenced operations again on the 2nd inst. under the direction of Mr. R. P. Travers, liquidator, with a force of thirty men, after being closed down for several months. The men are to be paid all arrears of wages on the 20th. This is a bit of good news.

The plans have been prepared and work will soon commence on a new vertical shaft in the Copper Cliff mine, as the present inclined shaft runs away from the principal ore beds.

Fifty men were laid off through the Evans Nickel mine shutting down at 11 p.m., 23rd Dec., on account of cold weather, and to enable Capt. Davis to have the main shaft cleaned out for the purpose of putting in the diamond drill to test for ore below the fifth level.

British Columbia

Slocan District.

The Nelson and Fort Shepherd Railway began running a regular train service about the 20th December. Both the Revelstoke and Bonner's Ferry routes had been closed by ice some weeks before and the Northport and Robson route was also blocked some few days before the N. & F. S. opened.

There is now uninterrupted connection with the outside world, and ore is being shipped regularly.

From December 21st to January 10th 1,511,172 lbs. of ore were shipped from Kaslo to the smelters in the States.

The sleigh road from the mines to Kaslo has been in fine condition and about 45 to 50 tons of ore are arriving daily at the wharves in Kaslo for trans-shipment to the States.

The Freddie Lee, Mountain Chief, Noble Five, Idaho, Washington, Rico, Blue Bird, Dardanelles, Antelope, Slocan Star, Northern Belle and several others are all winning ore.

The Surprise claim was sold to a Mr. Ferguson of Chicago, for $60,000; one-half cash.

Notice has been given that application will be made to the Legislative Assembly so as to permit of the Kaslo-Slocan Railway being constructed with a narrow guagc.

Notice has also been given that an application will be made to incorporate another company to build a Kaslo-Slocan railway. This is virtually the C.P.R., and it will be a fight as to who will control the Kaslo route, the Great Northern or the C.P.R.

The clearing of the right-of-way for the Kaslo-Slocan Railway is in great part finished and the company's agent at Kaslo has publicly and emphatically stated that the line will be in running order by August 1st.

Everything outside of the mines is quiet; everybody is waiting for the spring. The ore shipments are making a good impression on outsiders and money is already looser.

Nelson District.

Mr. J. J. Jordan, M.E., the new manager of the Hall Mines (Ltd.), has arrived at the mines. He has been employed in a gold mine near Cape Coast Castle, in the gold coast, W. Africa, also in mining in Mexico and Spain.

Matters appear to be jogging along very well up at the Silver King. There are at present some twenty-five or thirty miners at work, in addition to the surface gang. All of the underground work has so far been done by contract, and judging by the reports, those who have taken the work up have done very well. The contracts, which are nearly all along the line of development work, are let by the foot, and can be terminated any time the management considers a sufficient amount has been done in that particular direction. The work up to date has given the most satisfactory results. The main lead has been uncovered at various points for 2,000 feet, and so far the greatest part of the work has been done in ore. Nothing in the nature of a well defined wall has as yet been located, though it is expected that these will come as depth is gained. The work has opened the mine in excellent shape, and several hundred miners could be put to work at any time in the future that the company may think best. Drifting has been done each way from the winze that connects the upper and lower levels. These drifts are forty-five feet long and are in solid ore. Two new contracts have been let to carry on this drifting to some further extent. There is a tunnel in about sixty feet near the line between the Silver King and the Kootenay Bonanza, which shows good ore, as does the fifty-foot shaft sunk on the Bonanza. About thirty feet lower down than the mouth of the lower level, a shaft has been sunk from which ore is being taken out. Of the old levels, the upper one is in 240 feet, and the lower one must be in nearly 700 feet. There is an incline connecting the upper level with the surface, and a winze connecting the two levels. The greatest depth is gained in about 300 feet below the surface. A portion of the work will consist of stoping out the ore between the two main levels. The surface gang is busy cribbing up an ore dump, in which this output will be put until sorted for shipment. At present the ore is being sorted quite closely as it is broken down and will require but little more handling before being sacked. From present indications the desire is to get the mine in shape for the working of a heavy force of men when the tramway is constructed.

The trustees of the Nelson Hydraulic Company have unlimited faith in the gold producing nature of their property. They have determined that the spring will find them in a position to commence working, although all the preferred stock offered for sale has not been disposed of. With this end in view they have purchased some 80,000 feet of lumber for the flume, sluice boxes and building. The lying timber on either side of the flume is being cleared for a total width of seventy feet, to prevent accidents by fire or falling timber.

Trail Creek District.

Early in the season private parties started and the Government completed a wagon road from the town of Trail to the mines, seven miles in length. It was built on business principles, and though costing but $3,000 is a good road. The first heavy freight hauled over it was a boiler, engine and Burleigh drill for the War Eagle mine. Ten thousand dollars were spent, or misspent, on that property, and the result was two long tunnels without ore, and the company dropped the bond. During the fall the same company, or part of it, again took hold of the property, and under proper management a continuous ore body, 8 feet wide, carrying $40 in gold to the ton has been found and followed. A small force is working and will work all winter.

In the early part of the year the shaft on the Le Roi was extended to a depth of 200 feet. During the summer levels were run from the bottom of this shaft 70 feet each way on the vein, exposing a large ore body of better quality than at the surface. Water coming in too freely to handle with windlass, the mine was allowed to fill up. During the fall the company commenced shipping the dump and some surface ore, and the results were so good that hoisting and pumping machinery were put in and winter supplies laid in for thirty men and three teams. It is the intention to both sink and drift and to ship ore extensively all winter. Up to date the shipments aggregate 250 tons.

A bond was taken on the Josie by some Spokane parties early in the summer, and about $4,000 was spent in exploiting the property. They had varying success, but at the end had a nice vein of very good ore. Owing to the financial stringency the work was stopped. Sixty tons of the ore were shipped early in December, and on the returns depends its future as a shipping mine.

On the Nickle Plate 50 feet has been sunk under the difficulties of lack of money and abundance of water. The vein is a small one (about 18 inches wide), but carries the richest pyritic ore in the camp, averaging $115 in gold per ton. One carload of the ore was shipped early in December, but the returns have not yet been received. The owners propose to work a small force all winter.

Two men worked steadily all summer on the O K, and the result is a tunnel about 150 feet long and an uprise of about 70 feet. The vein is a continuous one and the ore all good, with some spots of marvellous richness. This vein has been developed, and the owners supported by a hand mortar, about $4,000 being " milled " in the mortar during one week in September. On the dump there are about 250 tons of ore, which if the weather allows, will be shipped this winter to the Tacoma smelter. There are many new and odd combinations of ore in this mine, namely, free gold with copper pyrites, free gold in massive galena, free gold in zinc blende, and occasionaly a combination of them all with a dot or thread of native silver. What this vein may carry at a great depth is beyond the knowledge of the experts, but all are unanimous in the belief that it would be a good thing to have in the family.

Fort Steel Division.

The season of 1893 has shown a marked improvement in the number of prospectors and the number of recorded locations. The claims compare 42 in 1892 against 175 in 1893. Free miners' certificates, 78 in 1892, against 284 in 1893. The shut down of many of the mines across the border deprives many of the prospectors who come in here of making a grub-stake this winter; but in the near future we hope to have mines of our own, where men can get grub-stakes to prospect in the country they work in.

The season's placer mining has been much the same as of late years. The Chinese on Wild Horse Creek have seemingly made the same amount of money, and the usual contingent left for China. The claims owned by Mr. Griffith were bought from him this summer by an English company. This syndicate put in good machinery and ran the claim all the summer under the management of a competent hydraulic miner, Mr. Beaston of California. The company had a lot of trouble getting the claim in shape to work, the former owners seemingly having allowed the claim to run itself, and the summer's work was chiefly making sluices, laying pipe and clearing room to pile boulders in the future. The clean-up was fairly good, and fully justified the supposition that the claim, fixed up as it is, with a good go-ahead summer's work, will fully justify the shareholders in their outlay of capital. We should judge that the clean-up of the various companics would amount to $30,000. On the Moyea river there are about ten men working, who seem to make enough out of the ground to buy whiskey with anyway. An application has been made by A. W. McVittie for a lease of ground on Palmer's bar, the idea being to bring on water from the Moyea and to run the fine gravel on the bar through an hydraulic elevator. This scheme should be a good one, as the outlay on the ditch would only be about $5000, and there are at least 100 acres of gravel on which the Chinese make from 25 cents to $1.50 a day.

Vancouver Island.

The shipments of coal for last year, notwithstanding dullness of trade in American markets, show a substantial increase over former years. The figures are: New Vancouver Coal Co., 1893, 388,649 tons, against 375,834 tons in 1892, or an increase of 12,815 tons; Union Colliery Co., 1893, 126,438 tons, against 93,826 tons in 1892; Wellington Collieries, 1893, 312,573 tons, against 276,118, an increase of 36,455 tons. The East Wellington Colliery for a portion of the year was closed, but its shipments were between 15,000 and 16,000 tons.

Miscellaneous.

The shipments of gold dust from this province, as reported by Wells, Fargo & Co., show a decrease compared with 1892 of $26,349.92, the figures being as follows: 1893, $302,340.57; 1892, $328,690.49.

The Consolation placer mine on the Big Bend averaged last season about $12 per day to the man, and the output is reported to have been over $20,000.

Watertight Shaft Walling with Stone Cribs.—At the Government colliery at Osterwald, in Hanover, sandstone rings made in 10 segments have been used for a deep sinking instead of cast-iron cribs. The joints are wedged with wood. These stone cribs are considerably cheaper than cast iron ones.

Tensile Tests of Winding Ropes. — A. Kàs, *Oesterreichische Zeitschrift fur Berg-und Huttenwesen*, has experimented at considerable length with different kinds of winding ropes, the ropes being either (1) new, (2) old but unfrayed, or (3) frayed, this last class being again subdivided according to the position of the broken strands. The experiments showed that the tensile strength of the rope was not, as is frequently supposed, diminished by the twisting together of the different strands, but that the opposite was the case, the tensile strength bei g slightly increased.

CANADIAN COMPANIES.

Boston Bar Gold Mining Company has been formed, with headquarters at Vancouver, B.C., to obtain by purchase or otherwise, and to hold at or near Boston Bar on the Fraser River, British Columbia, mines or minerals, and to carry on the business of miners of every description. Authorized capital, $50,000, in shares of $10 each. The directors are: Daniel R. Young, Vancouver; A. F. Griffiths, Vancouver, and Wm. R. Robertson, Vancouver.

British Columbia Mining and Manufacturing Co. has been formed with a capital of $100,000, to purchase from Hubert Kossuth Lee all rights, patents and privileges now owned or held by him in connection with certain mining machinery, and to manufacture and sell the same and to carry on the business of manufacturers of and dealers in all kinds of mining machinery; also to acquire mines and to carry on the business of miners. Head office: Vancouver. Directors: Wm. Ritchie Robertson, A. F. Griffiths and D. R. Young, Vancouver; H. K. Lee and Donald McPhee, Montreal.

Northern Belle Mining Company has been registered at Victoria, B. C., with an authorized capital of $250,000, in shares of $10 each, to carry on the business of mining and milling. Canadian office, Kaslo, B.C.

Victoria Chemical Co., Ltd., has been registered at Victoria with an authorized capital of $100,000, in shares of $50, and headquarters at Victoria, B.C., to acquire and take over as a going concern the business of chemical manufacturers, now carried on by John W. Fisher, J. A. Hall and Frederick Moore, under firm or style of Victoria Chemical Company, and to carry on the business of manufacturers of muriatic, sulphuric, nitric and mixed acids, explosives, chemical manures, sulphate of copper, sulphate of iron, nitrate of lead, soda crystals, bi-carbonate of soda, alum, and all kinds of chemicals, the chemical treatment of copper and other metallic ores, and the distillation and treatment of coal tar.

Pacific Brick Company (Ltd.)—Capital, $20,000, in shares of $20. Canadian office: Vancouver, B.C. Directors: Charles A. Beals, James Stokes, George Hartley, Vancouver. Formed to carry on the business of manufacturers of brick, tile, terra cotta, sewer and drain pipe and pottery, etc.

The Victor Gold Mining Co. of Gold River is applying for charter of incorporation to acquire certain gold mining property at Gold River, near Chester, Province of Nova Scotia. Directors: J. T. Burgess, A. G. Cunningham, Walter G. Brookfield, Geo. S. Campbell and A. N. Whitman.

The Kootenay Hydraulic Mining Company was the first to acquire placer ground in the Pend d'Orielle section of the Nelson mining division of West Kootenay. The first claims (three in number) extend from the Columbia river up the Pend d'Orielle river for a distance of a mile and a half. Afterwards other claims were leased, and now the company controls all the ground on the north side of the river as far up as the mouth of Fifteen-mile creek, or a total distance of nearly fifteen miles, following the sinuosities of the river. The company first put in a saw-mill to cut the lumber required for flumes, then built a wagon road over which to haul the lumber. A shaft was sunk on one of the claims to a depth of 100 feet without striking bed rock. Several tunnels and drifts, as well as prospect shafts, were also run or sunk, in all of which, without exception, gold was found. The wagon road runs from Waneta, on the Columbia, to Twelve-mile creek. From Twelve-mile creek to Fifteen-mile creek the road is but six feet wide.

A flume was built from Sixteen-mile creek to the bar at the mouth of Fifteen-mile creek, where the company made the first attempt at hydraulicing. By the time the pipes and pressure-box were gotten in place the season was so far advanced that the water supply was so low that the sluicing could not be carried on to advantage. Everything, however, is in shape for the high water which is sure to come in March. The returns were so good that the company erected a commodious building for a permanent camp at that point.

Work is now progressing at Seven-mile creek, where two pressure-boxes will be put in, so that Brown's bar can be worked at two different points. By the time the snow disappears there will be ample water, as it is brought from both Seven-mile and Nine-mile creeks. A large house has also been erected at Seven-mile creek for a permanent camp, and the headquarters of the company will be there from this time on. Other necessary buildings, like blacksmith shops, ice houses, and stables, have also been erected there. During the fall, when the water was very low, a little sluicing was done at Seven-mile, and the returns indicate that the gravel is rich.

The Kootenay Hydraulic Mining Company has already expended nearly $80,000 in developing its ground, and during the coming spring a large force will be employed in bringing water from the main Salmon river. This will require the building of a ditch from Sixteen-mile creek to Salmon river, a distance of between three and four miles. When the work is completed the water supply will be ample for sluicing every month in the year, while now the creeks supply only enough to work about four months.

Gold and Silver Mining in British Columbia in 1893.

The past two years have witnessed a renewal of interest in the alluvial deposits of the Province, and especially those situated in Old Cariboo. Here hydraulic mining on an extensive scale with modern appliances has been introduced. On the Quesnelle Forks, in the horse-fly country, and on the creeks surrounding Barkerville much capital has been invested in the opening up of new claims. During this winter hundreds of tons of hydraulic pipe are being hauled to carry the water to the "giants" that will tear down the banks and wash the gold. At Slough creek large engines and pumps have been placed for the purpose of sinking the shaft to bedrock, now the surface water drain has been completed. It is beyond speculation that in all these sections good results will be obtained, for previous prospecting has developed the presence of good pay. Cariboo is undoubtedly the most attractive field for hydraulic mining on the continent, and those who know the district well believe that in a few years the output will be climbing up to the total of its best former record. There is plenty of ground remaining for development, and veteran Cariboo ites believe that energetic prospecting would discover virgin fields perhaps as rich as those which were worked in the old days. With the completion of a railway into the district the chances are that prospecting of the country north and east of the famous Barkerville district would be renewed, and many important discoveries made.

In the Cassiar, Omineca and Yukon districts there are many streams that would pay good wages with cheap and rapid transportation near at hand and cheaper supplies to be had. Several of the old bars and benches of the Fraser, east and north of Yale town, are being opened by hydraulic and other methods. Placer mining is still being carried on in the Granite Creek, Kettle River, Big Bend and Bridge River districts. On Vancouver Island, on the west coast, several creeks pay small wages. Another attempt is being made to work the black sand deposits on the beaches of the northeast coast of Vancouver Island.

Outside of Kootenay district, little is being done to develop the gold quartz ledges except the work on the recently discovered ledge in the Alberni district at the head of China creek. It will shortly be known whether this field will prove a profitable one. The great cost of supplies and labor in the Cariboo district has hitherto prevented capital being expended there, as the ledges so far prospected do not carry gold in rich quantity.

The year just entered on gives promise of being a memorable one in the mining of gold and silver in British Columbia, for profitable results will give confidence to capital, and investments in the various branches of the industry will be made on a scale hitherto unknown but long sought. During the year past the resources of British Columbia have received a valuable addition by the developments which have taken place in the mining regions of the Kootenays. As might have been expected, the greatest amount of work has been done in the Slocan lead-silver region. The promise, of better transportation facilities early in the spring served as a stimulus to production and development, and as a result the tally sheet for the year shows some very encouraging figures. From about twenty producing properties in the Slocan the customs returns for the year show that ore to the attested value of nearly $125,000 was sent out to the various markets of the United States. In connection with this output must be considered the fact that some $50,000 worth of ore has been mined in addition to that shipped. This was taken out during the summer and fall and left on the dumps until the opening of sleigh roads afforded easier and cheaper means of transportation. At Kalso from 600 to 700 tons of ore were piled on the wharves awaiting the opening of the Nelson and Fort Sheppard railroad.

As an example of the wonderful richness and extent of some of the leads in the Slocan country may be cited the Slocan Star. On this property recent discoveries have resulted in placing in sight, according to the estimate of an expert, some 12,000 tons of ore which should net the owners over $100 per ton. A number of other properties have showings of ore ranging up into the hundreds of thousands, and most of the smaller are looking well and showing up more or less ore. Several companies interested in transportation have had estimates made by experts with a view to ascertaining the probable daily output of this section under favorable circumstances. The lowest figures which have resulted from these inspections are 350 tons daily for a period of 18 months to come. When it is remembered that the sworn values on the Slocan output, made for customs purposes, run to an average of over $150 per ton in lead and silver, some idea may be formed of the great wealth contained in this section.

At Ainsworth a considerable amount of development work has been done and several good shipments have been made, chiefly from the "No. 1." Among the recent discoveries at this point may be noted a strike of 8½ feet of clean galena on the Little Phil and Black Diamond.

The Toad Mountain District maintains nearly the same position held at the first of the year. The Hall Mines Company has taken the Silver King properties in hand, and a force of men are now engaged in development work which will enable the company to put on a big force of men in the spring. A tram line will bring the ore from this property down to Nelson for shipment. There are a number of good claims on the mountain, which may be expected to go ahead under the stimulus of a big producer in the vicinity.

On the Salmon river and its tributaries, and along the Pend d'Oreille river, a considerable amount of placer and hydraulic ground has been taken up by various companies during the year. Enough work has been done on these to demonstrate beyond a doubt that placer gold in paying quantities can be found all through that portion of the Kootenay country.

In the Trail Creek section the character of the ore changes to a considerable degree, and a sufficient amount of gold is found, in connection with other metals, to defray the working expenses. The Le Roi and other claims in this district sent out about forty tons of ore per week for some time during the fall.

In the Duucan river country the results have not been so satisfactory. Owing to its remoteness from transportation facilities, and the difficulties in the way of prospecting and development, but little was done in this section during the year. There is no doubt but that the district is extensively mineralized, and future results may prove more satisfactory.

The Lardeau and Trout Lake section of the Kootenay has made good progress during the year. The majority of the claims in this part of the country have yielded very encouraging returns for the amount of development work done. In several instances sufficient capital has been secured to open the leads in proper shape. The Black Prince and Silver Cup, two of the best claims, are in good hands, and a force of men will continue to work them all winter. A number of miners turned their attention to placer diggings in the Trout Lake country, when the slump in silver came, and enough work was done along this line to make the fact plain that placer gold exists there, but whether in paying quantities or not remains to be demonstrated.

In East Kootenay very material progress has been made all along the line. Old claims have been developed with good results, and a number of new and favorable looking locations have been made. The ores of this section while not of such high grade as those further south and west, appear in strong, well defined leads, which give every indication of permanency.

Generally speaking, the year 1893 has demonstrated that this portion of British Columbia contains vast areas of valuable mineral deposits which will from now on add a steady and ever-increasing stream of wealth to the output of the Province.

A Primitive Smelting Furnace.—Robert Peele, jr., (*School of Mines Quarterly*) describes a primitive smelting furnace in use by the Indians of Central Bolivia, for smelting silver ore. It is called in the native Quichua language "Huairachina," meaning literally a place where the wind is utilized. It is built of fire-clay, is usually from 30 to 34 inches high, and has an irregular oval cross-section, the inside dimensions being 4 or 5 inches by 8 inches. The inside height, from the bottom of the hearth to the edge of the open top is generally not more than 26 inches. Near the bottom of the furnace there are two main fire openings with wide lips, placed opposite each other on the longer sides of the oval, each six inches wide by three inches high. On one of the shorter sides, and a little below the level of the large holes, there is a smaller opening 2½ inches dia. which serves as a tap. Ranged above the fire doors are three rows of 2 by 2½ inch air holes on each side of the furnace, and below each of these is moulded a small lip of clay. The first row from the bottom comprises four holes, two on each side: in the rows above there are three holes on a side, all being placed symmetrically and exactly opposite one another. It is usual to set the furnace on a rock or built up base, 15 to 18 inches above the ground, and in such a position that the air holes on the two sides are in the direction of the prevailing wind. No artificial blast is employed; the average Indian has time enough to wait a favorable wind. The fuel used is a good quality of charcoal charged in alternate layers with the ore in the proportion of about 1 to 1. The materials treated are galenas, as well as zinc-blende and pyritic combinations and those containing the high grade sulphides, such as ruby silver, gray copper, silver sulphide, etc. Argentiferous galena is smelted without flux, and is itself used as flux for the other base combinations or dry ores, by mixing with the latter. The proportions vary greatly, without much regard to regularity of working, though the galena generally forms about 50 per cent. of the ore charge. The main point with the Indian is that his flux shall run well in silver so that when he has sufficient galena at hand he loses nothing by a generous admixture. High grade galenas are much prized, and are often transported long distances to mix with the more intractable sulphurets. In the absence of galena "asendrada" is used for fluxing; this is an impure litharge obtained from the native cupelling furnaces and also carries some silver. In preparing the ore for the furnace it is broken pea size and well mixed with the flux. This would, says Mr. Peele, appear to be a very crude method of smelting but upon the whole, the results obtained are fairly good and attest the skill of the native operator. Samples taken from old slag piles often run as low as 6 to 9 ounces of silver per ton, though assays have been known to be as large as 30 ounces. It must be remembered that the capacity of the furnace is extremely small, say from 50 to 150 pounds of ore in twelve hours, depending upon the force of the wind and the tractability of the ore, and that, therefore, only rich, carefully selected material is worked.

In 1545 the Cerro Rico de Potosi (Rich Mountain of Potosi) was discovered, about 30 miles from Porco, and the Huairachina was immediately introduced, forming for years the chief means of extracting the silver from the ores of these wonderful mines. It has been estimated that, between 1545 and 1572, not less than $250,000,000 worth of silver was produced at Potosi from these furnaces. But, as the rich surface ores were exhausted, the little wind furnace had to give place to the amalgamation process.

The Indians about Porco, who still adhere to its use, make a scanty living, either by working stolen ores or by sorting over and re-sorting the old waste dumps of the mines which formerly were so productive. With infinite pains and labor they collect small bits of good mineral which have escaped attention, or which, attached to large pieces of barren rock, may have been thrown upon the dumps as worthless.

Progress Made in Coking.—Mr. R. de Soldenhoff, *(South Wales Institute of Engineers)*: The writer reviews the state of manufacture in the past and refers to the progress realized under two heads, one refering to the improved article to be produced, and the other to the economy in manufacture. Referring to the first, what had been done generally was to reduce the coal in size, or in other words to crush it, or to separate the smallest of the coal—that is to say, such as would pass through a screen with holes of ⅜ of an inch in diameter and downwards—from the larger coal, and to use only the finest for the manufacture of coke. The question which was not perhaps absolutely settled was whether it was necessary to disintegrate the coal to the state of powder in order to produce good coke. His own view of the matter was that as long as the bituminous coal was in a granular state not exceeding ⅜", it would produce equally good coke as when it was ground to a powder. It was well known that coal in a powdery state, when dry, wasted considerably by being blown away from the trams, and through the charging holes during the charging of the oven, more when charging the coppée ovens. There was no doubt also that the yields in coke were lower with very finely crushed coal than otherwise. In most cases in the present practice the small coal had to be washed with a view to obtaining a good coke. The principal object of washing the coal was to separate the impurities from it in the shape of shale and pyrites. The washing machinery was very efficient, and it was not an isolated case to see very dirty coals producing good clean coke. It should be stated also that the washing processes, so far, had not been as successful in eliminating the sulphur as they were in eliminating the dirt. In sulphury coals—that was to say, coals containing from 1·5 to 2 per cent. and above of sulphur—only a small portion was eliminated, say from ¼ to ½ per cent., in the process of washing, which at first sight appeared strange, because the specific gravity of the pyrites was at least four times that of coal. The real difficulty experienced in eliminating the pyrites was in consequence of friability and mode of cleavage. The pyrites divided into small flattened little specks, which, owing to the law of copolarity, float on the surface of water, and therefore were carried with the washed coal. The writer then enters at length into the second point of improvements realized, namely, economy, which could be obtained in four ways:—1st, To reach a higher daily, weekly or yearly make; 2nd. To attain the highest possible yield; 3rd. To reduce the cost of making the article; 4th. To utilize the bye-product, or in other words, to utilize the surplus gases, etc., escaping through the chimney. As to the yields of the various ovens he quoted statistics showing the result of the yearly working of coppée ovens in comparison with Welsh ovens. The average quantity of coke made in 72 coppée ovens for a year showed 1,039 tons weekly. In 172 Welsh ovens, the average quantity made was 1,080 tons weekly, or nearly 6 tons 6 cwt. per oven per week for the Welsh ovens, and 14 tons 9 cwt. per oven per week for the coppée ovens. With coppée ovens at Ebbw Vale some ten years latea the comparative results were as follows:—

	Make per week, per oven, Tons. Cwt.	Yield. Per cent.
Coppée ovens..........	11·15	63·53
Welsh oven............	6·3	58 99

Looking at these results it was found that the weekly make of the coppée ovens was nearly double that of the Welsh ovens, whilst there was a difference in yield in favor of the coppée ovens of from four to five per cent. Comparing the mode of working the Welsh, beehive, and coppée ovens, it was evident that the coppée oven was the cheapest to work, and it would be sufficient to say, by way of comparison, that the cost of labour in connection with coke-making in the coppée oven in many places was on an average from 5½d. to 8d. per ton of coke. The beehive oven was the most expensive on account of the mode of taking the coke out of the oven by hand. As to the fourth point—the utilization of waste gases, viz., *(a)* the generating of steam by applying waste gases to the boilers; *(b)* the collecting and extracting of the bye-products—we hope to refer more fully in a future issue.

Test Chamber for Showing and Measuring the Indications Given by Gas Testing Apparatus—Prof. Clowes *(South Wales Institute of Engineers)* describes an improved form of test chamber. It is a wooden box about 20 inches on the edge and made gas-tight by running melted parrafine wax over the surface and joints. The front has a plate glass window, let in at a convenient height for observing a safety lamp or other form of testing apparatus. At the top and bottom are large square openings, closed by zinc trays in a water-seal; these serve for introducing the testing-apparatus, and for renewing the fresh air within the chamber. A light flat board hangs from a bar pivoted in the right hand top corner of the chamber; this board, when swung by means of a handle on the outside, produces a rapid and thorough admixture of air and gas when gas has been introduced into the chamber. There is a small opening above for introduction of gas into the chamber, and a similar opening below for the escape of the air displaced by the gas.

When a mixture of air with a known percentage of gas is to be prepared in the test-chamber, the requisite volume of gas is forced into the chamber from a gas-holder. The required quantity of gas is secured by pouring from a measuring vessel a volume of water, equal to that of the gas required, into the top of the gas-holder. This water displaces the requisite volume of gas from the holder, the light gas passing by a flexible tube into the upper part of the chamber. The heavier air escapes from the bottom of the chamber by a small outlet trapped with water. The air and gas in the interior of the chamber are then thoroughly mixed by swinging the mixing-flap for a few seconds. The lamp to be examined is introduced by opening for a few seconds the large aperture at the bottom of the chamber, and the flame-cap can then be carefully examined and measured by observing it through the window. It has been found that a considerable number of observations on different lamps may be made without material alteration of the atmosphere occurring.

The chamber is of exactly 100 litres capacity, and the measurement of the gas for the percentages is therefore simple.

The chamber is mounted on legs, which raise it when it is standing on an ordinary bench or table to a convenient height for observations. It is colored dead black inside to facilitate the observation of pale caps, and is used in a perfectly darkened room, or by covering the head with a black cloth as when using a photographic camera. It renews its atmosphere in the course of two minutes if simply allowed to stand with the large apertures above and below open; this time is much lessened by swinging the mixing-flap while the apertures are open. The mixing-flap has recently been cut away in front, so as to allow the lamp to be introduced before the gas is admitted to the chamber and the mixing is affected; this is found to be unnecessary in practice, as it does not affect the result arrived at; but it is frequently convenient to run through a series of tests with different percentages without removing the lamp from the chamber.

By means of the test-chamber the author has made numerous comparative experiments to test the relative delicacy of different forms of gas-testing safety-lamps. He has also tabulated their indications. Mr. Grundy has similarly examined and tabulated the indications given by Liveing's Electrical Indicator by means of the test-chamber; and other inventors have applied it to the examination of special forms of gas-testing apparatus. The chamber has uniformly proved itself most convenient for these purposes, and has worked with entire satisfaction and perfect ease. It is undoubtedly of advantage to place one at centres where those engaged in gas-testing may not only verify the indications of their gas-testing apparatus, but also accustom themselves above ground to the appearance of different percentages of gas as shown by the testing apparatus. The chamber has hitherto been made of wood, with detached legs for convenience in packing and in travelling. Messrs. W. J. Fraser, 98 Commercial Road East, London, are now preparing a chamber in metal, which will naturally be more costly but also more durable.

Modern Formation of Veins of Pyrites.—Dr. Fleitmann *(Chemikerzeitung VI. 47)* has made the following interesting observations: A covered, brick built cesspool has been lined with a coating of red clay in order to make it water-tight. This plan answered well only for about two years, after which it failed, and the cesspool was abandoned. It was then found that the clay, formerly red, was quite white, and in all directions intersected by veins of compact pyrites of 1 to 4 millimetres thickness. The iron peroxide, through the action of the ammonium sulphide of the sewage, had been transformed into iron sulphide, which, through molecular attraction, had accumulated in these veins.

The Relative Value of Charcoal and Coke in Blast-Furnace Practice.—E. Belani *(Stahl und Eisen.)* points out that in order to estimate the working value of a fuel in the blast-furnace the cubic contents of the zone of combustion must be taken into consideration, as well as the rapidity of the combustion; as the greater the quantity of heat which the unit of fuel produces when burnt in the unit of time, the less will be the loss of heat in the same period, and the greater will be the quantity of heat which will be available for absorption by the charge. Consequently, with different fuels, the least quantity required for a given purpose will fall to that one which, in the unit of time, develops the maximum quantity of heat.

The heat developed by the unit weight of fuel in the unit of time depends (1) on the size of the surface exposed to the action of the blast, and (2) on its relative combustibility. This latter depends on the state in which the carbon is present, and is in inverse, though undetermined, ratio to its specific gravity. Further, the more combustible a fuel is, the more of it will be burnt away in a given time, and the greater will be the surface exposed to the blast during that period; consequently, combustibility and exposed surface are relatively identical.

In discussing the relative advantages of charcoal and coke in blast-furnace work for the production of pig iron, the author remarks that the relatively lower quantity of heat developed by the coke in the unit of time (which consequently necessitates the use of a larger quantity of fuel) is one of the chief causes for the poorer quality of the pig produced when coke has been used, than when charcoal has been employed. If it were possible to obtain the coke in as voluminous a condition as the charcoal, the results obtained would probably be similar.

On the Use of Water Cartridges.—In some experiments made at the collieries of the Bonifacius and Zollverein Associations, in the case of eight shots in which the dynamite was surrounded by water, part of the bore-holes being in rock, and the remainder in coal, fire was observed on each occasion, this being occasionally accompanied by showers of sparks, thus proving that the use of water is not a sovereign specific under all circumstances for the prevention of explosions due to shot firing.

Utilization of the Vapours of Carbonization of Wood.—In the United States, increased attention is being given to the utilization of the vapours arising from the carbonization of wood in connection with the production of charcoal for iron works, and there is a great demand for acetic acid so obtained for the manufacture of white lead.

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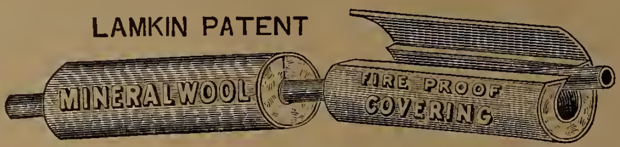

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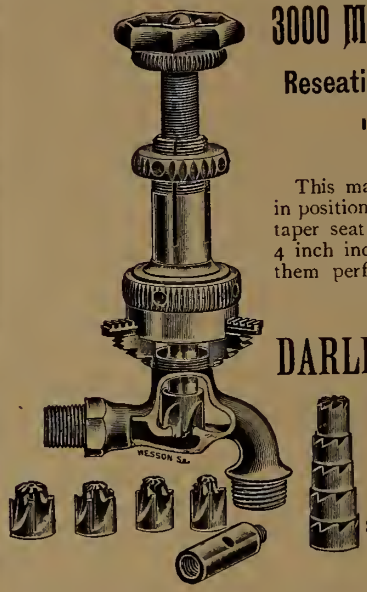

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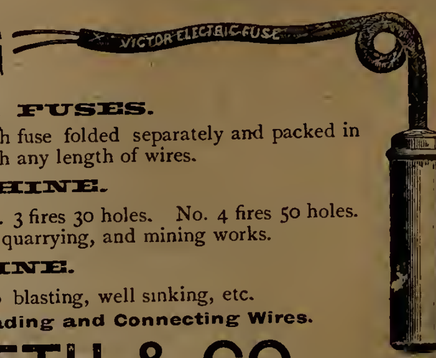

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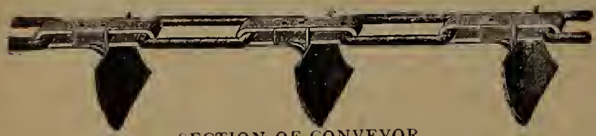

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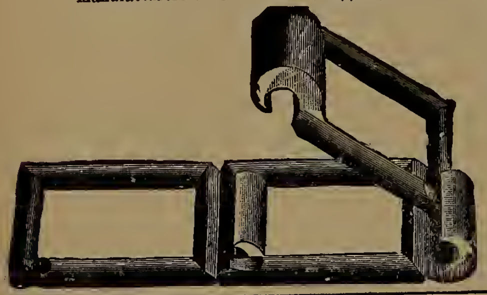

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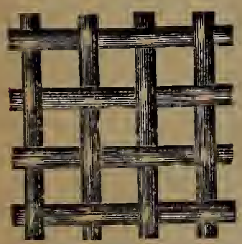

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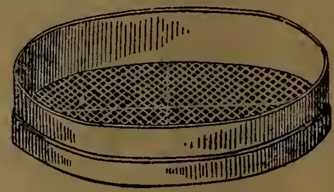

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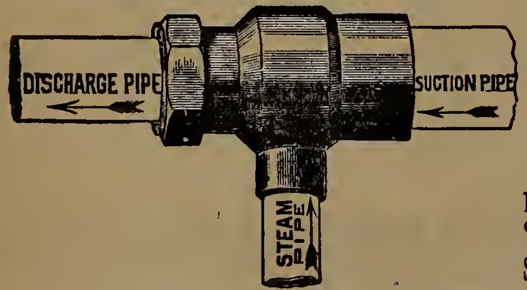

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Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one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

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

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

MINES OTHER THAN GOLD AND SILVER.

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

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

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CANADIAN MINING & MECHANICAL REVIEW

CONDUCTED BY - - - - - - - B. T. A. BELL.

THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC.

THE GENERL MINING SSOCIATION OF QUEBEC.

THE following Resolutions of Council indicate beyond a peradventure the status of THE REVIEW as the exponent of the Canadian Mineral Industries:—

The Gold Miners' Association of Nova Scotia.

"At the annual meeting of the Gold Miners' Association of Nova Scotia, held at Halifax on 6th March, 1889. THE CANADIAN MINING REVIEW was adopted the official organ of this Association.

(Signed), B. C. WILSON, *President.*
G. J. PARTINGTON, *Secretary.*

The Mining Society of Nova Scotia.

"Moved by Mr. R. G. Leckie, seconded by Mr. C. A. Dimock, That the thanks of the Society be tendered to Mr. B. T. A. Bell for his kind offer placing the columns of THE REVIEW at the disposal of the Society; and that THE CANADIAN MINING REVIEW is hereby appointed the official organ of the Society."

(Signed), H. S. POOLE, *President,*
H. M. WYLDE, *Secretary.*

The Asbestos Club, (Quebec.)

"Resolved: That THE CANADIAN MINING REVIEW is, by authority of the Members and Council, hereby appointed the official organ of the Asbestos Club.

(Signed), D. A. BROWN, *President.*
A. M. EVANS, *Secretary.*

The General Mining Association of the Province of Quebec.

At a meeting of Council held at Montreal on Friday, 6th May, 1891, it was moved by Captain Adams, seconded by Mr. R. T. Hopper, and resolved: That THE CANADIAN MINING REVIEW be the official organ of the Association.

(Signed), GEORGE IRVINE, *President.*
B. T. A. BELL, *Secretary.*

OFFICES:

Victoria Chambers, 140 Wellington Street,

OTTAWA.

Vol. XIII. FEBRUARY, 1894. No. 2

The Gold Mining Industry of Nova Scotia for 1893.

The decrease in Nova Scotia's production of gold during the past year was not so great as the earlier months of the year indicated. From the best data obtainable the output for 1893 was 20,260 ozs., against 21,080 ozs. in 1892.

Of this amount of 20,260 ozs. nearly seven-tenths was the product of the four districts of Stormont, Oldham, Caribou and Waverley, each of which produced in excess of 2,000 ozs.

The districts which show a substantial *increase* in yield over 1892 are: Stormont, Waverley, Tangier and Oldham. The chief districts showing a *decreased* yield are: Malaga, Uniacke, Montagu, Fifteen-Mile Stream and Caribou.

The main district of the year has been Stormont, which from a production of 2,482 ounces in 1892 has jumped to a yield of 5,753 ounces in 1893, an increase of 130%. There have been four producing mines in the district, two of which, the Richardson and the Copeland, stand about equal as to production, each showing about 2,000 ounces for the year.

The other two mines, the North Star and the Country Harbor Co., each produced between eight and nine hundred ounces, but the latter mine only had about eight months' run during the year.

The results of the last year's work in this district are very encouraging, and have been very gratifying to shareholders, and there is every reason to expect still better results in 1894.

The ore bodies worked are large, yielding at the rate of \$7 to \$8 per ton, and show no signs of exhaustion.

The second largest producing district for the year is Oldham, with 3,412 ounces against 3,093 in 1892. Of this amount 3,300 ounces is the product of the mines owned by Hardman and Taylor. Oldham has also kept up its record for high yields per ton, August, 1893, recording a yield of over 125 ounces per ton of quartz. The total yield is the highest ever recorded from the district.

The district coming third on the list is Caribou (and Moose River), which, however, records a loss of 500 ounces from the yield for 1892. The production for the year was 2,542 ounces. The cessation of work on the Truro Co's mine will readily account for the decreased yield. The Dixon and Touquoy properties have continued to be steady producers. During the year the old Lake Lode mine was unwatered, and a small amount of bullion produced. For 1894 this district may show an increase, as the Truro Co's property has changed ownership, and the Lake Lode may contain reserves of quartz unknown to present owners, but development is necessary and cannot be done quickly.

The remaining district showing a yield of over 2,000 ounces is Waverley. For the first time since 1868 this district has reached the above figure, the total amount produced being 2,110 ounces, which is entirely the output of the West Waverley Gold Co's mine. The East Waverley Tunnel Co. has not pushed work, and all other mines in the district have lain idle.

The largest decrease is shown by Malaga district, which reports 322 ounces against 2,656 for 1892, a decrease of over 2,300 ounces. During the year work has been practically suspended, and in the closing months some transfers of property were made which may prove beneficial and considerably increase Malaga's yield in 1894.

The next largest decrease is reported from Uniacke district (in which is included South Uniacke), being 1,300 ounces less than for 1892. This loss, as we predicted a year ago, has come principally through the decreased output of the Thompson-Quirk mine. The boundaries of their territory on the pay chute have practically been reached, and any increase of yield from this district must come from new developments. An attempt is now making by a new syndicate to reach the pay chute on ground east of the Thompson-Quirk territory, but should the attempt prove successful it will influence the production of 1895 rather than 1894.

Montagu shows a falling off of 1,100 ounces. The product of the Salisbury and Symon-Kaye Companies has been very small, and the poor ground encountered on the Annand property has precluded any large output by the English company.

Salmon river yields about the same as last year, as does Lake Catcha. Sherbrooke, we note, has been dropped as an independent district from the tables of the Mines Office Reports.

Fifteen-Mile Stream, in spite of consolidation, shows a decrease of nearly 700 ounces.

Tangier's output is increased nearly 400 ounces, entirely the work of the Mooseland Gold Mining Co.

The year as a whole has been unmarked by any salient features other than the rapid development of Stormont district, and the general interest taken in improvement of milling appliances. The gradual and general disappearance of some old fads as to incompatibility of capacity and large saving in the stamp mortar, has accompanied the demand for cheaper milling, and the number of tons crushed for 1893 will not fall far short (if any) of the maximum tonnage for any year since 1862.

Towards the close of the year several new companies have been incorporated to work (chiefly) old districts, and from the success of these companies must come any substantial increase for 1894.

The Phosphate Situation.

The remarkable depression which has so continuously characterized the phosphate industry of the world during the past three years, still shows no real signs of relief, and we are not yet justified in looking forward with much hopefulness to the immediate future.

Without indulging in the useless iteration necessary to an elaborate discussion of the various causes which have contributed to bring about the prevailing state of affairs, we may recall that in the year 1890 the prices of phosphate had reached an exceptionally high limit. They had, in fact, been steadily advancing, until they touched 1/4d. per unit for very high grade material. It was, therefore, possible to work the Canadian mines by modern methods on a sufficiently large scale to insure a reasonably profitable return on any amount of capital judiciously invested, and there was consequently great activity in all directions. New enterprises were started, new mines were opened up and interest was awakened in such kindred Canadian interests, as the mining of pyrites, the local manufacture of of sulphuric acid and the utilization of low grade or waste phosphates by transforming them into manufactured fertilizers. Suddenly came the news at this juncture, of the discovery of phosphates in Florida, and this, followed by the inevitable Southern "boom," and the unlimited and indiscriminate offerings of high grade material to the buyers of the world by those who had hardly commenced breaking ground and who were entirely ignorant of the world's wants and of its absorbing capacity, created a revolution in the phosphate trade, the effects of which have been universally disastrous.

Under the continuance of the senseless and unreasoning policy of the Florida "boomers" and in compliance with the immutable law governing supply and demand, the market values have steadily receded until they have now reached a point at which, even under the most favorable conditions, there can be no possible profit in any kind of phosphate mining.

That this view is not unduly pessimistic may be shown by a very brief examination of facts.

The total yearly consumptive capacity of the entire world does not exceed 2,000,000 tons of mineral phosphates of all grades and from all sources. Of this quantity probably 1/8 is of a grade varying from 30 to 45 per cent. and is used as a direct fertalizer without chemical treatment. About 6/8 are of a grade varying from 45 to 70 per cent. and are used in the manufacture of ordinary low grade superphosphates. The remaining 1/8 is of a grade ranging from 70 to 82 per cent. and is used partly for the purpose of enriching or bringing up to any desired standard the lower grade materials and partly in the manufacture of a high grade superphosphate containing about 18 per cent. of water soluble phosphoric acid. The sources of supply for at least 15/16 of the total quantity called for have long been accessible and are practically inexhaustible. The remaining 16th or that portion which contains from 75 per cent. and upwards of phosphate of lime, with a restricted minimum proportion of oxides of iron and alumina, has always been a much rarer commodity, and it was because of this rarity that its selling price was maintained by the miners at a properly remunerative level.

When the Florida phosphate raisers, in the first burst of their enthusiasm, undertook to supply the total quantity of this high grade material required for the world's consumption, the hitherto sufficient reason for high prices naturally cease to exist. Eager competition and cut rates soon brought them down to the proportionate parity of the lower grades, and such mines as those of Canada for example, which had hitherto produced very high grades at rather a high cost were not long able to hold their own and were, consequently, forced to be closed down.

The Florida miners, thus soon monopolized the business, but the cost of the monopoly has been a heavy one, and its preservation has involved a never ceasing slaughter of prices.

In proportion as they have been made to believe in the boundless nature of the supply, buyers in Europe have grown more and more capricious in their contracts and timid in their operations.

Contracts have been entered into and broken by them without scruple as prices have gradually broken away, and they have not hesitated to seize upon the slightest and flimsiest pretext for rejecting cargoes that have been shipped to them in good faith, or for claiming disastrously heavy allowances for insufficient discrepancies in the results of a chemical analysis. When these conditions are coupled with the lowest selling prices on record, and very high rates of freight, it is easy to realize that there is not a single mining enterprise in Florida which can claim to have earned a *bona fide* profit on the money invested in it.

The generally bad condition of the phosphate business is, therefore, no better in Florida than anywhere else, and in fact it may be justly regarded as very much worse, for the reason that its production of really high grade phosphate has fallen so far short of anticipations, that the average analysis of the 500,000 tons of hard rock already shipped, does not stand higher than 76 per cent. for the phosphate of lime, or lower than 3½ for the oxides of iron and alumina.

In order to at once better the quality of their product, and materially cheapen its cost, the Florida miners now wash their entire output by passing it through "Tennessee Log Washers," and large numbers of washing plants have been erected in different parts of the State. Whether the everage quality really will be permanently improved by this method of treatment is actually an open and a very doubtful question, but the cost of production has been decreased by it to an all round average figure which may be put at $3.50 per ton for mining, washing, drying and loading on the railroad cars at the mines, or at about $6 per ton free on board outgoing vessels at the shipping port of Fernandina.

The average amount of phosphate rock and gravel of the above mentioned quality obtained from the total material removed from the mines and passed through the washers and over the picking belt, is about 10 per cent., and the average capacity of the washing plant being placed at 500 tons of dirt per day of 12 hours, it follows that its actual net daily capacity is some 50 tons of clean rock phosphate. It would appear from this at the first glance, that the quantity to be produced from any given mine was merely governed by the capacity of the plant, but as a matter of fact, the all important question is narrowed down to the productive capacity and extent of any given phosphate pocket. If the pockets under exploitation are sufficiently productive, the miners may realize a small profit if they sell all their product and receive full payment for it on the basis of 8½d. per unit, or £2 15s. per ton delivered in Europe on usual European terms. If, however, these pockets turn out, as they most frequently do, to be of only limited capacity, it becomes necessary to occasionally remove the entire plant from place to place, in order to operate in paying ground, and the possible profit of the previous work is thus swallowed up by the expenses incidental to the stoppage and the removal.

It is hence no exaggeration to say that no net profit has been realized on the five or six hundred thousand tons that have been already mined and sent to Europe, and that the mine owners would be far richer and in every way better off if they had left it in the ground, or at least gone about their mining in the first instance with more prudence and descrimination.

Up to the present time they have been merely governed by an insatiable eagerness to do a gigantic business, and they have thus become easy prey for unscrupulous agents and dealers, who have systematically "beared" the market in order to cover their own speculative sales, and force weak holders of stock to realize at approximately the mere cost of their production.

The "weaker vessels" are, of course, being crushed rapidly to the wall and are dropping out of the race, and there can be no doubt that those who prove strong enough to hold their ground, will eventually consider the advisability of entirely changing their methods of sale. Instead of assuming the enormous, unfair, and unbusiness like responsibility involved in their present system of delivering their phosphate at their own risk to buyers in Europe, and of relying upon the caprice of these buyers to pay them for it after it has been received, or to reject it and sue them for damages while they hold it as a security for alleged claims, the miners will sell it on this side of the ocean, and see that it is weighed, sampled and paid for, ere it passes out of their possession.

If they somewhat diminish or restrict their trade by the adoption of this course, they will on the other hand impart a healthy tone to their own affairs and give a chance for other producers to come into the market with higher, more uniform and more costly material.

They will thus facilitate the reopening of Canadian and such other mines as may be able to supply the high quality needed for the manufacture of superphosphates containing 18 per cent. of water soluble phosphoric acid, and will at the same time weed out of the industry those parasitic speculators of the "nothing-to-lose-and everything-to-gain" order, who have hitherto been pushing them forward into bankruptcy.

"Fully Paid" Shares.

The widespread adoption of the principle of limited liability in mining and commercial enterprises, and the growth in public favor of shares in joint stock ventures as a means of investment, makes it highly desirable that the other side of the question should not be forgotten, and that investors should be made fully alive to the dangers which unwittingly they may incur. To one of these particularly it is our desire at present to draw attention. There is no more commonly accepted idea, even among those who are accustomed to dabble among stocks and shares, than that no danger or liability can be incurred by anyone accepting a transfer of shares, so long as these appear in the certificate issued by the Company to be fully paid up; and while there are very few who would accept a transfer of shares having uncalled liability attaching to them, in however good repute the Company concerned, without making some inquiry as to its financial stability and prospects, most men would without any hesitation accept the shares of any Company, however unsound, appearing to be fully paid. Indeed it is no uncommon experience for a commercial man to accept in payment of an obligation, which would otherwise prove a bad debt, shares of which his debtor may happen to be possessed, and which may or may not be saleable at the moment, without making further enquiry than to satisfy himself in a cursory way that there is no uncalled liability which may involve "throwing good money after bad." If no good should result, no harm will be done

This, however, may be an entirely erroneous idea. Under the provisions of "The Companies' Act," Revised Statutes of Canada, 1886, Chapter 119, Section 27 provides:

"Every share in the Company shall, subject to the provisions of Sub-section *d* of Section 5 of this Act, be deemed to have been issued and to be held subject to the payment of the whole amount thereof in cash, unless the same has been otherwise agreed upon or determined by a contract only made in writing and fyled with the Secretary of State at or before the issue of such shares."

(It is worthy of note that this Section is also applicable to many of the Provinces.) And the cases are not few in which shareholders, confident in the belief that, if they are not to gain anything by the liquidation of the Company of which they were members, the matter is at least for them at an end, have been rudely awakened from their fancied security to find that under the Section just quoted they are liable to the liquidator for the full nominal value of the shares standing in their name.

The evil usually arises in the following way, which will also serve to illustrate the practical danger involved. It is quite a usual thing at the time of the inception of a new Company for a vendor to the Company of goodwill, or patents, or property of any kind, to receive in part or full payment of the agreed on price, shares of the Company nominally fully paid, and, indeed, this is one of the favorite methods of proving to the public the *bona fides* of the vendor, who is also not seldom a promoter. This arrangement will no doubt be embodied in a contract between the parties, but very probably through the neglect of the solicitor, or for other causes, the terms of the Section of the Act above quoted will be overlooked, and the arrangement will be carried out and the shares allotted and issued in implement thereof without the contract having been fyled with the Secretary of State. If the company succeeds, well and good; but if liquidation should ensue it at once becomes the duty of the liquidator to place the names of the holders of these shares upon the list of contributories, and to make a call upon the full amount per share, since no contract having been fyled the shares must be deemed to have been issued, *and to be held* subject to the payment of the whole amount thereof in cash. Still, so far as we have gone, there is no danger apparent to the general public. The vendor must be held to attend to his own interests and to be responsible for his own negligence, and however harsh may be the consequences, he cannot be said to have anyone but himself to blame. The doctrine, however, is pushed much further. The liability does not rest in the public but in the shares, and any third party who may have accepted a transfer of these is equally liable as the original holder, and that notwithstanding any consideration which he may have paid to the latter in exchange for the shares. This at once opens up great danger to the investing public. It is very unusual for any vendor, however sanguine of the success of the Company, to allow all his eggs to remain in one basket, and he will thus take the earliest opportunity of working off the shares standing in his name to purchasers in the market. There is no particular designation attached to these shares to distinguish them from those which have been allotted in the usual way, and for which the Company has received cash; the shares appear from the share certificate to be fully paid; there is nothing whatever to indicate any hidden liability; and yet, though the innocent holder may succeed in proving his want of knowledge, and thus evade liability, he may only be able to do so after an expensive and protracted litigation in resisting the proposal to place his name on the list of contributories. On the other hand, the holder may have accepted the transfer of the shares in full knowledge of the non-filing of the agreement under which they were issued, in which case he has absolutely no answer to the liquidator's demands, and the pleasant delusion which the phrases "limited liability" and "fully paid" have fostered may involve positive ruin.

There are no more vexed questions in company law than those arising under this Section of the "Companies' Act," and the circumstances of each case are so various tbat the decisions can very rarely be accepted as precedents; and as is natural, while demands are made which, however tenable in law, very rarely appear to be so in equity, no obligations under company law have been fought with more bitterness or greater resistance than those arising on this point. The discussion of such legal points is, however, beyond the scope of this article, and we content ourselves with the desirability of transferees of shares satisfying themselves as to the history, or at least obtaining a certificate of the absence of liability from the transferer, upon which the latter could be held liable for any damage ultimately sustained.

It would appear to be a natural conclusion from what has been said, that a provision involving so much danger to innocent investors should be removed. It is extremely desirable that intending applicants for shares should be made cognizant of the whole arrangements which have been made with the vendors and promoters, and that some check such as is here provided for, should be made upon the power of directors to make allotments, otherwise in their anxiety to declare a company successfully floated large numbers of shares may be credited to parties from whom not a penny had been received in exchange. The necessity for publication prior to the issue of the shares of an agreement embodying any arrangement of this kind by registration at the Secretary of State's department, to which anyone may have excess on payment of a small fee, undoubtedly takes from it its underhand aspect and enables *bona fide* subscribers for shares to go into the transaction in the full knowledge of the circumstances. A way out of the difficulty, avoiding either objection, might be found in a provision that all shares in respect of which, though nominally fully paid, no cash has passed, should bear a distinctive mark or name, so that future purchasers may be alive to their character. This would naturally increase the difficulty to the original holder of disposing of his shares in the market, and in turn make him more anxious to see that the formality of registration, which to avoid expense he is often at present glad to have dispensed with, is carried through. In the meantime, as already pointed out, purchasers will require to be all the more cautious in examining into the history of any shares which they may acquire before accepting the transfer. There are to our knowledge at the present moment not a few holders of "fully paid" shares whose fancied immunity from "calls" is a pure myth, and who would be only too anxious to have their names removed from the register of members were they aware of the liability which their ownership involves. Apart from this, so much doubt has arisen from the decisions and cross decisions in cases arising under this Section, that it seems only reasonable that Parliament should throw more light on its intentions in this respect, and define more exactly the limits to which liability shall extend where transferees with or without knowledge of the shares are involved.

The Importation of Mining Machinery.

Since our last issue we have to acknowledge the following from Sherbrooke under date of 19th instant:—

"We wish to deny *in toto* the statement appearing near the top of first column of second page of your January issue, to the effect that we led in opposing the admission to the Customs Department of the list of mining machines not made in Canada. It was the general impression of the Sherbrooke meeting of the committee that if a complete list of mining machines made in Canada were submitted, that would answer every purpose, inasmuch as all machines not on that list were necessarily not made in Canada, and hence that the second list was superfluous. Had we led in this opposition, we cannot see that it could be construed as an antagonism to the miners; but in point of fact, we did not lead.

In this, as in the remainder of your remarkable article, we consider that regardless of facts, you are simply using your position to excite animosity against Canadian manufacturers.

We wish to remind you and to inform the mining public of the fact, which you conveniently suppress, that Mr. Halsey made the motion which we both voted for, favoring the extension of the scope of the Act so as to make it include quarrying, smelting, metallurgical, and allied lines of machinery. This fact alone is sufficient to show the falsity of your statements as to our narrow spirit in this matter."

(signed) F. A. Halsey,
J. M. Jenckes.

We cheerfully give prominence to this communication, for nothing is further from the action and policy of the *Review* "than regardless of facts" to use our position "to excite animosity against the Canadian manufacturers."

Referring to page 382 (*Journal of the Gen. Mining Ass'n Prov. Que.*), we find: "Messrs. Halsey and Jenckes made objection to furnishing the Department with any statement showing the machinery that was not manufactured (in Canada), claiming that a statement of what was made would serve the purpose equally well." Furthermore, being present at the meeting we have a very distinct recollection of the circumstance. Both gentleman were, we surmise, shrewd enough to foresee that the proposed statement of the various classes and kinds of mining machinery *not* manufactured in Canada (a very voluminous document embracing an immense area of specialties in mining plant), would be irresistible proof of the comparative insignificance of our mining machinery manufactures in comparison with other countries, and an unanswerable argument in favor of the Government's policy to encourage the extension of our mining industries and great mineral resources by the continuance of the present law.

Regarding the latter portion of the letter, upon which so much emphasis is laid, Mr. Halsey is certainly entitled to whatever credit there may be in *proposing* the resolution mentioned, although it is well to point out that he certainly was not the *promoter* of it. The necessity of an extension of the language of the Act so as to include machinery not only used in mining but also in "quarrying, smelting, concentrating, refining and treating ores and minerals," was introduced in the course of business by the Secretary, and it was only after an unanimous expression of opinion had been passed in favor of its adoption that Mr. Halsey *pro forma* put it to the meeting—that is all. Why should we suppress such an insignificant matter?

That the mining men of Quebec and Nova Scotia have throughout treated the manufacturers with the utmost consideration is undeniable. They were specially invited to all meetings, and asked, one and all, to furnish information respecting their manufactures, while on the committees that prepared the statement they were cheerfully accorded equal representation with the miner. In return we find them furnishing ambiguous and misleading statements to the Government, and inspiring articles in the press calculated to injure the interests of an industry which is their best friend, and from whose extension they have everything to gain.

Further, we may remind Mr. Halsey and Mr. Jenckes, and all the other Canadian manufacturers, that at every meeting in which this subject has been discussed, the REVIEW has invariably upheld their right to reasonable protection within the meaning of the Act; but they will excuse us if we resent, flat-footed, such distinctly untruthful emanations as the article in the recent issue of the *Manufacturer*.

The Victoria mines of the Low Point, Barrasois and Lingan Mining Company, Ltd., have been acquired by the Dominion Coal Company. Price £85,000 stg.

Par Nobile Fratrum.

Charles Ochiltree Macdonald, erstwhile an itinerant writer on space in the *Colliery Guardian*, and at one time the promoter of a windy and short-lived English financial sheet, and whose proposed "corner" in the Canadian spruce gum and maple sugar trade the REVIEW on a previous occasion referred, has joined hands with Howard Clark, a fanciful and eccentric scribbler of mining items on the Halifax *Critic*; and this brilliant galaxy of intellect and genius, supported by a "powerful company," will henceforth cater to the public under the high-sounding and pretentious title "*The Canadian Colliery Guardian Critic and Journal of the Iron and Steel Trades.*" Among the vicissitudes of his journalistic career, we understand the promoter of the new enterprise did a 'turn' with the pick (also short-lived) in the pits at Cow Bay, and it is quite evident he there inhaled freely of the atmosphere that is gassy. An explosion may follow when the English *Colliery Guardian* takes steps to interdict what is unquestionably a characteristically impudent infringement of its old established and world-wide trade mark. In the meantime, while anticipating a new source of amusement from the perusal of this weekly *omnium gatherum* of political, commercial, financial, mining and general news, edited by the paste pot and scissors, we cannot restrain a tear for such of the unfortunate investors as may have been induced to put their money into what cannot fail to be a short-lived and unprofitable venture.

The shipments of asbestos from the Eastern Townships last year were in the neighborhood of 6,000 tons—so we are informed.

Purchasing Silver, Gold and Lead Ores.

By H. VAN F. FURMAN, E.M.*

At our western metallurgical centres, as Denver, Pueblo and Salt Lake City, the margin in the ores has become so slight, owing to the fierce competition between rival smelters, the prevailing scarcity of desirable fluxing ores, and the declining price of silver, that ores are no longer purchased upon the assay value in silver, gold and lead, and a rough guess as to the probable cost of smelting, but the price paid lor a lot of ore is based upon the assay value of the ore and upon its chief constituents, as determined by chemical analysis and calculation as to the actual cost of treatment.

In determining the price to be paid for an ore, the following points must be taken into consideration:

First.—The assay value of the ore in silver, gold and lead; copper also being determined provided much is present.

Second.—The chemical composition of the ore. SiO_2 and Fe are almost invariably determined. Mn, Zn and CaO are frequently determined, and S, As, Sb, BaO, MgO and Al_2O_3 are occasionally determined.

Third.—The silver, gold and lead losses in roasting and smelting.

Fourth.—The cost of roasting.

Fifth the cost of smelting, including the cost of fluxes and the cost of coke and charcoal.

Sixth.—The character of the ore (coarse or fine.)

Seventh.—Desirability of the lot at the time of purchase.

Eighth.—Market value of the bullion at the time of purchase.

The assay value in silver, gold and lead is always determined on each lot of ore unless any of these elements are known to be absent. Fire assay is the method adopted. Copper, if present in sufficient quantity, is determined by volumetric cyanide assay or by gravimetric battery assay.

* School of Mines Quarterly.

The analysis of the ore for its chief constituents, as silica and iron, is quite as important as the assay for silver, etc., as the cost of treatment depends largely upon the mineralogical composition of the ore.

The losses in silver, gold and lead in treatment must be known in order to make the proper deductions from the gross value. These losses will depend largely upon the general character and composition of the bulk of the ores treated and the individual practice at any particular works. The Colorado practice (Denver, Pueblo and Leadville) is to pay for 95 per cent. of the silver contents, settlement being made on the basis of New York quotation for silver on the day of purchase, $19 per ounce for the gold, and so much per unit for the lead which the ore contains. The price per unit for the lead is based upon the market price of lead in New York upon the day of purchase and the cost of handling the bullion, including the freight to New York and refining charges.

The cost of roasting will depend upon the price of labor and fuel, the character of the fuel, and the type of roasting furnace adopted. For example, with the new automatic roasting furnace which Dr. Richard Pearce has lately patented and put in operation at the Boston and Colorado Works at Argo, Colorado, the cost of roasting at Argo is considerably less than $1 per ton. With prices of labor and fuel such as prevail in Denver, the cost of roasting in a long hearth reverberatory furnace (the usual practice), with a capacity of from 10 to 12 tons of ore per furnace per day, is about $2 per ton. As the ore is never roasted "dead," the roasted charge usually carrying 5 to 6 per cent. of sulphur, allowance will have to be made for the treatment of the matte (handling and roasting), which will be produced from the roasted ore when it is smelted, and the interest on the silver, gold and lead value which the matte has. Under the same conditions as above, $0.25 to $0.30 will generally cover this item, so that the cost of roasting in reverberatory furnaces will be about $2.25 per ton. As too much fine ore cannot be treated in the blast furnaces, some of the roasted ore will have to be fused or slagged. This involves an additional expense of from $0.25 to $0.75 per ton, so that the total average cost of roasting, at Denver, in reverberatory furnaces, may be stated to be about $2.50 to $2.75 per ton.

The cost of smelting will differ in each locality and according to the general practice of each individual works, and will, moreover, depend upon the composition of the ore (cost of fluxing), the cost of fluxes, the character of the ore (raw smelting, roasting, coarse or fine), the cost of fuel, the cost of labor, etc. Being made up of so many variables, this question will necessarily have to be determined in each individual case by the actual results obtained in working and after quite extensive operations. With prices as follows: Common labor (10-hour shifts), $1.75; feeders, ore wheelers, etc. (12-hour shifts), $2.50 per day; furnacemen (12-hour shifts), $3 per day; engineers and foremen, $3.50 to $4 per day; coke (10 per cent. ash), $7 per ton; limestone (50 per cent. excess CaO), $1.25 per ton; iron-ore (70 per cent. excess FeO), $5 per ton; and steam fuel (mine slack), $1.50 per ton; and with a large sized modern plant (capacity about 400 tons per day), the cost of smelting a neutral ore (composition $SiO_2 = 30$ per cent., $Fe = 30$ per cent., $Pb = 13$ per cent., $Zn = 8$ per cent., and $S = 5$ per cent.), will be about $4.50 per ton. This cost is distributed somewhat as follows:—

Labor	$1 90
General expenses (office exp. management), etc	0 27
Fuel for power	0 10
Interest, depreciation and repairs	0 50
Coke (15 per cent. charge)	1 36
Limeston (0·3 ton)	0 37
	$4 50

This figure of $4.50 per ton is the basis of the ore calculations at some of our large Denver and Pueblo works. Of course, this cost is liable to fluctuation from time to time. Having arrived at the cost of smelting a neutral ore it becomes necessary to determine what charges or allowances to make for each unit of silica, iron, zinc, etc., in excess of the neutral point. Taking the above figures as a basis we find that each unit of SiO_2 in excess of iron should be charged for at fifteen cents, and that each unit of iron in excess of silica should be given credit to the amount of fifteen cents. Each unit of lime should be given credit to the amount of six cents. The same credit is given for manganese as for iron, and the same eredit is given for magnesia and baryta as for lime, provided the ores do not carry a high percentage of MgO or BaO. Over 4 to 5 per cent. of MgO and BaO in the slags is undesirable (see "The Calculation of Lead Blast Furnace Charges," *School of Mines Quarterly*, vol. xiv., No. 2, p. 136). It is customary with the Denver smelters to charge fifty cents per unit for all zinc in excess of the 8 per cent. limit. A charge of fifty cents per unit for arsenic should be made.

The character or condition of the ore should always be taken into consideration. Fine ore is undesirable, as it causes the furnaces to run slow, thus increasing the cost of smelting, and if present on the furnace charge to too great an extent it is liable to cause trouble with the furnaces. When an ore requires previous roasting fineness is an advantage, as if in lump form it will require crushing.

The desirability of the lot at the time of purchase will frequently be a considerable figure in the price which will be paid for the lot, especially when the lot is sold on the public market to the highest bidder. This will depend upon the local conditions prevailing at the time of purchase.

The market value of the buillion produced is of great importance in arriving at the value of an ore and its cost of treatment. Upon the market value of the bullion will depend, to a large extent, the price per unit which will be paid for the lead. The market value of the bullion, as far as lead is concerned, will be the value of the lead according to New York quotation upon the day of sale less freight to New York and refining charges. If the net value of lead at the works is $60 per ton, and the loss in smelting is 8 per cent. the net value of each unit of lead will be $0·552.

There is generally a profit to the smelter on all gold purchased at $19 per ounce as the smelter receives $20 per ounce for the gold in the bullion from the refiners and usually makes no gold loss in smelting. Of course there is some loss of gold in smelting, but this loss is usually more than made up by the small amounts of gold in certain ores where the amount of gold is so small that it is not paid for.

In purchasing ore by bid in the public market, that is, from the public sampling works, the custom is to bid so much net for the ore at the sampling works. In purchasing ore by contract with the mines or ore brokers the price paid is usually based upon a sliding scale. For example: Oxidized lead ore, gangue silica, oxide of iron; carbonate of lime, baryta, and occasionally zinc. Treatment charges based upon $4.50 per ton neutral basis (SiO_2 = Fe) and additional charge of fifteen cents per unit for all SiO_2 in excess of Fe and corresponding allowance of fifteen cents for all Fe in excess of SiO_2. An allowance of six cents per unit for all CaO and BaO. No charge for Zn below 8 per cent. If zinc runs above 8 per cent. a charge of fifty cents per unit for all Zn in excess of the 8 per cent. limit to be made. Lead to be paid for as follows, based upon New York quotation of $4 per 100 pounds:—

	Per unit.
Under 5 per cent	nothing
5 per cent and under 10 per cent	25 cents
10 " " 20 "	35 "
20 " " 30 "	40 "
30 " " 40 "	45 "
40 " " 50 "	50 "
50 " and over	55 "

For every five cents per 100 pounds fluctuation of lead in New York an allowance of one cent per unit to be made, up or down Gold to be paid for at the rate of $19 per ounce, and 95 per cent. of the silver to be paid for at New York quotation on the day of purchase.

The method of calculation is best illustrated by the following examples, using the above figures as a basis, and assuming $4 per 100 pounds for lead and $0.83 per ounce for silver as the New York quotations:

Example No. 1—Sulphide Ore—Concentrates.

Composition—SiO_2	10 per cent.	
Fe	37 "	
Zn	7 "	
Au	1·2 ozs. per ton.	
Ag	10·5 "	
		Per ton.
Treatment—Roasting		$ 2 50
Smelting		4 50
		$ 7 00
Less for Fe excess		4 05
Net cost of treatment		$ 2 95
Value—Ag (95 % of 10·5 ozs., at $0.83)		8 28
Au (1·2 ozs. at $20)		24 00
Total gross value		$32 28
Less for treatment		2 95
Total net value		$29 33

In bidding upon the above ore in the public market the smelter would deduct from the net value of $29.33 per ton a certain sum for profit, as, for example, $3.50, the net bid then being $25.83 per ton.

If the ore was being purchased by contract, the treatment charge upon a neutral basis being $9.00 per ton, and gold being paid for at the rate of $19.00 per ounce, the figures would be as follows:—

	Per ton.
Treatment	$9 00
Less for Fe excess	4 05
	$4 95
Credit $1 per oz. for Au (1·2 ozs.)	1 20
For treatment and profit	$6 15

Example No. 2—Ore Oxidized—Coarse.

Composition—SiO_2	32 per cent.	
Fe	12 "	
CaO	6 "	
Zn	2 "	
Pb	25 "	
Ag	50 ozs. per ton.	
Au	0·1 "	
		Per ton.
Treatment—Smelting		$4 50
Excess of SiO_2, at 15c. (20%)		3 00
		$7 50
Less for CaO, at 6c. (6 %)		36
Net cost of treatment		$7 14
Value.—Ag (95 % of 50 ozs.), at 83c.		$39 43
Au (0.1 oz., at $20		2 00
Pb (25 % $0.552)		13 80
Total gross value		$55 23
Less for treatment		7 14
Total net value		$48 09

Upon the basis of the above contract schedule the figures would be as follows:

Value.—Ag	$39 43
Au (0.1 oz., at $19)	1 90
Pb (25 %., at 40c)	10 00
	$51 33
Less treatment	7 14
Price paid per ton	$44 19

Profit to the smelter = $48.09 − $44.19 = $3.90 per ton.

Example No. 3—Ore Sulphide—Lump.

Composition.—SiO_2	25 per cent.	
Fe	20 "	
Zn	18 "	
Pb	10 "	
Ag	25 ozs. per ton	
Au	0.3 " "	
		Per ton.
Treatment.—Crushing		$0 50
Roasting		2 50
Smelting		4 50
Excess of SiO_2 (5 %), at 15c		0 75
Excess of Zn (10 %), at 50c.		5 00
Net cost of treatment		$13 25
Value.—Ag (95 % of 25 ozs.), at 83c.		$19 71
Au (0.3 ozs., at $20)		6 00
Pb (10 %, at $0.552)		5 52
Gross value		$31 23
Less for treatment		13 25
Total net value		$17 98

For such an ore the shipper would receive about $14 per ton.

Screening and Cleaning Coal.

By Henry T. Wales.*

Amongst the most important factors upon which the success of a colliery depends is the reputation of the coal produced. This reputation, apart from mechanical and chemical composition, will depend upon the more or less effectual separation of the different sizes from each other, and their freedom from impurities when delivered to the buyer.

Fortunately, in the South Wales coalfield, the best seams are found to exist in a state of great natural purity, and perhaps on this account, therefore, but slight attention has hitherto been paid to the important subject of this paper. If we look, however, at other districts competing with Welsh coal in the same markets, we find that, to a very large extent, various mechanical arrangements have been adopted for sending the coal into the market in the best possible condition.

It is unnecessary for the writer to give any detailed description of the screens ordinarily in use at the steam coal collieries of South Wales—the type is almost universal, and consists of a hinged screen with a bar area of about 70 square feet and with spaces of about 1¼ inch between the bars. The small coal passes between the bars into the "billy" box, and the large falls from the end of the screen into the wagon.

The method in which the coal passes from the tram into the screen is somewhat primitive, the coal being shot on to the screen in a heap, which slides down quickly and falls into the wagon; this prevents proper separation of the small coal, and affords no opportunity for picking out any stones or other dirt which may be mixed with the coal.

The lumps of coal are also damaged in their rough and swift passage over the screen, and again by the vertical fall of 4 or 5 feet into the wagon; this is detrimental to all coals, but especially to those of a tender kind.

A good system of screening coal aims at reducing, as far as possible, the fall from the tram on to the screen, and also provides that the coal shall pass over the bars in layers and not in heaps.

These objects cannot be successfully attained with the rocking plate at present in use for tipping the trams, and the adoption of some mechanical means for tipping becomes necessary.

The side tippler has been found to attain the desired results (see plates 15-16). This consists of two steel rings 8 feet 3 inches in diameter, placed 6 feet 6 inches apart, and bound together with tie rods and angle irons; the rings are turned on the periphery and faced to fit the groove in the friction driving wheels. The tippler revolves on four turned rollers running on studs carried by cast-iron brackets, and makes a complete revolution in thirty seconds.

In the rim of the friction wheel there is a turned groove of V form in which the outer edge of the tippler ring is an exact fit for the whole of its circumference with the exception of one point, where it is thinned down to allow of the friction wheel running clear of it. This thinned portion is so placed that, when the tippler is in a position for receiving or delivering the trams, it will always be at rest, although the friction driving wheels may continue to revolve. The friction wheels are keyed on to a shaft which is driven by a belt and pulleys.

The trams run by gravity from the pit carriage into the tippler, and are held securely during the process of tipping by suitable means.

The tippler makes a complete revolution, and the emptied tram, being knocked out by the next full tram following, runs by gravity to the back of the pit, where it is elevated to the proper height for running into the carriage by means of a hoist or other suitable appliance.

As the title of this paper includes the subject of cleaning coal the writer proposes to describe a few of the arrangements which have come under his notice for effecting this object.

From the end of the screen the lumps of coal pass on to a picking belt, travelling at a proper speed, and placed, sometimes at right angles to the screen, and sometimes in the same line with it. This picking belt varies in length from 50 up to 250 feet, and in width from 2 to 5 feet. Plates 15 and 16 show a belt 50 feet long and 5 feet wide, of which the following is a description;—

The belt is built on two picth pine beams, 10 x 6 inches, placed 5 feet 6 inches apart, and on these beams are mounted the brackets and rollers for supporting the travelling belt. The belt is composed of three pitched chains of mild steel, 7¼ inches pitch, and of double and single link alternately; the single links are 2 by ¾ inch, and the double ones are 2 by ⅜ inch, secured at joints with 1-inch rivets. The plates are of mild steel, $\frac{5}{16}$ inch thick, with three steel snugs riveted on each. The snugs are bored to receive an inch turned pin which passes through the links of the chains. The plates are 9¼ inches broad, giving a lap of 1 inch over each other. The chains are carried by cast-iron rollers mounted on malleable iron spindles, 2½ inches diameter, with turned ends. The spindles are placed 2 feet 3 inches apart, and run in cast-iron brackets bored to receive them. These brackets are bolted to the pitch-pine beams, and have provision on top for carrying angle irons, 6 x 3 inches x $\frac{5}{16}$ inch, to act as guides for the plates, which have planed ends to ensure close working.

At the delivery end a double set of octagonal drums is fixed in a position which causes the belt to slope towards the jigging screen, and breakage of the coal in falling is thus avoided.

The belt is driven at the delivery end, and at the opposite end, the slack of the chains can be taken up by sliding plummer blocks and tension screws.

The jigging screen consists of a steel plate, perforated with round holes, and lying at an angle of 1 in 4. It is suspended by four ash springs, secured above to four trunnion brackets, and below to four steel brackets bolted to the sides. The screen is made to vibrate by means of two eccentrics, having a stroke of 5 inches, and making 100 strokes per minute, and the small coal taken out by this screen is conveyed by a cross belt to a truck standing on an adjoining line of rails.

The large coal now passes on to the lowering belt, which is 12 feet long and 4 feet wide. At the back end this belt is supported on trunnion brackets, and at the delivery end is suspended by two flexible wire ropes, passing round two drums which are carried on a shaft. The drum shaft is geared to a counter shaft by a pair of worm wheels, the wheel being on the drum shaft and the worm on the counter shaft; the same shaft also carries a pair of mitre wheels running loose, which gear into another mitre wheel keyed on to a third counter shaft driven by a belt and pulleys. Between the two mitre wheels, on the second counter shaft, is placed a cone-friction clutch, and when the belt is out of gear it will remain in a fixed position and be prevented from running back by the worm gear and back balance weights. The raising and lowering of the belt is effected by a hand lever which gears the clutch into one or the other of the mitre-wheels.

The whole of the machinery is driven by a high pressure horizontal engine with cylinder 10 inches diameter and 18 inch stroke, fixed near the delivery end of the picking belt.

It will be noticed that in this case the use of a steam hoist is necessary owing to want of height in the screen-wall; the vertical lift of the hoist is seven feet six inches, and it is worked automatically by the trams.

The dirt is picked out by boys at each side of the belt, and passes through shoots into wagons below, or may be elevated into trams and taken to the rubbish tip.

The small coal from the main screen and from the jigger screen is conveyed by cross belts into wagons, or into a pit below the level of the siding rails. In the latter case it is lifted by means of chain and bucket elevators, and may be sized in revolving screens or stored in bunkers for boiler and other purposes.

Very few cleaning plants have so far been erected in South Wales, but the writer is kindly permitted to describe two of them.

The first is at the Llanerch colliery, near Pontypool, belonging to Messrs. Partridge, Jones & Co, Limited.

Here the trams are of steel, and carry from 19 to 20 cwts. of large coal. From the cage they run into a side tippler, delivering the coal on to a fixed screen, at the bottom of which a slowly moving belt is placed. At the end of the belt is a shoot containing bars with 1½ inch spaces and underneath these bars a jigging screen, placed

* Paper read before South Wales Inst. of Engineers.

at right angles to the belt, divides the coal into nuts and small. Lower down the shoot is a second set of bars with 3-inch spaces for making cobbles. The large coal is delivered into wagons over a balanced shoot.

The feature of this arrangement is the tippler, designed by Messrs. Edward Jones & Evans, which does its work effectually and economically.

The tippler (Plate 17) moves on a shaft, and by means of a chain is connected to a piston working in a water cylinder; a hand lever on the tipping platform controls the movement of the piston.

The downward stroke of the piston brings the tippler into a vertical position, and at the same time compresses a set of springs fitted at one side.

As soon as the water is released in the cylinder, the springs give to the tippler a side motion, the speed of which is regulated by the hand lever.

The cover of the tippler consists of a wrought-iron shutter hinged at one end and in the middle, and, on commencing to tip, there is very little space between the shutter and the top of the coal in the tram. By means of a spring the shutter is locked in this position until the mouth of the tippler is within nine inches of the screen, when the spring is automatically released and the front half of the shutter opens and allows part of the coal to pass on to the screen; when within three inches of the screen, the second half of the shutter opens and the remaining coal passes out of the tram.

The tram is held in the tippler by four claws, which grip the side angle irons of the tram; at one side also a heavy fork, working on a centre, follows the motion of the tram in the course of tipping and prevents any movement endways.

The tippler is capable of dealing with 150 tons of coal per hour.

Another plant has been in operation for some time at the East Elliot pit, New Tredegar, belonging to the Powel, Duffryn Coal Co., Limited.

The output of this colliery is dealt with over two screens, and the ordinary tipping plate is in use. The screens are fixed and of the usual dimensions; immediately below the delivery plate of each screen a jigging screen is fixed, over which the large coal passes before reaching the picking belts. The jigging screens are 2 feet 6 inches long fitted with bars having 1⅛ inch spaces, and vary in width from 6 feet at the upper end to 4 feet at the delivery end.

The two picking belts are fixed in the same line with the screens, and are 50 feet in length and 4 feet 6 inches wide. They are built up on three double and single link chains, to which the plates are attached by means of hook bolts, allowing the plates to be easily and quickly changed when required.

From the ends of the picking belts the large coal is delivered into wagons over shoots fixed at right angles to the belts.

The types of coal cleaning arrangements differ in the several coalfields with the varying conditions which have to be provided for.

Midland District.—A peculiarity of the coal worked in this district is that, in several of the seams, the different beds composing the seam contain coal of two or more different qualities. House coal and steam coal are often produced from the same seam, and as it is in most cases impossible to separate the qualities in the process of filling the tubs underground, arrangements have to be provided on the surface for doing this work.

At a typical colliery the method of sorting and cleaning was as follows:—

The tubs are of wood, and carry 10 cwts. of large coal, no small being filled underground. Instead of having a door at the end of the tub, the largest pieces of coal are built up to form a wall.

After being weighed, the tubs run into a tippler delivering the coal, by means of a shoot or a screen, on to a picking belt fixed at right angles to the shoot or screen.

The picking belt is 250 feet long and 2 feet 9 inches wide. On each side of the belt twenty-five men are stationed to pick out the different qualities of coal and to remove any dirt that may be found. Empty trucks stand on both sides of the belt on lines of railway laid parallel to the belt, and the coal, which is of a hard nature, is thrown into the wagons, or packed carefully by a man standing in the truck, the belt being fixed at a convenient height for this purpose.

The smaller pieces of coal, which are not picked off, are delivered at the end of the belt into an elevator having buckets of the same width as the belt. This elevator delivers the coal on to a jigging screen, which divides it into two or three sizes.

The belt is composed of iron plates 12 inches broad, which are riveted to two long link claims, and is supported on rollers fixed 9 feet apart.

Separate engines are used for driving the belt and the screens, one having a cylinder 14 inches in diameter with 30-inch stroke geared 20 to 1, the other having a cylinder 6 inches in diameter and 14 inches stroke.

The quantity of coal passing over this belt is 150 tons per hour. The system of loading from the tub into the wagon with handforks is extensively in vogue in this district; by this method it is easy to keep a perfect check on the filling of the coal underground, both as regards freedom from dirt and small coal; the cost, however, is high, ranging from 4d. to 6d. per ton.

Any considerable quantity of dirt found in a tub is weighed and deducted, and the small coal is also deducted if exceeding ½ cwt. in a tub.

Lancashire.—In this district good examples of screening and cleaning plants are to be met with.

Jigging screens are used with perforated plates, or composed of iron rods woven like a rddle, and forming apertures about 4 inches square. In some cases Lyall's patent screens with a shaking motion from side to side have been adopted. These "riddles" give to the coal a rolling motion which displaces any small coal that may be carried by the larger pieces.

Underneath the main screen a second screen is fixed, of similar construction, but with a finer mesh for dividing the nuts from the small coal.

The picking belts are of various lengths—up to 150 feet, and from 2 feet to 4 feet 6 inches wide—they consist of either wrought iron or steel plates, and in some cases of cotton.

At one colliery, visited by the writer, an extensive system of cotton belts for cleaning had lately been put in, and the process of screening and cleaning was as follows:—

The tubs ran into a side tippler, which, on being put into gear, made a complete revolution in a direction backwards from the screen, and delivered the coal on the top end plate.

The tippler consists of three annular rings, the end ones resting on rollers. The centre ring is turned and grooved the outside and fitted with a corresponding friction pulley actuated by spur gearing, which is brought into play by a lever worked by a boy.

Whilst in the tippler the wheels of the tub rest in hollows in the rails, thus preventing any backward or forward motion, whilst two longitudinal angle irons overlap the side edges of the tub and keep it in place during the revolution of the tippler.

Lyall's side-shaking screens are used.

The large coal is delivered from the end of the screen on to a cotton belt running at right angles to the screen; this belt is 50 feet long and 2 feet 6 inches wide. On one side of this belt women are placed, who take off all coal requiring any dressing or chipping, and transfer it on to an auxiliary belt running parallel on the right hand side. This auxiliary belt delivers the coal to a man specially employed to dress it. After being dressed the coal is placed on the main belt, and the dirt is thrown into a bunker conveniently placed for the purpose.

The women also pick out all dirt and throw it on to another auxiliary belt on the left hand side of the main belt; this belt delivers the dirt into a cross belt, inclined at an angle of 30°, and leading to a bunker into which the dirt drops and is drawn off periodically into wagons standing below. The auxiliary belts are 12 inches wide.

This arrangement is capable of dealing with 100 tons per hour.

In some instances a system of revolving tables has been introduced for cleaning the large coal. The coal being delivered at the end of the fixed screen, is carried round on the tables, whilst a number of boys stand at the side and pick out the dirt. When the coal has been thoroughly cleaned, a lever and vertical stop is actuated which causes the coal to slide into a shoot and thence into a wagon. The revolving table is then ready to receive another load.

The capacity of a shaker screen probably depends upon the size of the meshes of the small riddle, the rate at which it is driven, and the percentage of small coal to be passed over it. If the small riddle has too much to do it soon becomes choked, and a large portion of the small coal rides over instead of passing through.

The limit to the quantity of large coal that can be passed over the 4-inch meshes seems to be governed by the capacity of the tippler.

In the case of coal containing 60 or 70 per cent. of small, the capacity of the screen will be from 50 to 55 tons per hour; on the other hand, where the small amounts to only, say, 30 per cent. the capacity will be quite 100 tons per hour.

It may be mentioned that with end-shaker screens the coal travels forward intermittently, and is delivered only on the back stroke. The side shaker gives to the coal a forward and side rolling motion, a constant delivery whilst at work, and an equal distribution of the various sizes of coal upon the different belts.

In an example of end-shaking screens (Plate 18), the main screen carries two meshes in one frame, and is vibrated by n eccentric fixed on each side of it. The lower or nut coal screen, is driven by another pair of eccentrics working in an opposite direction to those of the upper screen in order to balance the strain upon the frame and machinery. The upper screen has a traverse of 4½ inches and the lower one 5½ inches, and both make 110 double strokes per minute.

The coal is tipped upon the screens at A; the nuts and small coal pass through the ⅞ inch mesh and fall upon the sloping tray B, which delivers the mixture at the top of the screen containing the $\frac{5}{16}$ inch mesh. This screen takes out the small, which passes down the boxes D to the bottom of the two elevators and mixes with the coal which has passed through the crushers. The elevators deliver the coal into the bunkers, where it is stored for coking purposes. The nuts which pass over the $\frac{5}{16}$ inch screen are delivered upon the picking belt A, and thence into railway wagons.

The coal passing over the ⅞ inch mesh slides down to the 3 inch mesh, through which the cobbles fall on the belt B. The largest lumps are delivered on the belt C, and thence into wagons after being cleaned.

At the ends of belts A1 and B1 trap doors are fixed at E, so that whenever required, the cobbles and nuts can be diverted into the crushing pan H by means of the shoots F and the short carrier belt G. The shoots I convey the crushed coal to the foot of the elevators where it mixes with the small passing down the shoot O.

Balanced shoots are used at the end of the picking belts to avoid breakage in loading the coal into wagons.

Northumberland.—In this district small wooden coal tubs are in use, and the screening and cleaning is as follows in the most improved plants:—

The tub runs by gravity into a side tippler, worked by friction gearing, which delivers the coal on to a jigging screen; this screen is about 10 feet long and 5 feet wide, and its surface is composed of wire gauze, forming apertures about 1¼ inch square

By means of eccentrics the screen makes about 100 vibrations per minute, with a throw of 4 to 5 inches.

From the end of the jigging screen the large coal passes on to picking belts of various lengths and widths, travelling at a speed of about 50 feet per minute.

In some cases a partition is provided in the centre of the belt by means of angle irons, and into this space is thrown the dirt picked out from the coal.

At the ends of the belts balanced shoots or telescopic plates are used to prevent breakage in falling into the wagons.

The small coal, passing through the meshes of the main screen, falls on to a jigging screen below, where it is further sized, and conveyed away for various uses.

A few examples are found in the northern coal fields of revolving tables on which the coal is delivered from the jigging screen. These tables are 10 feet in diameter,

CANADIAN PIG IRON STATISTICS 1893.

The following Table has been compiled from Returns kindly furnished "The Review" by the Officers of the respective Companies, for the Year ended 31st December last.

Company.	Situation of Furnace.	Quantity Pig Iron Manufactured.	Value at Furnace.	Total Ore Charged.	Quantity of Fluxing Material.	Quantity of Fuel Charged.	Number Persons Employed.
Londonderry Iron Co. Ltd	Londonderry, N.S.	23,474 tons	$275,366	56,390 tons	13,500 tons	34,484 tons	400
New Glasgow Iron Coal and Ry. Co. Ltd.	Ferrona, N.S.	22,500 "	270,000	44,856 "	12,890 "	30,846 "	480
Canada Iron Furnace Co. Ltd	Radnor Forges, Que.	7,422$\frac{1438}{2000}$	185,575	16,700 "	1,680 "	750,000 bush. c.	600
Pictou Charcoal Iron Co. Ltd	Bridgeville, N.S.	*498 tons	Not given	853 "	124 "	68,220 "	100

* It should be stated that this company only resumed operations towards the end of the year, and the furnace was only in blast for a few months.

making three revolutions per minute, and are capable of dealing with 30 tons of coal per hour.

Scotland.—In the Scotch coal fields considerable attention has been paid to the question of screening and cleaning.

The tubs are of wood, carrying about 10 cwt. of coal. After being weighed they run into a tippler, usually worked by hand, which delivers the coal on to a jigging screen; the small coal passes through perforated round holes, about 1¾ inch in diameter, and falls into a wagon below or is taken by a conveyor to be sized or washed.

The large coal passes from the end of the jigging screen on to a travelling belt, from thirty to sixty feet long and 4 feet wide, and the dirt is picked out by boys stationed at each side.

Upon reaching the end of the belt the large coal passes over a fixed inclined screen, with bars about 6 feet in length, to take out any small which may have been made in the process of cleaning the large coal.

From the end of this fixed screen the coal passes on to a balanced lowering plate which delivers it gently into the wagon.

The small coal is either sold without further screening or is first washed. In other cases it is separated by means of revolving riddles into two or three sizes, each size falling on to its own belt, where the dirt is taken out by boys. Each size is disposed of at different prices.

In these cases the belts move at about 20 feet per minute, as against 40 feet per minute in the cases of the belts dealing with the large coal.

At some collieries an arrangement is in use which brings about very effective screening.

In these cases the tub is emptied into a small hopper, from which the coal is taken to the screen by means of a slowly moving conveyor about 8 feet long.

The bottom of the hopper lies below the level of the top of the screen, and the conveyor is inclined upwards at a proper angle. By this arrangement the coal is delivered on the screen, which is either fixed or jigging, in thin layers and in a continuous stream.

Costs.—These remarks would not be complete without some reference to the cost of screening and cleaning plants and to the cost of working them. Both these items must necessarily vary within very wide limits, owing to the great variety of circumstances to be found at different collieries.

Probably the largest quantity of Welsh steam coal which could be properly dealt with by a single belt is 70 tons per hour, and a fair estimate for a plant of this capacity, fixed ready for work, would be from £1,200 to £1,400, exclusive of the cost of the ordinary screen.

The cost of working will depend principally upon the amount of labor required for cleaning, and is found to vary in different coal fields from ¾d. up to 3d. per ton of coal cleaned. This cost is for labor only, and includes screening, cleaning, and loading into wagons, but nothing is charged for coal and stores used by engines, nor for repairs, interest on capital, or depreciation.

Undoubtedly the question of effectual screening and cleaning is one which must shortly claim attention from those connected with South Wales collieries. Most of the members are familiar with the complaints which are so frequently received from foreign buyers of dirt and excessive small mixed with large coal. Owing to the natural circumstances surrounding underground working in this district, it is inevitable that a certain quantity of dirt will be found in the trams. The weak roofs contribute to this result, and it is not uncommon to find crusts of dirt of greater or less thickness sticking firmly to the coal from some seams. It is equally certain, also, that no effectual system of cleaning can be carried out underground, although much can be done by strict supervision on the part of those officials whose duty it is to make frequent visits to the working faces.

To the keen competition of our home coalfields there has lately been added that of other coalfields, which have sprung up in almost every quarter of the globe, and, therefore, South Wales cannot afford to lag behind in the provision of such appliances as shall ensure that what is undoubtedly the best article in the world of its kind shall be supplied to the market in such condition as shall continue to secure for it the premier position and the highest price.

On the Deepening of a Shaft under the Cages.

Mr. Thomas Grundy (*Manchester Geological Society*), describes an arrangement used in the sinking of a shaft under the cages at Wigan Junction colliery. The shafts are situated in Abram, owned by the Wigan Junction Colliery Company, and known as the No. 3 and 4 shafts respectively. The pits had been sunk to the depth of, in the No. 3 pit, 600 yards; and in the case of No. 4 pit, to the depth of 510 yards; and the to mine known as the Wigan six feet. It is to deepening of the No. 4 shaft under the cages and the system of getting rid of the debris which we have for our consideration. The shaft was fitted up for winding coal and cannel from the Pemberton five feet, Bickershaw seven feet, and the Wigan four feet. It is fourteen feet in diameter, and in it are worked two cages having a length of seven feet six inches and width of three feet five inches, the cages are kept in position by means of eight conductors, four to each cage, and allowing a distance for clearance between the cages of two feet three inches. The rods were weighed at the ends by the ordinary cheese weights to the extent of about 50 cwt. to each rod. The cages were three decked, two tubs in each deck, and the cages were worked to the Wigan four feet mine, the mine next above to where the shaft was already sunk to, and having a distance of 30 yards between the two seams. You have now an idea how the shaft was arranged before commencement of sinking.

It was found necessary to deepen this shaft to the depth of 120 yards further, and knowing that strata which would have to be passed through would prove troublesome, in consequence of numerous faults running across the shaft, it was found desirable to dispense with a running jiddy as it would be necessary to make a rather wide excavation and put down an arrangement of falling doors. This was done and put in position in the shaft immediately opposite to the Wigan six feet mine, and a communication having been made in this mine between the No. 3 and 4 shafts, it was decided that all the debris, from the sinking and material for bricking, should pass through this mine to and from the surface. Arrangements being already in work in the No. 3 shaft by means of a single cage and conducting rods, whereby the material could be hooked on and sent to the surface or vice-versa.

The means adopted for winding were as follows: A rope 130 yards long was secured to the coupling immediately under the detaching hook, the rope being passed through holes eight inches in diameter cut through each deck of the cage, and as the rope was passed through the deck the men in charge of the work held the capping under the detaching hook till connection was made by screw, nut and pin. This was the only connection to be made or disconnected, and the time usually taken was about three minutes. The rope hanging then to the bottom where the debris was taken off, and when not in use in the day time was put on a reel on the lower side of the level. It was found that the length of the rope hanging down the pit between the two mines was rather an objection in making a quick connection, and to facilitate this a pair of clamps, with a hook at one end, were fixed on the rope about two yards underneath the cage.

These clamps serve the purpose of keeping the underhanging rope up when disconnection or connection was taking place, by the hook in the end of the clamp being brought to the side of a bearer and hooked into an eye bolt fixed on the bearer. You will see, from the sketch exhibited, the position of these, and that when disconnection had taken place the rope underneath is hanging by these clamps, the upper part and capping having been lowered underneath the scaffold and secured out of the way of the cage. It occurred to me to put a kind of false scaffold immediately under the conductor weight, as a safeguard in case of anything falling down the shaft or the vibration of the rods causing any of the cheese weights to come off.

In conclusion the writer points out that as the connecting of the rope to the link under the detaching hook was important, the persons engaged to do this work were the underlooker (in charge of the mine), the back fireman, and hooker-on; and these persons had written instructions given to them to stay there after the completion of their work of connecting the rope till the engine-man had stretched all the rope off the reel, and the hoppit had been hooked on to the rope, and run down and up; this time took about five minutes. These men were then at liberty to proceed to the surface, and the men in charge signed a special report that every thing was all right.

The sinking commenced at 4 o'clock in the afternoon, was continued till 5 o'clock in the morning, and any one entering the mines between those times did so from the No. 3 shaft.

The Limitations of the Gold Stamp Mill.

Last year our readers were furnished with a reprint of the excellent paper on this subject read before the American Institute of Mining Engineers. Since then the paper has been discussed by a number of eminent engineers as follows:—

R. RICKARD, Berkeley, California: I have been much interested in Mr. Rickard's description of the method of gold-milling now in use in Colorado.

There has always been a very wide difference of opinion regarding the merits of the Gilpin county method of dealing with the ores of that district. The present system of milling was introduced into Gilpin county at a time when there was no market for low-grade ores. Freights and

NOVA SCOTIA COAL DISPOSALS 1893.

From Returns kindly furnished "The Review" by the Officers of the respective Companies, the following Table of the Nova Scotia Coal Disposals for the Year has been compiled. As will be seen, the Mabou Coal and Gypsum Company is not included, along with one or two small operators, whose figures, however, would not make any material addition to our Statistics for the Year 1893.

Company.	Nova Scotia.	New Brunswick.	P. E. Island.	Quebec.	Ontario.	Newfounl'd	St. Pierre Miquelon.	United States.	West Indies.	Colliery Employees.	Colliery Consum't'n Railways, Engines, etc.	Bunker Steamers.
Intercolonial Coal Co.	100,651	3,565	15,943	85,895	33	880	......	... ..	......	3,666	11,749	......
Canada Coal & Ry. Co.	10,793	48,750	.....	......	..	23,774	......	248	.....	2,494	5,191	......
Cumberland Ry. & Coal Co.	129,515¼	133,290¼	......	119,284	..	.....	....	9,049½	......	7,513	27,694	......
Dominion Coal Co.	109,822	35,391	9,834	499,873	..	30,054	4,220	13,664	4,325	10,024	29,043	32,195
Acadia Coal Co.	178,429	19,329	24,500	9,557	..	......	......	......	......	5,803	22,634	12,954

The General Mining Association of London, Ltd., and the Low Point, Barrasois and Lingan Co., are given below in aggregate.

RECAPITULATION.

Intercolonial Coal Co.	222,383
Acadia Coal Co.	273,206
Canada Coals and Railway Co.	91,250
Cumberland Coal and Railway Co.	426,346
Dominion Coal Co.	868,445
General Mining Association	195,609
Low Point, Barrasois and Lingan Mining Co.	95,345
	2,172,584

smelting charges were such that only the highest grade of ores was profitable to handle. Had the present condition of railroad facilities and ore market been in existence, it is more than doubtful whether the system would have been so universally adopted. For the purpose of discussion, I would suggest whether a modification of the present system would not be advantageous.

In the early days of milling, and when there was no market for low-grade concentrates, the material flowing from the amalgamating-plates went direct to the creek; but later, when the large smelting industries of Denver opened a market for such by-products, concentration was resorted to with a very considerable increase in the yield of the ore.

In the paper under discussion, it is admitted that the gold and silver are chiefly contained in, and associated with the pyrite; and the reason given for the high drop and consequent slow mining is the necessity of reducing the sulphides to a very great degree of fineness in order to liberate the precious metals for amalgamation.

In an article written by the same author and published in the *Engineering and Mining Journal* of September 10, 1892, the result of a careful test of milling 8,400 pounds of ore from the California mine in the Hidden Treasure mill is given as follows:

	Gold ounces.	Silver ounces.
Contents of ore	7·46	32·86
Yield:		
By amalgamation.	5·25	14·00
By concentrates	1·74	10·22
	6·99	24·22

Equal to 93 per cent. of the gold and 73 per cent. of the silver contents of the ore treated.

It will be seen by these figures that slow work and fine crushing do not liberate all the gold and silver, as only 70 per cent. of the former and 42 per cent. of the latter are arrested by amalgamation, while 33 per cent. of the gold and 31 per cent. of the silver are still held by the pyrite, or such portion of it as is saved by concentration.

In view of the result shown by these statements, the question naturally arises whether it would not be advantageous to introduce concentration at an early stage of the operation, crush coarser and faster, thereby avoiding the certain increased loss from excess of slimes due to fine crushing, placing the concentrating tables at the outlet of the battery and removing at this stage of the operation all of the pyrite and its gold and silver contents, before passing the remainder of the pulp over the amalgamating tables.

In the article referred to, a comparison is made between milling and the treatment of the same ore by the smelter, with a result favorable to milling. The figures are as follows:

	Wet.	Dry.	
Ore treated.....	8,400 lbs.	8,064 lbs	
Obtained by milling, bullion.		$107 20	
Concentrates, net............		36 03	
			$143 23
Less milling, 84 cents per ton........			3 53
Net return by milling.			$139 70
If sold to the smelter the same ore would yield..			109 18
Leaving a balance in favor of milling of.			$ 30 53

If we take the same quantity of ore and treat it as suggested above, it will be found that the result will not show the present mode of milling in such a favorable light.

The contents of the ore are 7·46 ounces of gold and 32·86 ounces of silver.

The losses under the present system are probably greater than they would be if the ore were crushed coarser. For the purpose of the calculation, we will take the yield of gold at 93 per cent. and that of silver at 80 per cent. The original dry weight of 8,064 pounds would be reduced by concentration to 2,822 pounds, since 60 or 70 per cent. is the estimated proportion of soft feldspathic gangue in the ore, and this is easily removed.

2,822 pounds yielding 6·93 ounces gold at $20 would give		$136 60
And 26·28 ounces silver at $1...		26 28
		$162·88
Smelting charges and freight, $8 per ton.	$11 29	
Milling, 30c. per ton by the fast-drop mill of California type ..	1 26	
		$ 12 55
Net return....................		$152 33
Milling as at present................		139 70
In favor of proposed change..........		$ 12 63

or $3.10 per ton of ore treated.

The price of silver has been taken at $1 per ounce, because that is the value which figures in the article referred to.

It would be of great service to the mining industry if some of the mine owners in Colorado would make a test on the proper scale and with such thoroughness of detail as would make the experiment trustworthy.

HENRY A. VEZIN, Denver, Colo. (communication to the Secretary): About 1873 a well known metallurgist made some experiments in dressing ore from a mine in Gilpin county. It was done by a hand-jig and a tossing-kieve. No attempt was made to treat the refuse by amalgamation. The result was so favorable that he suggested to the manager of the mine the policy of crushing and jigging his ore, and allowing the tailings to go to the stamp-batteries, where all the ore was then being treated. Stamps were at that time the only available amalgamating machinery; but the metallurgist referred to anticipated that in order to obtain the best results, the ore would have to be crushed by successive comminution so fine that the tailings could not be fed to stamps; and he therefore had in view the use of other machinery to prepare the tailings for amalgamation. However, for the purpose of the experiment they could go to the stamps, provided coarse material was fed at the same time.

The manager understood so imperfectly one of the important points in the matter, that he placed his experimental works on the creek, about 200 feet below his stamp-mill. The ore was crushed to a diameter of ¼ to ⅜ inch by a Dodge breaker, screened by hand and jigged. The whole arrangement was crude, and required much manual labor. The tailings of all sizes were run to waste, no recrushing of dradge; no amalgamation. It was impossible to obtain samples of either ore or concentrates, or any data upon which to base a calculation, to determine the quality of the work. The only answer given to inquiries, was that it "did not pay." This result ir not to be wondered at, considering the crude methods, small scale and incomplete treatment. Since then nothing better has been tried, so far as I know, in the way of carrying out the metallurgist's suggestions.

Some years later, dressing works were erected in Black Hawk, Gilpin county, on North Clear Creek, to do custom work. The ore was crushed in a breaker and rolls, and treated on Collom jigs and buddles. The tailings were discarded, no attempt being made to crush as fine as would be necessary to save included grains of pyrites, or to crush very fine and amalgamate. This enterprise proved a failure. Since then, as I learn, the works have been remodelled, other jigs have been adopted, and stamps have been added for the treatment of the tailings from the coarse-grain jigs. The ore is crushed in a rock breaker and three pairs of rolls; is sized through 4, 6 and 8-mesh screens, and these coarser sizes are passed over jigs. The tailings from these are crushed by stamps weighing about 500 pounds, having a drop of 14 inches, and making 36-38 drops per minute. Stamping is done, presumably, through 40-mesh screens, and the stuff passes over amalgamated copper-plates outside the batteries. After amalgamation, the slimes are treated on slime-jigs and buddles. Here, I wish to call attention to the error in this treatment. Stamps are unsuited to prepare ores for dressing in which the valuable portions are friable, such as those containing the sulphides of the base metals. Even with fast speed and short drop, stamps produce, when crushing to, say 30-mesh, nearly three times as much slime, *i.e.*, stuff below $\frac{1}{200}$-inch in diameter, as good rolls crushing to the same size. With Gilpin county stamps, which have a high drop and slow speed, the product is still worse, *i.e.*, worse for dressing. If the coarser tailings from the jigs in this mill were crushed fine, by suitable machinery, the final tailings, to be treated by amalgamation, would be too fine to be fed under the stamps, unless they could be fed together with much coarser material. It would, however, be perfectly feasible to obtain, by other machinery, the finer comminution of the product required for amalgamation. The limit of fineness of stamp stuff is, probably, 8-mesh, or, say 2 mm., in diameter. This is the reason why the tailings of the 4, 6 and 8-mesh stuff are fed directly to the stamps. And, as long as the Gilpin county mill-men insist on preparing ore for amalgamation by their favorite stamps, so long will a comprehensive method like that outlined by the metallurgist fail to receive a fair trial at their hands.

I have had no opportunity of examining this mill myself. It is said, that it cannot compete successfully with ordinary gold stamp mills, except when treating ores carrying galena, or a good deal of pyrites. The charge for treatment is $2.50 per ton, and the capacity is 25 tons with 6 men, or 4.16 tons per man. Considering the size of the stuff treated, this capacity is very small. Though the ordinary stamp mill, in which a certain portion of the pyrites is recovered after amalgamation, does not return as much of the value of the ore as the other mill, its charge is so much less that the former must save from $1.25 to $1.50 more per ton in order to compete with it successfully.

E. E. OLCOTT, New York City: Much has been written on the subject of gold milling, including papers by Dr. Raymond (*Trans.*, i., 40); Professor H. S. Munroe (*Trans.*, ix., 84); Professor Egleston (*Trans.*, xii., 379); A. N. Rogers (*Trans.*, xi. 29); A. J. Bowie (*Trans.*, x., 87); Professor H. O. Hoffman (*Trans.*, xvii, 498); and John Hays Hammond's "Milling of Gold Ores in Cal." (*Report of State Mineralogist, 1888*).

I learn also, that Messrs. J. Ross Brown and John Hays Hammond are, at the present time, writing a book on stamp milling.

While, as has been pointed out by Mr. Rickard, the mechanical defects of the stamp mill are apparent, the advantages of the system are numerous. Its simplicity, adaptability and uniformity of work, are good points in its favor. The new machines which have been put on the market with the claim that they would supersede the stamp mill, have been numerous, but, so far, they have been unable to silence their clumsy prototype. The stamps still pound on, and are likely to continue to do so. Mr. Rickard has likened them to hammers. The ingenious inventor may get up a hammer, rule, and screw-driver, all in one, which may please the lover of novelties, but the skilful workman wants the old tried tools, not alone from prejudice but because he can do better work with them.

Wear and Tear.—The facility of renewing the wearing parts of the stamp mill is not an insignificant advantage, and counteracts in some measure the heavy consumption of iron per ton of ore crushed, and the necessity of discarding the castings before they are entirely consumed.

The shoes and dies are made of either iron or steel, experience varying greatly as to which is most desirable—much naturally depends on the hardness of the ore. As Mr. Rickard, says, the die should be softer than the shoe. It is sometimes made of mild steel, and the shoe of chilled iron. Excellent results have been obtained by me with mottled iron, a mixture of 85 per cent. hardest white iron and 15 per cent. of tough gray iron.

Iron shoes and dies last from one to three months in wet crushing, and the consumption of iron in the mortars averages about 1¾ pounds per ton of ore crushed. In South Africa, where the quartz is both hard and tough, the consumption of iron is high.

Messrs. Fraser & Chalmers are now manufacturing shoes and dies of what they call ferro-alumina, a highly crystalline hard white iron. Chrome-steel and Bessemer forged steel have been used with excellent results. Anything that increases the life of the wearing parts of a mill is important, for, we have not only to take into consideration the cost of the castings and labor of repairs, but also the loss of time, interruption to amalgamation, and the escape from the battery of unground ore every time the battery is opened. It is evident, also, that the work done by shoes and dies, that wear down evenly, is greater than where the faces become irregular and uneven.

In localities remote from the base of supplies, a cupola connected with every large stamp mill is very desirable. In it, with ordinary skill, the old iron can be recast, and, by varying the percentage of white and grey iron, and even old steel, excellent wearing parts can be made.

The screen is important. Formerly, slotted or punched Russia iron was almost always used, but of late, brass, phosphorbronze, aluminum-bronze, and steel wire-cloth, have been employed, on account of their greater discharge area. I have used phosphor-bronze screens in silver mills with the best results. By ordering the wire slightly heavier than in standard brass screens, a wear was secured several times that of the best brass screens that could be purchased. Aluminum-bronze is said to give as good results—in one case, wearing seventeen weeks, as against three weeks for Russia iron. Russia iron screens last from five to thirty days, average fifteen days.

Cams and tappets are now usually made of cast steel. Cams last from one to three years; the average in the California mill, Nevada, is sixteen months. Tappets should last four or five years.

Practice in Different Localities.—Mr. Rickard makes a comparison between Gilpin county, Colorado, practice and the more generally adopted California milling. The latter is unquestionably the best for most ores, and was adopted in the Black Hills, South Dakota, with few modifications.

As Prof. Munroe pointed out in the *Trans.*, ix., the gold stamp mill may be described as a combined crushing and amalgamating apparatus. The intimate admixture of quicksilver with the ore, by the swash in the battery, assists amalgamation; and copper plates inside the battery are to be recommended, except in cases where the percentage of sulphurets in the ore is very high. A good rule is to get your gold as soon as possible; and the following table, furnished by Mr. E. L. Young, will show, among other things, what a large proportion of the gold is saved inside the mortars in three mills, in Amador county, California:

	Keystone. water power.	South Spring Hill. water power.	Stewart. water power.
No. of stamps.....	40	30	40
Weight, pounds	750	750	850
No. of drops per minute.	96	90	85
Duty per stamp per 24 hours, tons.........	2½	2½	4½
Screens, slot-punched Russia iron............	No. 8	No. 7	No. 6
Miners' inches of water per 24 hours............	125	70	100
Head of water in feet	254	325	200
Cost of mining per ton	$3.50	$2.50	$0.40
Cost of milling per ton	.75	.65	.20
Percentage of amalgam saved in batteries..	.85	.65	.60
Percentage of amalgam saved on plates......	6.7	30	40
Percentage of sulphurets	1½ to 1¾	1	¼ to 1
Value of sulphurets, per ton	$110	$125	$60
Cost of working sulphurets per ton,............	$20	$20	$20

Some Stamp Mill Designs.—A diagram is presented herewith of a recently designed gold mortar. This is being built by Messrs. Fraser & Chalmers, for the Phœnix mill in Arizona. There is a recess for a copper plate at the back; but it is intended to use the battery without a copper plate in the front. In order to equalize the height of the discharge, iron filling up pieces are intended to be used under the screen, so that when new dies are put in, three thin filling up pieces will be put under the screen, and as the die wears down these can be removed, one by one. A more common means is to make the top bar of the screen-frame a little narrower than the bottom, so that by reversing the top and bottom of the screen different heights of discharge are obtained. The introduction of the steel lining-plate under the dies seems a doubtful experiment, though steel liners around the inside of the mortars above the dies are good.

The outward inclination of the screen (8° to 10°), spoken of by Mr. Rickard, is to be recommended.

Double discharge mortars have never seemed to give satisfaction for gold milling; theoretically they should effect a saving, but our best mill men do not believe in them.

I am inclined to consider as purely imaginary the grinding action on the ore, produced by the turning of the shoe on the die. Practically speaking, the stamp turns only when being lifted, and drops almost straight; the principal object of this rotation is to cause the cam and tappet, and the shoe and die, to wear more evenly.

In the west, axle-grease is usually employed on the face of the cams, but the practice in South America is to use molasses and water, so as to avoid any grease falling on the copper plates.

The cost of breaking rock in the crushers is far less than under the stamps, hence every mill man should see that as much work as possible is done by the rock crushers. When the ore coming from the mine is in very large pieces it would pay well to have a large sized rock breaker feeding into two smaller ones, so that the work of the stamps may be reduced to a minimum.

Various Notes and Comments.—I do not see how the rise in the temperature of the water caused by the friction in the battery can be sufficient to liberate bubbles of air which may float the slimed ore. Authorities do not agree with Mr. Rickard in regard to its being desirable to have the jar of the battery trasmitted to the plates, but on the contrary say that they should be supported independently.

The amount of quicksilver employed in the gold-batteries varies according to the richness of the ore and the experience of different localities. In Venezuela, at the Callao mill, the practice was formerly to keep the amalgam, both inside the battery and on the outside copper plates, quite hard. In the Black Hills, the amalgam is kept much softer. The amount of quicksilver that gold in different ores requires to make it adhere to the copper plates, can only be found by experiment. The coarser and purer the gold in the ore the smaller is the percentage of quicksilver required to form the amalgam. The loss of quicksilver is variable, depending on the amount of sulphurets in the ore, etc. Hammond gives the average loss as ½ ounce per ton.

Regarding the supply of water in gold mills, they can be run when necessary on a supply of 500 to 700 gallons per ton of ore; but it is desirable to have if possible an allowance of 1,000 to 1,500 gallons per ton of ore.

COST OF MILLING ORES IN VARIOUS LOCALITIES.

Sewart mill, Amador county, California, ...	$0.20
At the Spanish mine, California, belonging to F. W. Bradley, the ore only yields 91 cents per ton. It is mined for 40 cents per ton, and milled in Huntington mills, at a cost of...	0.23
Treadwell. Alaska	0.38
Deadwood Terra, Black Hills, South Dakota	0.55
Homestake, Black Hills, South Dakota.	0.64
South Spring Hill, Amador county, California	0.65
Keystone mill, Amador county, California.....	0.75
Mr. Rickard gives for Gilpin county Colorado	0.95
El Callao, Venezuela	1.18

Concentration and the Percentage Extracted.—There are very few gold mills in which it does not pay to concentrate the tailings, and treat or sell the sulphurets.

Frue or other vanners, revolving buddles, Colorado bumping tables, and blanket sluices are among the concentrators employed. The careful sampling and assaying of the tailings from all mills should be insisted on, so as to give absolute information as to the percentage of the gold that is saved. In the best mills in California the average results can be stated to be a saving of from 85 per cent. to 95 per cent. of the assay value of the ore.

PHILIP ARGALL, Denver, Colo.: The limitations of the gold stamp mill resolove themselves (according to Mr. Rickard) into the slow speed, long drop and high discharge, represented by the Gilpin county practice on the one side, and the fast speed, short drop and low discharge represented by the California practice on the other; while in the contrast between these systems he illustrates the very elementary axiom "that the treatment must be suited to the character of the ore." On this latter point, at least, we can all agree.

The high discharge is invariably used where fine crushing is desirable, or where stamping and pulverizing in one operation are necessary for the liberation of the fine gold. This practice is not by any means limited to Gilpin county or to any recent dates. As early as 1868, mills were running in Victoria, Australia, with drops of 18, 16, and 15 inches, the number of drops varying from 35 per minute upwards, and the weight of the stamp from 300 to 900 pounds.

At the Morro Velho mine, Brazil, the high discharge has long been used in the treatment of pyritic ores. Some carefully conducted experiments with high and low discharge at this mine, are given by Mr. J. A. Phillips, and are well worth quoting:

"With a 6 inch discharge, 75 per cent. of the stamped ore passed through a 120 mesh screen, and the loss in gold amounted to 44.70 per cent., while, with a 20 inch discharge, 87.5 per cent. passed through a 120 mesh screen, the gold loss being only 30.96 per cent. In other words, the high discharge reduced the material retained on a 120 mesh screen 15½ per cent., and thereby increased the gold saving 13¾ per cent.

It is a well established rule that fast speed, short drop, low discharge and heavy stamps are to be used for coarse crushing, while for fine crushing, slow speed, long drop, high discharge and light stamps are in order. The point at which fine stamping should cease, and from which the further pulverization of the ores should be conducted in Chilian or Hungarian mills, arrastras, or similar pulverizers, is not, however, very clearly defined.

The stamp is a very inefficient pulverizer, at best, and were it possible to get on the die at any one time all the fine particles requiring further reduction, the philosophy of lifting a 500 pound stamp 20 inches to crush these minute particles of ore, is not very apparent. Mr Rickard claims that the turning of the shoe causes the abrasion of the surface of the gold, etc. This action is, I believe, so insignificant in the stamp battery as to be almost unworthy of notice; and hence, when the grinding or abrading action is necessary to prepare the gold for amalgamation, resort is usually had to arrastras and similar grinding machines. This has been well illustrated at the Pestarena mine in Italy, where the best possible extraction with stamps did not exceed 65 per cent., while arrastras, in the form of the Frankfort mill, gave an extraction of 82 per cent.* The ores were principally iron pyrites, carrying the gold in minute particles, more or less enfilmed in micaceous schist. Not only fine grinding, but also time and *attrition* were found necessary for successful amalgamation.

Amongst the advantages claimed for the Gilpin county mills, we find the following:

(1.) "The deep discharge causes the pyrites to remain in the mortar long after it has been pulverized to a size smaller than the screen openings." Now, it is manifest that if the pyrites remained longer in the mortar than the other portions of the ores, the mortars would eventually be filled with pyrites to the depth of the feed used. This condition of affairs is not found to occur in practice. As I undrstand it, *all* the ores are retained longer in a deep mortar than in a shallow one; they are, therefore, crushed finer, and consequently the friable ores are reduced to an extremely fine state of division, and in great part converted into slime.

(2.) "The long drop gives the interval of time required to allow the settling of the fine gold." The coarse gold, in all probability, settles in the mortar and is amalgamated; the fine gold, however, would be thrown upwards by the splash, and caught in part on the copper plates, and in part discharged through the screens.

(3.) "The roomy character of the mortar aids the deep discharge in affording a chance for the gold to get out of the way of the falling stamp, and to become amalgamated on the copper plates." It is difficult to comprehend how the roomy character of the mortar, or the deep discharge can either jointly or severally afford a chance for the gold to "get out of the way" of the falling stamp, unless on the hypothesis that the gold is endowed with the potentiality of locomotion.

Mr. Rickard believes that the hammering which gold receives in a stamp-battery prevents amalgamation.

Professor Egleston says that † hammering gold on a smooth anvil with a clean, smooth hammer, prevented amalgamation; and he has further proved‡ that hammering gold in a clean mortar, under water, also prevented amalgamation. It is important to note that, in both examples, gold was hammered between smooth iron surfaces, an action that never occurs in a stamp-battery, in which the gold, if hammered at all, receives the pounding between rough and gritty ore, or at most, against but one iron surface—the result being the roughening and cutting of the gold flakes and particles, thus presenting new and clean surfaces to the mercury, and assisting the amalgamation. Indeed, Prof. Egleston's experiments confirm this view, for he found that when a freshly broken edge of the gold-plates came in contact with mercury, in every case it amalgamated at once. I have never found hammered unamalgamated gold in stamp-mill mortars where mercury was used, nor have I ever found a mill-man who has noticed such an occurrence. I am, therefore, warranted in the conclusion that the hammering (?) which gold receives in a stamp battery does not prevent amalgamation. On the contrary, I think it has a beneficial effect on that process.

We are told that the metallic sulphides commonly occurring in gold ores will be found, after stamping, in thin flakes and plates which readily float upon a running stream. These sulphides are iron, copper, and arsenical pyrites, zincblende, and galena, and I am not aware that they ever break up into plates and flakes under the condition named; they are, however, carried in a sluggish stream, floating, as it were, but simply on account of their excessive fineness.

The action claimed for the air in floating the slime in a mortar is, I presume, applicable to the California as well as to the Gilpin county mortar, if, indeed, it has any application at all. Now, the only way air can reduce the specific gravity of finely crushed ore, is by adhering in a fine film to the surface of the particles; and as the ore is wet from the moment it is put into the battery (and usually before it is put in) no air-film can form around the particles; therefore it is highly improbable that air gives the result claimed for it. As regards the heating of the water and air in a mortar, it must, under ordinary working conditions, be infinitesimal, probably not $\frac{1}{10}$ degree F. Of the many so-called contradictory features discovered in the stamp-mill, I will notice but one:

The vibration set up by the falling stamps is said to crystallize the iron work of the mill, and assist the work of gravity on the tables. I can see nothing contradictory in this. Vibration, under all conditions, will crystallize iron, and whatever good effect the vibration of the mill frame-work may have on the tables, it is not the same effect as the action of a jig.

The principal reason why the Gilpin county mill crushes less than the California is that it does more work because it *crushes finer*, and that, as the agitation of the water is less, the ore is not discharged so freely. The loss in efficiency, due to the greater depth of water is caused only by the resistance of the stamp in passing through it, and not to the loss of weight, for this latter is the same when it is lifted as when it falls.

Pause, during which the particles can settle, is counted by Mr. Rickard as the time between the successive drops of each stamp, that is $\frac{60}{30}=2$ seconds, but there is, in a 5-stamp set, a drop every $\frac{60}{5\times30}=0{\cdot}4$ seconds; consequently, the water in the mortar is agitated by 150 drops per minute; the only real pause at each stamp is the fraction of a second that it rests on the ore.

In comparing the amount of water used, it should be calculated per ton of material crushed. On this basis, there is no difference between the Australian and Colorado stamps; the former crushes 2½ tons with 5 gallons, the Colorado 1 ton with 2 gallons.

The greatest defect in the stamp-mill as a crushing machine is in the discharge. The ore, even with a double issue, cannot escape from the mortars as fast as it is reduced to a fineness corresponding to the screen openings, and it is consequently slimed. Particularly is this the case with pyrites and other heavy and friable minerals. This defect is augmented by the high discharge used in the Gilpin county mills, and it is claimed by Mr. Rickard to be made "an assistant to the mill-man." Now, if the greater part of the values were extracted from the pyrites, so that the tailings from the mills might run to waste, this practice would undoubtedly be the correct one to pursue; but inasmuch as the tailings are invariably concentrated, with a view to extract this very pyrite already reduced, in great part, to extremely fine slime, it is self-evident that "the mill-man's assistant" in the first operation becomes his adversary in the second.

There is always a danger in comparisons and generalizations. I therefore prefer discussing specifically milling under the conditions that obtain in Gilpin county; and to this end, it is obvious that one must take the whole process into consideration. Gilpin county milling is, in brief, fine stamping and amalgamating (very fully and clearly described in Mr. Rickard's paper) followed by concentration and smelting of the concentrated product. My experience is but that of an occasional customer of the mill. As such, I find the saving by amalgamation does not exceed 60 per cent. on average ores; and I freely admit that this is a good saving from ores carrying their principal values in pyrites. This statement of saving is confirmed by car-load lots that have been sampled at public samplers, and, afterwards, shipped to the mills for treatment, the complete returns of which I have had the privilege of examining, from time to time, as the tests were made. On straight iron pyrites, however, the saving by amalgamation in Gilpin county mills will not exceed 35 per cent. of the gold, as the following tests will show.

For the purpose of testing the extraction that could be made from pyrites, I had a carefully sorted lot of 11 tons put through a sampling mill, with the result that it assayed, gold, 1·06 ounces; silver, 1·74 ounces per ton. The ore was then shipped to one of the best mills in Black Hawk, Gilpin county, and the following result was obtained:

Gold saved.	Weight, oz.	Percentage saved.
By amalgamation..........	4·08	34·99
In blanket-tailings.........	1·52	13·04
In concentrates..	3·16	27·10
Total..	8·76	75·13
Silver Saved.		
By amalgamation	1.17	6.0
In blanket-tailings.	1.52	7.9
In concentrates..............	7.14	37.3
Total	9.80	51.2

	Pounds.		Gold oz.	Silver oz.
Weight of blanket-tailings........	416	containing	7.30	7.30
Weight of concentrates	10,200	containing	.62	1.40
	10,616		7.92	8.70

The gold might be described as fairly coarse. A few colors could be obtained from almost every panning. The amount of gangue in the pyrites was about 5 per cent., leaving, say, 10.45 tons of pure straight pyrite. It will be noted, however, that about 50 per cent. of this was lost in the tailings, together with 25 per cent. of the gold and 49 per cent. of the silver; while the 50 per cent. saved as concentrates contained 40 per cent. of the entire gold and 45 per cent. of the silver in the original ore. The concentration of the tailings in the Gilpin county mills is conducted on end-percussion tables (bump-tables). Now, as we have seen that much of the pyrites is reduced to slime in the mortars, the loss in concentration is

* The report of the Pestarena Company for the year ending June, 1889, shows that 20.5 Frankfort mills were kept working for 309 days, treating 4,345,443 metric tons, giving an extraction of 81.1 per cent., with a mercury loss of 234 grammes per ton of ore treated. The figures for the following year are 5,724,004 metric tons treated in 25.9 mills working 344 days; extraction, 78·77 per cent; loss of mercury, 230 grammes per ton.

†Trans., ix. 648. ‡Metallurgy of Gold, Silver, etc., vol. ii, p. 587.

necessarily heavy. It varies, perhaps, from 20 to 50 per cent. of the pyrites contained in the ore. Some of the Gilpin county gold-ores contain a fair amount of silver, the greater part of which is lost in the milling process.

The concentrates produced from the Gilpin county mills find a ready market at the Denver smelters, where the gold and silver are paid for at market rates, less 5 per cent., with a very moderate working charge, varying from $4 to $5 per ton.

It will be seen, that as the pyrites in the tailings is invariably concentrated and sold to the smelters, there is no gain in taking out part of its contained gold by amalgamation, more especially as in doing so, the ore is reduced to such a fine state of division that considerable loss is entailed in the subsequent process, a loss that far exceeds any advantage derived from extracting part of the gold in the mortars, and receiving the full market price for the gold so extracted. It appears, therefore, that concentration before amalgamation is the correct method to pursue in dealing with the average Gilpin county ores; and, in this connection, it is worth noting that this method is pursued in dealing with the *very coarse ores* from which the more or less solid sulphides are invariably picked out by hand and shipped direct to the smelters. It goes without saying, that if the principle is correct in the one case, it must be in the other: and if concentration by hand is applicable to pieces of ore from, say, one-inch upwards, mechanical concentration is equally applicable to the finer portion of the ore, as also to the mixed ores that require crushing preparatory to concentration.

I am fully aware that, in advancing the doctrine of concentration before amalgamation, I am going over old ground; nevertheless, I hold that it is the correct method to pursue, and, as such, cannot be set aside on account of the failure of previous crude tests, which were faulty in execution and incorrect in principle. Smelting is a very important step in the treatment of Gilpin county ores; without it, the present system of milling would cut but a sorry figure in the metallurgy of the west.

The full importance of smelting does not appear to be thoroughly understood by the mill owners, and it is not to be wondered at that the full advantage to be derived from concentrating and smelting is neither admitted nor practiced.

R. W. RAYMOND, New York City: Mr. Argall criticises Mr. Rickard's statement that the vibration of falling stamps, on the one hand causes a pulsation of the water flowing over the plates, and, on the other hand, crystallizes the iron of the working parts of the mill. But Mr. Argall's criticism is, that these two features are not "contradictory," as Mr. Rickard has called them. The point is an exceedingly fine one. The evident meaning of the author is, that one of the effects he names is advantageous, and the other disadvantageous. But it is much more important to note that Mr. Argall is himself not "contradictory" of Mr. Rickard, as I think he ought to be, with regard to the alleged crystallizing effect of vibration on the iron of the mill. He goes so far as to say that, "vibration under all conditions will crystallize iron." This is, beyond question, incorrect. It is not even settled that vibration will crystallize iron under *any* conditions. Mr. Howe* has compiled a summary of the evidence on the subject, adding an elaborate argument of his own to show that, possibly, vibration may sometimes have the effect mentioned; but the impression left by the whole discussion, is very strong, that, as a rule, the said effect does not take place as the result of vibration. Percy tried to find evidence of it, and failed. Stephenson found no change in a locomotive connecting-rod which had received 25,000,000 blows, at the rate of 8 per second; and he reported a similar absence of change in the beam of a Corliss engine which had received a shock of 50 tons eight or ten times a minute for twenty years. These, and many other pieces of evidence, will be found in Mr. Howe's book. The fact is, that Messrs. Rickard and Argall have adopted a current fable, which may or may not have a basis in occasional and exceptional experience, but which owes its vitality chiefly to its availability as an excuse to shield manufacturers from the blame deserved for bad work.

COLLIERY ENGINEERING NOTES.

Ventilation in Driving Levels.—G. Engeleke, (*Zeitschrift fur das Berg Hutten-und Salinenwesen im preussischen Staate*), describes the method of ventilating narrow workings at the Dudweiler mine, Saarbrucken, by means of small fans driven by compressed air, and taking their supply from the main air-ways. Two forms of Ser fan are used, one of an early form, about 20 inches in diameter, and driven by a strap from the engine; the other is slightly larger, and its axis carries the crank of a driving engine with a 2-inch stroke, so that no intermediate gearing is used. Twenty-one of these latter fans are in use, and they cost about £29 each. Compressed air for driving these fans and for other underground work is supplied from three wet compressors with an aggregate of 150 horse power. The air is compressed to four atmospheres and supplied by pipes, of which there are over five miles in the workings. The diameter of the pipe varies from 5·11 to 1·18 inches, and the pressure falls to two atmospheres in them at the extreme limits of the workings. The fans are kept locked in, and are under the charge of a special attendant.

Ventilation by this means is much better than when bratticing is used; the smoke from blasting is very quickly removed and the faces are cooled. The volume of air delivered by these fans varies from 180 to 724 cubic feet per minute, at distances from 150 to 293 yards from the inlet, when the fans are running from 189 to 435 revolutions per minute. There is a certain amount of loss at the joints and resistance at the bends, but two or three men can be supplied with sufficient air at 300 yards from the intake. The author then enters into the question of cost. Parallel drifts and stopings for 200 metres (218 yards) cost £168; brick brattice, £41 10s.; and fans and pipes £44 11s. In the cost given when brattice is used no account is taken of the extra work done at the main fan.

* Metallurgy of Steel, p. 196.

Shot-Firing Lamp.—The Roberts shot-firing appliance can be attached to any form of safety-lamp. A brass tube $\frac{3}{16}$ inch in diameter is inserted through the oil cistern, and its top is terminated in a brass box covered with gauze. A hole is made in the tube opposite the flame, and is normally closed by a sleeve pushed up by a spring. The lower end of the tube is also closed by a plate pushed over it by a spring. A blowpipe also passes through the oil cistern and is closed like the lower end of the tube. To fire the fuze it is pushed through the tube, the sleeve is drawn down by the pricker, and the flame is directed on to it by the blowpipe. When it is certain that sparks will not be thrown from the end of the fuze, it may be withdrawn.

Lock for Safety Lamps.—M. Rateau (*Societe de l'Industrie Minerale*) describes the special key used to open the lock on the safety lamp of Postolka and Eliasch, which is used at the Karwin collieries. This lock consists of a screwed bolt and a sleeve screwed both externally and internally. It can only be opened by turning the parts at an equal rate in opposite directions, and this is done by means of the key, which consists of a sleeve enclosing a spindle, these two parts being geared together by bevel gearing consisting of three wheels. A key for clossng the rivets is also shown.

Utilising the Waste Heat from Coke Ovens.—M. Rossigneux, in a paper read before the *Societe de l'Industrie Minerale*, recommends the greater use of the waste heat from coke ovens for the purpose of raising steam. He refers in this connection to the arrangements adopted at a battery of 100 Coppée ovens at Haveluy, the waste heat from which converts in twenty-four hours nearly 180 tons of water into steam of four atmospheres tension.

Accidents from Blasting in Collieries.—Mr. J. Ashworth, (*Manchester Geological Society*), deals with some recent accidents from blasting in coal mines, and suggests some methods by which explosives might be tested. The first is that they should be fired by a bare fuse without a detonator, and that they should be tested in bore-holes of different sizes. Experiments should also be made when an air current of high velocity is impinging on the mouth of the bore-hole. High explosives should be used in bore-holes of a size proportioned to their strength as compared with black blasting powder. When a small sized bore-hole is used, the tamping is stronger, and the explosive is distributed over a greater length, so that it can act over the same area as the powder. With regard to the air-current test, it has been noticed that the worst accidents have taken place when the shot faced ventilating currents of high velocity, perhaps because a detonating wave is set up. No explosive is safe in a fiery or dusty mine if its detonating vibration is like that of a mixture of fire-damp, coal dust, and air. A wet length of road is invaluable in arresting coal dust flame, but mere sprinkling the sides of the road with water is of no preventative value.

In discussing accidents from blasting in mines, Mr. J. Grundy criticises a recent paper by Mr. J. Ashworth, which describes amongst others an accident at Ashton Moss colliery. The author shows that this may not have been due to a secondary explosion of gunpowder, but might be due to the sudden compression of the air generating heat. In testing explosives it is scarcely useful to explode them with a bare fuse, and without a detonator, and without any precautions, but they should be tested under the conditions in which they are to be used. It would be a suitable field of research to investigate the question of resonance of sound under varied conditions, so as to ascertain whether an explosive or vibratory wave is concerned.

Removal of Fire-Damp.—H. Brenner (*Zeitschrift fur das Berg, Hutten und Salinenwesen im preussischen Staate*), gives an account of experiments carried on by D. Hilt at the Konig colliery, Grevenberg, near Aachen, to determine the possibility of removing fire-damp by exhaustion. The seam varies from 6 to 6½ feet in thickness, and from 20° to 50° in dip. A bord-and-pillar system of work is used and arranged so as to carry the air well up to the working face. A disused compressor was altered so as to exhaust at the rate of about 244,000 cubic feet per twenty-four hours. From the engine a pipe, 3¾ inches in diameter, was carried down the pit for a distance of 1300 yards, when it branched off in 2-inch pipes for about 300 yards. Finally, pipes of 1-inch bore were led into the workings, and terminated in perforated rose-ends or boxes covered with wire gauze placed near the roof. Gauges showed a vacuum of 9¼ inches of water near the pit bottom. This fell to 1·58 inch at the end of the main and down to 0·08 at the suction openings. A steam jet-exhauster was used, but with less success. The gases were exhausted alternately into one of two gas holders at first, but afterwards they were sent directly to the delivery pipe. As a whole, the experiments were decidedly unsuccessful, as the gas varied so greatly, and so much attention was required to keep the pipes and roses in order. The gases were used under boilers, but without appreciable economy.

Contributions to our Knowledge of Coal-Dust—Dr. P. Philips Bedson in a paper (*Fed. Inst. M. and M. Engineers*), gives an account of experiments made with samples of dust collected on the Ryhope screens, the general outcome of which is to confirm the results of his previous investigations which formed the subject of a paper read before this Institute some five years ago. The Ryhope coal-dust yields, when heated *in vacuo* at temperatures from 30 degs. to 100 degs. C., gases consisting of carbon dioxide, nitrogen, oxygen and combustible gases, which latter consists of paraffin and olefine hydrocarbons. The paraffine hydrocarbons are undoubtedly mixtures of marsh gas and some of the higher membersof the same series.

An account is also given of the results of an investigation of the gases enclosed by samples of coal-dust taken from the coal box or hopper, shortly after the accident which occurred in April, 1889, at Messrs. Straker & Love's colliery at Brancepeth. These dusts are entirely different in character from the Ryhope dust, one, viz., that collected from the timbers at the top of the box, yielding no combustible gas, but only carbon dioxide, oxygen, and nitrogen, whereas the second sample taken from the dust accumulated in the box gave a small proportion of combustible gas.

CANADIAN COMPANIES.

Dominion Coal Company, Ltd.—The first annual meeting of the Dominion Coal Company, the syndicate which secured control of the principal Nova Scotia mines, and which includes a number of well known Canadians in its list of shareholders, was held this month at Boston. A report of the operations of the company since its organization about a year ago was submitted by Mr. H. M. Whitney, president of the company. All the properties under option a year ago had since been secured and paid for in full. Two hundred thousand dollars had ben spent on the Louisburg railway, $150,000 for discharging plants and mining machinery and $100,000 for tugs and barges. The company mined 834,019 tons of coal, exclusive of the output of the Victoria mine, which will appear in next year's statement of business. The shipments increased 90,000 tons and the Canadian demand is steadily increasing. A new pit and the improvement of old pits are in progress. The report of the treasurer, Mr. J. S. McLennan, shows a gross profit on coal of $231,162.71, and profit on steamships, barges and gear, $163,267.95, a total of $331,430.66. For this has been written off to profit and loss expenditures for machinery, tugs, barges and equipment, with 10 per cent. of the cost of the discharging plant at Montreal and 33⅓ per cent. of the Sydney Hotel investment, $87,721.22, leaving a net profit of $246,709.44. A divided was paid on the preferred stock of $105,000, besides interest of $14,731.96 on the sinking fund, leaving $51,977.48 to profit and loss. If the full year's charges were deducted from the net profits there would have been $21,967.48 to profit and loss. The Board of Directors was elected as follows: Messrs. Henry F. Dinnock, Hugh McLennan, F. S. Pearson, W. B. Ross, Q. C., Sir Donald A. Smith, W. C. Van Horne, Henry M. Whitney, Alfred Winsor and Robert Winsor. There is a rumor that Mr. A. McKenzie, car accountant of the Canadian Pacific Railway at Winnipeg, has accepted the position of discharging and loading superintendent of the company at Montreal.

Sydney and Louisburg Coal and Railway Company.—A special meeting of the shareholders was held in London on the 14th inst. to pass resolutions for voluntary liquidation, the company's properties in Cape Breton having passed into the hands of the Dominion Coal Company.

The Maclaurin Phosphate Mining Syndicate, Ltd.—From the observations of the Official Receiver and provisional liquidator, Mr. C. J. Stewart, issued under a winding-up order made against this syndicate, it appears that it was formed in November, 1890, for the purpose of carrying on the business of phosphate and general miners, and to adopt and carry into effect an agreement for the acquisition of phosphate mines in the townships of Templeton, etc., in the province of Quebec, Canada. The nominal capital of the syndicate is £20,000, divided into 20,000 shares of £1 each. Of these, 11,445 have been issued; 6,455 were subscribed for, and the balance of 5,000 allotted in part payment of the property acquired. The Official Receiver asserts that no dividends have been paid, the operations of the syndicate having been conducted at a loss, and the shipment of phosphate appears to have greatly decreased since 1891, and latterly no business has been done. The unsecured liabilities are returned in the accounts at £3,795, against assets £1,538, the total deficiency as regards contributories being £13,708. The failure of the syndicate is attributed to the low state of market values and inability to discover phosphates at the mines in sufficient paying quantities.

Alberta Railway and Coal Company.—The Trustees, Executors and Securities Insurance Corporation announce that they have received instructions to pay on the 1st of February 10s. per cent. on the 6 per cent. mortgage debentures of the Alberta Railway and Coal Company. It will be recollected that in 1891 an arrangement was made for the payment of interest on these debentures in 1892, 1893 and 1894, partially in cash and partially in bonds of the Lethbridge Land Company, Limited. Engagements under this scheme were duly met in 1892, but in January, 1893, when 1¾ per cent. should have been paid in cash, and 1¼ per cent. in bonds, the only payment was £3 9s. in Lethbridge Land Company's bonds for each £3 coupon. On July 1, 1893, no payment whatever was made either in cash or bonds, the bondholders having agreed that net earnings to July 1, 1895, should be applied each half-year, as far as they would go, to the payment of the coupons maturing at the end of that half-year, this system to be pursued until July 1, 1895, when coupons then falling due are to be paid in full, all arrears to be met out of subsequent earnings. The payment just announced of 10s. per cent. is therefore in respect of the earnings of the half-year ended December. We understand that the company has received satisfactory news as to the earnings of the railway in the second half of 1893, while the coal sales are also increasing.

The Harrison Mining Company, Ltd., is applying for charter of incorporation under the Companies Act of New Brunswick. Authorized capital: $200,000, in shares of $10 each. Chief place of business to be at Fairville, Parish of Lancaster, St. John County, N.B. The directors are W. Wheeler, St. John, N.B.; Cyrus W. Davis, Waterville, Maine, U.S.A.; E. C. Elkin, St. John; M. S. Beach, Silverton, Colorado, and C. T. Bailey, St. John, N.B.

The Kootenay & Columbia Prospecting and Mining Co.—At the annual general meeting held at their offices in Ottawa, on 19th ulto, the reports showed that notwithstanding the depression in the silver market a satisfactory business had been done, the fine quality of ore mined having brought good returns. Work will be pursued vigorously during the coming season. The following directors were appointed: Archibald Stewart, Hector McRae, S. H. Fleming, W. A. Allan, and G. P. Brophy, all of Ottawa.

Intercolonial Coal Mining Company Ltd.—The annual general meeting of shareholders will be held at the offices of the company in Montreal, on 7th March.

Cumberland Railway & Coal Company, Ltd.—The annual general meeting of shareholders was held at Montreal, on 14th instant. The old board of directors was re-elected.

Ledyard Gold Mines Company, Ltd.—A company is being incorporated under the name of "The Ledyard Gold Mines Company, Ltd." to work the gold veins on east half Lot 19, in 1st Concession, Belmont, Ontario. Shaft No. 1 is now being continued, and it is intended to sink 100 feet in depth. Arrangements are being made to put in a Huntington mill, which seems well suited to this ore as it contains a good deal of sulphurets which will have to be concentrated.

The Armstrong Lime Company has been formed in New Brunswick to purchase from the owners all right in the trade mark "Green Head Lime" and to take over and carry on the business of manufacturing lime, owned by Messrs. J. and F. Armstrong. Head Office: Green Head, Parish of Lancastor, St. John County, N.B. Capital, $60,000, in shares of $100. Directors: J. Armstrong, F. Armstrong, F. W. Armstrong, and J. A. Armstrong of Green Head, and J. G. Armstrong of St. John, N.B.

The Strathroy Oil Company, Ltd. has been incorporated in the Province of Ontario, to carry on the business of producing crude petroleum oil, etc., in the Township of Enniskillen, County of Lambton. Authorized Capital, $100,000, in shares of $100. Directors: G. A. McGillivray, London; D. B. Lindsay, and Chas. Grit, Strathroy, Ont.

The Londonderry Iron Company.—The sixth annual meeting of the Londonderry Iron Company, Ltd., was held at their office in Montreal this month, when the annual report for the past year was submitted and adopted. The following board of directors was re-elected: Lord Mount Stephen, Sir Charles Tennant, Bart., Hon. Donald MacInnes, A. T. Paterson, John Turnbull, A. S. McClelland, and R. MacD. Paterson. At a subsequent meeting of the directors A. T. Paterson was re-elected president and managing director; Hon. Donald MacInnes, vice-president; J. Phymister, was appointed secretary, and F. C. Budden, treasurer.

Broad Cove Coal Company, Ltd.—This company has been incorporated by Act of the Legislature of Nova Scotia, to mine and deal in coal, coke, ironstone, copper, manganese and other minerals in the Province of Nova Scotia. Authorized capital, $3,000,000, in 30,000 shares of $100. The principals are: W. P. Hussey, Danvers, Mass.; W. H. Munroe, Edgarton, Mass.; John Y. Payzant, Halifax; W. H. Wiswell, Halifax; and the Hon. J. M. Raymond, Salem, Mass.

Caribou Gold Mining Co., Ltd.—Incorporated under Act of Legislature, N.S., 1894. Authorized capital, $200,000, in shares of $1. The principals are: James T. Burgess, J. B. Neely and Walter H. Covert, Halifax. Formed to operate in Nova Scotia.

Golden Lode Mining Co., Ltd.—Authorized capital, $30,000, in shares of $100. Formed to acquire gold areas at Mount Uniacke, Halifax County, or elsewhere in the Province of Nova Scotia. Principals: A. M. Jack, Henry Bell and A. A. Hayward, Halifax.

Tudor Gold Mining Co., Ltd.—Authorised capital, $100,000, in shares of $10. Principals: James C. Ayer, New York; Frederick Taylor, Lowell, Mass.; Sydney W. Thurlow, Lowell, Mass. Formed to operate in Nova Scotia.

Cochran Hill Gold Mining Co., Ltd.—Authorised capital, $500,000, in shares of $1. Principals: George Clark, D. F. Quigly, J. B. Neily, J. T. Burgess, A. P. McQuarrie, Alfred G. Cunningham and Walter G. Brookfield, Halifax. Formed to operate in Nova Scotia.

Pictou Development and Mining Co., Ltd.—Authorised capital, $100,000, in shares of $1. Principals: Wm. McKenzie, Thos. Tanner, C. L. Rood, Alvin J. Craig, Pictou, N.S.; George A. Pyke and Hugh D. McKenzie, Halifax; and D. G. McDonald, Elmsdale. Formed to operate in Nova Scotia.

North American Gold Co., Ltd. — Authorized capital, $250,000, in shares of $50. Principal: Adams A. MacKay, Halifax. Formed to operate in Nova Scotia.

Victor Gold Mining Co., Ltd.—Authorized capital, $200,000, in shares of $1. Principals: Jas. P. Burgess, A. G. Cunningham, George S. Campbell, W. G. Brookfield, A. N. Whitman, Halifax. Formed to operate in Nova Scotia.

Northumberland Coal Co., Ltd.—Authorized capital, $250,000, in shares of $10. Principals: Thos. F. Wentworth, Charles D. Ross, New York; John E. Marsh, St. John; Herman D. Walbridge, Washington; John O'Connell, New York; J. G. Blanchard, New York; F. V. Wedderburn, Hampton. Formed to operate in New Brunswick.

ONTARIO MINING ASSOCIATION.

Successful Meeting at Sudbury—Some of the Papers Read.

The annual meeting of the Provincial Mining Association of Ontario was held at Sudbury on Wednesday, 14th inst. Amongst those present were: C. F. Farwell, Sault Ste. Marie; R. McConnell, Mattawa; W. J. Miller, Thessalon; W. McVittie, T. Roberts, Whitefish; Mayor O'Connor, ex-Mayor Fournier, J. B. Hammond, A. McCharles, J. R. Gordon, C.E., Geo. Mickle, M.E., L. V. Rorke, D.L.S., R. W. DeMorest, D.L.S., W. A. Quibell, P.M., Jas. McCormick, M. C. Bigger, Dr. Struthers, F. Cochrane, Dr. Howey, J. W. Evans, M.E., T. J. Ryan, Geo. Tuddenham, A. H. Smith, A. W. Wolter, Jno. Frawley, Dr. Mulligan, Rev. W. K. Shortt, R. T. McEwan, G. W. Jackson, P. Maloney, D. L. McKinnon, J. W. Edwards, A. Ferris, S. E. Wright, A. Paul, A. McIntyre, Dr. Arthur, F. Sinclair, M. McCormick, W. Holditch, B. Washburn, D. Baikie, W. J. Ford, S. B. Eyre, P. McGregor, R. Ross, J. Bald, Wm. Chalmers, R. Martin and J. B. Veach.

Election of Officers.

The following officers were elected.
J. B. Hammond, Sudbury, *President*, re-elected.
Rinaldo McConnell, Mattawa, *1st Vice-President.*
John McKay, Sault Ste. Marie, *2nd Vice-President.*
George Mickle, M.E., Sudbury, *Secretary.*
R. W. DeMorest, *Treasurer.*

Ontario Mining Law.—Resolutions Passed.

1. That all royalties on minerals should be abolished.
2. That all applications for mining claims should be null and void at the expiration of sixty days, including all present applications in the Crown Lands office.
3. That any person, by paying the Government $1 an acre within sixty days for any mining claim taken up by him, and expending $2 an acre in development work within two years from the date of application, should be entitled to his patent.
4. That there should be a local office in every mining district to give all needed information to prospectors and others about mineral lands, and to record claims in, the same as in British Columbia.
5. That this district being the principal mining centre of the province the mining inspector should have his headquarters in Sudbury and be a practical mining man.
6. That the Ontario Government should do everything in its power to promote the opening up and development of the unsettled portions of the province, by giving liberal assistance to railways, colonization roads, and otherwise, as the best means of preventing the exodus of our young men.
7. That the members of this Association use their vote and influence to elect only such candidates as will pledge themselves to support whatever party in the Legislature will endeavor to carry out the wishes of the Association with regard to a proper mining policy.

President's Address.—The Desirability of Independent Representation for the Mining Districts of Ontario.

MR. J. B. HAMMOND.—The members of the Provincial Mining Association and Gentlemen. In choosing the subject just named as the basis of this paper, I have been guided by the consideration that we are here not only as members of this Association, but as citizens, alive to the importance of doing all in our power to aid the development of our mining districts. The whole Province and our fair Dominion as well, will share our prosperity if we succeed in doing this. I shall first recite a few of the most important ways of doing this, and pass next in review a few ways of not doing this, and conclude by a comparison of these ways.

In stepping aside in the course of this paper to consider briefly the industries of the district of Nipissing and Algoma which must go hand-in-hand with our mining industry, (I refer to our timber and agricultural resources) I am guided by the same consideration, that it is highly proper even from the special view of one who is a member of this Association, merely that such a one should be intensely interested not only in mining affairs but also in all matters touching mining affairs, to say nothing of our privilege, nay, our duty in looking as interested citizens after our welfare from this higher ground.

Upon the principle then that we are studying, not only our own personal interests, but also those of our neighbors and those who may be induced to unite their efforts with our own, in what way can we aid for instance, the growth and development of our New Ontario? We will all agree that, as an accomplished fact, the existence of the Canadian Pacific Railway, opening up to us as it does nearly all the settled parts of Canada, the United States and even distant countries across the seas, giving us outlet and inlet at all times for all purposes, is the greatest fact and factor in our development to-day. Were not such a road here in operation, who would think of spending time, energy and money in such an inaccessible portion of the Dominion as this would then be? What mine would be worked, how many settlers would we have, how much more difficult and expensive would be the vast operations of our lumbermen in these districts? Therefore, the patrons of industry on this one point, to the contrary notwithstanding, no one here who has spent months and years in seeking out our natural resources in our forests, hundreds of miles away from more thickly settled portions of Ontario, will for a moment deny that we have in these districts elbow-room for millions of people, at present locked up for the lack of means of inlet and outlet, except for a few miles each side of the line yet built in this vast country. In the interest of laying bare and making accessible the more remote parts of these districts and in aiding the discovery and utilization of illimitable resources, we are here to advocate the right and advisability of our Governments to grant liberal aid in donations of land or otherwise, towards promoting the building of such railways. Our most hardy prospectors tell us of large deposits of mineral and fine reaches of good land far to the north, east and west of this town. How long are they to remain untouched? Until they are reached by railroads. A rich mineral country is reported to the south of us from Georgian Bay northward. More railroads are needed in the Sudbury district. What can we do with the best nickel, copper or iron mine twenty, or even ten miles from a railroad? We must have live men, devoted men, well posted men, energetic men in the Dominion Parliament and Provincial Legislature who, bound by no party chains, study our interests and press our interests in this and all other respects from the sole standpoint of country first, and we can aid the country by sending such men to our houses of parliament. There is no way we can help so much.

Second only in importance to such a railway policy is a policy developed into simple, comprehensive and efficient laws regulating and inducing the thorough development of our natural resources as regards mining, agriculture, and the utilization of our forest supplies. That wise legislation is needed in these respects has never been in dispute, and that it is needed now more than ever before is admitted on all hands. Yet what do we see but waste on the one hand of the precious supply of pine, irritating and worse than useless restrictions in our mining law, and on the other, whole tracts of country withheld from both prospector and settler! Do these things aid the development of this country? Where are our supposed representatives? What are they doing to act in this way? They are party men, perhaps, but not men for this country. Again I say, having given them fair trial and found them wanting, we must send down only men pledged to country first. We can do this, and so help our country.

Is it right to have our pine kept from the settler who spends his time and tries to made a living in this country, to sell it in large blocks to the highest bidder who then proceeds to slash it all down, not even forgetting to take four and five inch tops of young trees? This is a shame! But I forget: there are but few settlers, and such as face such privations only serve to discourage the general settlement of the fertile valleys of these districts. People are starving in all our cities, and there is plenty of good land up here, but the government must have the ready cash for the pine at any cost. And how is it that we see so little of the hundreds of thousands of dollars got yearly in this manner from this country expended in opening up these regions? It is ridiculous, Gentlemen! You and I who are trying to do all we can for this country and to gain an honest livelihood from it do not like to see our resources wasted. We say that this waste should be stopped. Our true representatives will use every efforts to have it stopped, and to give the settler here rather than the fat government official, his just share of what he works so hard for. He has a right to this not surpassed by that of any alien, at all events, and where can we find the craven spirited individual who dares to say it is not a superior right. Let us send down men who will see to this matter before it is too late. We are told by some people who should know better or keep silent until they find out the facts, that we have no lands worth speaking of for the purposes of agriculture in northern Ontario. I regret to see signs of the spread of this erroneous impression in the second report of the Bureau of Mines. Dr. A. P. Coleman, Professor of Metallurgy and Assaying in the school of Natural Science of Toronto, in a paper contributed to that report on Ontario's Mineral at the World's Fair, page 185, says: "The Laurentian and Huronian country in the greater Ontario to the north and west was non-existent to the hard working man of the south except as a region of barren rocks and muskegs, where you might get some good pine lumber if the fires had not destroyed it, but that was worthless otherwise because you could not farm it. In spite of its immense area Ontario has reached its limit of rapid advancement according to old methods, and yet its people are afraid to venture on new and risky enterprises to develop the richness of th- mining country to the north." After citing the former failures in the Madoc region some twenty years ago, where now again, however, gold mining is being actively pushed, he closes the paragraph with the remark that "for some time to come we may expect Americans, Englishmen and everyone else except Canadians to develop and profit by our mineral resources until we have time to learn from them and gather the knowledge and courage to do our own mining and smelting." As regards the first part of the quotation, a little more study on the ground would show the gentleman that there is no reason whatever, under a continuation of the fostering care, encouragement and supervision given the farmers to the south of us, why settlers up here in Nipissing and Algoma should not prosper as well as the settlers below did under similar circumstances. The fact that hundreds are comfortably well off here already in spite of drawbacks not suffered by earlier settlers in southern and eastern Ontario, is sufficient proof of the fertility of the soil (which is already estimated to amount to from ten to twenty-five per cent. of the total area) of a generous climate and of the capability of the pioneer to adapt himself to both. The gentleman evidently did not see the potatoes grown in Algoma which took the first prize at the World's Fair! The latter part of his remark I shall deal with later on.

Again, what provision under the present timber policy is made for mining purposes? The lumberman and the mine owner are both seen racing for a tree, and the first man gets it, with this difference, that should the miner appear first on the scene, his uncut store is rudely seized by the second man, no matter how hardly pressed the miner may be in the present or in the future for the timber and wood standing on his claim. Gentlemen, I must blush for such a policy. Nor am I joking when I say that the question of fuel here is a burning one. But when has this not been so? Again, all mines and mining and smelting plants need, and must have large quantities of good sound timber, such as is fast disappearing under the present plan of operations, whereas not one tenth of our mines, even as yet found, are yet in operation, nor will be for years under our present law. Observe what an item of expense the getting out of wood already is, what branch lines of railway and numbers of wood trains must be utilized. These are facts which must be met and provided for by every mining company. When a prospector pays for a mining claim his right to the pine and all other wood on it should be strictly protected. It may be that for years it will not be used, but he has the first right to it on fair terms. Are our representatives representing and urging that right with might and main? If not, what are they representing? Perhaps the word is rapidly losing its meaning altogether. Think this matter over, gentlemen. We can help ourselves to our rights by settling up this country with farmers and miners, and by sending good men and true, who are not fighting party battles, to our houses of parliament, to see that we get those rights as inhabitants of this country, or know the reason why. We have responsible government in the country, and we fail of our duty when we fail to see to it that it is responsible.

Now, as to our present mining law. A residence of nearly five years in these districts has enabled me to make a few observations and get at some facts which I now intend to present to you. For the first time during all these years I shall request your indulgence for introducing my personality with that of others in the following account of a serious struggle with our legislature in Toronto with reference to those laws, a struggle that is not yet ended by any means, but which is to be continued until we have secured a just measure for mining life—not death.

The discovery of nickel ore in large quantities in association with the copper ore, of these districts, has drawn here a large number of people who, upon exploration, bought mining lands in the laudable hope of thereby bettering their fortunes, myself amongst the number. Coming here in '89, when prospecting for mineral was still the rule amongst energetic men, young and old, I joined in aiding and prosecuting this important work. In the latter part of 1890 I was in New York advertising and negotiating the sale of a large and valuable mining property in the district, when, on reaching the line at Prescott, on my return, I learned that the Ontario Government had just withdrawn from sale all mineral lands for some forty or fifty miles east and west of this town, (Sudbury), two of my own claims included. I could hardly believe my ears. I telegraphed right and left. It was too true. I tendered the purchase money in person having received no notification of any such intended action, and for the further reason that the claims had been located but a short time before. The money was refused. Thus, without warning, we were left in the dark for months, some for a year. Meantime, there was general consternation and much bitter and distrustful feeling throughout these districts. This feeling culminated in the convening of a mass meeting here by our then reeve, Mr. S. Fournier, the outcome of which was the sending of a delegation to Toronto to present an address drafted at that meeting, embodying the opinions of mining men and prospectors in the Sudbury mining district on questions of vital importance to them. The fate of these people was felt to lie in the hands of the Provincial Legislature. The deputation was composed of Messrs. Stobie, Fournier, O'Connor and Ryan, and was sent down early in March, '91. A back-set in our development was feared, and as the sequel only too well proved, it was rightly feared. Mining and prospecting here, as Father Taylor described the state of religion in a certain town, has been looking up ever since. You may have heard that this good man once went to a conference at which his ministerial brethren compared notes as to the state of religion in their respective parishes. Presently he was called upon to report for a town in which he had lately been laboring—a town somewhat noted for the low state of religion in it. "Oh," said Father Taylor, "religion is looking up there." The answer occasioned much surprise. "How is that?" inquired the leader. "Is there any ge eral awakening in the church?" "No." "Any special interest on the part of those outside the church?" "No." "Well, then, what do you mean when you say that religion is 'looking up' there?" "Why," said Father Taylor, dryly, "religion is flat on its back, and it has to look up if it looks anywhere."

The deputation asked for the first privilege of purchase for thirty days only; that a prospector by right of discovery and paying a fee of $5 be allowed to hold 80 acres one year on doing $100 worth of work, with the option of purchase within a year; that the territory withheld from sale be declared a mining district with a local office at Sudbury; that prospectors be thus encouraged to discover minerals. The document went on to state that selling mineral land as timber land was sold would discourage actual workers, and lead to locking up the country by monopoly; that a royalty on ore, or an increase in the price of land would also tend to limit the number of those engaged in the work and thus check development; also, that much of the mineral development in many states of the union was due to the fact that the above-mentioned recommendations were in force. Mr. Stobie advocated a school of mines, supported by Mr. O'Connor, on the ground of the Government's being able to smelt ore for small producers who could not purchase smelters. Mr. Conmee thought such an institution could be made self-supporting. Mr. Stobie showed that ore had to be sent abroad for treatment and report. Mr. Ryan called attention to the successful operation of schools of mines in the United States. These suggestions doubtless got Mr. Mowat's most serious consideration. I next notice the action during that same week of the geological and mining section af the Canadian Institute in advocating a Provincial Department of Mines, and calling a meeting for the 31st of March to consider measures for the advancement of the mining industry, and the advisability of establishing a Provincial Department of Mines. The arrangements were in charge of a committee composed cf Hamilton Merritt, George Mickle, Allen McDougall, Arthur Harvey, R. Clougher and R. Dewer. Rumors of royalty were in the air. The convention took place and waited upon the Ontario Government on the third day with resolutions advocating a Department of Mines, a provincial museum, the pushing of surveys, mining education, local agents, right of staking out, development work, sustaining of the price of mining lands, aids to roads and railways and emphatically pronouncing against all provincial taxation in the shape of royalties and ground rents. Mr. Mowat replied that he thought it would be found before the session was over that the Government had taken all the matters brought to their attention into consideration in the regulations they would submit to the House. The Dominion Government was also memorialized to do for the Dominion what the Royal Commission had done for Ontario, to see to the lowering of rates on ore railways, and the belief expressed that a free market for mining products would be of advantage to both parties and greatly tend to the development of the mineral resources of Ontario. Mr. F. L. Sperry was the special representative of Sudbury on this occasion and a member of the committee on resolutions.

We come now to the mining bills early in April, wherein we face royalty, agreed to by both political parties! There was considerable excitement in Sudbury that Friday evening. A meeting was held, and Messrs. Ryan, Skynner, Hammond, Sperry, Pings and Fournier were appointed a committee to draft a petition and have it circulated as widely as possible. At a public meeting on the Monday following the following resolutions were unanimously passed: That in the opinion of this meeting the proposed royalty of 3 per cent. upon the output of our mines imposes a heavy and unequal burden upon such mines as shall be discovered in the future, and would stop the further development of this important industry; that the prospectors will be obliged to stop work, as the most valuable mine would be unsaleable under the proposed royalty; that copies of these resolutions be sent to our representatives at Toronto, with the supplement of the *Journal*, with the request that they will support our views by every legitimate means in their power, and if they are unable to do that, in the opinion of this meeting that they no longer have our confidence, or are fit to represent the mining districts; that copies be also sent to the Toronto Board of Trade, with the request that they will use their influence to have the royalty clause eliminated. The township council also held a special meeting at which a resolution moved by Mr. O'Connor, seconded by Mr. Anctil, was passed, that the royalty clause, in the opinion of this council, would be detrimental to the interests of the Sudbury district, that it will frighten away capitalists and will prevent them from doing any work to further develop the mining industry of this district which needs all the help and care that the Government can bestow upon it, and humbly praying the members to remove said clause.

I may state that I found no difficulty in getting the supplement of the *Journal* well filled with able letters on this subject. We had six twenty inch columns of them contributed by John Hall, W. J. Skynner, James Stobie, F. L. Sperry, R. W. DeForest, Stephen Fournier, Alexander Paul, J. R. Gordon, C. A. Russell, A. McCharles, A. Hoffman Smith, J. H. Babcock, W. Canning, and myself, not forgetting a vigorous editorial by the editor, J. A. Orr, and I took copies for each member of the House and for general distribution to the press and Board of Trade of Toronto, saw them faithfully put on each desk in the Assembly Hall and I may add well read by the members. Mr. Conmee gave me valuable assistance in this matter. A large deputation waited upon the Government that week, and I had the pleasure of reminding the Attorney-General amongst other things, that if agriculture needed and obtained help from his Government, I claimed that mining requires even more assistance, since we could not grow mineral, once gone, gone forever, and the mine so much the poorer. Mr. Conmee predicted a serious reduction of the revenue of the Government from the lands should the royalty clause stand. This prediction has been amply verified. Mr. McKellar said that the royalty imposed in 1868 had to be repealed in 1869, because it put a stop to mining development or every kind. Mr. Mowat said: The subject is an important one. It has received a good deal of attention and it will continue to receive attention until we make up our minds what it is best to do. What did they do? They disregarded us all and imposed the royalty. Stock in the town of Sudbury took a heavy drop that day. We had been snowed under by over-selfish farmers, lawyers and doctors in the House. The prices of land ranged now from $2 to $4.50 per acre. True, we wrung from those people some trifling concessions. A seven years' respite was held out, or four years if rich in nickel. The royalty was to be calculated upon the value of the ores at the pit's mouth. I shall not soon forget Mr. Hardy's attitude in this whole matter and in insisting that four years was enough for nickel. He may be a big man, but he is not big enough for this country.

We presented James Conmee with an address in Sudbury for the brave fight he made in our behalf early in May, 1891. Our own representative was both in it and "not in it." He was for the royalty. A Bureau of Mines was established, and a man by the name of Mr. Blue, a gentleman not eminently known to our mining public as a mining man, was appointed director. It was a blue outlook all around. And so things drag along till the 7th of October, when the Sault Ste. Marie Board of Trade called a convention of all parties interested in mining to be held in that town on the 7th, 8th and 9th of that month. A series of eleven questions touching our interests was issued throughout the province, and many answers were obtained and read at the convention, which was duly held. Sudbury was represented by Messrs. Stobie, Hammond, Orr and Holditch. This convention was largely attended and was of a most interesting character. A full dozen of resolutions, including a request that we be properly represented at the World's Fair was passed, and thereupon was formed the Provincial Mining Association, whose constitution and by-laws lie now before you, and whose aim it has been and will be to know no party as an Association, to do all in our power to advance the mining and prospecting interest of this country, and to offer a bold and united front to all oppression. Our work during the past two years will be fresh in your memories, and though not yet crowned with success, never before have we had such golden opportunity to speak and act, each man of us, by our ballot, in upholding a platform we have conceived to be in the best and truest interests of our country.

I may, however, be allowed to recite briefly how, at the next meeting of the Ontario Legislature, we asked some assistance in connection with a customs smelter we endeavored to float, and the establishment of a government laboratory in connection with it; how we were refused, although the Toronto Board of Trade supported our claim; how a mining deputation consisting of Messrs. John McKay, Thos. Marks, J. J. Skynner, J. Bawden, Dr. A. S. Thompson, Arthur Harvey, T. D. Ledyard and Aldermen Leslie and McDonald of Toronto, introduced by Dr. Conmee, waited on the Government on the 8th March, 1892, and presented a petition asking in strong terms for the repeal of the royalty, and for the establishment of schools of mines; how vigorous speeches were made in support of the petition by Dr. Thompson, Mr. Marks, Mr. Harvey and Mr. McKay; how Mr. Hardy supported his policy of royalties; how the proposed laboratory would cost $3,000, and the officers in charge $3,000 more; how these gentlemen were dismissed with the everlasting promises of consideration; how the charter of the Customs Smelting Co. (Ltd.) was issued; how thousands of dollars are subscribed to the purchase of its stock by the poor of Sudbury; how capitalists and that for us good-for-nothing Ontario Government are still frightened; how Hardy proposes amendments; how certain people hate to confess that they were wrong; how the value of ore is now calculated (Heaven knows how) at the pit's mouth, less the cost of labor and explosives for mining and raising it; how nickel is finally put on the same basis as other ores; how fifteen years respite is allowed in certain cases; how the prices of land are again changed, ranging from $2 to $3.50 per acre; how a scheme for leasing lands is introduced; how we are not quite certain that it is much patronized even at the rate of $1 per acre for the first year; how, in view of all our discouragements we decide not to ask for any further subscriptions to the stock of the Customs Smelter (April); how great was the failure of the new mining law; how capital continues to give shifty mining legislation a wide berth; how we try to make the best of it; how Quebec takes back water on questions relating to royalty; how we try to induce Canadian capital to lead the way; how whole townships are withheld from sale; how Mr. Blue takes up the cudgels in defence of the Government; how our Association sends twelve more questions through the country (Sept., 1892); how we spend hundreds of dollars a year and one year after the other in trying to sell good properties at reasonable prices without success; how the two or three companies here are clearing from one hundred thousand to two hundred thousand dollars a year working on a very small scale; how some of us that are not in it and can see or make no chance of getting into it, have to starve or leave the country; how $2,308,475 was realized by the Ontario Government at a sale of timber limits in these districts on the 13th of October, 1892; how unlikely it is that very much of that $2,308,475 or of the many other minerals taken out of this country by the Government will ever be returned to it; how the Algoma Land and Colonization Co. tries to settle Algoma; how nickel is raised in the estimation of the nations; how Mr. Blue and Mr. Stobie get along; what efficient aid the Sudbury *Journal* gives us; how the fur flew as our Mr. McCharles and Blue had their set-to; how Mr. Clemow spoke out in meeting on the unrighteous timber policy of the Government; how Hammond wanted nickel-steel produced in Canada; how Mr. Stobie and Mr. Hardy had it out; how we met in Sudbury on the 17th of February, 1893, and what we did; how the International Mining Convention in Montreal came off; how the royalty was sat upon, Mr. Ian Cameron, a Scotchman managing a mining company in the Sudbury district to the contrary notwithstanding; how a certain discussion at that convention elicited the fact that Mr. Blue had "changed his mind," but without assigning his reasons since pronouncing so strongly against royalty in the report of the Royal Commission; how our petitions take in the country; what extracts from the Report of the Royal Commission we circulated; how another Customs Smelter fails to float (April, 1893); how our petitions are reported as gone astray in Toronto; how Mr. McCharles continues to keep his end well up through it all in spite of everything; how Mr. Hardy claimed that he did not have information enough to aid a custom smelter, and that such a course would compete with private capital, forgetting the policy of his government in supporting model farms and cheese factories in direct competition with, but for the benefit of the farmer as the other would be for the miner and smelter; how Hardy said that the people need not expect smelting works unless they sent Government supporters to parliament; thus trifling with this important question; how Sir Oliver writes Hammond that the Government's mining policy would be announced before the House closed (May 18th, '93; how this was not done; how Mr. Meredith wakes up and charges the government with delaying the matter in order to use their mining policy at the next election; how we conclude that we need not ask that government for assistance; how we begin to feel as if we had better take the matter into our own hands and put in men who will do something for us besides building fine places to sit in at the expense of this country; how Conmee criticised, in the House and out of it, Ontario's so-called mining policy; how it is reported that Messrs. Long, Stratton, Brown, Proctor, Ireland, Jones, Dunstan, Cheeseworth, Ann, Hilyard and Hunter, get Conmee to preside at the organization of a society to be called the Ontario Mining Association (June, '93); how Rat Portage's petition to Sir Oliver in the August or September of '93 looks as if we might have drawn it up; what we did at the "Soo" on the 4th of October last; how two representatives of large English capital are bluffed by the royalty clause at Rat Portage; how we now have the government between the devil and the deep sea.

But enough of this, gentlemen. I come now to the consideration of this question from a different side. What induced the government to act thus? What has their action amounted to, or how benefited any part of the Province? And how is this state of things to be remedied?

The inducement could only be, and undoubtedly was, revenue, direct provincial revenue. This can be derived by a fixed price for the sale or lease of mining lands, by royalty, or by both. The Government took what appeared to be the most direct way, and said "both." A more miserable failure was never known. The revenue from Nipissing and Algoma from mining lands in '92 was less than 6,000 ($5,921), and from Rainy River, Thunder Bay and elsewhere, less than $10,000. The paltry sum of $15,273, gentlemen, is the total revenue from mining lands in '92! The monthly expenses alone, in any ordinary mining company in operation easily amounts to more than that. Alas! our predictions were only too well fulfilled. I suggested to the Attorney-General and his advisers in this matter, before that Act was passed, another—the indirect—way of enriching the Province as a substitute for government royalty, fearing that a fixed or clumsily alterable per cent. imposed as royalty, would deter capitalists, on whom we had to rely, from embarking in the venturesome operation of mining, and that if such proved to be the case, the revenue to the province could only be an imaginary one. The absence of royalty then, would be an added inducement to capital, of considerable power in establishing new companies and pushing development and manufacture in this country to the limit of the demand.

Prices would come down as a result of keen competition and improved processes, the demand would increase immensly, and the result would be that such a vast amount of work and supplies would be needed at each mine in operation that ten thousand-fold more benefit would be derived by the country at large in furnishing labor and supplies, and from the finished product, than from any amount of imaginary royalty. Besides which, under this plan, each man in connection with the industry, and there would be thousands of them, would handle his own money and stand a good chance to be able to pay the tax-gatherer. Thus you get both direct and indirect revenue, instead of losing both; should royalty keep or help to keep our mineral under the ground. Capital is like quicksilver. If you make a grab for it you will get very little. Make trenches and channels for it to run in and you can lead it anywhere and make it do almost any work you wish. There is one case, however, in which the grabbing process would work. Should our resources as a country be taxed to the utmost to supply the demand, you could ask anything you wanted and get it. What is the chance that this will ever happen? I should say a man would be safe in stating that there is a very small chance, if any. Not one in a hundred. We have vast quantities under the old law untouched and doubled in value by the fact that such bear no royalty. This produces speculation and little development or selling except at what some call fancy prices, if the owner so choose. The capitalist, again, looks at it from the standpoint of its being a flaw in his title to be forced to the payment of a fixed government royalty on a property which may prove so expensive to work under the law of demand and supply that the royalty would amount to the interest on his investment or even encroach upon his capital. A private royalty, subject to private terms as influenced by competition, the law of supply and demand and paid as part of the purchase money, or even as pure royalty, would be under more control and is not therefore so objectionable. It is open to negotiation, option, etc., and the capitalist is able to feel his way.

Again, and this is more general than is supposed, the unsettled feeling with regard to the stability of our mining laws, the unequal conditions already obtaining in Ontario, and the dread of their further complexity and variety have had much to do with hindering capital seeking mining investment from locating itself here. The precarious nature of mining needs added terrors. I leave the further discussion of this part of the subject to other members of the Association.

Finally, how is this state of things to be remedied? In this connection it will not be out of place to glance for a moment at iron. We have, confessedly, the best of ores, the Dominion Government gives a bonus of two dollars per ton on pig iron manufactured in Canada from Canadian ores, the customs tariff on pig iron is four dollars per ton, a total bonus of six dollars per ton on pig iron. We have not yet, however, a single pig iron plant in Ontario, but are still found using imported pig and scrap to the tune of $9,883,420 in making products worth $23,009,257? How is that? What are our legislators doing about it? Are they really aiding the growth of smelting plants in a practical business way? If so, what has it amounted to? Have they placed sufficient duty on scrap iron? Have they guaranteed the bonds of an iron or nickel smelting company, holding the property as security? Have they made a loan to a good substantial company on the same security? Have they given a cash bonus of even $100,000 to start these great industries? No. They sell our timber for millions of money, and give us nothing back to help a community so poor that it cannot even mine its own ores in creating an industry, and a market that more than any other, by reason of natural facilities, would fill this country with population and prosperity. And still they persist in collecting royalties that are sleeping quietly under the ground! They never think of us or this country except when they want money; they sell us the land at their own prices and turn round and make it difficult for old and new comers to do business by putting us upon an unequal footing as regards titles to our purchases and in refusing our petitions for needed help. We have got too many party-first men, tinkering lawyers and good doctors of medicine making our mining laws, and neglecting the true interests of mining in both houses of parliament. We can alter this state of things, gentlemen. We mean to do it. We are going to send down country-first men. The time has arrived when party bias disturbs the financial equilibrium of this country, and hinders its development.

There is another way we can improve the present state of mining. We can educate the people of our own country who have money for legitimate investment in sound methods of mining and smelting. We can encourage the formation and working of development companies to search out and test good properties. Such a company if it finds one good property in seven at an expense in exploration of $25,000 or $30,000 on each on an average, will be amply repaid and encouraged to close the sale and reorganize or expand for mining and manufacturing saleable products. We would thus learn to feel our own strength more, and rely less on outsiders. The difference between the raw and the manufactured product would be kept in this country, as is being so continuously stated. We would soon hear of nickel-steel being made in Canada, instead of seeing a Scotchman's, Mr. Cameron's, opinion, presumably in the interest of a single company here, spread on the pages of the report of the Mining Bureau ('92), page 148, for instance, where he says, "I do not know that it would be a very great advantage to have the refining of nickel done in this country." The reasons assigned are, that wet processes would require the importation of acids, etc., freight charges on refined nickel for Europe would be greater (how much is not stated) than on matte, consumption must increase first or chemicals bought as cheaply here as in England or France, the duty on nickel in Europe, admitting, of course, that there is none in Great Britain, etc. Gentlemen, we have all the necessaries for manufacturing acids and chemicals cheaply in Canada; we are not confined to wet processes, as he must know, in producing nickel oxide and nickel steel, and it would be well for all such persons to know that we will not stop short of the realization of all this, that the sturdy sons of Canada refuse to be sat upon by any outsider or insider, that we are not blustering but organizing our forces and clearing the road to our work. And if the Government wants to make money or royalty on mining lands what is to prevent them from entering the field of mining and smelting and refining like other people? They run cheese factories and model farms. As it is here, they merely survey townships from time to time, name a price per acre, put on a royalty and stand off and cry quits! If we have not got the education, as some assert, why not start schools and smelters that would give the needed education? A few years of this kind of work would furnish a far different looking yearly report. This effort to help ourselves as a province, no matter what odds we face, will do more lasting good than the misrepresentations of Mr. Archibald Blue and his sneers in his last Report of the Bureau of Mines at those holders of mining lands who, after having spent years of time and the hardest kind of work, to say nothing of the expenditure of thousands of dollars of hard cash and running risks he has not faced now offer mining property for sale or to come to some arrangement for getting in some return. Is it for this that he pockets his allowance from the public funds? Is this the way to develope this country? or to bring any credit to himself? Is it apologists for the tinkered mining laws of party lawyers that we must have as public servants? What state of things is this in our country? Labor, thank heaven, will soon be king in this Dominion. The reign of bluster and "boodle" is drawing rapidly to a close.

Speaking of the last report of the Bureau of Mines, it is especially interesting to note the cheerful and patriotic, not to say arrogant, style of Mr. Blue's argument. Take a few of his ideas. He quotes in the foot note to page 146 from the *New York Engineering and Mining Journal* of May 13th, 1893, in showing the rapidly increasing demand for nickel for various purposes, as follows: (read the foot notes).

Again, on pages 147 and 148 he says: (read marked portions).

He states, then, in his summing up, in the first place, that no little misapprehension however prevails as to the demand for nickel, but he does not venture to state who it is that declares that there is no limit to the quantity which the markets are capable of absorbing. It would be highly interesting to know the names of the men who would make such a statement as that and who have been so honored by Mr. Blue with his particular notice.

Again, he is impudent enough, in the face of the experience of his government of the last few years, to assert that those are dreamers who are in just as good a position to know about this matter as he is and who state that there have been cause of policy, want of capital and lack of enterprise in blocking the wheels of progress in the Sudbury mining districts. But that is not all. Such men are not only dreamers; they have mining locations to sell. Agan, we are extreme optimists with locations of unknown value to sell (page 148). That is their crime! They should not have mining locations to sell! Again, (page 147), "There is no hindrance to investment in Ontario." Again, we consume upwards of 300,000 tons of pig iron every year, and yet. of iron mines there is not one that is worked, although we have iron mines in great abundance. Neither is there one blast furnace to smelt iron ore, and he winds up by saying that all the indications point to a steady increase in the consumption of nickel. Gentlemen, you may easily judge such a man for yourselves. Then Mr. Cameron is pulled in again, and in some peculiar way, his statements seem to be taken at their face value all through this report. I repeat it, it is a most peculiar thing that this man lately from the old country and a mine manager for a company who have no royalty to pay, is so largely quoted to bolster up a mining policy unworthy of the name.

The effort to help ourselves will be better for us than clinging to Prof. Coleman's opinion that "for some time to come we may expect Americans, Englishmen and everyone else except Canadians to develop and profit by our mineral resources." This is a most humiliating confession from a Canadian. It has been made by many Canadians. True, we wish to keep nobody out. They are all welcome. There is room for all. But we would be pretty slow and small spirited if we did not find a way of justly sharing in the credit and profit connected with this business. Now is the time to strike and to strike high. Put in men who will see to this.

Finally, more mining schools will aid education. Cheese factories are good. So are customs smelters. Mining schools are good. Let us have one here as well at Kingston. With a customs smelter here running in connection with a well equipped laboratory and testing works we may reasonably expect to get upon our feet without waiting another fifty years in Ontario for others—outsiders—to come in, pick up a little here and there, and leave us in our original and fast becoming chronic condition and disposition of waiters. Our stomachs refuse to wait any longer.

To close, gentlemen. In pleading the cause of independence in politics in the interests of this country, I am obliged to define what I mean by that word. My definition is simple. That citizen is independent, as I take it in the political sense, who will prefer and defend by all lawful and honorable means and put before any other consideration our common country, our common welfare. Such a citizen is not a party-first man, nor is he pledged to support any party, nor is he an apologist for party straight. What we have and prefer in common in this way is the basis of our present civilization. We have not yet fully developed or adopted a higher style of civilization as citizens of the body politic. Are we seeking, then, or have we found that common country, that common constitution and that common welfare as determined by the majority of our citizens from time to time and are we found defending or preferring them, we are then acting as responsible and independent citizens. A minority or a majority may use petitions, moral force, discussion, education, criticism, reason, appeal, organization, in a word, agitation (small shot, but plenty enough to bring down game) for pressing what seems to the individuals composing that minority or majority to be legitimate claims, and may also try by all lawful and honorable means, for example, by representation in the common councils of the country to have laws limiting their right to common existence and common welfare altered or repealed, or may try by the same means to have laws passed which they believe would advance or protect their interests; but that minority or majority, whether entirely composed of responsible citizens or otherwise, has no other rightful means of redress. The ballot is the independent man's bullet.

A true friend of his country is first and foremost a citizen and has a perfect right to speak and act upon equal footing in this country with any other citizen in that capacity in the political field. Upon this field we may all meet in the common light of the sun. As to matters affecting the relation of man with his Maker and his religious belief, our constitution requires and demands the utmost freedom in the interests of peace. This is not a political relation or a political union, and is not a question of majorities or minorities. It has nothing to do with politics. We can, then, only have political independence by being bound together by majorities for the common welfare. When political parties or individual representatives fail to represent the common interests they fall to pieces or are replaced, and reconstruction takes place in the interest of that welfare; but we sow the baneful seeds of discord and confusion and destroy the purpose for which our constitution was set up when we fail to observe as a rule of action the vast difference which exists between our political union and our connection with our Creator.

Thanking you gentlemen for this hearing, I take my seat.

A New Method of Mine Models.

Mr. J. W. Evans, M. E.—In this paper I wish to touch briefly on methods of representing our nickel deposits which will give every one a proper conception of their nature and extent. The method on which I wish to touch particularly is that of representing them by complete models—made from plans and profiles to a convenient scale and having ore and rock accurately shown as they occur on the ground. The method of working is as follows:—

A survey is first made of the property, parallel lines being laid out along the whole deposit from 15 to 25 feet apart, according to the nature of the ground. These are chained and stakes are planted at given distances on each line. Careful measurements are then made to establish the exact positions of ore and rock, both on the surface and in any test pits or shafts there may be on the ground. The levels are then taken at each stake and between them where necessary, and plan and profile are then made from which the figures are taken for the model, a suitable scale having been chosen. The first kind I refer to are models of surface shows (surface model of a large exhibit in Denison here shown). To admit of easy handling it is well to make the model of blocks of wood from 5 to 6 inches square. They are cut to the proper shape according to the plan and profile and ore and rock are shown as they occur on the ground by having ore and rock (which has previously been crushed to a suitable size) glued on in their respective places. In this way surface exhibits can be shown exactly as they are, and in a manner easily understood by all; which cannot be said for plans.

For mine models, where there are a number of levels, the work is more complicated, and connected surveys have to be made of each level.

In the model of the largest nickel mine in the Sudbury district, *i.e.*, Copper Cliff mine (which was here exhibited), which has seven levels, the blocks are 5 inches square and are made to the scale of 20 feet to one inch, each block representing 100 feet square of ground. They are cut out where openings occur according to the plans and profiles of the mine. The thickness of the blocks corresponds to the distances between the levels, so that the top of each layer of blocks represents the floor of each level. By removing them layer by layer, one gets a plan of each level, and tier by tier, sections through the mine. The different kinds of ore and rock are glued on in their respective places in the same manner as in the surface models. Little miners made of brass to scale are placed about the drifts and stopes to better illustrate their sizes and extent.

In this manner a whole mine can be accurately shown to the shareholders or intending stock buyers, who could get but a very crude idea of its form and extent from plans.

An Old Prospector's Views and Criticisms of the Ontario Mining Act.

Mr. James Stobie.—Ontario, between the Ottawa River and the Lake of the Woods, is in round numbers 1,000 miles, and between the north shore of Lake Superior and Huron on the south and Hudson Bay on the north about 400 miles. The question now arises what can be done with this vast unknown territory? It is too far north to be of much use for agriculture, and the greater part of it is of little value for timber. These two facts are well known. But who can tell the future value of its mineral resources? It cannot be travelled over on horseback like the prairies or even like the Rocky Mountains. The only way of access is by canoe routes, and these routes are often very many miles apart, and consequently the country lying between them is unknown, and even if known will have to be examined on foot, and the wherewithal to exist on will have to be borne on human shoulders. The season when this vast country can be explored for mineral is short, and the difficulties many, and not the least are the flies during any part of the summer when there is no frost. These are some of the physical difficulties that have to be contended with. I will let some other prospector give the financial troubles which we get into. Were I to give an account of my own experience in this respect during the past 25 years it would prove more amusing than instructive but nevertheless very serious.

A Common Error.—Old Ontario need not think that all this northern country is like the Sudbury range. The most of it is barren of any of the useful minerals. I class the surface rocks for exploring into four different kinds, as follows:—

1. The barren rocks, which occupy by far the greatest area.
2. Rocks with indications of useful minerals.
3. Rocks with enough of the useful minerals to tempt the explorer to take up claims and spend time and money on them, but having no paying mines. This class is the most ruinous to the explorer and capitalist.
4. Belts or ranges carrying some of the useful minerals in payiug quantities. The Sudbury range may well be classed as such. Comparatively speaking the Sudbury range has been like a picnic excursion to explorers, but how many have made any money on it? By far the greatest number have spent years of hard labor as well as money, and up to date have not received any returns, while several poor fellows have lost their lives in pursuit of mines. The country north of the 47th parallel will all have to be examined in the manner already mentioned, whether barren or productive. The first thing the prospector has to do is to find a range or belt bearing mineral in paying quantities. This is the rub. He cannot tell in what direction to travel if in a barren district, unless he find drift boulders carrying mineral. These do not travel from the south, east, west or north, but from a direction a few points east of north. It is a much greater discovery to find a good mineral belt than to find a mine on such a belt when it is discovered. A great many spend their time and money on the third class of rocks. A considerable part of the Algoma district belongs to this division.

An Explorer's Qualifications.—Now what kind of men are competent to overcome the many difficulties which have to be faced north of the 47th parallel in Ontario? The fat and wealthy man cannot do it. Neither the capitalist, office-seeker, dude or miser will make such sacrifices nor those who are fond of luxury. The man who will be successful must be sound in mind and body. He requires indomitable pluck and great power of endurance in order to contend with all the difficulties he will be sure to meet with in this rock-broken and pathless wilderness, and also to be well posted on the mineral question, so that he can tell a paying range from a poor one. He must not get home sick or lost in the woods, neither be afraid of the bites of bears or black flies. I might add a great many other qualities he must possess and some that he must not possess to fill the bill of an explorer.

A Poor Reward.—The reward offered to such men by the Ontario Government is that he may go into this now worthless territory and search for minerals. They do not stipulate that they are bound to sell to him the mines he may discover, and if they do allow him to go on and develop the claim he has to pay from $2 to $3.50 per acre, and yet it is not his, but must continually pay 3 % royalty on the output of the mine whether rich or not. This prevents the explorer from making ready sale of his property, and he is always too poor to work it himself. It is a financial impossibility for the explorer to make anything under the present Mining Act of Ontario. Let any person calculate the difficulties the explorer has to contend with and his running expenses while exploring, and he must come to this conclusion, namely, that the explorer should get whatever he finds and a bonus thrown in. For without the explorer who has both muscle and brains, the mineral, which is now of no value as it is hidden in the ground, will forever remain as useless as a snowdrift. Old Ontario may make all the selfish and prohibitory laws she wishes. They will only have this effect, that is, to retard the development of what is now useless and therefore worthless. All the country need ever expect to derive from mining is increase of labor, population, wealth, and commerce in all its branches. The old settled parts of Ontario ought to be satisfied with such important returns for the little the poor explorer may be given under the most liberal mining law.

Good Advice Thrown Away.—If the advice of the Royal Commission had been carried out and their recommendations adhered to by the Government, in place of the dog-in-the-manger policy adopted by men who had no practical experience of mining, we would now be advancing towards a prosperous and well developed condition in the mining industry, instead of having the prospectors frightened away from this vast territory by this bad policy. No doubt but the people who read Mr. Blue's report will feel themselves justified in demanding a royalty from the mines in Algoma and Nipissing. I would not object to paying a royalty if his reports were true. In his report of 1891 he states that ore is worth $7.50 per ton at the pit's mouth, and in his report of 1892, he says that there is in sight 650,000,000 tons on the Sudbury range. This would amount to $4,875,000,000, which would make millionaires of every man, woman and child between North Bay and Sault Ste. Marie. I have to say that there is not that amount of metallic ore in sight on the surface in the whole known world. The director of mines tries to bolster up the Mining Act by such windy statements as the above. They are so easily pricked that you cannot touch them without letting out the gas with such a rush as to disturb his equilibrium.

The remarks I have made in this paper might be very much enlarged, but if we are to live in this northern country we will have more to do than write papers and send petitions to Government. These have all been ignored for the past three years; let us now move in another direction.

Reservation of the Public Domain for the Actual Explorer and Settler.

Mr. J. F. McKay, Sault Ste. Marie.—The Provincial Mining Association of Ontario has always approved of the principal of reserving at least a certain portion (say every other township) in the district for the actual explorer and settler. However, at a joint meeting of representatives from the Patrons of Industry, the Dominion Grange, Toronto Trades and Labor Council and the Social Problem Conference, a resolution was agreed upon and made the first in their platform that the public lands should be reserved for the actual settler. The platform of the Liberals of Canada also contains a plank that the public lands should be sold to the actual settler only and not to the speculator. Both the Republican and Democrat party at their conventions held in 1888 affirmed the policy that the public domain should be reserved for homesteads for American citizens and settlers, not aliens, alleging that policy to have brought their great western domain into the magnificent development which it has acquired. Other representative organizati inte iave passed resolutions and approved of this principle, and considering that this principle has been accepted by both the great parties of the United States for years and that so many representative parties in Canada have declared in favor of this policy, I will try to point out a few of the many advantages which the actual explorer would derive under a law of that kind. We all agree that all possible encouragements and assistance should be given the explorer if we hope to have the mineral resources of our country developed, and the more explorers we have in the country the more liklihood there is of a speedy development.

One of the first objections to the present mining regulations is that when the explorer makes a discovery he has no way of protecting his discovery whatever except by paying $1 per acre, and to accomplish this he usually has to give a large interest in his location to get some person to advance the necessary money. He would be relieved from this hardship if he was allowed to locate 160 acres by paying $5 and taking possession as soon as he makes the discovery. He then should explore his location and if it did not turn out satisfactory he could have his location ticket delivered up to the agent and cancelled and commence to explore for new locations, and in this way he would have only lost his time which is quite sufficient. If the location was valueless and if the location proved to be a valuable mine he then could control all interests in it within himself.

Another objection is that when a valuable discovery has been made in the past it has been customary for speculators to buy up the Crown Lands in that neighborhood and explorers are thus deferred from giving their attention to what would otherwise be a most alluring field for exploration.

(3.) Under this policy intending explorers knowing that the lands adjacent to a valuable discovery is open for location until some person has discovered mineral and resides thereon, would crowd into that portion of the district where rich mineral was known to exist, and could aid each other in matters of transportation of supplies, and in many other ways by helping to advertise that portion of the district and attract capitalists there. The explorer should perform 90 days work on his mining location the first year, and one year after the date of his location should be allowed to sell and assign same, but such purchaser should be obliged to perform development work for two succeeding years before the patent issued to secure a large amount of proper exploration and development work throughout the district.

Northern Ontario has an area of at least 120,000 square miles, while Michigan has only about 58,000. Statistics show that Algoma is far ahead of Ontario in the yield of farm products per acre, and we have practically an empire of rich agricultural timber and mineral lands, and all that we require to develop these is men. The speculator in mineral, timber or agricultural lands is almost always the greatest obstacle to the proper development of the country. While some may be satisfied with the policy to keep this entire Northern Ontario tied up from the actual settler and explorer, and sell off a few square miles of timber limits from year to year, and point to this country as having a timber wealth of at least $50,000,000, which must be kept to furnish revenue for the government of coming generations, yet I think most of us and most of the organizations in lower Ontario, of which I have already mentioned, prefer a policy that points to the development of this Northern Empire, a policy that would put us in a position like that of Michigan, which had in 1890 nearly 2,000 saw mills, a lumber product of $68,141,189, iron ore to the value of $15,800,524, copper $15,855,427, charcoal iron nearly $4,000,000, and many other valuable products, and in 1890 had a population of over 2,000,000, and property of the value of over $1,130,000,000.

Algoma has the greatest and most valuable resources of any part of Canada, and all that is necessary to make it a great country is for our Government to give the same inducements to actual settlers, and explorers as were held out to the pioneers who rushed in Oklahoma and the Cherokee strip.

The Ontario Mining Law—The Worst Features of the New Act.

MR. A. MCCHARLES, (Sudbury.)—The royalty, in its deterrent effect upon capital, is of course the worst feature of our present so-called mining law. But the whole Act is bad from beginning to end, and for the very simple reason that it is founded upon a wrong principle. A proper mining law should be framed with the view of promoting the development of the mineral resources of the country; but the express aim and purpose of the new Act is to obtain revenue from our mines and mineral lands. No wonder, therefore, that it has paralyzed the mining industry all over the province in so short a time.

Effect of the Royalty.—All sorts of attempts have been made by the Government apologists and others to justify the imposition of a royalty on our mines, and to belittle its effects. But let us look at the plain facts of the case. During the three years before the passing of the present Act over 40 mining claims (of 160 acres each) were sold in this district, not for speculation, but for actual mining purposes; and several companies, such as the Dominion Mineral Co., the H. H. Vivian Co., the Chicago Nickel Co., and others, came in and began operating here. Besides, a large number of other properties were opened up more or less in those years, and public interest in our mines was in an active, promising state. But for the three years since the new Act came into force, except a few small dickers in part shares in claim by hard-up prospectors, in order to get some money to live on, I have not heard of half a dozen sales taking place; and not a single new company of any account has come into the district, or any new plant been put up. There is no disputing these facts, nor the story they tell.

As an instance of the evil effect of the royalty and the agitation it has caused, upon English investors, I may give a short abstract from a letter I received last year from a London broker: "It is very difficult to interest capitalists in your nickel mines. Apart from the present state of the money market, when your own prospectors and miners are so dissatisfied with your mining law people here naturally suppose there must be something very wrong about it." And so there is.

Other Districts.—Now, we are often told that the limited demand for nickel and not the restrictive mining law, is the sole cause of the slow progress of mining in this district. But last spring, before the collapse in silver, the Port Arthur *Sentinel* said of the disastrous effect of the new Mining Act of that district: "The Act has had a fair trial and what are the results. Where we had, two years ago, hundreds of men employed in working mines and prospectors in dozens exploring for new ones, we have now absolute quietness and stagnation, not one mine working and not an explorer in the field." Then the same or worse complaints are heard from the Lake of the Woods gold district, though the whole world and his wife are after gold mines now; and last summer the people of Rat Portage presented Sir Oliver Mowat, during his visit there, with a strongly-worded petition against the most objectionable clauses of the Act, almost in the same terms as we have been using here. They even went farther, and asked for bonuses, in lands or money, for the establishment of mining works, and also for monthly premiums on the output of the mines. The highest authority on mining affairs in America called it "An Act for the better suppression of mining in Ontario," which very aptly describes it.

The Government Reports.—There is one hopeful sign however, that a more liberal and progressive mining policy may be adopted by the government, perhaps this coming session. The sooner the better for the country. In the first report of the Mining Bureau not less than 48 pages were devoted to a special defense of the royalty clause; but in the second report, issued last fall, the question of royalties is treated very briefly and in a series of foot notes in very small print, as if half ashamed of being discussed at all. There are several things in this last report that I would like to criticise, but have only time to point out two of them just now. For instance, it is argued that because some mines in the United States and the tin mines in England pay large royalties to private owners, a government royalty cannot be so very wrong here. But our mines are not in the United States or England—the two principal mining countries of the world—but in Ontario, where the conditions as to capital, mining enterprise, and market for ores are entirely different, and they are neither coal nor tin. The director of the mining bureau seems to conveniently forget another thing in this connection, or that there is no similarity whatever between government and private royalties. The one is fixed and compulsory and applies to all mines alike, the poorest as well as the richest; while the other is always optional, and usually agreed upon in lieu of part or whole of the purchase value of the property, the rate depending on the character of the mine and various other circumstances. In order to make the comparison fair, the government should do their own prospecting, find the mines, bring in the capitalists, negotiate the sales, and take the same risks and chances as the private individual from first to last. But instead of doing all this or any part of it, they simply pass a law, very much after the fashion of the Medes and Persians, and coolly exact an unearned tribute out of the discoveries made by a lot of poor men, who are the pioneers of the mining industry everywhere, and who deserve the most generous consideration at the hands of the government and the country at large.

Then the local manager of one of the companies here is regarded as an oracle and almost lovingly quoted in the same "bundle of rubbish," as approving of our present one-sided mining law, no doubt on the well known principle of "you scratch my back and I'll scratch yours." But it is positively adding insult to injury, that the mere opinion of a single foreigner—who has not been two years in the country yet, and whose peculiar distinction among mining men since he came here will never point a moral or adorn a tale—should be paraded in the report as of far greater importance in the eyes of the government than the united representations of over 3,000 Canadians in the district, including mining engineers, business men, settlers, prospectors, lawyers, doctors, all classes in the community in fact, who petitioned last years against the Act. Truly our patriotism would need to be made of good stuff here to stand all the slights put upon us.

A Common Sense View.—But the most pointed and emphatic condemnation of the royalty and the leasing of mineral lands, which are the two leading features of the new Act, has not come from us but is to be found in the report of the Royal Commission, sent out by the Ontario Government four years ago to investigate the whole subject of mining, and which cost the country nearly $15,000. On page 306 of that report we find this sensible paragraph, without any political frills on it: "To place a burthen or restriction upon the mining industry in one section of the country from which it has been freed in another would be a fruitful cause of irritation. But even if the policy of restricting and burthening the industry could be generally applied, no one can believe that greater activity would follow. One might, with as good reason, hope to see a man's locomotion improved by attaching a cannon ball to each of his legs. At any rate, as long as mineral development in Ontario continues to depend largely upon investments of foreign capital, and especially of American capital, a liberal policy must be followed; mining lands must be not less free here than in the United States, where, with the single exception of New York, there is neither reservation nor royalty. So, also, as regards the leasing of mineral lands, the influence of the United States system would make its adoption well nigh impracticable here."

No more need be said on this point.

Paltry Excuses.—We are sometimes asked, if the new mining law is so bad, why the companies actually at work here do not take part with us in protesting against it. How childlike and bland? The present Act suits these companies only too well, as it tends to keep others from coming here, and they are all working on properties taken up under the old law, and will, therefore, never have any royalty to pay.

Another lame excuse frequently heard is that the Government, not being practical mining men, did not know what they were doing when they passed the ill-advised Act. But after all the information they got from their own expensive Royal Commission, and the endless discussion on the subject in the press for years, if the Government did not understand the matter, they simply did not wish to. Lastly, it is asserted in some quarters that we are not agreed as to what kind of a mining law we want. The best answer to this charge is that we have passed virtually the same set of resolutions at all the annual meetings of our Association for the past three years. We are agreed not merely on what we want, namely, a simple, just, well defined and permanent mining law, but fully as much on what we don't want, and that is, the present arbitrary complicated and unworkable Act.

Other Bad Features.—Next to the royalty, the most unrighteous feature of the new Act is the clause reserving power in the Lieutenant Governor-in-Council to set apart, without any previous notice, and even to withdraw from sale altogether, the whole or part of any locality or territory that is "shewn to be rich in mines or minerals." Now, who is to find this out? Not the government, but the poor, hard working prospector, and then as soon as his discovery is made known the land is withdrawn from market. The township of Garson here is a case in point. Two years ago several parties took up claims there and spent time and money in opening the properties up, but only one of them has got his lease from the government yet. But this clause in the Act is really absurd. If a district is not rich in mines or minerals no one but a fool would want any mining claims in it.

Another mistake was doubling the price of mineral lands. In justification of this step we are told that the price of mining claims in the Western States is $5 an acre, which is quite true. But it must be remembered that claims there are on veins, and limited to 300 x 1,500 feet or about 11 acres, and need not be paid for at all if worked; while here, owing to the mode of occurrence of the ore beds, the average claim is 160 acres, and mining companies generally want a much larger area to work on. Worse still, the price of mineral land in the eastern part of the province, which is more accessible and nearer shipping points, and where labor and supplies are cheaper, is put at $1 an acre less than in the western part, which is traversed by only one railway line, and harder to explore and mine in, and more disadvantageously situated in every way. There would be more justice and common sense in the exact reverse of this plan, grading the price of mining claims, not on an upward but on a downward scale from east to west.

Only Want Our Rights.—We have never asked for anything but our just rights, and we should not take less, if we are not to become abject slaves, instead of free men. The laws affecting all other industries in the country are made to suit the wishes of those engaged in them, such as agriculture, manufacturing, commerce, railroading, navigation, fishing, as well as the different professions, and even the sportsman down below have the game laws made their own way. Why, then, should the poor, struggling, unestablished mining industry, be legislated upon without any regard to the wishes of those engaged in it. The legislatures in most of the Western States adopted the laws the miners made for themselves in the early days, and we know with what excellent results. It is difficult under the most favorable circumstances to interest capital in mining enterprises in Ontario, but with such a serious obstacle as the royalty in the way, it is almost impossible to do so, as many of us here know to our cost.

A number of other papers were submitted, and the meeting adjourned at eleven p.m.

Mining Society of Nova Scotia.—The annual general meeting and dinner of this Society will be held in Halifax on 7th March. A number of interesting topics are up for discussion.

EXPLOSIVES.

The Explosive Properties of Ammonium Nitrate.

Berthelot (*Abstr. J. Ch. Soc., 1882, 453*) and Thorpe (*Trans. Ch. Soc., 1889, 220*) proved that endothermic combinations decompose explosively under the influences of mercuric fulminate, and it is well known that explosives require a variable initial impulse to cause their decomposition. The following experiments were made with shells of 8 cm. calibre, weighing 7 kilos, and capable of holding about 200 grammes of explosive, the force of the explosion being estimated by the number and weight of the collected pieces and the distance to which they were scattered; the difference between this weight and the original weight being reckoned as shell reduced to powder by the explosion. In the case of black gunpowder fired electrically by a platinum bridge, 10 pieces were collected whose collective weight was nearly that of the original shell, but, when a fulminate cap was used, 77 pieces whose collective weight was but 3.8 kilos was obtained. Shells filled with bellite, dynamite, and cotton-powder, exploded by means of 1 gramme of mercuric fulminate, were reduced to powder. One gramme of mercuric fulminate produced no effect on a shell filled with ammonium nitrate, except to evaporate a small amount in the immediate vicinity of the fuse, whilst the screw holding the shell was moved, Three grammes of fulminate caused a low, rumbling explosion, and 62 pieces of shell were collected which weighed 6 kilos. A shell containing 180 grammes of ammonium nitrate and 20 to 30 grammes of bellite (composed of dinitro-benzene 1 part and ammonium nitrate 4 parts) yielded, on explosion by 1 gramme of mercuric fulminate, 230 pieces weighing 2.75 kilos. Hence it appears that ammonium nitrate requires a stronger initial impulse than either dynamite or dry cotton-powder; that its employment, unless it is mixed with charcoal or aromatic nitro-compounds, is negatived on account of its weaker action, although for coal mining purposes its employment would seem to be advantageous, as but a slight rise in temperature accompanies the explosion.

Combustion Temperature of Explosives—Although regarded with skepticism, the calorific intensities recorded in our literature for black gunpowder lie between 3,000° and 4,000° C.; for gun-cotton, 5,000° and 6,000° C.; and for nitro-glycerine, 7,000° and 8,000° C., the most obvious objection to the adoption of these figures residing in the fact that the lowest of them is above the melting points of gun metals.

Col. von Wuich, taking the data of Noble and Abel, Bunsen and Schischkoff, E. Wiedeman and others, at the outset finds that the cardinal error of previous methods of determination or estimation consisted in assuming the specific heat of the products of combustion to be independent of the temperature, so that the constants used were then determined at their freezing points, whereas von Wuich finds it evident, from simple logic based on the phenomena of nature, that thermal capacity "decreases as the quantity of heat in a given body increases," and he proceeds to estimate the specific heats of the products at the higher temperatures.

As the result of this computation, when calorific intensities or, as he styles them, combustion temperatures, are obtained with the specific heat determined at 0° C., he gets 3,340 C. for gunpowder, 4,893° C. for trinitro-cellulose, and 7,240° C. for nitro-glycerine. Using this newly developed expression for the specific heat, he obtains 1,874°, 2,516° and 3,005° C. for gunpowder, gun-cotton and nitro-glycerine, respectively.

Trials of Explosives—A further series of trials of explosives has been made in the experimental level at the Konig Colliery near Neunkirchen, in the Saarbrücken district. H. Lohmann (*Zeitschrift fur das Berg-Hutten-und Salinenwesen*), observes that the admixture of dynamite with hydrated crystallised salts is a great improvement over the old forms of explosives intended for use in fiery mines. Dynamite mixed with 40 per cent. of such hydrated salts (soda) gives a comparatively high degree of safety both as regards fire damp and coal dust, and gives a large percentage of lump coal. *Carbonite.*—The samples of carbonite tried in this series of experiments showed a much higher degree of safety both for fire damp and coal dust. *Water Cartridges*, in which the explosive is surrounded on all sides by water, are very safe. *Ammonia Dynamite.*—The sample tested consisted of 40 per cent. of ammonium carbonate, 10 per cent. of potassium nitrate, and 50 per cent. of nitro-glycerine and kieselguhr, this latter being added in a quantity sufficient to produce a plastic but not an oily cartridge, Other ammonium salts, such as the oxalate, may be used instead of the carbonate, provided a sufficient quantity of an oxidising substance is added to convert the whole of the carbonic oxide produced into carbonic anhydride. Ammonium carbonate proves to be less suitable than the oxalate in preventing explosions. A useful mixture consists of 45 per cent. of ammonium oxalate, 15 per cent. of sodium nitrate, and 40 per cent. of nitro-glycerine and kieselguhr. The results of further experiments made with explosives consisting of ordinary black powder, to which ammonium carbonate was added, led to the belief that by changing the ordinary composition of the powder it will become possible to use it in the presence of fire damp or coal dust. It appears probable that a fine grained powder of the composition of sporting powder, in which ammonium oxalate is substituted for a portion of the carbon, might prove a suitable explosive, and the author is experimenting in this direction. *Securite.*—Whilst further experiments with this explosive in its old form gave bad results, a greatly improved and satisfactory variety was also tried. *Roburite* gave perfectly satisfactory results when employed in the absence of fire damp. It is generally thought that this explosive consists of chlorinated and nitrated hydrocarbons, but the analysis of a sample showed not even a trace of chlorine to be present. The *Wolf benzene lamp* was experimented with, in order to ascertain whether the explosion of the lighting capsule inside the lamp would lead to an ignition of gas outside the lamp. This only occurred on the 250th explosion, after the lamp had become very hot.

In a further series of explosions a steel mortar was used, and the explosive charge did not exceed 250 grammes. *Ammonia dynamite* proved itself a very safe explosive. *Kieselguhr dynamite* and *gelatine dynamite* are about equally dangerous. *Roburite* is safer than *gelatine dynamite*, but worse than *ammonia dynamite*; but it is believed that an improved form of *roburite* has recently been manufactured. *Carbonite*, the new form of *securite*, and dynamite mixed with 40 per cent. of soda (*Wetterdynamite*), are very safe explosives. *Blasting gelatine* is extremely dangerous. *Carbo-dynamite* gave negative results. *Favierite.*—This explosive is usually compressed into small wooden cylinders, and is thus protected from the damp. As, however, the compressed explosive is difficult to ignite, a hollow is left in the centre of the cartridge, which is then filled with loose explosive, the ignition of which explodes the compressed portion. As with *roburite* and *securite*, the transport of *favierite* is very free from danger, and it can be immediately destroyed by water. To prove its safety when used in the presence of fire-damp or coal-dust, experiments were made with five different sorts, one of which—No. IV.—proved to be a very safe explosive. It consists of dinitro-benzene and mononitro-naphthaline, together with ammonium and sodium nitrates.

Safety Fuse and Lighter.—According to Mr. J. Grundy, *Manchester Geological Society*, though safety fuse may be more convenient under certain circumstances, it is difficult to see why electric shot-firing is not more generally used. The author gives a description of Bickford's colliery fuse, safety lighters, and nippers. The lighters consist of a thin tin tube about 2½ inches long by ¼ inch in diameter. It is open at one end to allow the fuse to be inserted to a depth of 1¼ inch, and holds a small glass bulb containing acid; this is broken by the nippers, so as to allow the acid to come into contact with some substance which causes the ignition of the fuse. The essential factors for their use are that they should be kept dry, that the end of the fuse is in good condition, and that suitable nippers are used and applied in the right position, namely, at the end of the igniter. This system of shot-firing is much preferable to the use of a wire heated in a safety lamp.

Firing Shots in Fiery Mines.—M. Tauzin, *Comptes Rendus Mensuels de la Societe de l'Industrie Minerale*, describes the fire-syringe (*briquet pneumatique*) of Bourdoncle for igniting the fuse when firing shots in fiery mines. The fuse is held by a rubber washer, which is caused to grip it when the cylinder is screwed down. An air-tight piston works in this cylinder, and is forced down by a rapid blow so as to compress the air and thereby ignite the fuse. The cylinder can then be unscrewed so as to release the fuse after the first sparking is over. An attachment to the base of this device allows it to be placed on the ground while the piston is being forced down. This device has been adopted in several mines with success. At the Concordia Colliery at Oelsnitz, in Saxony, blasting has only recently been introduced in winning the coal. The dynamite cartridges are surrounded by water, only one shot is fired at a time, and that only after taking the precaution to lay the dust with water to a distance of 33 feet from the hole before firing.

CORRESPONDENCE.

The Walker-Carter Process at Marmora, Ont.

To the Editor of the Review·

SIR,—The very radiant commendations made by Messrs. Beckwith and Murdoch regarding the operation of the Walker-Carter gold extraction at Marmora, as published in the January issue of the CANADIAN MINING REVIEW, would leave the impression to general readers, that the whole problem of the treatment of the so-called refractory auriferous minerals was now successfully solved, and having given much study and attention during the past season of 1893 to the Hastings county gold deposits, and the means of extracting the precious metal from their characteristic mispickel ores, I would venture a few observations from the point of view of one who is earnestly searching for the best practical process for treating these sulph-arsenides.

The operation of roasting or calcination divides all gold extraction methods into two broad classes (1) treatment of raw ores, and (2) treatment of roasted ores, which limits their respective economic application to certain localities where the cost of fuel is not excessive; and even where the necessary combustible may be obtained at average prices, the cost of roasting, especially where wages are highly paid, affords a very considerable margin in favor of a non-roasting method.

The rational process for treating refractory sulphurets, and not embodying a previous calcination is the leaching by cyanide so successfully adopted in South Africa and elsewhere, and in the working of which improvements are being made almost daily. It is unfortunately true that, although a weak solution of cyanide of potassium will readily leach out from 85 to 90 per cent. of the assay gold contained in the Hastings county mispickel ores, yet the arsenical compounds exert such a decomposing action on the cyanide, as to render the method impracticable without adopting certain modifications. The results attained by recent experimentation in this direction are highly encouraging and promise ultimate success.

Mr. H. Beckwith has given a very fair description of the Walker-Carter process as operated at the small reduction mill at Marmora, and which I had an opportunity of examining during a visit of three days made a few months ago, but my own observations do not permit me to render such glowing eulogies of every point and effect of the process and the results obtained by it. The ore under treatment was not of a very refractory nature; it contained from 3 to 5 per cent. of sulphurets, part of which were arsenical, but free gold was often visible in it, even to the naked eye, and abundant color of free gold always obtainable by "panning." The superintendent stated that the ore averaged $10 per ton by *his* assay, and upon this basis he figured out the 90 per cent extraction effected, to his own satisfaction, and I note that Mr. Beckwith guardedly says respecting this, "*I am informed* that the percentage of gold saved averages 90 per cent. of the value contained in these ores," and I respectfully beg to challenge the correctness of the assay of the raw ore, which I afterwards verified to be $16 in place of $10, and I wish to ask did Mr. Beckwith control this very important factor and base of his conclusions? The complicated retort furnace employed in this process certainly does deliver a well-roasted product; the ore takes some five hours to travel through it, and the output was from 4 to 4½ tons per diem of 24 hours. The president of the Hastings Gold Reduction Co., who are the Walker-Carter process in Canada, informed me that the cost of such a furnace was $3,000, and if a larger output was required, the furnace must be duplicated. It is a pretty piece of mechanism, requiring constant attention to regulate, and suggesting the comparison of taking a man's measure for a suit of clothes with a sextant. There certainly are other roasters capable of delivering a perfectly "sweet" product, while not possessing the objectionable complications of the Walker-Carter machine, and although to the eye of anyone visiting these reduction works, the furnace appeals most conspicuously, I can hardly imagine that Mr. Beckwith intends to convey that it is a *sine qua non* to the alleged success attained.

The method of amalgamation forms the special characteristic of the Walker-Carter process, namely the *vaporisation* of mercury by heat in contact with the pulverized and roasted ore, and which appeals to the mental conception of the most perfect means of catching every atom of gold already rendered "free" by the previous roasting; and so far I agree with the purpose of the invention and the results attainable, but unfortunately such finely disseminated mercury is not so readily reamassed, and as will be easily conceived, this method of vaporisation gives rise to a large proportion of "floured" mercury, the dread of all amalgamator-mill men, and "floured" mercury running to tail carires off gold, being in fact "floured" gold-amalgam.

While the superintendent of the mill informed me of his small loss in mercury, I mentally observed that the tailings from the settling tubs were most carefully allowed to run direct into the rapid running river; "dead men tell no tales," but my credulity had been strained, and I could not do him the injustice to disbelieve him, until having carefully verified the point at issue. I therefore clandestinely obtained a sample of the tailings, by catching a few buckets of slimes outside the mill at various intervals of the operation of running off the overflow, and from the deposit thus secured, I obtained abundant "shows" of "floured" amalgam by "panning." I would wish to know if Mr. Beckwish investigated this point before stating that the process "is a success," and that he does "not know of any process or system of extracting gold from its ores, that can compete with the method."

Now as regards known means of gold extraction applicable to the arsenical ores of Hastings county, and employing the roasting operation, chlorination stands foremost both as regards effective duty in recovered gold, and the purity of the bullion. But there is one other point, and an important one, which must not be lost sight of when dealing with the highly arsenical sulphurets of certain zones in the Hastings county gold belts, and that is, that the *arsenic* has a far greater value than the accompanying gold, and from this point of view, I presume that the Walker-Carter process and its admirers do not lay claim to any advantages obtained from their plant, although Mr. Murdoch's testimony affirms that "so far as *his* knowledge goes, the condensation of the poisonous arsenical gases is something never before accomplished in a continuous operation?"

With this special occurrence of auriferous mispickel the economic advantages of saving the *arsenic* is imposed and thereby the profitable roasting of the sulphurets. Chlorination, however, demands a "dead" or perfect roast for its success, and is more costly in chemicals than the cyanide treatment, which works like a charm, with auriferous mispickel which has been previously subjected to even a *partial roasting*, so that as far as present facts and experiences go, I hold the opinion that with these mispickel ores or their concentrates, a roasting with the object of securing commercial white arsenic should be first effected, and the calcined ore then subjected to leaching by cyanide, and in cases where the gold is found to be somewhat coarse, an amalgamation before the cyanide treatment should be resorted to, and with such a combination I find that practically all the value of arsenic and gold is secured, at a working cost below that of the Walker-Carter process as operated at Marmora.

In conclusion, the Hastings county gold region is in my humble opinion destined to revive in the near future, and offers steady rewards to intelligent investors. If the Walker-Carter process is to be the saviour of these hitherto rebellious products, it merits a well earned recompense, but we have a right to demand more tangible facts and results, before giving to it the confidence intended to be inspired by the testimonies of Messrs. Beckwith and Murdoch as referred to above.

Nothing but the disastrous records of the process failures, as at Deloro and more recently in the case of the Crawford mill, has been keeping the development of this district in abeyance, and we would like to think that the Walker-Carter results were *not* following in the same train of historical events.

J. Lainson Wills, M.E.

New York, Feb 22nd, 94.

Silver-Lead Mining in British Columbia.

DESCRIPTION OF THE MINES OPENED IN THE FAR-FAMED SLOCAN DISTRICT.

The Nelson *Tribune* in its issue of 10th instant gives an excellent description of the mineral development of the Slocan district, British Columbia, from which we quote:

The Read & Robertson.—This group is located in the four-mile section of Slocan district. The group consists of the Tenderfoot, Read, Robertson, Cosmopolite, and North Star. The Jenny Lind corners on the vein, and it is on that claim and the Read and Robertson where the immense croppings are which attracted so much attention to the property. The surface showing is 20 feet wide and can be traced for 1,000 feet. Formation, argillite and black lime; vein filling, lime spar and galena. In places from 2½ to 4 feet of solid galena can be seen, while the entire vein is a rare concentrating proposition. An average sample of the croppings yielded 142 ounces silver and 70 per cent. lead. This property was bonded for $14,000 to the London Mercantile Association, in October, 1892. They paid down 10 per cent. of the bond and expended $4,000 in development. The same cause is given for forfeiting this bond as is given for forfeiting the bond on the Great Western. Many claim the Read and Robertson group is the coming great mine of the North American continent. J. A. Finch and associates now have the property bonded. No work is being done at present, on account of the depth of snow and lack of accomodation for a working force.

The Payne Group.—The Payne was the first location made in the Slocan district, and the first to pass into the hands of monied men. The group is made up of the Payne, Maid of Erin, Mountain Chief and Two Jacks, all located on one ledge. The formation is slate shale, the vein trending about 35 degrees east of north. The width of the vein is from 8 inches to 4 feet, carrying galena from 6 inches to 2½ feet in thickness. One hundred tons are now being shipped, which samples 225 ounces silver and 70 per cent. lead per ton. On the Maid of Erin there is a 40-foot tunnel. Five openings on the Payne range from 6 to 22 feet in depth, and on the Mountain Chief a 110-foot tunnel taps the vein 100 feet in depth. Scott McDonald owns one-half of the Payne claim, and S. S. Bailey the other half and the remainder of the group. Present working force eight men.

The Noble Five Group.—Many persons contend that the Noble Five group is equal to the Slocan Star in extent and value. The discovery was made on Sept. 28th, 1891, by W. M. Hennessy, J. J. Hennesy, Frank Flint, J. L. Seaton and J. G. McGuigan. The claims staked were named Noble Five, Knoxville, Bonanza King, World's Fair and Maud E. The owners claim the formation is slate and porphyry, the vein having a northerly and southerly direction. Width of vein varies from 2½ to 6 feet, although in one place it is much wider, as in an upraise 9 feet of solid ore has been encountered. This winter 350 tons of ore have been shipped, which, it is claimed, yielded 150 ounces silver, and 69 per cent. lead per ton. The claims were worked through adit tunnels, except in one instance where an 80-foot cross-cut has been run, so as to ensure safety from snowslides. The three tunnels on the property aggregate 600 feet. The working force is 20 men.

The Mountain Chief.—This great little mine is located within a mile and a-half of New Denver and is the property of George W. Hughes, he having purchased it in 1892 for a consideration of $15,500. The vein is from 2 to 6 feet wide, with a pay streak of clean galena from 1 to 3 feet. Upwards of 1000 tons have been mined, the shipments giving returns of 130 ounces silver and 70 per cent. lead. The property is worked through tunnels driven on the vein. From 15 to 20 men are steadily employed.

The Dardanelles Group.—The property of this company consists of seven claims, located in the Dardanelles basin on the summit of the divide. The claims are named the Dardanelles, Antelope, Buffalo, Okanagan, Diamond Cross, Hidden Treasure and Cariboo. The Dardanelles and the Antelope, so far, are the only ore producers. The formation is slate and porphyry, the vein trending northerly and southerly, ranging from a narrow seam to 5 feet in width. The Antelope claim has been leased to different parties; 50 tons of ore has been marketed, which yielded 99 ounces silver and 51 per cent. lead. The most development work has been done on the Dardanelles. An incline shaft has been sunk 200 feet, as the vein is very flat, the total vertical depth from the surface to the bottom of the shaft is not over 100 feet. Smelter returns from 150 tons shipped range in value from 248 to 322 ounces silver and from 26 to 30 per cent. lead per ton. On account of the great flow of water, heavier machinery is required before further sinking can be done to advantage. In the meantime, the company will run levels on the vein, exploring for additional ore chutes. There is a steam hoist and pump on the property placed there at quite an expense, as the freight over the 4-mile trail was 10 cents a pound. Although the expenditures so far have been in excess of the receipts, yet the company is sanguine of future profits.

The Washington Mine.—The Washington mine is owned by the Washington Mining Company, in which J. L. Montgomery, T. E. Jefferson, and Ralph L. Clarke are the shareholders. The vein is in slate formation and has a north-east and south-west trend. Previous to the time of the company taking hold 560 tons of ore were shipped. Since the company took over the property the shipments have increased, but the exact tonnage and value of the ore is not attainable, as the officers of the company refuse to give information. The equipments of the property are the best of any in the district, and the company evidently feels as though it had a valuable mine and the working is being done on a business-like basis. Thirty-eight men are on the pay-roll.

The Blue Bird.—The Blue Bird belongs to the Washington Mining Company and is not being worked. It is in black lime formation intersected by porphyry dykes. The shipments of ore have aggregated 300 tons, averaging 144 ounces silver and 71 per cent. lead. This is one of the early producers of the district, and is considered by many a valuable property.

The Slocan Star.—This is the bonanza mine of the district, and many are of opinion that it is the "big mine" of British Columbia. The group consists of the Slocan Star, Slocan King, Jennie, and Silversmith. They were located on the 7th of October, 1891. Formation, slate, which the vein cuts obliquely on a north-east and south-west trend, dipping with the hill at an angle of about 45 degrees. On account of the strike of the vein along the mountain on the west side of Sandon creek, is tapped by crosscut tunnels. The present working tunnel is 140 feet in length, piercing the vein at a depth of over 100 feet. Here the vein is fully 50 feet between walls, every particle of which—aside from the first-class ore—can be profitably concentrated. A drift runs to the north-east on the foot-wall, where the ore is mixed. The tunnel, however, is continued across the vein to the hanging-wall, where a large body of clean galena was struck. On drifting north-easterly this body widened out to 12 feet, without a particle of waste, therefore the company was not long in extracting the 500 tons which have been stored at Three Forks, awaiting completion of the Nakusp and Slocan railway. An upraise has been made to the surface through ore continuously. A lower tunnel, to cut the vein at a depth of 400 feet, has been started and work on it will be pushed. It is likely the company will stope 1,000 to 1,500 tons before the sleigh road from the mine to Three Forks breaks up. There is one ton of ore sacked in the ore-house which runs over 1,000 ounces of silver. The average value of the first-class ore now being shipped is 100 ounces silver, $8 gold, and 70 per cent. lead per ton. The Byron N. White Company, organized under the laws of Wisconsin, with a capitalization of $500,000, is the owner. Fifteen men are employed at present.

The Northern Belle Group.—This group is located on Jackson creek, four miles from its junction with Kaslo river, and is 21 miles distant from Kaslo. The group comprises the Northern Belle, Dublin Queen, Kootenay Star, and Ophir claims, each 1,500 feet square. The property has been worked continuously since the date of location, in June, 1892. The hanging-wall of the vein is slate shale, on which there is about a foot of porphyry casing, the same as the other bonanza mines of the argillite belt. The foot-wall is lime and slate, through which the vein cuts. The lode is from 6 to 12 feet wide, all the filling being concentrating ore. There are, however, chutes of clean ore from 18 inches to 3½ feet in width, which is simply broken down, sacked and shipped. Developments on the property consist of two adit tunnels, each 250 feet in length and another started, which is in a distance of 15 feet. Winzes are being sunk and uprises made to connect these tunnels. Six hundred tons have been marketed or are in transit from the mine to smelters since the company assumed possession on June 1st, 1893. From 300 to 450 tons per month is the proposed output for the future. This ore has an average value of 100 ounces in silver and runs 80 per cent. lead per ton. It costs less to transport it to Kalso than any other mine in Slocan district, being only $10 per ton. It is claimed there is a profit of $50 for the company on each ton handled, which appears like huge dividends. The Northern Belle Mining Company of Seattle owns the property. Dr. E. C. Kilbourne of that city is president. The capital stock is $250,000. The present working force is 24 men.

The Surprise.—The Surprise is in slate and porphyry. It recently changed ownership, Chicago parties whose names are withheld being the purchasers. Rumor states the consideration at $60,000, half cash. Recently a shipment of 100 tons was made, which a vague report values at 229 ounces of silver. Except that 8 men are employed, no other information could be obtained.

The Whitewater Basin Mines.—Whitewater creek empties into Kaslo river about 17 miles from Kaslo. Along the mountains bordering this stream and in the basin near its source quite a number of locations have been made, some, it is claimed, carrying a large percentage of gold on the surface. From the Whitewater claim, J. C. Eaton, in 1892, shipped 7 tons of galena ore which netted him about $900. During the past year the Wellington mine shipped several carloads, the figures for which are not obtainable, as the manager is absent in Eastern Canada. A diamond drill was used on the Wellington, but owing to the seamy character of the formation its use had to be abandoned. The Virginia, bonded by J. A. Finch, is being worked by a small force.

The Noonday Group.—The Noonday group is made up of the Noonday, Fourth of July, and Grey Eagle claims on Cody creek, and is the property of G. J. Atkins & Co. Formation, slate and porphyry. Have an 8 foot vein of concentrating ore. Fully 100 tons on the dump of clean ore, which will run 115 ounces silver and 78 to 80 per cent. lead. Total length of tunneling 300 feet. Employ 12 men.

The Idaho and St. John.—This property consists of two parallel locations, about 200 feet distant from each other, the veins on which are from 5 to 6 feet wide. The ore is galena carrying grey copper. The pay streak is 2½ feet wide and solid in places, often averaging 200 ounces in silver. One tunnel is in 300 feet, from which three cross-cuts have been run varying from 20 to 40 feet in length. Another tunnel is 60 feet long. Besides the above there is in addition at least 150 lineal feet of development. Total figures of shipments not obtainable, but one carload of ore from these claims netted $1,760. H. H. St. John, "Al" Behne, and E. C. Gove, are the owners. The working force is 20 men.

The Lucky Jim.—The Lucky Jim group, which lies within a few hundred feet of Bear Lake consists of the Lucky Jim, St. George, and Roadley claims. It was located in May, 1892; hence the claims are 1,500 feet square. James Shields, Charles Druin, and Robert Williams were the locators. The hanging-wall is dolomite and the foot-wall slate shale; the trend of the vein is nearly east and west, dipping at an angle of about 45 degrees into the mountain, or south. On the surface the ore exposed was fully 8 feet wide in places. Tunnels and cross-cuts on the property aggregate about 500 lineal feet, the deepest workings being about 80 feet from the surface. Between 50 and 60 tons have been shipped, which, it is said, returned 67 ounces silver and 60 per cent. lead. This is one of the lowest grade mines in the district, but being located less than half a mile from the proposed Kaslo & Slocan railway, the savings in transportation will be quite an item. Dr. E. C. Kilbourne of Seattle, owns one-half, Robert Williams one-third, and Thomas J. Roadley one-sixth. No work of consequence is now being done, only two men being employed.

The Ruecau Group.—For convenience, the owners of this group call their property the "Reco," their possessions consisting of the Ruecau, Texas, New Denver, Ephriam, and Clifton. The vein is exposed and cuts through four of the claims. The formation is slate, intersected by porphyry dykes, through which the vein trends at nearly a right angle. Ten feet is the average width of the vein, which carries galena and carbonates, the pay streak ranging from 18 inches to 8 feet in width. Forty tons have been shipped, which ran from 167 to 261 ounces silver and 65 per cent. lead. John M. Harris, F. T. Kelly, and S. M. Wharton, are the owners. Their working force is 15 men

The Queen Bess.—Located on south side of the mountain from Idaho basin. Slate and lime formation; vein trending northeast and southwest; development, 300 foot tunnel which cuts the vein at a depth of 65 feet, and a shaft 40 feet in depth. In places have 8½ feet solid galena. On dump, ready to ship, 50 tons of ore. A parallel vein 14 inches wide carries galena and carbonates. Owned by Seattle parties and J. H. Moran. A force of men were put to work the last week in January.

The Vancouver Group.—Located on south side of Four-mile creek, 1,500 and 2,500 feet above Slocan lake and distant 4 miles from the townsite of Silverton. Formation, slate; veins, northeast and southwest trend; said to be huge fissures which can be traced three miles. The two carloads of ore shipped last winter averaged 250 ounces silver, one carrying 40 per cent. and the other 55 per cent. lead. Over $4,000 worth of development work has been done. The claims are named Vancouver and Mountain Boomer. Mahon Brothers are the owners.

The Grady Group.—But little information can be gleaned concerning this remarkable showing on Four-mile creek. Five hundred tons of ore, valued at $125 a ton, are on the dump ready to ship. The property is held under bond to the McNaught Land and Investment Company of Seattle, N. F. McNaught being in charge. It is claimed the price to be paid is $70,000, of which two payments of $5,000 each have been made.

The Cumberland.—The Cumberland is in the same basin as the Idaho, and is south-east of that mine. The formation is slate and lime; north-east and south-west trend and dips at an angle of 80 degrees from the horizontal; vein filling, galena and quartz; average width of vein 4 feet, and pay ore 14 inches, although in places it is 20 inches solid. Development consists of a tunnel 132 feet on vein, a crosscut tunnel 60 feet, one drift from crosscut tunnel 40 feet, another drift 70 feet, and one shaft 15 feet. Sixty tons of ore are ready to ship. Four men are kept at work. The owners are Martin Clair, C. M. Gething and F. F. Macnaughton.

The Alamo Group.—Situated in Twin Lake basin and discovered in June and July, 1892. Claims consist of the Alamo, Twin Lakes and Ivy Leaf. It is a contact vein, between slate and porphyry. One tunnel 250 feet in length and another 165 feet. Ore, galena and carbonates, which run very high. One carload has been shipped and other shipments are ready. Vein runs from 3 to 5 feet in width. Four men employed.

The Bon Ton.—It would be impossible under present circumstances to mention and describe all the many claims in various stages of development in the Jackson basin or on both sides of the creek. Outside the Northern Belle, the Bon Ton is the only one which made a shipment. It was but a few tons, and the returns were between $300 and $400 a ton. The Sunset, Lucky Boy, and others are said to be healthy prospects.

The Big Boulder.—So much has been written of the famous Big Boulder that a few brief notes regarding it in this article may not be amiss. Development in the upper works of the Slocan Star shows where this great mass of galena rested in the vein before it took its slide down the hill to where it was found by "Jack" Cockle. Evidently erosion of the country formation below the ledge matter caused the boulder to drop from its natural place in the vein, and it was carried down the hill by its own gravity. There has been shipped from the boulder 40 tons, which yielded 130 ounces of silver and 70 per cent. lead. The owners expect when the remainder is sorted to secure at least 25 tons more of the same grade.

The Chambers Group.—This group consists of the Chambers, Wellington, Eureka, and Jay Gould. It is situate on the south fork of Carpenter creek, above the mouth of Cody creek, and was located on October 26th, 1891. The hanging-wall is shale and the foot-wall quartzite. It is fully 80 feet between walls, the vein carrying stratas of clean galena and concentrating ore. Sample assays return an average of 120 ounces silver and from 60 to 80 per cent. lead. There has been 300 feet of development work done. The present owners are the Bank of Montreal, G. J. Atkins & Co., and Ed. Becker, Charlie Kent, and Tom Litster. This is said to be the finest concentrating proposition in the district. Not being worked at present.

The Slocan Boy.—This claim lies above the Washington, the vein passing through a portion of the ground. It is owned by Spokane parties, who on account of private financial embarrassments are not working the property at present. A quantity of ore is on the dump, but no shipments have been made.

The Great Western.—The Great Western was located in October, 1891, by Tom McGovern and Charley Franklin, of Ainsworth, and is 600 × 1,500 feet. It is now a Crown grant claim. It is in the argillite slate belt. The vein is a very strong one, although but 2½ feet in width, dipping at an angle of 60 degrees. From 3 to 14 inches is the width of the pay streak as far as developed, and there are about 30 tons of ore on the dump, which will average 120 ounces in silver and 70 per cent. lead. The development is made up of tunnels, alongside the vein, cross-cuts, etc., which aggregate about 450 feet. The property was bonded in 1892 to the London Mercantile Association, who paid $5,000 on the bond, and expended $10,000 in development. The instability of the price of silver caused the company to throw up the bond and forfeit the money paid. The locators are still the owners.

The Eureka.—The Eureka and Mineral Hill claims lie north-east of the Slocan Star group on the same vein, and are the property of G. J. Atkins & Co. This ledge is at least 20 feet wide. They have run two tunnels, aggregating 500 feet, and have struck ore in the lower one. Assays have yielded 169 ounces silver, and 70, 72, and 74 per cent. lead. Nine men are employed on this property, and work will also be commenced on the Elgin, on Slocan Star hill, in the spring.

The Lorna Doone.—This claim is an extension of the Vancouver and carries 18 inches of very rich ore. Rathbourne & Culver, the owners, have been offered $12,000 for it. Its location is 3½ miles east of Slocan lake, near Four-mile creek. Several tons are on the dump, but no shipments have been made.

The Dayton.—This ledge was discovered last year by William Springer. It carries dry ore and is located in the granite belt, 3 miles east of and near the foot of Slocan lake, 20 miles from New Denver. The vein is 2½ feet wide, carrying 10 inches of pay ore, averaging 215 ounces silver, and $21 gold per ton. The highest assay was 920 ounces silver and $40 gold. Mr. Springer has sold the claim to Mr. Hanauer, the Salt Lake smelter man.

The Greenhorn.—The Greenhorn claim is located on Cody creek, opposite the Freddy Lee, and is in the same formation. There is three feet of solid galena in sight which samples 100 ounces silver and 60 per cent. lead per ton. John McNeill of Ainsworth, is the owner. The vein has been traced through the entire length of the location, 1,500 feet.

The Eureka Group.—To the north of Kaslo river, on the divide between Liddle and Bear creeks, is a group of claims named the Eureka, Yosemite, Homestake, Scottish Chief and Parrot. They are in the trachyte formation, and trend northeast and southwest. The veins are from 5 to 10 feet wide, carrying chutes of ore from 16 inches to $2\frac{1}{2}$ feet in thickness, all galena, assaying 125 ounces silver and 77 per cent. lead per ton. On the Eureka and Yosemite there is 150 feet of tunnelling and 44 feet of shafts with open cuts 60 feet in length. On the Echo, another claim of the group, there is a 25-foot tunnel on a pay streak from 6 inches to a foot wide, carrying fine-grained galena assaying as high as 327 ounces silver per ton. McDonald Brothers, McPhee and Moore are the owners.

The Jardine Camp.—The Jardine camp was discovered in September, 1891. The principal claims are known as the Trapper, Silver Tip, Beaver, Lone Star, Cornet, Snowflake and Mountain Dew. They are located three miles from McDonald Brothers' Halfway house and 13 miles from Kaslo. The formation is trachyte with serpentine dykes, the veins trending north-east and southwest. A considerable amount of work has been done by the owners. The Beaver is 12 feet wide, carrying galena and copper. There are between 50 and 60 tons on the dump. There is four feet of ore in the upper tunnel of the Mountain Dew, which assays from 26 to 204 ounces silver. The Silver Tip carries dry ore, assaying as high as 400 ounces silver. Andrew Jardine, John (Lardo) McDonald and Jack Allen are the owners.

The Montezuma.—The Montezuma is only eight miles from Kaslo, on a tributary of the south fork of Kaslo river. The formation is slate, granite and lime, the vein cutting through the same. There was nine feet of clean galena on the surface, and development work has proved the vein to be from 3 to 4 feet in width. There is a crosscut tunnel 70 feet in length, tapping the vein 40 feet in depth. From the tunnel a drift has been run 40 feet, showing from 1 to 4 feet of ore. Its value is 80 ounces in silver and 60 per cent. lead per ton. Tom McLeod, Ed. Becker, and others are the owners.

The Fisher Maiden.—The Fisher Maiden, Stand-By and Sixty-Three are owned by W. A. Crane and Dan McDonald. They are in the granite belt, near Eight-mile creek, down the lake from New Denver. The veins are from 6 to 7 feet in width, carrying from 18 to 20 inches of ore, the lowest assay of which was 220 ounces in silver. Ruby and silver glance predominate. In one place 6 inches averaged 600 ounces per ton. The Fisher Maiden and Stand-by are held under bond to Seattle parties for $30,000. This property is six miles back from Slocan lake.

The Navigator.—The Navigator adjoins the Alpha claim of the Grady group and is a parallel vein. It is a 3-foot ledge with a pay streak 8 inches wide, carrying 120 ounces of silver and 65 per cent. lead. The formation is slate, the vein trending northeast and soutwest. Jasper King and Ben Anderson are the owners, and they propose to do considerable development work the coming summer.

The Grey Copper.—This claim lies between the Blue Bird and Reco, and cuts through slate, porphyry, and lime formation. The vein is 3 feet wide and shows ore for 200 feet, averaging one foot in thickness. Assays run from 145 to 160 ounces silver and 72 per cent. lead. This claim is owned by Jack Thompson, Ed. Becker and Charley Kent.

The Tom Moore and St. Lawrence.—North-east of the Great Western are located the above-named claims. The ledge is about 5 feet wide, composed of iron carbonates, decomposed lime and galena. Some ore has been extracted, but not enough to ship. These prospects are surrounded by the big mines of the McGuigan basin. M. C. Monaghan, G. Hawley and Tom Hennessy are the owners.

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Established 1882

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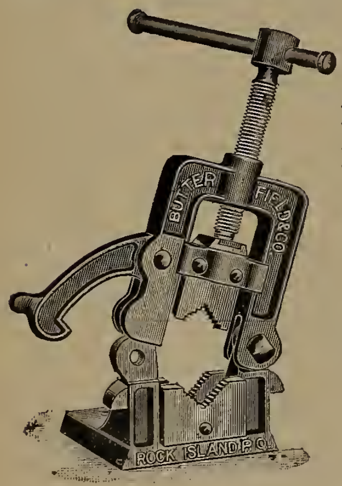

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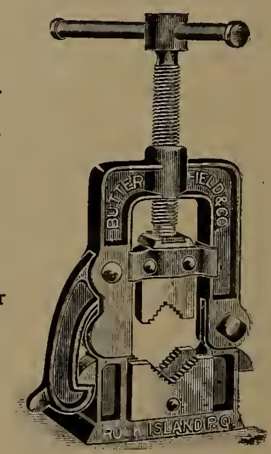

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Canadian Mining Schools.

The work and usefulness of mining schools in Canada is, in the phrase of physicians, indicated by (1) the deep and widespread ignorance of the country's mineral resources; and (2) the ill success of too many efforts for the development of its mineral wealth. It is too often attempted to hide the first behind sweetly-sounding generalities upon our enormous subterranean riches. Capital and pluck have too frequently been the blind and beaten pioneers in fields where no intelligent investigator has yet entered. No country in the list of the English-speaking communities which stretch round the globe has done so little to promote the scientific investigation of the mineral resources of its territory as the Province of Ontario. Its highest function as yet in the discharge of this duty is in the publication of a very excellent yearly report. While the common sense of the Australian provinces has for many years past found ample reward for its liberal yearly appropriations for diamond drill exploration, Canadian honest imbecility and careful stupidity, which, like Siamese twins, have been yoked together in the rule of Ontario mining affairs, place this part of the Dominion behind all other communities, having regard to the wide extent of its mineral areas and their extensive distribution in the eastern section along the rear agricultural frontier. Nor has the Geological Survey of Canada been less culpable. What work of helpful value has it done for the iron ores of Frontenac, Lanark and Renfrew, for the gold miners of Hastings, for the silver miners of Thunder Bay? While Prof. Winchell's explorations in Minnesota have almost at his heels been followed by capitalists who have developed the greatest iron mines the world has yet seen, resulting in the employment of an army of laborers, the construction of railways, the building of a fleet of the largest freight carriers on the lakes, and in a large measure in the reduction of the price of pig iron throughout the Northern States—thus spreading the benefit among a population six fold that of the Dominion—our geologists have been supplying us with their yearly tale of ponderous twaddle, their canoe trips hither and thither, and other topographical work, all very good and useful in its way and excellently well done no doubt by right good fellows, but for the practical development of the industries of the country for the most part of no value whatever. It is plain to every one, to every citizen and to every intelligent foreign visitor that irrespective of anything savoring of politics the men at the head of Government mining affairs in this country have no "go" in them. Look at Ontario's expenditure of $800,000 in the last 20 years for surveying townships for the benefit of that class alone which gets all the good things in this country—the lumbermen—while in the same period she has not expended one dollar for anything in the nature of original mineral exploration. If it is a government function to examine the condition and value of our forest areas so that the purchaser may equally with the seller have reliable information of the value of any part; if it is in the same line of duty that such examination is made of various belts of land as to warrant the advertisement that these are fit or those unfit for settlement; if it is the duty of Government to admonish the the farmer of the blunders of his dairying system and instruct him in improved processes, it is more so than all these the duty of Government to so explore the mineral areas in its possession as to enable the Crown as the public trustee and the miner as a customer to form an estimate of the value of mining locations and the best methods of exploiting them. For this reason: that where the business of mining has to undergo the least hazard, wherever it is a prosperous industry, it adds vastly more to the national wealth in proportion to the capital and the men employed in it than manufacturing, farming or any other industry.

A paper on "The Growth of American Mining Schools and their Relations to the Mining Industry," by Prof. S. B. Christy of California University, read at the International Engineering Congress, in August last, very clearly establishes the claims of these institutions upon the regard of the State.

Having pointed out that in the United States the yearly increase in the number of students of mining engineering keeps pace very closely with the yearly increase of mineral production, the writer proceeds to show that the numbers of mining, civil and mechanical engineers graduated from the different schools are in the ratio of 1, 6, 11. In answer to the question, "Are mining schools justified?" Prof. Christy answers thus: "Miners may be insignificant in numbers but in respect to the value produced as a result of their labor, they are the most important element in the entire population." In 1880 the actual money value produced in the United States as result of labor per capita was as follows:

Agricultural	$ 289 00
Manufactures	996 00
Mining industries (all engaged)	1,167 00
Miners only	1,577 00

In 1889:

Actual value produced by all engaged in mining industries per capita	$ 981 00
Per miner only engaged	2,900 00
Per administrative officer	23,020 00
Per estimated engineer	97,872 00

Between the two periods it will be seen that the effective value of the miner's industry was nearly doubled, which was no doubt chiefly due to the improved machinery and methods introduced, and this in turn may be credited to the skill of the mining engineer. "Surely it is not a bad investment to spend a thousand dollars a year in educating a man for four or five years who shall have the direct control of the production of $3,000,000 as the result of the work directed by each mining engineer in the United States during his working life." "The farmer can harvest his crops year after year; most of his increase comes from sun and air and rain; he has only to fertilize the soil now and then, and his farm remains a source of wealth from generation to generation. But there are no fertilizers for worked-out mines. The crops the miner reaps can be harvested but once, and what he leaves behind through lack of skill is forever lost."

The two features of the work of American mining schools which have produced the best practical results are the "Mining Laboratory" and the "Summer Schools of Practical Mining." In the former problems in ore-dressing and metallurgy are worked out by the student "very nearly on a scale of 12 inches to the foot." The latter begun as a mere summer jaunt, has been developed by Prof. Munroe of the Columbia School of Mines, into a three months' course in surveying, field geology, mining and metallurgy. Experience gained shows that a saving of energy will be effected if the schools study mainly, though not exclusively, those branches locally more important and readily studied in detail. Thus, for example, where argentiferous galena abounds, the mining and smelting of silver-lead ores will be the principal theme.

The 3rd section of the Canadian Statute establishing the Geological Survey, enacts as follows: "The object and purposes of the survey and the museum in connection therewith, shall be, to elucidate the geology and mineralagy of Canada and to make a full and scientific examination of the various strata, soils, ores, coals, oils and mineral waters, and of its *fauna* and *flora*, so as to afford to the mining, metallurgical and other interests of the country, correct and full information as to its character and resources." This is comprehensive enough certainly. It warrants the Government to commit to a summer mining school the exploration by means of the diamond drill of any mineral territory whatsoever in Canada. If such work shall be undertaken in some of the eastern sections of Ontario where the mining industry once active now languishes, the results even if of negative value will be most important. They will either lead, as many believe, to the revival of mining industry upon an intelligent basis, or they will advise the capitalist to set his capital at work in more profitable channels. It is not claimed that the Dominion Government should endow a mining school by any means, but that it should give effect to the economic purview of the Dominion Survey Act by assisting summer mining schools in connection with McGill and Queen's Universities in the exploration of the mineral regions in the vicinity of populous districts in Ontario and Quebec In such the expenses will be less than in remote regions and the revival of mining enterprise will more readily follow any favorable results from such exploration. Once the work in such districts is fairly done experience will have been gained for settling the question whether more distant areas should be exploited in this manner. It may be assumed that at no distant date there will be a contingent sufficiently interested in the scientific investigation of the mineral resources of Ontario, who will hasten the funeral obsequies of the Reign of Dulness to whose sway the mining interests of that Province are now committed. Mr. Harty is known to possess liberal ideas, and to be unfettered by the conservatism of departmental traditions. He is pointed out as the coming Minister of Public Works, and is believed to be in thorough sympathy with a liberal mining policy. But in view of such a prospect the Dominion Government should not be idle. Speculation has had its innings in iron and lead and phosphate mines, and failed. The politicians have had their innings and failed, and it is not likely the Wilson tariff will help Canadian miners. Let the mining engineers now have an innings, that it may be seen whether or not our mining school boys will be able to grapple, as we believe they can, with the two prime questions: (1) Are the mineral lodes of eastern Ontario and western Quebec of sufficient value to warrant the investment of capital? (2) What are the principal features in the disturbance, continuity or barrenness of these lodes, and what their stratigraphical relations? It is not unlikely the Dominion Survey will rebel. The mutually repellant membership of that august body will be certain to develop mutual attraction against any project not emanating from them. It is no derogation from their scientific attainments to say that the project on foot can get along very well without them. They can give it most valuable assistance if they will, the result of which may satisfy the country that they can run boring drills without bringing on national bankruptcy or incurring the ridicule of those who understand the business. Such a consummation will draw to the Geological Survey a degree of public regard with which on patriotic grounds the REVIEW is most anxious they shall be invested. The Canadian summer mining school is a candidate for public favor whose claims cannot be ignored by either the Dominion or Provincial Governments.

A little over 2,000 tons of low grade Canadian Phosphate was shipped to the United States last year.

The Iron Tariff of 1887.

—

There are two questions of interest in connection with the iron tariff adopted in 1887. The first is, "What has been the effect of that tariff upon the iron industries of Canada?" The second is, "What has been the effect of the tariff upon the imports of iron and steel and of manufactures therefrom?"

I. What has been the effect of the tariff upon the Canadian industries connected with iron and steel?

Examining first the Trade Returns we find: (*a*) That the total imports of iron and steel and their manufactures during the five year period, 1882-86, (when the old tariff was in force), was $75,251,232, and during the five years 1889-93, under the new tariff, it was $70,972,717, a decrease during the last period of $4,278,515. (*b*) Analysis according to the degree of labor required for making these imports can be made by dividing them into classes:

1. Interchangeable Mechanism—the manufacture of which requires the highest skill in workmanship. This class includes sewing machines, firearms, locomotive engines and agricultural implements.

2 Hardware, cutlery and edged tools.

3. Machinery.

4. Castings and forgings.

5. Rails and railway supplies.

6. Other forms of iron and steel.

7. Pig iron.

Classes 6 and 7 include, 1st. Pig iron, the basis of the iron and steel industries; and 2nd. Other forms of iron and steel, in the making of which skilled labor enters to a limited extent. They constitute the raw material entering into the manufacture of iron and steel articles by Canadian workmen and are (in addition to pig iron), bar iron, rolled or hammered, boiler plate, steel bloom ends, rolled iron for horse shoe nails, steel for skates, files or saws, wrought scrap iron, etc., and parts of articles in other respects manufactured in Canada.

Taking the above division and applying it to our imports from Great Britain and the United States, from which two countries came, in the two periods under consideration, 98 per cent. and 95 per cent. respectively of the whole import, we obtain the following results:—

Interchangeable Mechanism—
Imports from G. B. and U. S., 1882-86.. $ 5,369,861
" " " 1889-93.. 2,857,637
Decrease.......... .... $ 2,512,224

Hardware, Cutlery and Edged Tools—
Imports from G. B. and U. S., 1882-86.. $13,094,440
" " " 1889-93.. 11,915,967
Decrease...................... $ 1,178,473

Machinery—
Imports from G. B. and U. S., 1882-86.. $10,130,588
" " " 1889-93.. 8,393,159
Decrease.......... .. .. $ 1,737,429

Castings and Forgings—
Imports from G. B. and U. S., 1882-86.. $ 3,214,366
" " " 1889-93.. 1,676,382
Decrease...................... $ 1,537,984

Rails and Railway Supplies—
Imports from G. B. and U. S., 1882-86.. $15,733,927
" " " 1889-93.. $12,194,419
Decrease.............. ...... $ 3,539,506

Other forms of Iron and Steel—
Imports from G. B. and U. S., 1882-86.. $22,719,719
" " " 1889-93.. $28,225,739
Increase... .... $ 5,506,020

Pig Iron, and probably including Scrap—
Imports from G. B. and U. S., 1882-86.. $ 4,045,587
" " " 1889-93 . $ 4,738,946
Increase...................... $ 693,359

The *decreases* in imports are all in the groups the several articles composing which require the higher skill in manufacturing. The *increases* in imports are all in those groups which require the lower skill, thus emphasizing the conclusion that the Iron Tariff of 1887 has given greater employment to skilled hands in Canada engaged in supplying the wants of the Canadian people in the first five groups than was given under the old tariff. The imports of raw material and of partially manufactured articles (classes 6 and 7) have increased $6,199,479, and the imports of the finished manufactured articles have decreased ten and a half million dollars. In the same time the manufacture of pig iron in Canada has amounted to 160,326 tons (bounty paid).

2. In further corroboration of this conclusion the Census Returns show the following results:

IRON AND STEEL USING INDUSTRIES.

YEAR.	No. of Establishments	Employees.	Wages.	Value of Raw Material.	Finished Product.
			$	$	$
1891.....	11,005	48,046	17,125,122	27,917,058	64,487,942
1881.....	9,312	36,846	11,383,576	16,351,205	37,056,037
Increase.	1,693	12,100	5,741,456	11,565,853	27,431,905

Employees increased............ 33 per cent.
Wages " .... 50 "
Expended for raw material...... 70 "
Value of output... .... 74 "
Average wages in 1881 ... $309 per employee.
" " 1891.... 350 "

Showing that the work now done requires greater skill than that done before the adoption of the Iron duties.

In addition to these establishments there are others using iron and steel and making products from them in connection with their main business. Thus, carriage making is a manufacture which is of a mixed nature, but in which 60 per cent. of the cost represents manufactured iron and steel in various forms. Carriage making has increased its establishments by 193, its employees by 343, the amount expended for wages by $720,727, the value of the raw material used by $1,494,534, and the value of the output by $3,168,536—the total value of the raw material used in 1891 being $3,946,080, of which 60 per cent. would be manufactured iron and steel.

II. The second question is: What has been the effect of the Tariff of 1887 on the import trade of Canada with Great Britain and the United States?

Taking the same classes and the same periods we have the following:—

	5 Year Periods. 1882-86.	1889-93.
Interchangeable Mechanism—		
Imports from G. B.	$ 620,305	$ 309,745
" U. S.	4,749,556	2,547,892
Proportion—G. B.	11.5%	10.8%
" U. S.	88.5%	89.2%
Hardware, Cutlery, Edged Tools—		
Imports from G. B.	$ 4,759,913	$ 3,096,052
" U. S.	8,434,503	6,698,444
Proportion—G. B.	36.0%	31.6%
" U. S.	64.0%	68.4%
Machinery—		
Imports from G. B.	$ 2,475,474	$ 1,490,846
" U. S.	7,355,114	6,902,313
Proportion—G. B.	25.4%	17.8%
" U. S.	74.6%	82.2%
Castings and Forgings—		
Imports from G. B.	$ 1,433,952	$ 696,483
" U. S.	1,780,414	979,899
Proportion—G. B.	44.6%	39.2
" U. S.	55.4%	60.8
Railway Supplies and Rails—		
Imports from G. B.	$12,629,781	$10,899,048
" U. S.	3,104,146	1,295,371
Proportion—G. B.	80.2	80.9
" U. S.	9.8	9.1
Other forms of Iron and Steel—		
Imports from G. B.	$19,757,893	$20,403,933
" U. S.	2,961,816	7,821,806
Proportion—G. B.	87.0%	72.3
" U. S.	13.0	27.7
Pig Iron—		
Imports from G. B.	$ 2,747,947	$ 2,822,265
" U. S.	1,297,640	1,916,681
Proportion—G. B.	67.9	60.0%
" U. S.	32.1	40.0%

With one exception all the classes have been imported in a decreased proportion from Great Britain as compared with the United States.

Taking totals and from all countries we have:

Total Imports, Home Consumption,	1882-86	$75,251,232
" " "	1889-93	70,972,717
Imports from Great Britain,	1882-86	44,125,291
" "	1889-93	39,718,373
" United States,	1882-86	29,683,187
" "	1889-93	28,162,406
" Other countries,	1882-86	1,442,754
" "	1889-93	3,091,938
Proportion from Great Britain,	1882-86	58.6%
" " "	1889-93	56.0%
" " United States,	1882-86	39.4%
" " "	1889-93	39.6
" " Other countries,	1882-86	2.0
" " "	1889-93	4.4

It is thus apparent that Great Britain has lost an average of $881,373 a year; the United States have lost an average of $304,160 a year, and other countries have gained an average of $329,837.

Taking the last year of the old Tariff (1886), and the latest year of the new (1893), examination shows that Great Britain's goods were tariffed in Canada to the extent of 10.9 per cent. in 1886, and in 1893 to the extent of 15.2 per cent. In 1886 the United States goods were tariffed to the extent of 22.7 per cent. and in 1893 26.2. It is thus seen that the United States' goods were tariffed in 1886 11.8 per cent. higher than those of Great Britain, and in 1893 11.0 per cent. higher, showing that on the whole the tariff has not caused a discrimination against Great Britain.

With respect to the proportion of free and dutiable goods, the returns for 1886 show the free were 37.3 per cent. and dutiable, 62.7. In 1893 the free were 39 per cent. and dutiable 61, showing an increase in free goods. In 1886 the imports from Great Britain were: Free, 39.4 per cent. and 60.6 dutiable. In 1893 there were free 42.4 and dutiable 57.6 per cent. In 1886 the imports from the United States were 9.3 free and 90.70 dutiable. In 1893 there were 11.8 and 88.2 respectively. The increase in the free goods from the United States is due to the fact that all mining machinery was practically upon the free list in 1893.

Taking the division into classes we find the following percentage of duty paid:—

		1886.	1893.
Interchangeable Mechanism—			
Per cent. of duty on total imports,	G. B.	21.65	21.74
" " "	U. S.	27.50	30.15
No free goods in this class.			
Hardware and Cutlery—			
Per cent. of duty on total imports,	G. B.	24.26	30.00
" " "	U. S.	28.80	60.72
" " dutiable imports	G. B.	24.55	30.44
" " "	U. S.	28.95	60.80
Machinery—			
Per cent. of duty on total imports,	G. B.	24.38	28.07
" " "	U. S.	23.99	27.00
" " dutiable imports	G. B.	No free	29.74
" " "	U. S.	goods	28.22
Castings and Forgings—			
Per cent. of duty on total imports,	G. B.	24.40	52.67
" " "	U. S.	25.08	31.02
" " dutiable imports	G. B.	26.85	58.12
" " "	U. S.	25.20	31.62
Rails and Railway Supplies—			
Per cent. of duty on total imports,	G. B.	0.57	5.90
" " "	U. S.	1.64	1.50
" " dutiable imports	G. B.	14.23	32.80
" " "	U. S.	11.50	13.40
Other forms of Iron and Steel—			
Per cent. of duty on total imports,	G. B.	11.16	14.33
" " "	U. S.	11.97	19.21
" " dutiable imports	G. B.	15.16	21.49
" " "	U. S.	18.84	26.30
Pig Iron—			
Per cent. of duty on total imports,	G. B.	18.30	36.16
" " "	U. S.	10.10	30.00
" " dutiable imports	G. B.	No free goods.	
" " "	U. S.	"	

Taking the two countries the changes which have taken place in the imports, by classes, in 1893, compared with 1886, are—

Imports of—			
Interchangeable mechanism from	G. B.	$ 3,834	6.6%
Interchangeable mechanism from	U. S.	50,587	10.3%
Hardware and cutlery from	G. B.	266,417	32.06%
" "	U. S.	70,389	5.06%
Machinery "	G. B.	127,297	93.40%
" "	U. S.	575,529	57.60%
Castings and forgings "	G. B.	22,653	20.90%
" "	U. S.	114,222	40.50%
Rails and r'y supplies "	G. B.	464,200	25.80%
" "	U. S.	4,624	3.00%
Other forms of iron and steel from	G. B.	522,370	15.80%
Other forms of iron and steel from	U. S.	$1,219,033	186.00%
Pig iron from	G. B.	27,960	7.20%
"	U. S.	215,434	108.00%

A study of the tables indicates,

1st. That the tariff has developed the iron industries of the country very greatly.

2nd. That in providing themselves with machinery to the considerable extent they havé, our workers in iron have met the changed conditions with commendable enterprise.

3rd. That this development of an important industry has been accomplished without making in the change any considerable difference in the conditions under which the two countries from which we buy are placed relatively to each other in their competition for our trade; and—

4th. That other countries have entered the field to a larger extent than formerly, and are supplying us with a considerably increased amount, the changes being as under:—

IMPORTS FROM COUNTRIES OTHER THAN GREAT BRITAIN AND UNITED STATES.

	1886.	1893.
Interchangeable mechanism	$ 15,109	$ 24,559
Hardware, cutlery and edged tools	149,734	205,690
Machinery	5,452	64,557
Castings and forgings	2,504	413
Rails and railway supplies	45,388	54,549
Other forms of iron and steel	131,563	275,229
Pig iron	2,067	359
Total	$351,817	$625,355

The Real Estate Miner in Ontario.

Thirteen columns of the last number of THE REVIEW were given to a report of the annual meeting of what is known as the Ontario Mining Association, held at Sudbury on the 14th ultimo. We shall now devote a little space to review and comment on that report, and if we cannot agree with all the resolutions of the Association and the opinions of its officers, we have at least given them the honor of a hearing.

It might with truth and force be said that the report of the meeting is its own best comment, for the vein of fault-finding and peevishness which runs through almost all the papers will condemn them in the judgment of sober men. It might also be said that an apology was due to the readers of THE REVIEW for publishing the report at all, for the manner of discussing subjects pursued by the president and other members of the Association is utterly foreign to any candid or scientific method of dealing with a subject. But there is no better cure for grievances than to let them find utterance. If they are reasonable redress will come. If they are the vaporings of idle and mischievous men, a breath of free air will explode them.

It will doubtless be asked: Who are the men composing this Ontario Mining Association? This is an important question if we would set a right value on their opinions. Who are they? Few of them are known to us as mining men. In the list of those who were present at the meeting, and who may or may not be members of the Association, we do not find more than one or two who are known as miners or mine managers. There are a few lawyers, three or four doctors, half a dozen speculators in mining lands, two or three land surveyors, and half a dozen others whom the lawyers and speculators employ at odd intervals to explore the woods for mineral after fly time. The leading men are Mr. Hammond, the president, Mr. Æneas McCharles, Mr. John McKay, and Mr. James Stobie. Who has ever heard of these men as miners, or mine captains, or mining engineers, or mining capitalists, or law makers or statesmen? Within a very narrow circle they are known in a small way as mining brokers who buy and sell the lands of others at the best commission they can bargain for, or as men who, by some chance have got hold of a good location at a low figure and are doing their utmost to make a fortune by the sale of it. These are leaders in the Ontario Mining Association, the men who mould its opinions and crystallize them into resolutions.

The president's address at the opening of the meeting is unique in the record of addresses. We have never seen or read anything of its kind before. It is long, but that does not describe it. It is demonstrative, and the vigor is lost in swelling words. It is historical, and the narrative flounders in mazy phrases, and long sentences which end up in the bottom of a bag. It is critical, and the critic's weapon is a blade of lead. It is personal, and the personalities are puerile and rude. It is many other things besides, the half of which never before were brought together in one address, since the days of Anacharsis Cloots, Attorney-General of the Universe. If we had to describe it in a word we would say of this address, that it is fustian—one long unmatched web of fustian from first to last. One wonders if the air or rocks of Sudbury favor the begetting of such a literary prodigy as this Mr. Hammond—or has he come to us from over the borders? Fustian is a common product of the rostrum over the borders, where the American bird soars and screams; but the fustian of President Hammond's address is an exaggeration even of the rhetoric of Sir Hudibras.

Mr. Hammond finds a hundred faults with men and laws and governments, but we cannot pursue his long wail into particulars. Sir Oliver Mowat and Mr. Hardy do nothing right; they will not follow where Hammond, McCharles, Stobie *et hoc* would lead; and so they are weighed and found wanting. "The reign of bluster and boodle is drawing rapidly to a close." The Legislative Assembly too, is selfish and stupid, both sides of it; but thank heaven the Ontario Mining Association is going to send down "country-first" men, who will alter this state of things, and give the millions taken for timber and mining lands to Hammond, McCharles & Co. But the worst enemy of all in the eyes of President Hammond, is "a man by the name of Mr. Blue." Whether it is the color or not, one cannot tell, but to the delicate organism of the presidential ear this name is as offensive as is a red rag in the eye of a bull. So it is also to the Stobie ear and the McCharles ear. What has Mr. Blue—a most efficient officer of the Bureau of Mines—done to make these men his enemies? From their manner of writing they almost make him famous, so that instead of mentioning him as "a Mr. B" he would be better described as "the Mr. B." But we protest against this greatness being thrust upon one man, much as Mr. Blue may have done. He is not the Government of Ontario. Neither is he the Legislature of it. He does not make and unmake laws. He does not vote public moneys, or build railways, or work mines, or create a market for iron, copper and nickel. Not even the royalty is a thing of his creation, much, perhaps, as he might like to be a king and draw the royalties into his coffer, a la Hammond, McCharles and Stobie. He may now and then have drawn tribute in blood from these crowned heads of the Sudbury hills, with the pen he wields so skilfully; but if he would draw more of it, and draw oftener, the crowned heads would be cooler and wiser. Then there is Mr. Ian Cameron, "a Scotchman," manager of the Dominion Mineral Company. He, too, is a bad man for presuming to express an opinion in favor of royalties payable to the Government, and from the way in which he is spoken of, it might be thought that in some men's minds it is a crime to be a Scotchman. Be this as it may, we know that Mr. Cameron has done more to advance the mining industries of Ontario during the short time he has been in the country than his traducers have done in a lifetime.

Another man who comes in for the censure of the Ontario Mining Association leaders, is Professor Coleman, of the School of Practical Science, at Toronto. Dr. Coleman had the temerity to say in the last report of the Bureau of Mines that the best agricultural lands in Ontario have already been taken up, and that the northern portion is chiefly valuable for its minerals. He did not say that there is no good agricultural land in the Laurentian and Huronian districts of the north. There is much good land there, and doubtless it will all be taken up in due time; but the minerals are the most important source of that extensive region's wealth. Mr. Hammond is indignant at the inference which he himself draws from Dr. Coleman's words; yet he could listen without a word of protest to Mr. Stobie's description of the "vast unknown territory" between the Great Lakes and Hudson Bay as "too far north to be of much value for agriculture, and the greater part of it is of little value for timber." Dr. Coleman said nothing so unkind as this of northern Ontario; yet he must be denounced as an enemy by the President of the Ontario Mining Association. On another point, too, Dr. Coleman comes in for censure at the hands of the president, in venturing to express the opinion that "for some time to come we may expect Americans, Englishmen, and everyone else except Canadians to develop and profit by our mineral resources until we have time to learn from them and gather the knowledge and courage to do our own mining and smelting." This is described as a humiliating confession from a Canadian, and the president exclaims: "We would be pretty slow and small spirited if we did not find a way of justly sharing in the credit and profit connected with this business. Now is the time to strike, and to strike high." Quite in the tragic vein! But why don't these gentry get to work? They have never done anything but talk, and scold, or perhaps, sell a mining lot on a broker's commission.

President Hammond, however, has a personal grievance against the Government, for the better understanding of which we quote his statement of it:

"The discovery of nickel ore in large quantities in association with the copper ore of these districts has drawn here a large number of people who upon exploration bought mining lands in the laudable hope of thereby bettering their fortunes, myself amongst the number. Coming here in '89, when prospecting for mineral was still the rule among energetic men, young and old, I joined in aiding and prosecuting this important work. In the latter part of 1890 I was in New York advertising and negotiating the sale of a large and valuable mining property in the district, when on reaching the line at Prescott, on my return, I learned that the Ontario Government had just withdrawn from sale all mineral lands for some forty or fifty miles east and west of this town (Sudbury), two of my own claims included. I could hardly believe my ears. I telegraphed right and left. I tendered the purchase money in person, having received no notification of any such intended action, and for the further reason that the claims had been located but a short time before. The money was refused. Thus, without warning, we were left in the dark for months, some for a year."

Now, what does it mean? Plainly this: that Mr. Hammond went down to New York to negotiate a sale of public lands of the Province, to which he had no right and no claim. If the lands were his, the act of the government in withdrawing land in a certain district from sale could not have interfered with his negotiations in the slightest degree, and no telegraphing right and left and no tendering of purchase money would have been called for in his case. Had he done some work on the lots before they were withdrawn from sale, or made a payment on the purchase money, the patents would no doubt have gone to him under the old Act. But upon his own showing he sought to make the sale of a large and valuable mining property of the lands of the Crown as if they had been his own. The Commissioner of Crown Lands interposed his fiat; and hence those tears and sneers and jibes of President Hammond of the Ontario Mining Association. Out upon such graceless men who seek to make a public grievance out of their own failure to carry out a crooked deal!

We thought of saying a few words more on the papers of Mr. Stobie and Mr. McCharles—McCharles, the great Æneas of the Sudbury Mount Ida—and also on the policy of the Association as formulated in the resolutions; but we are conscious of having already given too much time and space to the men of this Association and the grievances which they flaunt in the eye and ear of the country. When they show that they are mining men they will be entitled to a hearing, and they will get a respectful one; but mere brokers and speculators in mineral lands cannot hope to dictate the mining policy of Canada, or of the least of her Provinces.

The Editor of the REVIEW acknowledges the receipt of a handsome gold pin from Mr. Poole, the retiring President of the Mining Society of N.S. Needless to say, this souvenir will be cherished with the memory of many pleasant gatherings with the "boys."

The "Critic" at its Old Tricks.

With the assurance that is characteristic of profound ignorance the revised version of the Halifax *Critic* (etc., etc.,) in its issue of March 9th, presumes to "edit" our recent review of the gold industry of Nova Scotia in 1893.

Only in so far as the accuracy of our figures is concerned do we propose to take notice of what, otherwise, is simply an impudent attempt to fill space with material taken from the REVIEW, purloined in so garbled a manner. and so distorted by defective punctuation as to make it impossible for its readers to understand what is quoted from the REVIEW and what is the product of the *Critic's* remarkable editorial brain.

Briefly:—The figures of the gold output of 1893 were obtained (through the invariable courtesy of the Mine's office staff) from the sworn returns on record in the office of the Department of Mines, and are *correct.*

The *Engineering and Mining Journal* on January 20th published the yield of Nova Scotia gold mines for 1893 at 18,730 ozs., but on February 17th made a correction and put the production at 19,900 ozs. The new editorial scissors being sharp and the paste pot full, the *C. C. G. and Critic* had the same item in its issue of March 2nd, but of course carefully omitted to credit it to the *E. and M. Journal* whence it came.

The figures of 19,900 ounces were correct as far as the returns were fyled up to January 20th, but before the REVIEW's figures were made up (on the 1st of February) additional returns of 360 ozs. *mined and milled in the year 1893*, were fyled, so that the correct return was, as given in the REVIEW, 20,260 ozs. Had the *Critic* any desire to ascertain the facts it could have verified the REVIEW's figures by stepping across the street and compiling the returns for itself, but the deceased *Critic* never had any hankering after truth nor for work, and its successor it is quite evident is following in the same path.

Next, the *C. C. G. and Critic* says, "The REVIEW states the yield of 1892 as 21,080 ozs., the Government as 19,998 ozs." If this omniscient knight of the paste pot had taken the trouble to read the Governments' reports he would never have written that line.

On page 69 of the Report of 1892 the yield is given at 21,080 ozs., 3 dwt. 18 grains, and on page 31 of the same Report there is given in detail the figures making up this total; page 30 of the Report for 1893 also gives the total of 21,080 ozs. as the correct yield for 1892.

Then the *C. C. G. and Critic* endeavors to find "something unsatisfactory" in the paragraph relating to high yields at Oldham, which read "Oldham has also kept up its record for high yields per ton, August 1893, recording a yield of over 125 ozs. per ton of quartz." Perhaps this statement *is* "unsatisfactory" to the *Critic*, but it is a statement of *fact*. On the 26th of August, 1893, the Standard Gold Co. of Oldham crushed six tons of quartz—four of these tons cleaned up collectively 191 ozs. of gold, or at the rate of 47¾ ozs. per ton; the other two tons gave a yield of 252 ozs. or at the rate of 126 ozs. per ton. We do not think many people would consider such a statement "unsatisfactory," and, fortunately, the REVIEW has not yet come to such a pass as to first inquire of such an irresponsible organ as the *Critic* whether it is "satisfied" before publishing the truth.

Finally we are told that our paragraph:—"The district coming third in the list is Caribou (and Moose River) which, however, records a loss of 500 ozs. from the yield for 1892, is at variance with the facts."

On page 31 of the Report for 1892 we learn that Caribou and Moose River yielded 2,335 ozs., 16 dwt., 10 grs. plus 750 ozs. returned in December, or a total for 1892 of 3,085 ozs., 16 dwts., 10 grains. The yield for 1893 was 3,542 ozs., hence the decrease was 543 ozs; we called it 500 in round numbers—where's the variance. *Mr. Colin Ochiltree Macdonald Killiecrankie*? The variance is really in the *C. C. G. and Critic's* defective arithmetic. By what mathematical process the editor makes 2,542, 206 less than 2,335 is unknown in Ottawa and must be indigenous to the atmosphere of the *C. C. G. and Critic's* sanctum.

The President of the Mining Society of Nova Scotia.

Mr. John E. Hardman, S.B., who succeeds Mr. H. S. Poole, M.A., F.G.S., A.R.S.M., in the Presidential chair of the Mining Society of Nova Scotia, is well known not only in the Province of Nova Scotia, where he resides, but throughout Canada, as a mining engineer of great ability and enterprise, notably in gold mining, where his successes at Oldham and West Waverley have done much to revive confidence in the future of this promising industry. Since he graduated at the Massachusets Institute of Technology Mr. Hardman has had a varied experience in metalliferous mining in the United States, and the excellent equipment of his works at the Oldham and Waverley mines bear high testimony to the thoroughness of this training and his skill as an engineer. The economies in milling practice which he has introduced are models worthy of imitation at many of our gold mines elsewhere in the country. Mr. Hardman is an able writer, a ready, fluent and incisive speaker, and an energetic worker for the advancement of provincial mining. Many of the most important amendments, made in recent years, to the Mines Act, are very largely due to his watchfulness, while his numerous contributions to the literature of the Society, notably his papers on "Recent Gold Milling Practice in Nova Scotia," "Government Aid to Mining," etc., have been of the greatest service and value. Mr. Hardman is a member of the American Institute of Mining Engineers, the Federated Institute of Mining Engineers (Great Britain), and the General Mining Association of the Province of Quebec, by whom, at its last session, he was elected an honorary member. In his election we congratulate the Mining Society in having found a worthy successor to Mr. Poole, the esteemed retiring president. Our engraving is from a recent photo kindly furnished by Notman, Halifax.

Our Pig Iron Industry and the Tariff.

By the time this issue is in the hands of our readers, the Budget will doubtless have been presented to the House by the Minister of Finance, putting an end to the suspense which has interfered seriously with the development of business during the past month or two.

The Canadian Iron Industry has been the theme of much discussion since the question of a change in the tariff was first brought forward, and the amount of information that has heen elicited during the course of this discussion must enahle both sides of the House of Commons to deal most intelligently with the question of the continued encouragement of this industry. It is satisfactory to be assured that in a general way the principle of protection will be preserved, for it must be evident to the mind of every one who desires the development of the natural resources of this country, that if there is one distinctly Canadian industry, it is the manufacture of iron.

In its first stage, that of the smelting of iron ores into pig iron, the representatives of the Maritime Provinces, of all political opinions, cannot fail to see that the prosperity of these Provinces is dependent to a large extent on the encouragement of this industry. From the various articles that have appeared in the newspapers from time to time, it is satisfactory to note that pig iron can now be produced and sold in Nova Scotia at prices quite as low as the same grades of Scotch iron are sold at in the centre of the Scotch iron trade in Glasgow. The long distance, however, separating the Nova Scotia furnaces from the Quebec and Ontario markets, which are the principal users of pig iron, and which requires to be covered by rail haulage, has to be provided against. The rate of freight charged by the Government Railway, the Intercolonial, via Levis and Grand Trunk Railway, to Montreal, is about $3.50 per ton, of which the greater part of course goes to the Government. The steamer freight from Glasgow is in summer not over $1.00 per ton.

It will be seen, therefore, that a large part of the present protection covers merely the difference of freight between foreign and Canadian iron to its principal market, this difference going back to the Government in the form of freight paid to the Intercolonial Railway. It is surely a good thing to support an industry that pays such a large amount of freight to this line.

The Province of Quebec has also especial claims on the country, for here the manufacture of charcoal iron is one of the principal natural industries, giving employment to the very class whose claims on the consideration of the country are being pressed so prominently at present.

The members of the House have doubtless had an opportunity of reading the very interesting and instructive address on the Canadian Iron Industry recently delivered by the Vice-President of the Quebec Mining Association, Mr. Geo. E. Drummond. It is particularly interesting to note from it the great number of persons who are employed directly with this industry. Not only are they not confined to the comparatively small number engaged in smelting the ore at the furnaces; there are the farmers, who mine the ore on their farms; the wood cutters, who prepare the wood in the forests for the making of charcoal; the large number of teams and men who haul this wood and ore to the furnaces and charcoal kilns, and the many others who are connected in one way or another with preparing the material necessary for smelting the ore. It is certainly a benefit to any country to have varied interests, and this is one which has been a boon to the farmer in these days of cheap grain.

The pig iron smelted in Canada is at present used for two purposes only. The larger quantity is of course used by the various foundries throughout the country for the manufacture of iron castings, and the balance is used in the manufacture of mild steel, by the Nova Scotia Steel Co. It has still to find a further and much larger outlet in the manufacture of all the other descriptions of iron and steel used throughout the country.

The pig iron stage has reached a wonderful development during the past few years. Let us hope that the Government will still encourage it to such an extent that in a few years more nearly all the heavy iron and steel used in the country will be rolled from Canadian material.

Cape Breton Coal Trade.

It is pretty safe to predict a season of great activity for the coal trade of Cape Breton, greater probably than this district has heretofore enjoyed. The Dominion Coal Co., who, in addition to the collieries they operated last year, now control the Victoria mine on Sydney Harbor, have been busily engaged all winter in preparing for enlarged outputs and more rapid and larger shipments. A magnificent shipping wharf in Sydney Harbor, erected upon the site of the old "International" wharf, will be completed by 1st May, in readiness for the opening of navigation. This wharf, which is built of Georgia pine upon cresoted piles imported from Perth Amboy, will possess labor-saving features and facilities for rapid, and, at the same time, careful shipping, which have been hitherto unknown in Cape Breton. The new wharf is considerably higher than the old one, and the water on both sides was dredged last autumn to admit of large steamers completing their cargoes alongside. A crane is being erected upon the wharf to lift and lower cars into vessels' holds, thus avoiding the breaking up of the coal which has hitherto been a necessary result of the old methods of shipment by drops and chutes.

At the mines themselves work has been correspondingly brisk. It is true that the Gardiner and Emery pits have been closed down, it having been found by experience that they were costly and difficult to work, while the coal from neither pit was good enough to counteract these disadvantages, but, on the other hand, a new shaft (Dominion No. 1), has been sunk at Old Bridgeport, to the Phalen seam, which will in a very short time be putting out three or four times the combined output of the pits that have been abandoned. In addition to the sinking of this shaft, which is the largest in Nova Scotia, the Old Bridgeport and Caledonia shafts and heapsteads have been enlarged and improved to admit of largely increased outputs. In the case of the Caledonia mine the Dominion Bridge Co. have erected an iron heapstead, which is another new departure in this section of the mining world. The International, Reserve, Glace Bay, Gowrie and Victoria collieries, while they have not received the special attention devoted to Caledonia and Old Bridgeport, have all been put in good shape, and at the present time are busy banking out coal. Mr. David McKeen, M.P., has now associated with him as assistant manager Mr. W. Blakemore, late of Cardiff, England, a gentleman standing high in the ranks of mining experts in the old country. Mr. Blakemore, whom many of our subscribers will remember meeting at the last two gatherings of the Mining Society in Halifax, will, no doubt, find full scope for his abilities in developing the immense resources at the command of his employers. In addition to work upon the new shipping wharf and at the mines, the Dominion Coal Co., or rather the firms under contract to them, have been actively pushing on their railway to Louisburg during the winter. The new line from Bridgeport to Glace Bay was opened for traffic on January 1st, and the extension to Cow Bay will be ready for operation early in August. The remaining distance to Louisburg will be finished with as little delay as possible, one section of it being already well on the way to completion. Over and above the large amount of work done under contract, the company themselves have had from 400 to 500 men employed all winter upon the railway approaches to their new wharf, so that it can be seen that the winter of 1893-4 has been a busy one for the laboring classes in Cape Breton. The new company, about which there have been so many "Mother Shipton" prophecies in the local press, has so far done nothing to merit the abuse so freely hurled at it, but, on the other hand, has brought prosperity to very many who could not have looked to the old companies under the former regime for work during the winter months.

In a review of the Cape Breton coal trade the Dominion Coal Co. naturally monopolizes the chief notice, but it must not be overlooked that the General Mining Association, whose "Old Sydney" colliery was not acquired by the syndicate, will still be doing business at their old stand at North Sydney, where they are making considerable additions to their shipping facilities. They are sure to hold their own, especially as sellers of house coal, and will probably roll off a shipment during the coming season which will eclipse any of their previous efforts. And finally, the Messrs. Burchell will also be doing business at their "multum in parvo" colliery at New Campbelton, upon an independent basis, and are justified in hoping, from the success their coal met with during the short time their mine was in operation last year, that they will secure as many crumbs from the richer men's tables as they will be able to digest. With freights still low everything points to the probability of Cape Breton coal not only holding its own during the coming season, but pushing farther afield than ever before, and we trust that our predictions of an active and lucrative season will be amply verified.

The Importation of Free Mining Machinery into Canada in '93.

During the fiscal year ended 30th June 1893, the value of the mining machinery imported duty free into Canada under the provisions of the law admitting mining machinery of a class or kind not manufactured in Canada, amounted to $87,208 of which $72,478 came from the United States and $14,730 from Great Britain. The distribution by provinces shows the importations as follows:—

To Ontario	$27,889
" Quebec	18,519
" Nova Scotia	22,019
" New Brunswick	30
" Manitoba	9,166
" British Columbia	9,585
Total	$87,208

Asbestos Shipments 1893.

The quantities of Canadian asbestos shipped by the Quebec Central Railway from the Eastern Townships mines during the year ended 31st December last were:

From Coleraine	20 $\frac{500}{2000}$
" Black Lake	1,551 $\frac{1550}{2000}$
" Thetford mines	5,338 $\frac{1900}{2000}$

To this must be added the quantities shipped from the Ottawa and Elzevir districts, Ontario, figures of which are not obtainable at date.

Gold Production of British Columbia in 1893.

The Annual Report of the Hon. the Commissioner of Mines is to hand, and as usual contains a mass of valuable and interesting information respecting the mineral developments of that Province during the past year. The export of gold dust as reported by the Banks in Victoria was of a value of $316,279, and the estimated yield $353,355. In explanation of the decrease from the export in 1892 ($332,938) it is stated that a large portion of the product of the mines in the Yukon district was shipped to San Francisco, and that the majority of the shipments from the Kootenay country left the Province via Spokane, Washington, and were therefore not reported in Victoria. While the amount produced by placer mining is somewhat less than that obtained in 1892, the total yield is greater, owing to the returns of some of the quartz claims in the Yale and West Kootenay district having been taken into account.

The anticipations formed in 1892, of an increased output from hydraulic workings, have not been realized, owing to the development work on the majority of the claims not having reached the stage when results could be expected, whilst in other cases operations have been hindered by an insufficient supply of water.

This branch of placer mining is yearly attracting greater attention throughout the Province, and the amount of capital already invested and to be laid out during the coming season, more particularly in working the bench lands in the vicinity of the Fraser River and its tributaries, is very considerable.

Interest is also being taken in the beds of the Fraser and Thompson Rivers, with a view to dredging, and, judging from the number of applications for leases for this purpose, a serious attempt will be made to prove the worth of the gold hidden in the strata of these rivers. Special machinery for dredging is in course of construction at different places on the Fraser River.

The returns of the principal districts are given as under:

Cariboo District.

Barkerville division, 1st July to 15th Nov.	$ 73,000
Lightning Creek, " "	49,000
Quesnelle, " "	25,450
Keithley Creek, " "	54,550
Estimated product from 15th Nov. to 31st Dec., say	8,000
	$210,000

Cassiar District.

Dease Creek	$ 6,500
Thibert Creek	4,409
McDame's Creek	9,876
Liard River	1,700
Stickine River	450
	$ 22,935

East Kootenay.

Wild Horse Creek	$ 19,000
Moyie River	700
	$ 19,700
Lilooet	51,376

EN PASSANT.

Intelligence has been received of the decease at Gresse, in the Duchy of Mecklenburg, Germany, of Baron Ohlendorff, founder of the great European fertilizer of Ohlendorff & Co. (now the Anglo-Continental Guano Works, Ltd.), owners of the Squaw Hill and Ætna phosphate mines on the Lievres River.

The announcement of a united meeting of General Mining Association of Quebec and the Mining Society of Nova Scotia, at Sydney, Cape Breton, during the week commencing 7th July, has created the liveliest satisfaction among the mineral operators of both provinces. The visitors are invited by the Dominion Coal Co. and the General Mining Association, Ltd., of London, whose guests they will be. The outline of the attractive programme sketched by Mr. Blakemore at the last meeting of the Mining Society (see this issue), should conduce to a record attendance.

In view of this invitation a general desire has been expressed in Quebec that the June meeting of the General Mining Association should be postponed, and it is more than likely that this arrangement will be ratified at an early meeting of Council.

We are authorized to state that the claims made with so much ostentation by the *Canadian Colliery Guardian*, *Critic*, &c., &c., to be the organ of the Dominion Coal Company, Ltd., are wholly without foundation. The management repudiates any connection with such an irresponsible sheet.

The Stellarton *Trades Journal* sizes up the personality of this revised edition of the Halifax *Critic* succintly in a recent editorial as follows: "A fortnight ago we hinted our suspicion as to the personality of *Guardian* writer. We suspected a certain impecunious fellow—a mercenary mountebank. The style of the article in the *Guardian* furnishes proof that we made a bull's eye. If a man is hungry he may beg bread; if he be ignorant he may acquire knowledge by application; if he be poor he may accumulate wealth by industry, but, as one has quaintly observed, 'if he lacks common sense, God help him; he can get it in no other way.' And that is what the *Guardian* fellow lacks."

During the debate in the House of Commons the Review will have on exhibition in the main Parliament Building a thoroughly representative exhibit of the products of the Nova Scotia Steel and Forge Co. (Ltd.), the New Glasgow Iron, Coal and Railway Co. (Ltd.), the Pictou Charcool Iron Co. (Ltd.), the Londonderry Iron Co (Ltd.), and the Canada Iron Furnace Co. (Ltd.) thus practically demonstrating to both political parties the growth and development of the iron industries of the country under a beneficient protective policy. The whole exhibit is an excellent object lesson. The bounty must be continued for a fixed period—ten years if possible, and it is sure to carry.

Mr. J. A. Mara, M.P. for Victoria, B.C., the gentleman to whom more than any other the whole mining community is under a deep debt of gratitude, for his successful efforts in the House of Commons to have mining machinery not manufactured in Canada admitted duty free, had an interview with the Hon. G. E. Forster, M.P., Minister of Finance, on the 19th instant, and urged that, at all events so far as British Columbia was concerned, all mining machinery should be admitted absolutely without restriction. This protection to the most promising of our native industries deserves favorable consideration.

The Dominion Coal Company (Limited) has purchased the very fine vertical three-stage compressor which was a prominent feature of the exhibit of the Rand Drill Company at the World's Fair. As this machine is not made in Canada we are anxious to ascertain whether the Jenckes Machine Company is making any opposition to the claims of the Dominion Coal Company to have it entered duty free? To be consistent they should certainly do so, but then the shoe would be pinching near at home.

The proposal to federate the existing Canadian mining organizations is receiving attention and there is good prospect of something being done at the next meetings of the societies interested. In the meantime committees have been delegated to form a basis of federation.

Photography in mines was the subject of an interesting paper by H. W. Hughes at a recent meeting of the North Staffordshire Institute of Mining Engineers. The writer pointed out that for mining it was necessary that the operator should either be an engineer or have an engineer associated with him, and for many obvious reasons it was necessary that the camera should be of the lightest and most compact form for underground work, as it often had to be erected in awkward and confined situations. Practically speaking, it might be said that the rapidity of a lens depended on its aperture and focal length, and as in underground work speed was of the greatest importance, a lens possessing such advantage should be secured. The difficulties to be overcome in mine photography were not many, but were hard to surmount. In all classes of mines the smoke resulting from blasting, the moisture-laden and misty atmosphere, and the dripping of water from the roof, were generally present, these being supplemented in coal mines by the presence of coal dust, which not only thickened the atmosphere, but deposited particles on the lens and plate. The condensation of water, on the lens and plate was, perhaps, the most difficult matter to avoid. So far as the plate was concerned, one had to trust to luck; but with the lens the best preventive was to carry them in the trousers pocket, and so warm them up to the temperature of the body.

At the same meeting Mr. T. H. Wordsworth gave particulars as to the working and cost of a disc coal getting machine made by the Yorkshire Engine Company, which was at work at the Middleton main, or Silkstone seam, at Messrs. Pope & Pearson's collieries at Altofts. This seam has been worked at three collieries for the past thirty years, at a depth of 420 yards, up to a large fault. The method of work was the long wall with park gates. When the seam was first opened an attempt was made to hole by hand, but the cost was excessive, 2s. per ton.

With two men, under favorable circumstances, the machine in question would cut sixty yards in one shift of eight hours, but if another man was sent to cut away the debris, a greater length could be cut. The machine was worked by means of compressed air, and the number of shots had been reduced in a face 570 yards long from thirty per day to twelve. It was hoped by still further increasing the cut to still further dispense with them, and the total cost of getting the coal was 1s. 7d. per ton. The number of men, too, was reduced, 120 being able to do the work of 173.

Tyrell-ania has been suggested as a most appropriate designation for that section of north-western Canada, recently the scene of some exploration by Mr. J. B. Tyrell and about which there has been so much nauseating flatulency in the columns of the daily press. In glancing at the mass of inspired puffing and free advertisement of the doings of this modern Gulliver one cannot restrain a smile at the utter insignificance of the work done both in its value to the country, and in comparison with the sterling achievements of many of the members of the present staff of our Geological Survey. Moreover it must occur to most that $7,000 out of the total annual appropriation of $60,000 for the Survey's work is a somewhat heavy expenditure to squander on a section of country entirely beyond the economic uses of the people for many generations to come. The country is thirsting for knowledge of its resources much nearer at home and extravagant junkettings of this kind should be tabooed.

The holders of the MacArthur-Forrest cyanide process patents in South Africa—the African Gold Recovery Company—have had a very good innings on the Rand, but now trouble is booming ahead. According to the South African *Mining Journal*, it is currently reported that the committee which has for some time past been privately engaged in investigating the validity of the African Gold Recovery Company's patents has come to the conclusion, after patient investigation of all the evidence available, that the patents could be opposed with good prospect of success in a Court of law. An ultimatum will probably be shortly presented to the company demanding substantial reductions in the royalties at present paid, and should the demand be refused, immediate litigation will probably result. What will be the consequence of such action it is impossible at present to predict. One thing, however, is certain, if change is to result, it will certainly not be in the direction of increased charges for the use of the patents, seeing that competition with other chemical processes as well as with improved appliances for the extraction of gold by concentration will have shortly to be faced. In this important item amongst the total cost of gold mining and recovery, there is, therefore, good prospect of reductions being effected, which, with those daily being brought about as a result of recent lowering of prices of coal and dynamite, should certainly exert an appreciable influence during the coming year in increasing the profits earned throughout the district.

Mention is made in a recent issue of the *Honduras Mining Journal*, among other things, of a somewhat curious discovery, bearing not only on the theory that the Aztecs did not smelt their gold ores, but on the immense antiquity of gold mining as a Mexican industry, which has lately been made in the State of Chiapas. For a long time the superintendent of the great Santa Fé copper mine was perfectly satisfied that the mine was absolutely virgin, since none of the immense masses of copper ore cropping out in all directions showed the slightest trace of having been touched. True, there was one shallow hole near by, which, however, might easily have been sunk by some wandering prospector during the last few years. Lately, however, it was found necessary to grade out a hillside some 200 yards from the mine. The hill was densely wooded, but, after felling the timber and excavating two feet of black vegetable mould, traces of ancient workings were discovered resulting in over 50 metres of an ancient dump being unearthed. This dump was found to contain blocks of rich gold bearing copper ore, thrown away as useless. The shaft of an old mine was also found. The whole workings appeared to be entirely separate from the Santa Fé mine and in a lower formation. A further discovery was made on the Victoria mine, half a mile to the south-west of the Santa Fé mine. Here also there was not the slightest trace of any human being having worked on the mountain, not a dump, not a loose stone, and the ground covered with immense forest trees. A tunnel was being driven to crosscut the ore body, and had gone through over 70 ft. of ore, when suddenly an ancient working is blasted into. There are no traces in the neighborhood of any patios, dumps, arrastras, or furnaces; no trace of human habitation beyond an occasional idol found in the caves or hollows in the Santa Fé mine. The small broken grinding stones which might well have been used for maize, were found, but where was the free milling gold ore treated which came from the mines that must have been extensively worked, judging by the extent of the Santa Fe dumps and of the Victoria workings?

The deposits of domestic gold bullion at the mints and assay offices of the United States during the year 1892 aggregated $32,367,850. and the deposits for the calendar year 1893, $36,056,300, showing a gain in the deposits of gold of domestic production in 1893 over that of 1892 of $3,688,450. It is now estimated by the bureau of the mint, says the Wall Street *Daily News*, that when the final figures are received covering the statistics of the production of gold in the United States for the calendar year 1893, an increase over that of 1892 of about $4,000,000 will be shown. The largest increase in any single state during the year was in Colorado, and which approximates $2,000,000. The only state in which a decrease is shown is Nevada, which shows a falling off in 1893 as compared with 1892 of about $575,000. The present indications are that the production of gold for the current calendar year will largely exceed that of 1893. The larger part of the increase will be from the mines of Colorado.

A report by Mr. Henry Hall, Inspector of Mines, has been presented, in the form of a blue book, to the Royal Commission on Explosions from Coal Dust in Mines, giving the result of a series of experiments made with coal dust collected from the principal seams in various mining districts. Altogether fifty-two samples were received, and, with the exception of four or five, all were tested in a mine shaft placed at Mr. Hall's disposal by the proprietors of the White Moss Colliery, Skelmersdale, a wrought iron cannon being used for the gunpowder shots. Mr. Hall says that a careful examination of the results warrants the following conclusions: (1) That the flame from a blowing out gunpowder shot in the presence of dry coal dust always ignites more or less of such dust, and so increases the burning and charring effects of the shot; (2) that when a large flame, such as that of a blowing out gunpowder shot, or the flame from the ignition of a small quantity of fire damp, traverses an atmosphere containing a very moderate quantity of dry coal dust, the dusty atmosphere will explode with great violence, and the explosion will continue on and pass throughout any length of such atmosphere, its violence and force increasing as it progresses; (3) that coal dust from several seams in different districts, notably those from Glanmorgan, Monmouth, Durham, Lancashire, Yorkshire and Scotland, are almost as sensitive to explosion as gunpowder itself; (4) that coal dust is, as a rule, more sensitive to explosion in proportion to its high quality and freedom from impurities; (5) that a ready supply of oxygen, such as is supplied by a brisk ventilation, has the effect of making coal dust explosions more probable and more severe; (6) that certain "high explosives" are incapable of igniting or exploding coal dust. Of the whole of the dusts tested, that from the Albion Colliery, Glanmorgan (Aberdale or Merthyr 4 ft. seam or upper 4 ft.), excelled all others in violence and sensitiveness to explosion, and this seam has the worst history of any in the kingdom, upwards of 1,600 persons having been killed in it by explosions since the year 1845. It was also evident from the experiments that the higher the quality of the coal seam the more liability there is to explosions of dust. With regard to precautionary measures to be taken in the face of these facts, Mr. Hall urges the total abolition of gunpowder from coal mines and the substitution of certain "high explosives." Many of the largest firms in the country have, he says, already of their own motion taken this step.

A locomotive made by a Manchester firm, Messrs. Beyer, Peacock & Co., has been utilised for the first time on the Argentine railways for the purpose of testing the value of petroleum oil as fuel in the place of coal. A tank engine was successfully run from Beunos Ayres to Ferrari, a distance of 74 kilometres, in one hour and four minutes, petroleum being the only fuel employed.

The Broken Hills Mines, Australia, established a record last year by putting out in round numbers 12,500,000 oz. silver and 48,000 tons lead. In only five years—1873 to 1877 inclusive did the whole of the Comstock mines yield in the aggregate so much of the white metal. The Comstock silver record is 21,750,000 oz; that was in 1877, which was 18 years after the mines there were opened—a comforting reflection in these days when the notion is prevalent that silver mines are things of but three or four years! Carrying comparisons a little further, says the *Australian Mining Standard*, it is found that, notwithstanding the falling off in the value of silver and lead, the output of Broken Hill last year was worth £2,915,000, which is more than the gold output of the whole of Victoria has been for any single year since 1886.

An Australian miner in South Africa thus describes his experience in South Africa: "Johannesburg is a large place for its age. It has a population of about 40,000 whites. Everything in the way of necessaries is very dear; any sort of a shop will bring about £40 to £50 per month, and small at that. Most of the business people are Jews. There are more people out of work in Johannesburg than ever I saw in Sydney, and before long there must be a general reduction of wages. Many Australians have found their way here, and, for what reason I cannot learn, the South Africans have a terrible down on them. I certainly would not advise anyone to come here. As soon as the war is over I shall make my way to Matabeleland, where they say gold is to be found. I cannot hear of any alluvial in this country anywhere. As to the mines, there is a run of country being worked some 40 miles long. Coal mines are at each end, so that fuel is easily obtained. Very little timber is to be seen, and that used for mining purposes is nothing but saplings. The largest timber used is pine, and there is not much of that.

"All the mines are worked with Kaffir labor, and the wages are about £1 per week. A white man superintends some 35 Kaffirs. The Kaffirs can work as well as a white man, and I imagine if similar labor was introduced into Australia many reefs would pay to mine which are now lying idle. The reefs here are not worth more than 8dwt. or 9dwt. The "banket," as it is called here, reminds me very much of cemented wash, in fact it is nothing else. There is a large amount of machinery here. The batteries in almost every instance are large, varying from 40-head to 200-head of stamps; so that Johannesburg ought to turn out a large quantity of gold. No concentrating is done here; the cyanide treats the tailings, and the battery work, consequently, is not as careful as it is in Australia. Another feature of the mines here is the extensive use of rock drills. In some there are quite 30 in operation, one white man, with two negros, having charge of each machine. These men work 10 hours per day, and earn £1 per week, and there is plenty of demand for such work. As the result of my experience on this field, I certainly should not advise miners from Australia to come here."

At the monthly meeting of the Leeds Association of Engineers, Mr. W. D. Wansbrough, Lincoln, read a paper on the history and development of the portable engine. He said that as these engines were usually placed in the hands of unskilled attendants, an important object had been to simplify every detail. Further, the ever-increasing demand for them had led to the development of manufacturing appliances for the duplication of pieces of machinery, which had now reached such perfection that a working part could be taken out of one engine and used in another with equal facility. He estimated the number of portable engines annually produced in this country at not less than 10,000, some of which were sent out to the most obscure corners of the earth. In short, portable engines had become great pioneers of civilization, and were the hewers of wood and drawers of water for our colonists. Although the portable engine did not become a commercial success until recent times, yet so far back as 1775 Smeaton described a movable engine with boiler and condenser, of 6 feet stroke, self-contained, and internally fired. Mr. Wansbrough alluded to the inventions of Murdock, Murray and Trevethick, and that about the year 1839 several portable engines of improved design were patented, amongst which were the self-contained threshing engines of Tuxford & Ransome. The famous Cambridge boiler, brought out in 1847, in which the flue was carried the length of the boiler three times before entering the chimney, and which is still made, was a distinct improvement on the earlier types. In 1861 Messrs. Robey & Scott introduced a boiler for portable engines, the principle of which has been adopted by Mr. F. W. Webb for the London & Northwestern locomotives. The great fault in portable engines at this time was that the working parts were not sufficiently accessible for examination or repair, but Mr. Wansbrough showed, by a comparison with later types, that this defect had been completely eliminated, and a general appearance of neatness maintained. Link-motion expansion gear was introduced in 1869, but it was only recently that persons appreciated its advantages. An engine could now be governed so perfectly that it would not vary its speed whether the full load was put on or entirely removed.

A new invention for the pipe induction of coal claims is now being discussed in the United States. The system embodies the reduction of all coal at the mines to the form of impalpable dust, at a cost of 3 to 5 cents per ton; the separation from the coal by one of the present washing processes of all free sulphur, pyrites, slate, etc., at the cost of another 5 cents per ton; the mixture of the coal powder with about its own weight of water; thus converting it into a sort of black milk, and the pumping of it in that state to any desired distance to any desired market, as oil now is pumped.

When the mixture has arrived thus far, it is deprived of most of its water in great settling basins; but as much as 8 or 10 per cent. of the fluid is left in the mixture, which in that state is pumped short distances only to points of consumption where the remainder of the water may be dried out by the otherwise waste heat. The capacity per day of twenty-four hours of a twenty-four-inch pipe, with a mean speed of five miles per hour, is about 31,000 long tons, taking the coal conveyed at 351 pounds per cubic foot of mixture. At 1,200 pounds pressure for pumping stations thirty miles apart, a four-inch pipe would carry 320 tons daily; an eight-inch pipe, 1,834; a twelve-inch pipe, 5,120. The total coal consumption of New York City averages considerably under 25,000 tons per day; the New England States burn about 50 per cent. more than this; the whole United States nearly twenty times as much, in round figures, so that comparatively few pipes would suffice to handle the whole coal supply of the country. The evaporation of the water from the coal dust presents no serious difficulty.

This system opens up again the question of the comparative value of coal dust for fuel. While in many cases coal dust is commercially valueless, in others it cannot be replaced by any other form of coal for real services; for instance, in the manufacture of fuel or other gas; the making of stiff coke; the mixing with iron ore dust before coking, to the great improvement of the product, both in quantity and quality; the remedying of the smoke nuisance, as the dust mixed with air is blown into the furnace, and the maximum combustion is secured; and generally, wherever coal is burned merely to generate heat in properly designed combustion chambers. The inventor of the pipe conduction of coal claims, and apparently with good reason, that it effects a great saving in cost of transmission.

At the New York meeting of the American Society of Mechanical Engineers, Mr. C. H. Manning read a paper in which he described a method of manufacturing large steam pipes he employed 11 years ago for several thousand feet of 20 inch pipe, with very satisfactory results. The pipe was made of mild steel ¼ inch thick, double riveted, and with die forged flanges ⅜ and ½ inch thick. The pipe was riveted with an Allen pneumatic riveter having 70 inch reach of arms which limited the length of the sections. The longitudinal seams were placed quartering 45° from top of pipe, with the laps pointing up so as to be readily accessible for calking. The quarter turns were made of two 5-16 inch sheets curved on a cast-iron former, and having a row of rivets along the back and another row along the throat. The tees were made of three sheets, shaped over similar formers, and the rivets were all on the sides. A serious difficulty had been previously experienced in keeping the round-about joints tight. Leaks had been caused by condensed water being retained by these seams, which caused unequal expansion, as the portions covered by them heated much slower than the unprotected or dry surfaces. This was remedied by making the section conical, and bringing all the laps in one direction, and then laying the pipe on a down grade with the smaller ends the lowest, so that the water ran out. The last course of the pipe was not coned, to avoid having two sizes of flanges. Mr. Manning has never known a riveted pipe to give out under water-hammer, and a hammer that would completely wreck a cast-iron pipe or split a welded pipe would only strain the longitudinal joints of a riveted pipe.

The investment of money in coal mining in France has not been profitable, according to *L'Economiste Francais*. From the statistics of the Ministry of Public Works, it appears that the capital invested in the coal mines of the country was very nearly 1,700,000,000 fr. In 1882 and 1883 the average interest earned on this amount was only 2¼ per cent.; in the years 1884-89 it was 2 per cent.; and only in the exceptionally prosperous years 1890 and 1891 did it go as high as 3¾ per cent. It is true that in 1891 the average earnings in the two districts of Nord and Pas-de-Calais reached 6¼ per cent. on the capital, but in the same year the average returns for the mines outside of these districts was only 2¼ per cent. A few coal mining enterprises in France have been financially successful, but these are offset by a long list of failures.

In an address before the students of Case School of Applied Science, Cleveland, Mr. T. D. West, considering some of the elements essential to success in foundry and other engineering achievements, and pointed out that the advancement of the times called for the manager of such works to possess a fair knowledge of chemistry; not necessary to make a chemical analysis of metals, but to understand the different elements, such as silicon, carbon, sulphur, phosphorous and manganese, have in influencing the attainment of desired results in mixing metals. Chemistry is rapidly coming to the front as a very beneficial factor in aiding the founder to determine the results in mixing of metals, and allay much of the uncertainty and loss in that line, which past and present practice reveal in the operations of a very large majority of our foundries. The science of steam, gases, and metallurgy, combined with a knowledge of electricity and construction of machinery, are more essential to a manager of a foundry to-day than is generally conceded, and one aiming for such an occupation, cannot make any mistake in obtaining all the knowledge he can of all the elements here outlined. For the foundry he could with all assurance say, there is a large field for displaying intelligence, knowledge, skill and experience in managing men and overseeing the manufacture of foundry products, and he doubted if the demand is not about the same with all industries that have in any wise made progress in keeping up with the "times." The higher the standard of intelligence and knowledge exacted from the manager or overseer, the better for all concerned, also far fewer strikes and bickerings with workmen; for whatever failings workmen may possess, they readily recognize true ability, and will respect discipline, when enforced by intelligence and common sense.

Mr. Benjamin Jones, of Cleveland, has invented a new process in molding, claiming particular advantages in connection with the casting of steel. The improvement is in the preparation of molds, mold facings and cores, the object being to produce cores and molds capable of withstanding the intense heat had in the manufacture of such castings and that will shrink with the casting in cooling and cleave readily from the casting.

After giving the components of the core, and stating how the core and mold facing are prepared, the patent sets forth that the core having been thus built up, a suitable binding and hardening substance is introduced so as to form one compound with the sand and combustible substance of which the mold or core is composed. Being applied while hot and in a liquid condition this binding substance is burned into the mold. If all the gases in the hardening substances were retained, disastrous results would ensue in the operation of casting, through the formation of blow-holes, but by burning the binding substance into the core and mold, enough of the gases is eliminated to avoid these troubles. It is claimed by the inventor that a core, mold or mold-facing composed in accordance with his formula will not only withstand the intense heat produced in steel casting, but will shrink approximately with the casting in cooling, and thus permit of the casting in steel of complicated work such as propellor blades and bomb shells.

A recent test made at the plant of the Cleveland Rolling Mill Co. was a partial demonstration of the possibilities of Mr. Jones's method. A feed roll, with reductions from 17 inches to 13 inches, was cast in steel, with arms and hubs, the whole coming out clean, without crack or flaw. The length of the roll was 5 feet 10 inches, and contraction brought it to 5 feet 8½ inches. The thickness was one inch and one quarter. Heretofore rolls of this description have been cast at this plant in three pieces.

A few years ago pig iron was bought by French rolling-mill managers and iron founders in accornance with contracts made at a fixed price *(a prix ferme)* made in advance for a certain period; but now this system has been to a large extent superseded by contracts based upon a sliding-scale *(echelle mobile)*, the variations in the price of the pig depending on the fluctuations of that of coke, which is, observes the *Revue Industrielle de l'Est*,, a much more rational arrangement. The advantage to both buyers and sellers of being constantly posted up in the average price of the coke consumed by the Meurthe-et-Moselle blast furnaces (which yield more than half the out-turn of France) has induced the above-named journal to publish, month by month, a return of the quantity of coke bought from the furnaces, and the mean of all the prices paid for it by the ironmasters. Each rolling-mill manager and founder will thus be enabled, by the mean of the previous month, to calculate the price he will have to pay during the current month as per contracts made in accordance with the sliding-scale.

Prof. Carpenter in a recent address at Gray College, discussed the comparison of different methods of transmitting power, reaching the following conclusions as to the loss in per cent. required for different methods:

	Per ct. of Loss.
Line shafting:	
Loss by friction (average 25 per cent.)...	15 to 40
Electricity:	
Loss in transforming from mechanical to electrical, and vice versa..........	20 to 30
Line loss..........................	2 to 5
Total loss..........................	22 to 35
Conveying steam:	
Naked steam pipe (still air)............	37.6
Pipe covered with solid wood and earth.	11.2
Pipe covered with solid wood and pipe covering	4.8

Carbon re-actions in the blast furnace, formed the subject of a paper before a recent session of the South Staffordshire Institute of Iron and Steel Works Managers, in which the writer, Mr. W. J. Hudson, claimed the keynote of economic smelting was to deoxidise the ore by means of carbon monoxide at a temperature too low to permit of any of the carbon dioxide then formed being reduced again to the lower oxide. In concluding the paper, in which technicalities were mostly dealt with, the writer observed that it was evidently of the highest importance to secure complete calcination of the ores when they were of the carbonate variety, such as Cleveland ore or the native mine of South Staffordshire. For every unit of carbon (of dioxide) remaining unremoved from the ore another unit of carbon might have to be removed from the fuel, thereby increasing a preventable waste. The chairman said that, according to the remarks of Sir Lowthian Bell in a recent paper he had written, the size of the furnace giving the best results was about 11,500 cubic feet. That furnaces of medium cubic capacity were capable under certain conditions of producing equally as efficient results as those of much larger capacity was amply proved by the fact that in America furnaces of 25,000 cubic feet were made to produce as much as 3,000 tons of iron per week, whilst in Cleveland, where the cubic capacity of the furnaces was as much as 33,000 feet, the average yield was only about 800 tons per week. In addition, the fuel consumption in America was about 3 cwt. less per ton of iron, as compared with Cleveland. Of course, the difference in the quality of the ore obtainable in the two countries accounted in a great measure for this disparity, but not altogether, as was shown by the fact that the Dowlais Iron Company, Cardiff, could produce better results with the same economy of fuel, with a furnace of 25,000 cubic feet capacity, than was obtained in Cleveland with furnaces of 30,000 cubic feet. It appeared to him that the manufacturers of the Middlesborough district—much as they prided themselves on being foremost in the iron and steel making industries—were too much wrapped up in the formulas and scientific attainments, and did not pay sufficient attention to acquiring that practical knowledge which would enable them to get the most economical driving out of their furnaces.

THIRD ANNUAL GENERAL MEETING

OF THE

Mining Society of Nova Scotia

AT HALIFAX, ON 7th MARCH.

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

H. S. Poole, M.A., A.R.S.M., Acadia Coal Co., Stellarton.
R. G. Leckie, M.E., Londonderry Iron Co., Londonderry.
John E. Hardman, S.B., Oldham Gold Co., Oldham, N.S.
R. H. Brown, M.E., General Mining Association of London, Ltd., Sydney.
W. Blakemore, M.E., Dominion Coal Co., Glace Bay, C.B.
G. W. Stuart, Cariboo Gold Co., Truro.
J. C. McDonald, Antigonish Gold Co., Country Harbor.
C. F. Andrews, Richardson Gold Co., Country Harbor.
J. D. Copeland, Richardson Gold Co., Country Harbor.
Dr. E. Gilpin, Jr., Inspector of Mines, Halifax.
Hugh Fletcher, B.A., Geological Survey, Scotch Village.
J. T. Burchell, Cape Breton Coal Co., Sydney.
James Baird, Joggins' Mines.
B. C. Wilson, East Waverley Gold Co., Waverley.
A. A. Hayward, South Uniacke Gold Co., Waverley.
R. G. E. Leckie, Torbrook Iron Co., Torbrook.
T. R. Gue, Acadia Powder Co., Halifax.
Duncan McDonald, Truro Foundry Co., Truro.
W. G. Matheson, Matheson & Co., New Glasgow.
Howard Clarke, Halifax.
Dr. A. H. Mackay, Halifax.
H. A. Saunders, Lake Lode Gold Co., Caribou.
Capt. George MacDuff, Waverley.
W. R. Thomas, F.G.S., Montagu, N.S.
C. E. Willis, Canadian Rand Drill Co., Halifax.
J. W. Sword, Ingersoll Rock Drill Co., Montreal.
B. T. A. Bell, Editor CANADIAN MINING REVIEW, Ottawa.
H. M. Wylde, Halifax.
G. E. Francklyn, General Mining Ass'n. of London, Eng., Halifax.

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

New Members.

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

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

Report of Council, 1893-4.

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

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

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

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

Receipts.

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

Expenditure.

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

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

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

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

The Engineering and Mining Journal.
The Iron and Coal Trades Journal.
The Colliery Guardian.
The American Manufacturer and Iron World.
The Journal of the British Society of Mining Students.
The Canadian Engineer.
The Canadian Mining and Mechanical Review.
The Canadian Colliery Guardian, Critic and Journal of the Iron and Steel Trades.
Transactions of the Manchester Geological Society.
The Proceedings of the South Wales Inst. of Engineers.
The Massachusetts Inst. of Technology.
The Transactions of the Am. Inst. of Min. Engineers.
The Transactions of the Canadian Inst.
The Trans. of the Mining Ass'n and Inst. of Cornwall.
The California State Mining Report.
Catalogue of Stratagraphical Collection of Can. Rocks.
Transactions of Federated Inst. of Mining Engineers.
Geological Survey of Canada, and others.

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

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

Mr. Fielding, while agreeing with the spirit of the matter presented by the Society, pointed out the impossibility of precluding individual members from introducing private bills which might affect mining legislation, yet assured us that so far as lay in his power he would endeavor that a hearing should be given to the Society and others in all proposed legislation affecting the mining industry.

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

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

The Report was adopted.

President's Address.

MR. H. S. POOLE, M.A., A.R.S.M.—With the anticipated pleasure of seeing to-day elected as my successor in office one who has done so much to assist the development of our Society, and under whose guidance much more may be confidently expected, there is in me a feeling of gratification that the lot to appear at the head of a movement that holds out so much promise as does our Society should have been mine at its inception and until to-day. A continuance of such vitality as our organization has shown during the past two years warrants us in believing that more than a justification exists for the formation and continuance of a mining society in Nova Scotia. The growth, the vigor of our Society is seen in the increased membership, and in the prominence and character of the men who have joined us, and our growing weight in the community is marked by the general interest taken in our proceedings, and by the attendance at our meetings.

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

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

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

Our papers and discussions on gold mining have emphasized the fact that although this branch of our industry is over 30 years old no gold mine has yet attained a vertical depth of 500 feet, an insignificant depth in comparison with that reached in other gold fields in half the time. Coupled with it there is a common belief that the pay streaks do not extend to any greater depth. For my own part I am not satisfied that the reasons offered for holding this belief are sufficiently reliable or convincing, although at the same time I acknowledge a difficulty in proving either one theory or the other lies in the generally small extent of the pay streaks, and the want of a key to the order, if there be any, in which they occur. To the researches and mapping of the Geological Survey and carefully kept records of mining experience we can alone look for satisfactory guidance.

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

However well pleased we may be with the standing we have attained, however full our hopes may be of effecting one or more of the objects that specially instigated us to draw together, and however diverse our individual interests may be, we all feel the latter should be subordinate. That in making common cause against the varied difficulties that meet us as miners in this Province, lies our strongest hope of successfully competing in the open markets of the world. That in united appeals to public opinion can the above hope for extraction from the sloughs of legislation through which well-meaning friends have diverted our road of life. It is perhaps not without some comfort to find that Nova Scotian legislation does not in this respect stand alone—New Zealand presses us hard for muddiness of mind on mining matters. We led off and publicly declared that after January 1st, 1884, "It shall not be lawful for *any* person not having a certificate of competency to be employed at *any* mine in the Province." To appreciate in full the force of this enactment the broad definition in the law of what constitutes "a mine" should be remembered, and that boys and laborers are persons employed under ground. New Zealand, not to be outdone, in section 29 of the law of that Province, enacts that no person under 18 years of age is to have charge of an engine for raising or lowering men, and the Act then proceeds under the general rule to forbid anyone under 21 years of age to have charge of a steam engine. In the same Act section 27 prohibits the employment of boys in any capacity, while section 31 carefully provides for the registration of boys employed in connection with mines.

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

But before saying anything more on the relevancy of such a Statute, let me remark no reflection is intended on

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* From some seventy questions the substances of several is as follows:—

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

the wisdom of opening the door of instruction on mechanics to engine-drivers and others laudably desirous of adding to their knowledge and fitting themselves for more responsible positions, but don't let it be done on the plea that the book-taught man will drive an engine or a gin, or turn the handle of a windlass, moving living freight more safely than one with experience alone. Again, I would repeat every credit is due for the faculties now supplied for the education of workingmen. The criticism I make turns on the muddiness of mind* that confuses the user of a machine with a mechanic. As well insist that every dispenser of drugs shall be a doctor; every wearer of clothes, a spinner and weaver; every printer, a paper-maker, or every master of a passenger ship carrying sons and daughters of Africa shall be a marine architect.

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

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

I have dwelt perhaps too much on this one amendment, but I wished to make it a typical case. I have already drawn your attention to other points in the Act which appear to me inconsistent with the fundamental object of the law, the preservation of life, and I will ask you to recall to mind what I said at Montreal a year ago. Inconsistencies that I then hoped had only to be pointed out to be remedied, but now I find they are defended. Credit is claimed for them as made in the interests of the working man; credit for deleting the General Rule which prohibits the unramming of shots, a rule expressly made to protect the working miner; credit for failing to allow work to proceed under substitutes in the absence through sickness or otherwise of certificated officials; credit for making the sinking of a hole for coal illegal, that when for water, or for gold, or for iron is within the law. If such restrictions are right and proper the country should see that they be not exceptional, but are as a part of one harmonious system, dealing with all classes of labor impartially.

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

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

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

Amendments to Constitution and Bylaws.

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

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

That new sub-sections be added as follows:—

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

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

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

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

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

Election of Officers and Council, 1894-5.

The following were elected for the ensuing year:—

Past President.

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

President.

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

Vice-Presidents.

R. G. LECKIE, M.E. (Londonderry Iron Co.) Londonderry.

DAVID MCKEEN, M.P. (Dominion Coal Co.) Glace Bay.

GEORGE W. STUART (Caribou Gold Co.) Truro.

Hon. Secretary.

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

Secretary-Treasurer.

H. M. WYLDE, Halifax.

Council.

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

R. H. BROWN, M.E. (Gen. Mining Assoc'n. of London, Ltd.) Sydney Mines.

DUNCAN MCDONALD (Truro Foundry and Machine Co.) Truro.

CHAS. FERGIE, M.E. (Intercolonial Coal Co.) Westville, N.S.

W. L. BLAKEMORE, M.E. (Dominion Coal Co.) Glace Bay.

W. G. MATHESON (I. Matheson & Co.) New Glasgow.

C. E. WILLIS (Canadian Rand Drill Co.) Halifax.

GRAHAM FRASER (New Glasgow Iron, Coal and Ry. Co.) New Glasgow.

GEOFF. MORROW (Stairs' Sons & Morrow) Halifax.

Votes of Thanks.

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

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

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

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

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

Election of Honorary Members.

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

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

Federation of Canadian Mining Associations.

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

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

AFTERNOON SESSION.

Invitation to Visit Cape Breton.

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

MR. W. BLAKEMORE.—You will remember that at our last meeting Mr. McKeen invited us to hold the summer meeting at Cape Breton. He now writes me to submit a programme. It is his desire to make the visit a pleasant one and he says both in the mines and shipping arrangements of Cape Breton and in the scenery of the country there will be found ample to repay anyone for making the visit. He says further that any member of the Quebec Association will be heartily welcomed. He suggests that the members leave Halifax on Monday, July the 9th. They will arrive at Sydney on the evening of that day. There will then be a large hotel in order and it will be ready to receive the gentlemen. On Tuesday it is proposed to take the members to the International Pier which will be one of the largest on the continent. It will load two vessels of the same size as the "Teutonic." There is an immense tower by which the buckets can be swung around to either side of the vessel. At the pier the works will be explained by Mr. H. Donkin, C.E. Then the party will be brought back on the steamer to the Sydney hotel and have lunch. In the afternoon they will go out on a special train to some of our mines, probably the Caledonia. That mine is being equipped in a superior manner. The shaft has been doubled in size. We are putting in self dumping cages, cages of double capacity in putting out coal. All the arrangements for weighing, etc., are new and very complete. The air compressor is a duplex compound steam compressed air of large size. The coal cutting machinery will be new. We have the Stanley heading machines, in the advertisement of which it is claimed that in eight hours the machine has been able to cut from ten to twelve feet. In a six feet heading, we are heading thirty feet in eight hours, blasting it, loading and carrying it away. That is quite a record in heading, such as I think was never seen in the old country. We have also the longwall cutter for under-cutting the coal. We have the Sergeant and Harrison machines. All of this machinery will be interesting even to our gold mining friends from a mechanical standpoint. The mine is lighted up by electricity. You might then have the ordinary meeting in the evening, the reading of papers and transactions. The representatives of the Dominion Coal Company will read several papers explaining the workings of their departments. The Company's engineer, Mr. Pearson, will read a paper on compressed air, and I will read one on underground work. Mr. Brown of the Sydney mine, has invited the members out to the old Sydney mines on the following day. They are the oldest in Cape Breton, and have a very interesting history. In the evening it is Mr. McKeen's desire to entertain the members at a public dinner at the hotel, to which will be invited the prominent men of Sydney. On the third day he will place a steamship at your disposal to take you to Louisburg. The cruise down the coast will be very interesting. Those desiring to return on Friday can do so, but if they desire to remain there are many things of interest to be seen. These suggestions are now open for your approval. Mr. McKeen is anxious that our large and important property be inspected.

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

MR. B. T. A. BELL.—On behalf of the Quebec Association I can only express heartiest appreciation of the thoughtfulness which has prompted the invitation to our members. We had arranged to hold our June meeting in Quebec and were in hopes of having the pleasure of the company of members of the Mining Society. I will, however, submit this kind invitation at the earliest opportunity and I hope to be able to report that our Association has cancelled its Quebec meeting and that we will be fully represented in Cape Breton.

Publication of Transactions.

MR. B. T. A. BELL.—As a matter of economy in printing, I think it might be well this year to defer publication of the Transactions until the end of the year when a full report of the year neatly bound and indexed would be of more service than the present method of issuing quarterly parts.

This was agreed to.

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

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

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

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

The figures given are the averages of large totals, e.g., those for stoping represent over 5,000 tons, those for driving are averaged from nearly 4,000 feet of levels, etc.; those for sinking represent a total of 1,100 feet.

For convenience I have tabulated the results as follows:

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

MR. JOHN E. HARDMAN, S.B., OLDHAM, N.S.

President Mining Society of Nova Scotia.

—		By Hand Drills.			By Air Drills.	
	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
	$	$	$	$	$	$
Shafts, per foot sunk ..	23.58	4.81	14.32	16.46	13.82	15.52
Winzes, " " " ..	13.08	9.40	11.53	13.32	8.92	11.38
Raises, " " raised..	9.00	7.11	7.99	.....	.....	.....
Drifts or Levels, " " driven .	9.45	3.75	6.86	8.05	5.28	6.86
Cross-cuts, " " " .	10.10	3.52	8.84	4.54	4.23	4.45
Stopes Overhand, " fath. stoped	23.48	6.91	14.40	18.34	11.32	15.34
" " " ton "	14.24	1.53	5.34	20.58	12.29	15.49
" Uderhand, " fath. "	36.07	14.26	30.73	19.41	14.12	15.69
" " " ton "	11.77	7.01	10.20	25.57	11.39	17.94

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

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

The figures for winze sinking, like those for shafts, are nearly identical, $11.53 for hand against $11.38 for air; nor is there much discrepancy between the maxima and minima, and what has been said as to shafts will apply equally to winzes.

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

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

The figures for stopes are not by any means so flattering to the air drill. The explanation for this in the case of the overhand stopes is doubtless to be ascribed in part, as before, to the length of the machine, but also in part to its weight, and to the inevitable delay and loss of time in removing the heavy drill and stoping bar to a place of safety when firing, and the bringing back and setting up of the drill afterwards. From the nature of the case in a narrow lode but few holes can be drilled from one setting up of the machine, and lightness becomes an all-powerful consideration. The difference between having to carry a 150-pound drill and a 250-pound drill up a narrow, flatly inclined belt over a hack-stope, becomes painfully apparent when you try it yourself.

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

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

It would therefore seem, from the foregoing figures, as if there were scant grounds for advising the use of a compressed air plant for narrow-vein mining, and were we to stop at the figures given there would be little or nothing to be said for air drills. But what the table does not show is the great advantage in time that is gained by the air drill. In shaft and winze sinking the rate by air has been (with us) doubled, enabling one to sink 100 feet with air before hand drilling could reach 50 feet. In driving and cross-cutting the rate is from two to three times the speed obtainable by hand work.

A monthly run of 57 feet in cross-cutting hard whin rock being compared with 20 feet by hand in the same cross-cut. In another case one shift with an air drill drove 1.4 as many feet as double shift by hand could do in the same ground, showing nearly three times the speed.

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

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

Some Remarks on the Gold Production of Nova Scotia and How It May be Increased.

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

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

Having been intimately associated with gold mining since its inception in the Province, and generally familiar with its "ups and downs," I fail to find any evidence—and do not consider—that the decreased yield of the past few years at all indicates any exhausting of the supply of gold, or that the profits of the industry are any less on the amount of gold produced, but is rather attributable to the altered conditions, requiring larger outlay of capital, consequent upon the transition from mere surface mining—or more properly *prospecting*—to a more advanced and systematic mode of operating, rendered necessary by the increased depth of the workings, the additional plant necessary to treat larger quantities of low grade ore, and the presence of more refractory ore—or more properly of ore which has not become disintegrated by elemental surface influences and from which our universal practice of free gold milling and amalgamation fails to extract the gold as it readily did from the surface rock where the gold had been liberated by natural process during untold periods of time.

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

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

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

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

In evidence of this, and that our people are recognizing this condition of things, I may refer to the fact that for some three or four years past there has been a tendency or movement toward concentrating the numerous small properties into large compact blocks of ground which should include a majority—or if possible all—the known veins in a given district so as to thereby warrant the erection of efficient plant and extensive operations from one central point on a scale which would command competent ability and economize management to a minimum; and this concentrating of interest; and the investing and introducing of capital; and equipping under a new regime has absorbed and necessarily further absorb much time during which time there is but little gold forthcoming.

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

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

Wherefore I do not attribute the decreased yield that has occurred during the past three or four years to any exhausting of the mines, to any decreased average of gold in the ore, or to any inability to make the industry as remunerative as heretofore, but rather to the gradually altering conditions of the business during that time—to that inevitable transition period, if I may so express it—the interim of transference from circumscribed areas, and limited, if numerous, operations, to the rehabilitating under a new regime, with larger properties, improved management and plant and more extensive working, under more systematic and thorough mining practice.

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

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

It is regretable if any indefiniteness in our statutes tends to foster contention. We are assured there need be no misapprehension, yet in practice there has arisen a wide divergence of construction, and recently an individual facetiously defined a government lease to a gold mine as "a quit claim deed which guaranteed the owner in peace-able possession so long as the property was of no value." But, seriously, considering that the miner has to pay the government as much for 17 acres of gold mining areas as does the agriculturist or the lumberman for 100 acres, and then has to keep on paying rents and royalties eternally, it is but reasonable that he (the miner) should expect to find that government as anxious to secure him in an incontestible title as to receive his deposit, or if need be, put him in possession without recourse to the courts.

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

MR. G. W. STUART.—I am sorry that Mr. Wilson did not remain to read his paper; not that I can find any fault with the manner in which that office was performed by the President, but I would have liked to ask Mr. Wilson a few questions. One of them is this: Whether or not he has taken it for granted that all the gold raised in the Province is returned? I speak feelingly on that matter. It is only a short time ago I was called upon to pay a forfeit of $500. I happened to be bondsman for a company for its mill license. The fact had slipped my mind. I had long since lost all confidence in the management, but had entirely forgotten that I was on their bond. The mill ran for several years all right. They finally ceased to pay dividends or royalty. After a couple of years the manager left the country. I was called upon to pay up the money. That is all because the returns were not made. If we made a determined effort I think we could get the government to remove the royalty on gold. The old clause in the law about working was practically a dead letter. Practically, all we had to do was to pay two dollars per area. Since 1891 the law has been changed. We have been obliged to pay fifty cents per area rental as well as the two dollars per area, when we acquire them. That fifty cents is more than equivalent to the royalty. The government could consequently very well relieve us from that tax. I would suggest that we take the matter up at our next meeting. If the government would establish an assay office and make it compulsory to bring gold to that office to have it assayed, valued and stamped with the government stamp, it would become legal tender. The charge could be a nominal one, merely enough to support the office. If that were done I think you would find the returns larger.

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

THE PRESIDENT.—That statute is still in existence.

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

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

Other Papers.

During the afternoon Mr. H. McInnes, Barrister, Halifax, delivered an interesting address on the Provincial law respecting Employers' Liability, citing a number of decisions of the courts bearing upon the subject. Mr. R. E. Chambers, Mine Superintendent at Ferrona, also contributed a valuable paper "On the Value of Blast Furnace Materials." We regret, through pressure upon our space to be unable to furnish our readers with the reproduction of these in this issue. The remainder of the afternoon was taken up with a discussion of the advisability of securing larger accommodation for the Society. It is not unlikely that in the near future some action may be taken in this matter.

The meeting adjourned at six o'clock.

Third Annual Dinner.

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

HON. W. S. FIELDING, on rising, was greeted with loud applause. He said that he enjoyed an unexpected pleasure in being present. He had been one of the party at Montreal, and had many pleasant recollections of evenings spent around this board, and when he received the invitation to be present this evening it was with much regret that he thought he would have to decline. He was absent in a distant part of the county engaged in business which was occupying public attention at the moment and it seemed impossible that he could get here in time. Some years ago there was a governor in this Province named Sir Hastings Doyle, and, at the same time there was a very popular clergyman here, who was a neighbor and a warm personal friend of Sir Hastings. They were in the habit of meeting together frequently in an unconventional way and enjoying the pleasures of the table. One day Sir Hastings had some particularly fine soup for dinner that he knew his friend the clergyman would enjoy, and sent his servant over with an invitation to come and dine with him. The clergyman reflected with much sadness that it was a fast day, and sent word that he would not be able on that account to accept the invitation. But the attraction was too strong to be resisted, and before the servant had quite got out of the house the clergyman called him back and said "Never mind; tell Sir Hastings that I will grant myself a special dispensation and come." And so, after he had sent off the telegram to Mr. Bell, expressing regret that he would not be able to be present this evening, he concluded that he would grant himself a "special dispensation" and come. (Applause).

This was an age in which co-operation in every department of society was necessary, and if co-operation was necessary in other departments why should it not be made use of in respect to the many important interests to promote which this Society was formed. The formation of the Society was a wise step. Already the members had good results to look back to and no matter what government might be in power in the future, as the years rolled on the Society would find a large field of usefulness and as the result of the exercise of its legitimate influence upon public affairs there might be a development of the mineral wealth of the province that would be a source of profit to investors. Both as respects gold, coal and other minerals, which, perhaps had been too little considered, he believed that there would be a development of our mineral wealth which would be a source of pride to the province, of revenue to the provincial treasury, and, what was of equal importance, of profit to the pockets of the men who worked the mines. For years men had been boasting of the mineral wealth of the province and had been crying for capital to develop the mineral wealth and trade of the province. Now a time had come when, more than ever before, capital was being drawn to the province, and though there might have been differences in the past he was persuaded that the members of the mining fraternity, united and working together, would be able to so influence legislation that capital would be attracted, justice done to all concerned, and the mineral wealth of the province be made a blessing to all who were interested in the country. (Applause).

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

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

MR. JAMES BAIRD having done ample justice, in a few humorous remarks, to the charms of the fair sex in responding to "The Ladies," songs were given by Messrs. Ernie Wylde, R. G. E. Leckie, Thomas and Sword. The health of the retiring President, Mr. H. S. Poole, was given by the chairman. Mr. Hardman dwelt on the fact that the existence and prosperity of the Society was mainly due to the work that had been accomplished by Mr. Poole. (Applause.)

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

OLD KING COAL.

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

Chorus.

Then this man set up a whimsey, got a banksman and a bailie,
And a stout lot of sinkers got he.
They began to dig and bore, then they blasted, then they swore.

But they sank all the way jollily,
Through clunch and binds they knocked, black bat and pelton rock,
Through the gubbin and the balls d'ye see,
Then they drove out a big heading, just to search among the bedding,
For the place where King Coal should be.

Chorus.

So they found old King Coal at the bottom of the hole,
And his face they were glad for to see,
Though with thumb to nose it bore, the strange legend not of yore,
Pay up increasing royalty!

Then in all the country round, in every house is found,
Old King Coal smoking jollily,
And many a good fellow sits by him and gets mellow
As all jolly fellows should be.
For old King Coal is a jolly old soul,
And a jolly old soul is he,
And many a good fellow sits by him and gets mellow
As all jolly fellows should be. (Applause.)

MR. B. T. A. BELL responded to the toast of "Our Sister Societies." He thought that the attractive programme outlined by Mr. Blakemore at the afternoon Session would be certain to attract to Cape Breton a good representation of the members of the sister Association in Quebec. It was a great source of satisfaction, and it might be taken as fair indication of the advancement of mining in Canada that these organizations of mining men were springing into activity and were accomplishing good work for the country. He commended the Mining Society to the government as an institution which merited their support, inasmuch as there was no better means of advertising the wealth of the province than the Society's publications. He concluded by reciting the following humorous composition on the present system of examination for a certificate for workers in coal mines, which was respectfully dedicated to their good friend the Hon. Mr. Fielding:—

"OUR CERTIFICATE."

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

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

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

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

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

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

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

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

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

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

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

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

Mr. LECKIE spoke briefly in reply. He expressed his pleasure in being present. He did not know of any other profession in which the feeling of fellowship prevailed to the same extent as in the mining profession.

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

Coal Mining in Cape Breton.

BY W. BLAKEMORE, M.F.I.M E., GLACE BAY, C.B.

The first thing that strikes an English Mining Engineer when he visits the coal mines of Cape Breton is, that nature has been especially bountiful, not only in respect of the number of coal seams which she has placed in the Island, but equally so in respect of their quality, thickness, and perhaps more especially in their disposition. It might be possible in several districts of the United Kingdom to find an equal number of workable coal seams within a corresponding area; indeed, in the Midland Counties, the writer has inspected mines which contain eight workable seams of coal and six of iron stone, all lying flat within a depth of 200 ft. from the surface, but in this case the coal measures would only aggregate 30 ft., being an average of less than 4 ft. to the seam; whereas, if you take the coal seams that are being actually worked in Cape Breton today, you have:

The Sydney Mines seam	6′
" Victoria "	6′ 10″
" Harbour "	6′ 2″
" Phalen "	8′ 6″
" McAuley "	5′

averaging 6′ 6″. And if to these we add the seams which have been partly worked and proven, and which will, no doubt, within a few years be in operation again, this average will be raised to upwards of 7 ft., viz.:

The Hub seam	8′ 6″
" Lingan main seam	6′
" Barra Sois "	6′
" Block House "	10′

averaging 7′ 7″. The only deposit in England which will at all compare with such a yield of coal in a given area as the above, is to be found in South Staffordshire over a restricted district not exceeding twenty square miles, where the celebrated "ten yard" or "thick coal" is found; nowhere else can we find so many tons of coal to the square mile.

The next feature of interest is, the remarkable access which one has to these coal measures, which are so deposited that, one by one, they all crop out to the surface, so that if you stand at the sea coast in the centre of the coal basin and proceed inland, you will strike the outcrop of each seam, and find that at different periods; in the first instance, for the limited domestic consumption of the early settlers; later on for the added requirements of fishing fleets or agricultural laborers; and still more recently, to supply ocean steamers, inland manufactories, and far distant cities of New England or the St. Lawrence; these various seams have been proved and developed, until at the present time an annual output exceeding 1,000,000 tons has been reached. It is needless to say that, at any rate, in the early stages of this process, there would have been very little development if the working of the mines had involved deep and costly sinkings. In fact, it is not too much to say that the mines would not have been worked until the present day, when large capital is obtainable, and modern mechanical appliances are available; for the rocks which overlie the coal measures are so loaded with water, that the process of sinking and recovering must always have been an expensive one. But nature having in one of her kindliest moods lifted the coal measures, and fractured them along the ridge of an anticlinal, exposing and laying bare their edges, the early pioneers of the industry, readily and at little cost, drove down their slopes from the surface, and by small winnings recovered such coal as they required; and then as their energy and industry opened up outside markets, they pushed their levels along, draining the upper portion of the workings and conducting the water into the sea. So that until comparatively recent years, in spite of large volumes of water flowing through the mines, not even a pump was required. It is very interesting to traverse some of these old levels, especially in the Phalen seam. There is one at Bridgeport, upwards of two miles in length, discharging the water, which is yielded by crop workings more than 2,000 ft. in width, into Indian Bay, one mile east of Lingan Harbor. The workings here are very old. The writer has had the opportunity of inspecting a plan made early in the present century, which shows the small pillars and openings which were in vogue in those days. And while the primitive methods adopted and the limited output of coal prohibited the possibility of large profits being made, it is certain that perseverance and economy enabled satisfactory results to be obtained. But with coal mining in Cape Breton as elsewhere, it is, "*O tempora, O mores!*"—and although there is still an immense area of "crop" coal remaining ungotten, the improved methods, as well as the market exigencies of the present day, have forced workings into the deep, where there is less water to contend with if the upper reaches be properly drained, and where at the same time there is a wider field for operations. Before quitting this part of the subject it should be noted that, exclusive of the areas at Broad Cove, which are only just being opened up, and the full extent of which is therefore unascertained, upwards of 1,000,000,000 tons of unworkable coal are known to exist within a distance easily reached. A "largesse" of riches such as few, if any, mining districts can boast of.

Another most important feature in connection with these mines is the nature of the roof and floor. As a rule in the United Kingdom, although coals may be of a good workable thickness and excellent quality, the roof is more or less indifferent, and it is somewhat exceptional to have a strong rock cover. In Scotland, and the North of England, the roof is as a rule better than in Lancashire, Yorkshire, the Midlands or South Wales, but per contra, the coals are thinner, especially in Scotland, where seams not exceeding 18″ in thickness are worked. In the other districts, however, it is a noteworthy fact that the thickest seams have the worst roofs.; and this unfavorable symptom reaches its climax in South Wales, where it would be impossible to work some of the best seams owing to the exceedingly rotten character of the roof, if they had not attained such notoriety for steam purposes, as to command a high price in the market. Perhaps the best evidence of the general character of the roofs in the United Kingdom is the amount of the timber bill per ton of coal mined, and speaking from a long experience of mines of varied characteristics, the writer has come to the conclusion, that this item amounts in Lancashire and Yorkshire to an average of about 10c. per ton; in the Midlands about 12c.; and in South Wales 16 to 18c. Comparing these with Cape Breton, where the timber bill averages say 2c. per ton of coal mined, and allowing for the difference in price (pit timber being just three times as dear in the United Kingdom as in Canada) we should get a comparison, as between 6c. here and 10, 12 or 18c. there; which substantially demonstrates the strength and uniformity of the roofs in this district. The floor is almost as hard as the roof. Indeed, if it were not so, the quantity of water flowing through all the mines would render them like a quagmire and make it almost impossible to maintain the tracks or keep timber in position. When to the advantages already mentioned, are added an easy gradient, which as a rule does not exceed 3″ in the yard, and a practical immunity from explosive gas, it will be seen that the difficulties presented by coal mining in Cape Breton are indeed few and comparatively easy to overcome; and the only one worth mentioning has already been referred to, *i.e.*, the presence of a large quantity of water. This has been dealt with in the upper reaches by sea levels, and below that principally by steam pumps; which, owing to the character of the water have to be specially constructed, and all the working parts lined with non-corrossive material, to resist the action of oxide of iron, with which the water is heavily charged. The energies of those who are so extensively developing the mines at the present time, are directed towards dealing with the water at the higher levels, and preventing it from finding its way into the deeper workings, and if this can be successfully carried out, the probability is, that with greater cover, and by holding the surface water in check, very little will have to be dealt with in the deep.

Although this article was only intended as a brief sketch of the salient features of Cape Breton mining, for comparison with English, and any detailed particulars as to the methods of worki g are reserved for another, it would be improper to conclude without some reference to what, after all, is the most important aspect of the case, that is the quality of the coal. One can conceive of all the conditions enumerated above, in combination with coal measures, the inferiority of which rendered all such natural advantages valueless, but in this, as in most cases, "an ounce of fact is worth a ton of argument," and the successful manner in which the Cape Breton Coals have established themselves in the principal markets of Canada for domestic, steam and gas making purposes, as well as the increasing favor in which they are held by steamship companies, substantially demonstrates their excellence and adaptability. And if, as any one desirous for the prosperity not only of Cape Breton, but of the Dominion, would fondly hope the near future may see the development of the iron ores, which abound in the Island, and the establishment of blast furnaces and rolling mills in our midst, there will be with cheap and abundant fuel, such a development in the industry as will make Cape Breton the "Staffordshire" of Canada.

Price of Nickel—In spite of the increased supply and the undoubted ability to supply much more from Canada on demand, the price has not declined to any marked extent.

The Lake of the Woods as a Mining Camp.*

By Henry DeQ Sewell, O.L.S., A.M.I.C.E., Eng., D.L.S., Port Arthur and Rat Portage.

At the last annual meeting of this Association I attempted to give you an account of gold mining as it had occurred under my own observation, in a comparatively limited and unknown area, viz.: Taché and Tenderwood to show what could be done towards promoting our mining industries, by a few energetic individuals and how if it were only properly followed up, many of the stations on our great national railway, the Canadian Pacific, might be profitably turned into mining camps, or bases for mining camps, and thus contribute materially towards the exploration and development and consequent prosperity of the vast and extensive mineral wealth of this country. It thus naturally occurred to me, on being asked to contribute a paper at this meeting of the Association to give you a description of an older, larger and better known mining camp in the same district, viz., The Lake of the Woods, and whilst it covers, and is distributed over a much larger area than those of the Taché, I trust it may be deemed a fitting sequel to the former paper and will I hope prove equally interesting and instructive and thus help to draw attention and capital to the comparatively neglected science and industry of mining, that has hitherto been so overlooked and neglected in Canada, and which if judiciously and properly followed out is one of the richest and most profitable of the industries of this country. For the purpose of this paper, I think it will be sufficient to describe the position of the Lake of the Woods, by saying that Rat Portage, which lies at the entrance of the Winnipeg river, (the principal outlet of the lake, on the north shore) is a station on the Canadian Pacific Railway in lat 49°-27′ N. and lon. 94°-44′ W. being 293 miles west of Lake Superior and 133 miles from Winnipeg. The lake extends from Rat Portage on the north to Hungry Hall, at the entrance of Rainy river, for a distance of about 70 miles, whilst from the extreme east to the extreme west of the lake, the distance is nearly 100 miles, having an area of about 1,600 square miles. This extensive sheet of water is literally dotted over with thousands of islands, of most varied forms and shapes and in endless variety of color, far surpassing in beauty and grandeur anything else of its kind on this continent that the author has ever seen. Whilst at the same time it affords a most easy and economical means of access to the mines, that lie scattered along its shores.

Such is the outline of the Lake of the Woods which together with the adjoining main land, forms the limits of the area that I propose to describe. As, however, the Laurentian formation predominates in the southern part of the Lake of the Woods our attention will necessarily be chiefly confined to the northern part of the lake, the formation of which is mostly composed of the Huronian or Keewatin formation intersected with considerable belts of Laurentain rocks. There are many minerals found within this area, but gold is the one principally sought for, and therefore is the one with which we are mostly concerned. It is found mostly in quartz veins, that occur in the Keewatin formation, although the most promising veins are mostly found in near proximity to the Laurentian, whilst lying in the Keewatin, which is the true gold producing rock. The Huronian or more properly speaking the Keewatin formation, thus occupies a considerable tract of territory on the Lake of the Woods as well as on the south of Rainy Lake, where it meets the higher series of the Conchiching group. The typical Keewatin consists of greenish or greenish grey strata, with a dip nearly vertical; the principal portions having a slatey structure, consisting of chloritic argillaceous, talcose, silicious, dioritic and fine grained micaceous slates, with interstratified beds of diorite, frequently much tilted. It is from these slates at or near the line of contact with the Laurentian granites and gneisses we look for, and frequently obtain our best results of gold bearing ore.

The Sultana—Is a most interesting property; it is situated about eight or nine miles east of Rat Portage on the north shore of the Lake of the Woods. During the past two years considerable exploring work has been done on it. Latterly however a shaft has been sunk to a depth of 105 feet. At 68 feet (the first adit level) drifting east and west along the vein is being carried on whilst sinking goes on at the bottom. They have at present a force of 30 men employed. The dimensions of the shaft are 14 x 8 feet and that of the drifts 7 x 5 feet. The strike of the main lode is northeast and southwest with so far but little perceptible dip. Average width of the vein is four feet six inches composed of fine sugar quartz. Average value of the ore is $15.50 per ton of 2,000 lbs. The mill consists of 10 stamps and two improved frue vanners. They have also a cyanide of potassium plant of the MacArthur-Forest type for the special treatment of more refractory ore, so far, however, they have not required to put this plant into active service. They want steam pumps and hoists badly and were this provided the mine would assuredly make a much better return than the solitary gold brick which is brought into Rat Portage every week. In fact it is needless to say that under proper management, this property which has abundance of ore averaging $15.50 per ton of 2,000 lbs. would undoubtedly yield handsome dividends. Since writing the above they have purchased three air drills and compressor plant.

* Read before the Association of Ontario Land Surveyors at the Canadion Institute, Toronto, 27th February, 1894.

The Gold Hill, or Northern Gold Co., is in the same formation as the Sultana. The main or Ada G. shaft is down to a depth of 66 feet, while the Pearl shaft on the Pearl lode is 61 feet deep, with a drift commenced in a 4-foot vein at this depth. These veins run parallel with each other, their strike being N. E. and S. W.; average width of veins, 4 feet; dip, 10° S. The shafts are 8 x 5 feet; average assay value of ore from both shafts, $17.50 per ton of 2,000 lbs. A ten stamp mill has lately been erected. This and the Sultana are the only mines in the district that are really getting into fair working order. They have 25 men employed systematically in sinking and drifting on both veins with an additional 5 men employed in attending to their mill and reduction works. The results in the way of gold products are, I am assured, most encouraging. This property is situated on the east shore of the lake and about 4 or 5 miles from the Sultana.

The Bull Dog adjoins the Gold Hill mine. It has a shaft sunk 80 feet, with some drifting east and west along the vein, which is 3 feet 6 inches wide, and the ore assays from $10 to $70 per ton of 2,000 lbs. This mine owns and operates a steam drill, hoist and pump. Hitherto they have had a Crawford mill, but as this machine has proved a complete failure, it has been removed to make way for the old-fashioned but reliable stamps. The shaft is 5 x 8 feet. This is a promising property, and one that has every likelihood of turning out a paying concern. Near the Bull Dog is

The Winnipeg Consolidated, a property that has been shut down for years owing to work having been commenced before a title to the land had been secured; they sunk a shaft to a depth of 104 feet and put up a 5 stamp mill on the property. The vein measured only 8 inches at the surface, but at the bottom of the shaft it was nearly 8 feet wide. The ore averaged over $22 per ton of 2,000 lbs. Of course no Company could possibly last without some prospect, no matter how remote, of some day obtaining possession of the land on which they were operating. Consequently the Company collapsed, and the property has fallen into the hands of parties who want a good price for it, and who are likely to continue to want it.

The Pine Portage is about one mile east of the Sultana, on the mainland. It is one of the strongest and best defined veins on the lake. The vein is about 6 to 7 feet wide. The shaft is sunk at a junction of an east and west vein with a north and south fissure vein, the drifting being done on the fissure vein. The ore is black in color, and is extremely refractory; it averages $12 per ton of 2,000 lbs., although some assays have gone as high as 22 oz. or $440. The shaft is 120 feet deep, and the drifts and crosscuts amount to 150 feet. They have erected a 10-stamp mill and frue vanners. The work was done at the same time as the Winnipeg Consolidated, and had the ore been as suitable as the others that I have already mentioned for economical working, it would probably have been a working mine today. Unfortunately as a result of this mine closing down, chiefly owing to the presence of tellurium in its ore, the public generally seem to have come to a conclusion that the Lake of the Woods ores are generally full of tellurium, and are consequently very refractory. This conclusion is, however, not borne out by assays and subsequent developments. Generally speaking the Lake of the Woods ores are comparatively free milling for some distance down from the surface, after which they are mostly affected with iron, sulphur and copper only, thus necessitating the use of some concentrating process, but not by any means such an expensive process as the presence of tellurium has hitherto demanded, and which in the case of Pine Portage resulted in the closing down of the mine.

The Treasure has been sunk 53 feet 6 inches with a crosscut of 10 feet; average width of vein, 3 feet 3 inches; average value of ore, $16.25 per ton of 2,000 lbs. It is a promising prospect.

The L' Di Vere is owned by the same party as the Treasure; has been sunk 100 feet, the average assay being from $10 to $20 per ton of 2,000 lbs. There is a steam hoist on this property. The width of the vein is about 3 feet.

The Wild Rose is situated near the L' Di Vere and the Treasure. It contains a very promising vein 3 feet wide, of good looking quartz, yielding from $10 to $27 per ton of 2,000 lbs. It is a property of considerable promise, situated as it is in the heart of the auriferous mining belt.

The Bad Mine is another favorable prospect, on which active development is now going on with the view to purchasing it should the present developments warrant it. One interesting feature of this property is that the vein occurs in the Laurentian formation instead of the Keewatin, or at the junction of these formations. Consequently the developments on this property are extremely interesting from a geological standpoint. These last four prospects are situated near Rossland station on the Canadian Pacific Railway about 8½ miles east of Rat Portage, and I have selected them as fair samples of many prospects which exist on the Lake of the Woods, such as Britannia Island, Cariboo, Woodchuck, Argyle, Regina, etc.

In conclusion I may say that I regret that I was only a comparatively short time at Rat Portage last year, and that during that time I was extremely busy, or I have no doubt that I should have been able to have gathered together more data of this very interesting gold field, which is still very much in its infancy. Enough development has, however, been already done to prove the existence of gold in paying quantities, and also to prove that there are many really good claims that are still undeveloped, and that in order to secure a paying mine it is not necessary to invest in and develop one of the most ancient mining locations, which appears to have been the general practice so far; but that it is equally safe to invest in and develop recent mining claims, which if carefully selected are just as likely to turn out well. It will thus be seen that the Lake of the Woods is a very promising locality for anyone who may desire to experience the pleasures and profits of gold mining. The ores are generally easily milled, the veins are of fair width, and although so far none of them have proved very rich, good paying veins can be secured that will carry on an average of from $10 to $17 per ton of 2,000 lbs. The known gold area is constantly increasing, promising free gold finds having been found on Manitou Lake, La Seine River, and the south part of Rainy Lake. In fact, owing to the rich discoveries of gold, and also coal, on Rainy Lake, our American cousins have not only already laid out a town site on the American side in the state of Minnesota, about 14 miles east of Fort Francis, but they intend building a railroad from Tower and Ely to Rainy Lake. In fact the country may be considered as almost entirely unexplored, the few properties now under development having been found more by accident than as a result of systematic and careful search. So that there is ample scope left for the explorer and miner to win for themselves the profits, which properly belong to the careful and assiduous searcher in nature's laboratory.

Kingston School of Mines.

The short course of study which has for the past eight weeks been in progress at the newly established School of Mines in connection with Queen's University, was brought to a close on Tuesday evening, the 6th inst. Mayor Herald, of Kingston, presided, and there was a good attendance of ladies and gentlemen interested in the work.

MAYOR HERALD in opening the proceedings said that he was proud of his official connection with a Council which had recognized the worth of the School of Mining. He referred to the action taken on Monday night. He He believed that as inhabitants of a young country we Canadians should look about us and see what resources we have to depend upon. Among these would be found fisheries, timber lands and mines. The Dominion Government should assist schools of mining, as a means of properly developing our mines. He then read a letter from Mr. B. T. A. Bell, editor of the CANADIAN MINING REVIEW, expressing regret at being unable to be present at the exercises.

PROFESSOR GOODWIN gave a brief review of the work done during the term, which, he said, was necessarily of an outline character, but had been very thorough and practical. There had been an introductory course consisting of ten lectures on chemistry, delivered by Dr. Goodwin, with the object of giving the students such a knowledge of the subject as would enable them to go on intelligently with the study of mineralogy. The work in mineralogy had covered the remaining six weeks, Professor Nicol leading his class rapidly through the general principles and then plunging into the identification of minerals by simple tests. The blow-pipe class had made very satisfactory progress, every member having become fairly efficient in the use of the blow-pipe. A good deal of practice in assaying had been given the class, by means of the charcoal, gas and the portable coke furnace. In geology the work had been of an equally practical character. Professor Miller had had charge of this branch of study, and the results of his teaching were very satisfactory. Mr. W. H. Merritt had attended to the "Discovery and Mining of Ores," and had been very successful in his teaching. Only one member of the class had found time to attend Mr. Mason's lessons on mechanical drawing, and his work had been so neatly and carefully done that it was placed on exhibition.

At the conclusion of Dr. Goodwin's address the Mayor presented certificates, stating that certain work had been studied by the student during the term, to the following named members of the class: F. Broome, J. Donnelly, R. J. McDowall, C. G. Rothwell, W. H. Stevenson and E. M. Morgan.

J. Donnelly, on behalf of the class, read the following address to the teaching staff:

Kingston, March 6th.

The Staff of the School of Mines:

GENTLEMEN,—The students of the special course, on the completion of the session, desire to show their appreciation of the work of the course, and to testify to the great benefit they have derived from it, due principally to the plain and practical teaching which has characterized the lectures and work. You have taught us where to look for minerals, and having found them, to test and prove what they are, to open and work the mine in the most improved and modern methods, assay the minerals to determine the economic value of each, to make a mechanical and freehand sketch of the mine and its vicinity, and in short to do everything pertaining to the work of mining and prospecting.

No other class could have had more painstaking and earnest teachers, and we hereby tender our sincere thanks to Professors Goodwin, Nicol, Millar, Merritt, Mason and Walker for the kindness and consideration shown us, with the hope that you may long be spared to continue the good work.

We commend the Ontario Government for the assistance given this school, and trust it will see the wisdom of increasing the grant.

Our thanks are also due Representatives Harty and Metcalfe and Mr. Blue, Director of the Mining Bureau, for their kindness in sending the students valuable reports and supplies. Wishing the school prosperity, we remain,

On behalf of the class,
W. H. STEVENSON,
F. BROOME,
C. GARNETT ROTHWELL,
JOHN DONNELLY, JR.,
Committee.

Several of the students spoke in high terms of the ability and carefulness shown by the teachers.

Inspector Kidd and A. J. Macdonell, manager of the Ontario Bank, each made a brief but practical address. Mr. Macdonell suggested that students in future be taught enough of the law regarding mines and claims to serve their purpose, and also that the mechanical work connected with the prospector's profession be taught. He said that in the Rainy River district the people do not favor the Ontario Government's laws regarding mines. They were afraid to open a mine lest they should have to pay a royalty. The Geological Survey was doing good work, and he suggested that a limited number of the students of the School of Mining be attached to the Survey.

PROFESSOR MILLAR asked why there should not be a Geological Survey in connection with the school.

C. F. GILDERSLEEVE and H. A. Calvin, M.P., also spoke. Mr. Calvin said that he would be happy to do all in his power to further the interests of the school, but as he was not the Finance Minister, he could not definitely promise much.

PROFESSOR FOWLER made a humorous address, in the course of which he said that it was a good thing to have a number of men who knew where to look for mineral deposits, and know also where such deposits would not be found.

PRINCIPAL GRANT spoke of the need of a community such as this, doing something in aid of this branch of education. The seven students who had been given diplomas were not the only special students in connection with the school. There were in all 48. The object of the special courses was to bridge over the gap that exists in every country between the practical miner and prospector, and the School of Mining. These special classes are now held in connection with all the great schools in Europe. In the United States they have instituted the correspondence system to impart knowledge on subjects connected with mining. This system would be investigated, and if any merit should be found in it, advantage would be taken of it. One of the first additions to be made to the School would be a department of mechanism. The speaker expressed his satisfaction with the action of the City Council in giving a grant to the School. If that body had done this last year $1,000 would have been saved, for the Dominion Government had offered that amount provided the school were estadlished before a certain time. The citizens of Kingston would not lose a cent on account of this grant, for the property that had been so long an expense to the city would begin to pay as soon as the Governors took hold of it. There was a standing offer on the part of the Dominion Government to assist schools of navigation, and such a school would be instituted here as soon us practicable.

The meeting closed with a vote of thanks to the Mayor.

Specimens of various kinds of quartz and a number of instruments used by prospectors and miners were exhibited, and the students performed several experiments to illustrate the studies upon which they had been engaged during the course.

Mechanical Appliances for the Shipment of Coal.*

BY MR. S. W. ALLEN.

Great care and much ingenuity has been from the earliest times displayed in order to bring into the market the coal in as large and unbroken masses as possible. Notwithstanding all the care that can possibly be bestowed, a very large proportion is broken up into small particles, and thereby reduced considerably in value. The small coal at one time being almost unsaleable, and at the present time—even when there is a large market for it in the manufacture of patent fuel and coke—the loss entailed in bringing it to the surface, and the small price that can be obtained for it, only serves to emphasize the fact that the greatest care should be taken that the lump of coal hewn from its bed shall be transferred through all its varied travels to its destination in as near as possible the same state as it left the collier's hands in his stall in the depths of the coal mine. Many of the most important colliery districts are situated a considerable distance inland, and as the coal trade of this country depends to a great extent upon foreign shipment, it follows that the coal must be carefully conveyed by railway, canal or other means to port of shipment, and various systems have been in use for this purpose. In some places, such as on the River Tyne, the trams, or corves, in use at the colliery are taken direct from the mines and deposited in the vessel's hold, without any intermediate handling; but this system is only available in such places where the colliery is situate in close proximity to the dock or river where the shipment takes place.

* From a paper read before the Institute of Marine Engineers, February 24, 1894.

SUPPLEMENT TO CANADIAN MINING REVIEW.

p of Members of the Mining Society of Nova Scotia, taken from a Photograph for THE REVIEW at the Halifax Hotel, 9th, March, 1894.

MacDuff, Waverley. B. C. Wilson, Waverley. J. Baird, Joggins. B. T. A. Bell, Ottawa, *Hon. Secretary.* H. S. Poole, M.A., Stellarton, *Past President.* J. T. Burchell, Sydney. C. E. Willis, Halifax. J. D. Copeland, Country Harbor. D. McDonald, Truro, *M. Council.*

W. R. Thomas, Montagu, *M. Council.* George Stuart, Truro, *M. Council.* R. H. Brown, Sydney Mines, *M. Council.* John E. Hardman, S.B., Oldham, *President.* W. Blakemore, Glace Bay, *M. Council.* W. G. Matheson, New Glasgow, *M. Council.*

W. A. Sanders, Halifax. H. M. Wylde, Halifax, *Secretary.* C. F. Andrews, Country Harbor. J. C. McDonald, Country Harbor.

As it is the purpose of this paper to deal especially with the coal-shipping side of our subject, we will not enter into the various methods in use at the collieries for the transference of the coal from the trams to the waggons or other receptacles ; but suffice it to say that the tram is generally discharged into a shoot or screen, the small passing into a hopper, or what is called a "Billy Fairplay," placed underneath to receive it, the large sliding out at the other end and falling into the waggon ready for conveyance to the port of shipment. In some cases the coal was deposited in barges or keels, as they are called in the neighborhood of the Tyne, and were then brought to the side of the vessel and loaded by hand through ports in the side; this was, of necessity, but a slow method of procedure, and the growth of the steam coal trade within recent years soon demanded some mechanical methods, in order to keep pace with the times, and to do this efficiently much ingenuity and scientific skill has been displayed in devising means to meet the requirements of different localities and varieties of coal. It will be sufficient for our purpose to divide the various kinds of coal into two classes—viz., coal with a close, dense and compact structure, such as that found generally in the north of England, and the coal with a porous or loose structure, breaking with an uneven fracture, the angles of which point in all directions, such as the celebrated steam coals of Glamorganshire and Monmouthshire. The class of coal first mentioned will slide freely down an inclined plane, of small angle, and its natural smoothness and evenness of fracture allows it to be very easily handled, and transferred from one receptacle to another with comparatively little loss from breakage, whereas the latter, or Welsh steam coal, requires an inclined plane of considerable angle before it will descend with its own gravity, in consequence of its uneven fracture and open and porous nature, whilst its fragile and tender structure necessitates that special means shall be employed to allow it to slide easily, and to prevent its falling any considerable height when being loaded either into waggons or the holds of vessels. The early history of coal shipping is more particularly identified with the north of England and Scotland than any other port of this country; and to the neighborhood of the River Tyne or the Wear we should repair in order to commence our review of the principal machines in use in days gone by. Some of the oldest of the mechanical systems on the Tyne may be seen still at work in that neighborhood. In some places where the colliery was situated close to the river side, the waggons were taken direct from the mouth of the pit and run down an incline, the descent being governed by a rope passing over a pulley at the head of the incline, the descent of the full waggons pulling the empty waggons back again ; and, in other cases, by a winding engine hauling the empty waggons back, and allowing the full ones to descend. The vessels at this time were comparatively of small dimensions, and in order to deposit the coal on board, the height of the staging had to be sufficient, in order to allow the coal to fall by gravity into the vessel's hold. In other cases the coal was deposited in lighters, or keels, and then conveyed alongside of the vessel, the keel men shovelling the coal in through ports in the side in baskets. The system of allowing the coal to fall by gravitation has been brought to very great perfection at the north-east ports, and it will not be out of place here to describe the principle on which this system is based. A staging or staith is erected on the river or dock side, on to which the waggons run, an opening is made in the platform, of considerable length, and sufficiently wide to come in between the rails, under this opening a large hopper is constructed, into which the coal falls, and at the bottom another opening is made, and connected up to a wooden tube or spout, down which the coal runs into the hold of the vessel, the speed of its descent being govered by an adjustable door in the spout. The hopper is always kept full, and as the coal runs out of the spout in a steady stream, the waggons are being constantly emptied into the hopper. These waggons are invariably constructed with doors fitted into the bottoms, through which the coals fall vertically, and the sides and ends made sloping outwards, the top being considerably larger than the bottom. No arrangement was made for the varying height of vessels, or the amount of rise and fall of tides. It soon became necessary to adopt means to meet these circumstances. The staiths had to be increased in height, and the spouts made to rise and lower, and the openings in the hopper were provided at various heights each governed with regulating doors. And owing to the narrowness and length of these spouts it has been rendered possible to allow of a considerable latitude for swinging the point in a horizontal direction. This has been found of very great advantage in loading into hatchways that do not come exactly opposite the centre openings in the staiths, thus allowing, in many cases, the coal to be shipped into two or more hatchways at the same time. Probably the most elaborate system of staiths erected on this principle may be seen in operation at the Hendon Dock, Sunderland.

It will readily be seen that coal only of a certain class can be thus dealt with—that is, coal that will slide at a comparatively slight angle, and of sufficient strength to hold together under such treatment or when very large lumps have not to be dealt with, in which case various means were adopted to lower the wagon bodily on to the deck of the vessel when the doors were released, and the coal allowed to fall direct into the hold. Several of these original and very ingenious machines may be seen still at work on the Tyne, There is a machine in the neighborhood of Wallsend which is, I believe, still in use. It is a combination of the spout and the drop system, and although there is no arrangement for regulating the height of the spout, the drop has a very considerable range. The waggon is brought to the front of the tip and is pushed on to a swinging cradle or platform with an aperture in the middle ; this platform is suspended by four rods to a cross-bar, affixed to the ends of two upright poles or jibs, the bottoms of which are hinged to the upright posts of the front part of the staith, so that when the cradle with the poles is allowed to fall forward and descend in a radius of a circle to the depth required, it became necessary to apply an arrangement to regulate the lowering, and to bring back the empty waggon and cradle to its original position ; this is effected by attaching a wire rope or chain to the top of each of the poles, the other end of the rope being made fast to a barrel fixed upon a horizontal shaft placed at the top of the staith, and at the outer end of this shaft were also fixed other barrels to which were attached wire ropes, one end of the ropes being securely fastened to the bottom of a long pole or pendulum, the top of the pole being attached to fixed uprights and the lower end being free to travel as the rope was being wound on to the barrel by the descent of the loaded cradle ; a large cast iron weight attached to the lower end of the pendulum brought it back to its vertical position, and correspondingly the cradle with the empty waggon to its proper level, in order to have it replaced by a full one. The regulation of the descent and the return of the cradle was governed by a large break-wheel fixed on the transverse shaft, the lever being in charge of the brakesman. A man usually descends with waggon and cradle to release the door fastenings, and frequently to hammer away with a sledge on the sides of the waggon in order to persuade any obstinate coal that may have remained behind, that an eviction was necessary. This system is still largely in use in the north of England, and has been elaborated to a considerable extent on the Wear, and in Sunderland Docks, where we may find many excellent examples. In most cases the waggon comes on the staith also, on a high level, and is transferred on to a cradle, as before described, but instead of wire ropes and poles being used, the side supports are after the fashion of a portion of a huge beam or cantilever, one end of which is attached to a very strong shaft, and to the other is suspended the cradle for sustaining the waggon, the shaft being considerably below the level of the platform, or railway ; to one or both sides of this shaft, and to the supporting beams, are attached immense brake wheels with large balance weights fixed to their lower ends to govern the descent and return of the waggons. These drops are capable of loading coal into very large-sized vessels. Another method adopted was to run the waggon on to a suspended platform directly over the vessel's hatchway ; the cradle and waggon were then lowered vertically by the means of chains fixed at one end of the cradle and the other attached to sheaves on to a brake wheel shaft situated overhead, the descent and return being governed by balance weights. A somewhat similar plan was also in use at the port of Cardiff, at the West Bute Dock, then called the Bute Ship Canal. The waggon in this case was not lowered vertically, but the front part was made to decend in order to allow the coal to slide out at the end of the waggon, the doors being placed at the end in all coal waggons in the South Wales district. This system worked very well in all cases where the vessels were small, and consequently little variation in height occurred, but the constant increase in the sizes of vessels, and the amount of damage the coal suffered in falling into the hold soon necessitated other methods being adopted, and consequently they have been for very many years obsolete, and have long since been replaced by more modern appliances. On the River Usk, at Newport, may still be seen many ancient contrivances for lowering the front ends of the waggons and lifting the back ends when shipping into vessels at the top of high tides. In all the methods adopted on this river the waggon is tipped into shoots, the front end of which is lowered on to the hatchway, and is ingeniously arranged so as to be easily pulled back out of the way, and prevent its projection into the river when not in use.

In the early part of the present century, and down to a recent date, tubs were largely employed on the River Wear, at Sunderland. These tubs fitted into a barge or keel, the trams were lowered immediately over the keel, and the coal then dropped into the tubs; the barge was then taken and placed between the wharf and the vessel, and the tubs lifted out and lowered down into the hold, the bottom of the tub being made to open, the coal being deposited with as little breakage as possible. One of these elaborate machines used for this purpose consisted of a large beam supported on central trunnions, a sheave was placed at each end, and a rope or chain was passed over them and connected at one end to the barrel of a winding engine. The tub was first hoisted in a vertical direction, and on continuing the revolution of the engine the beam was caused to rotate upon its axis until the tub was over the hatch, when the engine was reversed, and the tub lowered over into the hold. Various other methods were in use at that time for lifting the tubs from the barges, and a floating barge, fitted with a steam engine and machinery by which the tubs were transferred from the keel to the ship, was also employed, but on account of its unwieldy nature was soon rendered obsolete.

In dealing with South Wales steam coal, very special means have been from time to time employed, and owing to the continued enormous demand for what is generally admitted to be the best steam coal in the world, the ports of Cardiff, Barry, Newport, and Swansea in particular vie with each other in providing appliances to rapidly and carefully ship this valuable commodity with the minimum of breakage and maximum of speed. The steam coal trade is of such a recent date that the history of it is almost identical with that of the steam engine and steam shipping. Thirty years ago very few of these steamers came to these ports for coal, and the majority of vessels were small craft, with an occasional full-rigged ship or barge, with small hatchways and a long distance for the men engaged in the hold to trim the coal into the far end of the vessel. No mechanical contrivances, as far as I am aware, have ever been used in the Welsh ports for this purpose, but I find that considerable attention was given to this point in the neighborhood of Liverpool and the north of England, and I also find in a specification, dated 1850, by Messrs, Wm. Laird and Alfred Edward Cowper, that several very clever contrivances were proposed for this purpose by them, and as the question of breakage is at the present time of so much importance, I have no doubt that a reference to their invention will not be out of place here, and I therefore append an extract from their specification :—"We claim, as our invention, the application of an endless chain of buckets or blades for the purpose of lowering coal and similar descriptions of cargo into ships and other vessels as herein described. We also claim the application of an endless web or chain placed horizontally, or nearly so, for the purpose of conveying and distributing coal and similar cargo into ships and other vessels, by means of a trunk kept constantly filled, so that the coal may gradually descend as it is withdrawn from below instead of dropping unchecked to the bottom. We also claim the application of a railway suspended to the deck beams for the purpose of loading and discharging cargoes in ships and other vessels."

I am not aware whether these inventions were ever practically used, as I fear that owing to the amount of time required in order to erect and take down such a formidable structure, the time usually allowed for loading vessels in the present day would scarcely permit it, when it is a common occurrence for a 1,000-ton vessel to enter the dock on one tide and get loaded and away by the next tide.

The character of any mechanical contrivance for lowering the coal from the waggon into the hold and distributing it when there, is one that deserves particular attention. There can be no doubt that the old system of boxes, as employed at the West Bute Dock, Cardiff, up to about the year 1860, was as perfect a plan as could be desired for carefully shipping the South Wales steam coal without breakage, but owing to the small hatchways and want of more powerful machines, it soon became evident that other and quicker methods of work were an absolute necessity, and the old machinery was, at about the date mentioned, taken down and re-erected at the East Bute Dock, and was in use regularly, from that time until the last few years, discharging ballast. The machinery consisted of a long projecting jib, reaching out over the dock a distance of 30 ft., and fixed 35 ft. 6 in. from the ground, upon which worked a travelling carriage carrying sheaves, over which the chains passed for lifting the boxes, and backing in and out was performed by a horizontal winding engine, with a single cylinder of 18 in. diameter and 3 ft. stroke, driven by a Cornish boiler 5 ft. 6 in. diameter and 18 ft. 3 in. long, working at a pressure of 25 lb. ; the engine was reversed by a gab end on the eccentric rod being dropped on one or the other of a pair of levers attached opposite each other on the weigh shaft that actuates the slide valve, and a simple throttle valve, with handle, was used for shutting off the steam for starting and stopping ; a complicated arrangement of hand levers and treadle governed the various brakes, clutches and levers that were required to be used every time the box was raised, lowered, or backed in and out, the result being that the attendant was engaged in a kind of dance from one treadle to the other, while his hands were fully occupied with brake valve and eccentric levers, but notwithstanding all this complication, I do not ever remember a single accident happening to this old machine. The boxes were of iron, and contained about two tons of coal, and brought to the docks on a kind of framework on wheels, the whole having a very similar appearance to an ordinary coal waggon. The train of waggons were run on to the line of rails between the engine house and the dock wall, the full boxes being lifted from there to the hold, and the empty returned again on to the waggon, and so on. I feel convinced that had this system been carried out with better appliances there would have been no necessity for the present method of tipping the waggons. The whole arrangement might easily have been mounted on wheels and made to traverse along the dock side to any distance.

At Cardiff and the neighboring ports, a system of balance tips has for a long time been in successful use, and where the coal is brought in at a sufficiently high level to ship into the largest vessels, it must be admitted that this system is as rapid a method of shipment as can be desired, and with improvements in the apparatus for allowing the coal to pass gently into the hold, I have no doubt that as little breakage can take place with this method as with any other. The most perfect tips of this kind can be seen in the East and West Bute Docks, Cardiff, and at Penarth Dock. The level of the water in the East and West Bute Docks being constant, and not varying with the tide, as at Penarth and Barry and other tidal docks, the distance therefore from the rail level to the water always remaining the same, the highest tip being 28 ft. from the water to the rail level, it will be seen that when a modern steamer, measuring, say, 30 ft. from the water's edge to the top of the bunker hatch, is to receive her bunker coal, even the level of these tips is much too low for such a purpose, and in order to increase this height various methods have been adopted which we will endeavor to describe in due course. The principle of the Bute Docks balance tips may be described as follows: At a sufficient height a train of loaded waggons are brought in and shunted as close up to the tip as to allow of each waggon being detached and accurately weighed, it is then brought forward by either horse power or hydraulic capstan on to a turntable, where each waggon is turned round, the door being invariably at the back end in this district, in order to prevent the doors from being strained during its transit by rail from the collieries to the docks. The waggons are then hauled on to a cradle suspended by wire ropes passing up overhead, and attached to heavy balance weights governed by a large pair of brake wheels and powerful lever, the weight of the coal causing the waggon to descend and the balance weights bringing back the cradle to its original level. When the height of the tip is insufficient to ship into a very large vessel, it is usual to lift up the tail end of the waggon, and if necessary, also lower the front end. The lifting was formerly done by hand, by means of a powerful crab crane, but this has been done away with for some years and a hydraulic ram has taken its place, the winch only being used for hauling up the slack when tipping by balance alone. In working these tips, counter weights are used in nearly every operation; thus in raising the butt or point of the shoot the labor on winch handle is very materially reduced by their assistance, while the clever anti-breakage arrangements can scarcely be improved upon in this respect. At the commencement of loading a vessel the coal is allowed to slide down a shoot into an anti-breakage box. This box holds about a ton of coal, the weight of which causes the box to descend, and is governed by a rope, one end of which is brought on deck and the other is attached to a brake lever, so that the whole arrangement is perfectly under the control of the man on the deck of the vessel. When the box is empty, the brake rope is released, and the box is thereby brought back to be filled again, and so on until a cone or pyramid of coal is formed in the hold, after which the box is allowed to rise out of the way. The remainder of the cargo is allowed to slide down the sides of the cone into the distant parts of the hold where the trimmers are employed to place the coal where required. Most modern steamers engaged in the coal trade are now built specially for this purpose, and very little trimming is necessary. The amount of manual labor to handle waggons containing 10 tons of coal is by this system reduced to a very small amount. The incline down which the trains of coals are brought to the tips is very slight, being only sufficiently steep to allow of the capstan drawing about twenty or thirty waggons with ease, and 3½ in. in 100 ft. has been found to answer this purpose admirably, being just enough to enable the men to start the waggon with the aid of the capstan, while with the momentum thus obtained they can be run on to the weighing machine, and then easily stopped without applying very great pressure on the brakes, the hydraulic power being only required to give the waggon a start; each waggon, therefore, is weighed, turned around, tipped, turned around again, and is then sent down an incline of about 1 in 70, this being sufficient to allow them to run down quietly by their own gravity. In consequence of the continued increase of the height of vessels coming to this port to be loaded, and especially for bunkering into steamers when light, tips have had to be specially constructed, the existing levels being insufficient. The tips for this purpose are capable of raising a waggon 12 ft. above the ordinary height of the high level railways. These tips are worked entirely by hydraulic power.

At Penarth the tips are entirely on the high level system, and the dock being tidal, a much greater height can be obtained from the water level to the high level railway than in Cardiff, except on the top of spring tides, when the loading has to be stopped until the tide recedes sufficiently, and thus any required depth can be obtained. The principle of these tips is practically the same as those at Cardiff, but with the exception that hydraulic power is used for working the anti-breakage box, and the details of the machinery are slightly different. The manner of bringing in the loaded waggons and taking away the empty ones is sufficiently different to warrant our giving a description of it. The dip sidings are parallel with the dock and the train of loaded waggons is shunted down an incline, until it is arrested by a stop block at the safety catch, each waggon is then separated from the trains as required and the catch allowed to fall back, the remaining waggons following on down the incline as far as the catch or stop, entirely by gravitation, the incline being sufficient to allow of their doing so without any other assistance. The waggon being detached is then pushed by hand on to a turntable and then turned at right angles, and pushed off to a short incline leading to the tip. After the waggon has been tipped, an operation identical with that performed at Cardiff, it is pushed on to a return incline, at the end of which is another turntable, and upon this the waggon is again turned at right angles, in order to transfer it on to the empty road incline, from where the train of empties is taken away by the shunting engine when required. It will be seen that no horses or hydraulic capstans are used, but there is a very large amount of manual labor required in order to bring the waggons from such a considerable distance to the tip and then to return them again to the empty road. Gravitation has been employed to its fullest extent in each of these operations. These tips are built upon projecting jetties, and thus enable ships to lie at an angle to each other, an accommodation that is of very great advantage when shipping into long vessels, as it allows the tips being built closer together than would otherwise be the case, thus considerably economising the room in the dock.

Having now so far described some of the appliances in use during the early history of coal shipment in South Wales and the North, together with the excellent modern balance tipping arrangements in the neighborhood of Cardiff, we will turn our attention to some of the various systems of coal shipping by hyd aulic power; and to Cardiff, Barry, Newport and Swansea we should repair in order that we may see to what perfection hydraulic power has been applied for this purpose. Probably the first use to which this power was applied for coal shipping was the old arrangement in use many years ago in the Glamorganshire Canal at Cardiff, the old sea lock where the coal was brought down in canal boats, fitted with large iron boxes, similar to the system formerly employed at Sunderland, to which we have referred. The boxes were lifted up out of the boat by a vertical ram and two horizontal rams pushed them out over the vessel, a gantry being fixed above for that purpose; this system has been for very many years obsolete, but as far as I am aware I have no doubt that it was the pioneer to hydraulic coal shipping.

The hydraulic tips made from the port of Cardiff, by Sir William Armstrong, are all on the low-level system and consist of a central ram and cylinder fixed below the level of the dock wall. The top end of the ram is attached to a strong iron cradle working between a pair of upright guides of sufficient length to allow the ram and cradle to be raised to the required height; upon this cradle is fixed a tipping platform hinged at the front ends by means of strong gudgeons, the back being attached to another ram working in a cylinder 9 in. diameter and fixed by oscillating trunnions to the main cradle. The waggons are weighed, turned and brought on and taken off much in the some way as on the high-level balance system. When the loaded waggon is brought on to the cradle, the pressure water is admitted to the main cylinder by an attendant perched up in a house at the top of the tip from where he can watch all the movements of the machinery under his control. The cradle being raised to a sufficient height, the door of the waggon is loosened and the tipping ram at the back of the platform is brought into play, causing the back end of the waggon to rise and the waggon to assume an angle of 45 degs. in order to allow the coal to slide out in the shoot. The pressure water for the tipping cylinder is taken from the main cylinder, the valve being situated on the rising cradle, and actuated by the attendant turning around a long square bar running the entire height of the tip and passing through an opening in the cradle. Upon this bar a valve lever with a square hole is allowed to slide freely; the other end of this lever is connected up to the valve levers, so that upon the bar being turned in one direction the pressure valve is opened and the exhaust in the opposite direction. The raising and lowering of the shoot is also performed by the motion of the cradle—thus, when the butt of the shoot is required to be raised or lowered, two arms are made to project from the front of the cradle, and upon the pressure being attached to the main cylinder the cradle rises with the shoot to the required position, the lowering being accomplished by simply opening the exhaust valve, allowing the water to escape. A vertical rack is fixed each side of the main uprights, and a self-acting catch is fitted to the butt of the shoot, so as to hold it any height required, the point of the shoot being caused to rise or lower by means of a pair of chains attached to each side of the point, and passing over four sheaves at the top of the tip and down each side near the central guides. A claw to fit the link of the chain flatways is pushed between an oblong slot in the cradle at any point desired, the rise or fall of the cradle causing a corresponding rise and fall of the point of the shoot, and a similar claw is fixed each side near the top of the tip in order to keep the point in any desired position.

At the Alexandra Dock, Newport, and the Prince of Wales Dock, Swansea, the coal is brought in on the low level and the train of waggons run down an incline entirely by their gravity. They are then weighed and turned round and brought on to the cradle of the tip, being hauled on by means of an hydraulic capstan. The waggon is then raised to the required height and is then tipped up by the ordinary tipping ram as before described: the waggon being emptied, is run on to a high-level incline overhead, down which they descend by their own gravity and are taken away by the dock locomotives. The advantage gained by this system over the ordinary low-level is that a full waggon can be brought up in readiness to place upon the cradle while the other is being tipped and run on to the incline, and thus very little time is lost in each operation. The perfection to which hydraulic power has been utilized in the shipment of coal by Sir William Armstrong has left very little for outsiders to do in this class of machinery, and consequently very few firms have turned their attention in this direction—among the latter, Messrs. Brown Bros., Edinburgh, whose low-level tips at the East Bute Dock are excellent examples. In these tips the central ram hitherto universally adopted in hydraulic tips has been entirely replaced by suspending the cradle by means of a series of six round wire ropes, 1 in. diameter; these ropes pass around sheaves fixed under the cradle and up over similar sheaves fixed at the top of the structure, and down again on each side, one ram being placed at each side of the tip working downwards, the ropes being passed around sheaves at the head of each ram and the ends fixed to the cylinder; large weights are also attached to the head of the rams, and assist in balancing the cradle, &c., so as to economise the water power as much as possible. The wagon is tilted by means of wire ropes, attached to the tipping cradle, and passing overhead and down one side and around a ram placed underground at the back of the tip, the other end being fixed to the bottom of the cradle, so that the latter is free to travel up and down, and upon the ram being brought into play, the tipping cradle is raised or lowered as required. A crane is fixed at the side for use in working the anti-breakage box and other work as required, and the whole is under the control of a topman, situated in a small house fixed high up on the side of the structure. The method of working the shoot, &c., is very similar to that employed on the Armstrong tips.

Thomson's patent coal tips, as used at the Leith Docks, Edinburgh, next claim our attention. These machines, as hitherto made with a separate tipping ram, require a man stationed aloft to work the hydraulic apparatus, and who stops the rise of the platform at the proper place, and then tips the waggon by hand-gear. The cost is thus incurred of the constant attendance of a comparatively skilled man, the most expensive of any employed in the operation, and unless he stops the ascent of the platform and waggon at the precise moment required, which he can seldom do, the coals are exposed to a considerable fall when they leave the truck, the waggon being necessarily higher than the shoot. This, as all coal merchants know, causes an amount of breakage that is most detrimental to the marketable value of the coals. In Thomson's patent coal tips these various disadvantages have been obviated by the invention of a simple and effective means of tipping the waggon by the action of the same ram that raises it. This operation, also, is performed at the exact height that is required by a simple automatic apparatus, and without the least attention or intereferenc of the men working the tip. The greatest perfection to which hydraulic coal tipping has attained up to the present may be seen at the newly constructed docks at Barry and at Cardiff, where the latest developments of tipping arrangements are now employed. The high-level tips at Barry are on the hydraulic principle, and are built by Messrs. Tannett, Walker & Co., of Leeds, the height of the ordinary tipping level being sufficient to meet the requirements of most vessels at H.W.S.T., but where it is necessary to ship into the bunker hatches when light upon the high spring tides, it becomes necessary to raise the waggon still higher. These tips are arranged so that the platform can be lowered right down to the level of the coping, or raised to the height of 37 feet from the coping, thus enabling the shipments to be made into the largest vessels afloat. The hydraulic rams for lifting the cradle are arranged so that when the loaded waggons are run on from the high level, the whole of the pressure water is forced back into the hydraulic mains by reason of the weight of the coals in the loaded truck, the empty waggon being lifted by the pressure water being only admitted to one of the rams, there being a series of four rams attached to each cradle, so that either or all of the rams can be used simultaneously; but it is never necessary to admit pressure to more than one of them for lifting the empty waggon and cradle, but where the loaded waggon has to be lifted the other rams are brought into play. The ram for lifting the cradle is suspended on trunnions in the usual way, but the pressure water, after being used, is conveyed to the return mains through a system of pipes that rise and fall with the cradle. The whole of the water used at Barry Dock throughout the hydraulic system is returned through a series of pipes back to the hydraulic engine house, to be again pumped under pressure, and a portion is returned back into the pressure main when the full waggon is descending.

In this paper, up to the present, we have only dealt with machines of a fixed description, so that ships can only be loaded at fixed points. In these days, where rapidity of loading is of the greatest consequence, it is necessary, in order to get sufficient despatch, that the coal should be tipped into two or more hatches at the same time. Many and various schemes have been devised for this purpose, and a great number of patents have recently been taken out. The first practical machine of this description that I am acquainted with was used at the old dock at Newport. The waggons were run on to the cradle from an inclined way. There were two fixed positions that the tip could be fixed in, each of which had an inclined bank, up which the loaded waggons were drawn in order to raise them sufficiently high to run on to the cradle. A winding engine and boiler was placed inside of the structure, for hoisting the cradle with the waggon sufficiently to be tipped into the shoot.

I will just notice here the design of Mr. Butler, which is sufficiently novel and practicable to engage our attention. He proposes to use an ordinary balance tip, constructed after the lines of the Bute and Penarth tips, but mounting the whole upon wheels; and in order to convey the waggons on to the tip from the high level, a bridge is constructed of sufficient length to connect up the back portion of the tip to an abutment some distance away, in order to allow the tip being traversed along the dock wall, the girder or bridge having an arrangement at each end to allow of its movement.

Mr. George Taylor, of Penarth, has devoted a considerable amount of time in developing schemes for moveable tipping arrangements, the most notable of which are the moveable tips at the Roath Basin, Cardiff, and built by Sir William Armstrong, Mitchell & Co. The waggons are brought on to the cradle from a series of curved lines, each communicating with a turntable, and from which each curve line radiates. This system has proved highly successful, and is in daily operation at Cardiff. At the Alexandra Dock, Newport, Messrs. Tannett, Walker & Co., of Leeds, have erected a movable tip on a somewhat different principle. The waggons in this case are brought in at right angles to the dock, where they are run on to a traverser, this apparatus being traversed along with the loaded waggon until it comes opposite the position where the tip is placed. It is then run on to the cradle, raised by hydraulic power, and tipped, the empty waggon being then transferred on to another traverser, which travels upon an elevated way, extending the whole length of that portion of the dock that the tip is capable of travelling over; the empty waggon is then run down over an incline, the upper end of which is fixed at a certain position on the elevated way. Lifting the waggon up bodily, by means of a crane, and swinging it out over the vessel has been in use at several ports for a long time, worked by hydraulic and steam power, but the employment of a movable crane for this purpose, I think, is confined to the Bute Docks, Cardiff, where a very powerful crane is in use, built by Sir William Armstrong, Mitchell & Co.

An ingenious arrangement has been devised by Mr. Charles Hunter, of the Bute Docks, for preventing the breakage of coal in its descent into the hold of the vessel. A large hopper is placed over the hatchway, and a kind of telescopic vertical tube is attached thereto. An inverted conical bottom, connected with the central chain, governs the exit of the coal and assists in trimming it in the hold.

We will now refer to the elaborate arrangements presently in use at the New Roath Dock, at Cardiff. In this system the coal is first deposited into a large box, which is placed in a pit that runs parallel with the dock side. This box is carried upon a low carriage which runs on rails at the bottom of the pit. Powerful hydraulic travelling cranes are then used for lifting the loaded boxes up out of the pit, then swinging them around and lowering the box and its contents into the hold of the vessel. The bottom of the box, being made conical, is then by a separate gear lowered and the coal deposited in the hold. Several of these cranes and tip-up arrangements are employed at the Roath Dock, and are capable of shipping into the largest vessel afloat. Messrs. Tannett, Walker & Co. have erected at Barry Dock one of their patent movable tips. The cradle of this tip is lifted by means of four cylinders with pistons and rods attached to each corner of the cradle. A very powerful jib is projected from the centre of the tip out over the hatchway, to which is suspended a 5-ton anti-breakage box, into which the coal is allowed to descend and then lowered into the hold in the usual way. To get the coal on to this tip, movable turntables travel along a prepared way and are always fixed in the position that the tip is required to work. Short inclines of movable rails are laid down to connect the main line up to the turntables. Messrs. Fielding & Platt, of Gloucester, have supplied the Barry Company with one of their patent movable tipping arrangements. This consists of a powerful travelling crane running parallel with the dock wall. A bridge, connecting the high level railway to its main structure, is at a considerable height above the roadway below. This bridge is made so as to allow the front or crane portion to travel 1,000 ft. along the dock wall, so as to suit the varying positions of ships' hatchways. The shore end of the bridge is provided with a series of movable rails, to drop in the gaps occasioned by the varying positions of the bridge. The tip is used exclusively for tipping the waggons of coal in specially designed boxes which are lifted up vertically, and then jibbed out as far as the hatchway of the vessel. The box is then lowered into the hold, doors in the bottom and sides being then opened by hydraulic gear, and the contents deposited as desired.

Having now described and shown the leading features of the various forms of coal-shipping appliances that have been used for a considerable time back, and some of the modern contrivances introduced within the last few years, I have come to the conclusion that no better system has ever been employed for shipping the very fragile South Wales steam coal than the system of boxes introduced from twenty to forty years ago, but as long as the demand for rapid shipment is so universal, I am afraid it will be impossible to return to this very excellent arrangement. Next to this, however, must be given the preference to the system of shipping into a large anti-breakage box placed at the mouth of the shoot. It makes very little difference whether the shoot is a long one or a short one, as the coal sliding down it suffers no injury. It is the sudden fall that the coals get when being emptied from the waggon and the long drop that does the mischief. The shoot should always be kept full of coal, and the anti-breakage box as large as possible with sufficient strength in the machinery for carrying the weight. Modern hydraulic cranes for lowering the full anti-breakage box are no advance upon the old system of balance weights, unless the ram is made use of for pumping water into the pressure mains upon the descent of the full box. Movable coal tips certainly are the ideal method for rapid shipment, as by this arrangement coal can be loaded into every hatchway of the vessel at the same time, but it has been found in practice that with the best system of fixed tips, placed at sufficient distances apart, the coal can be shipped quite as fast as is required, and when proper care is taken in using the anti-breakage boxes, as little breakage occurs as in any other arrangement.

The Pictou Coal Field.

Of unusual interest in the present expansion of the coal trade of Nova Scotia and one of the most valuable contributions yet made to the practical or mining geology of the Dominion is the paper on the Pictou Coal Field, published in the Transactions of the Nova Scotia Institute of Science, by Mr. Henry S. Poole, M.A., F.G.S., A.R.S.M., Superintendent of the Acadia Coal Mining Company, and retiring President of the Nova Scotia Mining Society, whose skill as a structural geologist the REVIEW has before had occasion to notice.

It is now more than twenty years since the officers of the Geological Survey examined and reported on the Pictou coal field, giving in detail much of the important informotion thercon that had been collected by them and previous observers. Their report has been accepted ever since as a fairly correct delineation of the structure and salient features of the field. It contains two papers by independent observers, Sir William E. Logan and his assistant Mr. Hartley. Sir William took the least known portion of the field on the eastern side of the East river, leaving with Mr. Hartley that lying on the western side and both banks of the river.

Sir William, in his report, refers to the broken character of the field, the depth of the superficial deposits, to the numerous dislocations and the absence of rock exposures in many parts preventing a perfect series of the measures being built up; and he goes on to say, "what is now offered is to be considered as only a distant approximation to the truth, to be improved hereafter as occasion may serve and further developments may occur."

Additional facts which further working in the mines and later explorations in the field have brought to light now suggest certain modifications of the conclusions then reached. This review of our present knowledge of the subject is submitted as supplementary to the Report of Progress, for 1866-9, with a map drawn by Mr. J. G. Rutherford from mining plans and other correct data. On comparing this revised map with that of 1869 it readily will be seen in what respects structural modifications have been suggested especially in that portion of the field which Sir W. Logan was careful to refer to as "wholly committed to Mr. Hartley." For many years the Survey map had been accepted as correct and no one thought of seriously questioning its accuracy. It was not until in the ordinary course of working one of the Albion seams of coal that it became a matter of moment to the writer to verify the assumed position of one of the known faults, and then on a comparison of several mining plans and reports being made it became apparent not only that the Survey map was incomplete but that it had inaccuracies which a full acquaintance with the records available at the time of its preparation might have avoided. This awakening of doubt led to further study and independent investigation stimulated by Mr. Hugh Fletcher, B.A., of the Geological Survey of Canada, who working in the neighborhood took a deep interest in the questions at issue, and to whom an indebtedness is due that only those who know him well can fully estimate. As investigation proceeded it became evident that some local knowledge of the structure surrounding the coal field was desirable for the better understanding of the conditions which effected its partial destruction, or if preferably put, its partial retention. But it was not realized until the field of observation was thus widened how much of geological interest there is to be seen within an hour's drive of Stellarton.

Within that limit rocks of several ages can be studied. To the south rise peaks of great antiquity, yet composed of slates and sandstone with coarse grits, veined and contorted, derived from the destruction of still older formations of which no remains are now to be seen. These rocks are barren of fossils and for lack of more accurate knowledge of their age, they are classed as Cambro-silurian. On the flanks of these higher hills rest slates of exceeding fineness, which owe their origin to deposits in deep Silurian seas and they have retained remains of the life of that epoch, of crinoids, mollusks, corals and trilobites. In their turn as time rolled on these slates became exposed, suffered disintegration, and supplied material for the growth of succeeding systems. The ephemera of to-day can stand on the very bed they gave to ocean on the cradling of the oldest members of the Carboniferous. On other sides of the field lie the equivalents of those deposits of later date, made of household interest by the writings of Hugh Millar, that are brought by great convulsions in contact with the coal measures.

While these cycles were proceeding, but prior to the later changes the region had been the seat of frequent volcanic activity, the strata were rent, lava had flowed and heat had altered the character of the deposits. And again when time had built up thousands of feet of Carboniferous strata, thick beds of coal, of sandstone, of shales and fireclays, and consolidated them under the weight of their own accumulations, had broken and uptilted them when no longer able to bear the strain of seismic movements and then exposed them to the denuding influences of air and sea, they in their turn made a floor, now once more visible, on which a new epoch piled up a new series of deposits widespread along the coast. These brought to the surface remained exposed, while elsewhere secondary formations were adding to their records, and they so remained contributing their quota of disintegrated material until the glacial epoch came and spread its coating over all.

Subsequent to the deposition of the strata that have the red New Glasgow conglomerate as their base there are no remains of any other system until the Glacial epoch, and it would seem that since the disturbances that in mesozoic times defined the general outline of the country erosion has been continuous. Small deposits of peat, silt and river gravels are additions in modern days; the former only has been partially mapped, while no attempt has been made to show the glacial drift which covers so much of the coal field and the surrounding formations at low elevations and on the northern slopes of the hills, the lee side of the drift in this part of the Province.

This deposit greatly interferes with the study of the subjacent strata and leaves much conjectural in the disturbed portions. It is so often foreign to the composition of the underlying rocks that it is very misleading to the prospector. In this field the sinker of trial pits more speedily reaches the metals in the hollows than on the ridges of the land.

The tops of the hills in Pictou County are not so rounded as to suggest an erosion at all comparable to that which gave form to the crests of the Atlantic ranges of slate quartzite and granite, nor does the general contour of this field indicate that it owes its present form principally to the erosion of this period. Rather that its hills and valleys are the result of long continued preglacial denudation directed by the texture of the measures and the faults which traverse it, the subsequent glacial erosion playing but secondary part. The preglacial water courses seem to have had the same direction as those of to-day, and to have been filled in with till which in many parts still remains, as for example in the valley of McCulloch's brook, at lower levels than the beds in which these streams now flow.

In parts the composition of the till is irregular, notably in the neighborhood of the present streams. Heavy deposits of sand occur in it near the East river and near the mouth of McLellan's brook high above the bed of the stream. In the sand are layers and balls of clay, boulders of foreign stone and occasionally a pocket of fragments of black shale torn from the adjoining banks. In other parts clay predominates and the sand is in streaks and layers.

This irregularity has suggested that these deposits may in part owe their origin during the ice age to summer floods having had their strongest flow approximately along the course of the drainage of to-day. With the material of local origin are striated fragments of the neighboring Lower Carboniferous and older rocks, and occasionally great boulders brought from the Cobequids and even more distant localities. To the south on higher ground, the major part of the deposits is of shattered fragments of local rocks, with sharp edges like the refuse of a quarry.

Red Rocks—When after 1858 the mineral rights other than those reserved to the General Mining Association were thrown open to the public and explorations became general, the coal prospector who in his search met with rocks of a red color, stopped working in that direction convinced that he had reached a horizon beyond the coals of workable thickness. In practice he was right; no good seams are immediately overlaid by red rocks in this field. This experience of the miner perhaps led the geologist who followed to infer that all the red rocks, so called, of the district are necessarily older than the coal measures; at any rate they were so classed, except by Sir William in McBean's areas.

The red rocks immediately south of Stellarton railway station and those about French's tunnel on the Middle river are so given by the Survey, but they are now believed to be of the same horizon as beds in undoubted coal measures, and the faults necessarily assumed to separate the two divisions have been proved, it may be said, to be non-existent.

In 1852 Mr. H. Poole mentioned the radical change that takes place in some of the strata when traced but a short distance; a change the more noticeable when the beds are followed from the centre to the margin of the field. Shales become more and more arenaceous until ultimately they pass into beds of sandstone even with intercalated conglomerates; black fireclays become brown and ultimately cold grey; and coals become coarse, then black fireclays and finally thin out. Boreholes at Westville put down from the upper to prove the quality of expected lower seams passed through into red rocks without finding the equivalents of seams underlying in order to the eastward at equal depths.

The coal of McLeod's pit on the east side of the East river, which is on the attenuated extension of the main seam, it is said directly overlies red rocks. This change of color and character accompanies an approach to the margin of the basin; and if the present margin approximates at all to the margin of deposition, which is the present conclusion, a very decided difference in the appearance and quality would naturally be expected in those portions of any beds which bore this relation to one another.

Red rocks occur in strata both above and below the coal measures, and slight exceptions have been seen in these measures where they are barren of workable seams. There is a group of beds some 40 feet thick under the Marsh pit series and overlying the widow Chisholm seam on McLellan's brook that were cut by No. 2 borehole of the Acadia Coal Company in 1878, which are mottled with red somewhat similarly to the sandstones at the New Glasgow athletic grounds and other spots along the northern margin of the field, believed to be of other age. There is also a small local band overlying the Deep seam on the high ground approaching the McCulloch brook fault where that seam begins to become inferior in quality, and some of the sandstone bands thrown out on sinking the Forster pit became red on exposure to the weather.*

*Logan's report p. 34.

The red rocks are found of many shades, varying from the bright brick color of the metamorphic beds at Fish-pools, Riverton, and the purple grits of McLellan's mountain to the dull and chocolate reds of the Lower Carboniferous and the Millstone Grit, and the fresher tints of the Permian with their local and characteristic metallic sheen. As it were a forecast of the latter, there seems a general resemblance to them in certain beds that lie on the northern limits of the field. These beds are classed as Millstone Grit, but it must be confessed there is an inability to trace a similarity either in structural character, cleavage or appearance with rocks taken as typical of that system in this field; for instance, with those of McLeod's brook and those on the East river above the brick-yard unmistakeably of the same age. The relative age of the red rocks in the several sections of this field has been so differently regarded by independent observers that in offering a new arrangement there is here no singularity. What the proper horizons are is of course still open to question, but in the recognition of distinct groups in series hitherto classed as identical an opening is made for future closer comparison and proper classification. The upper division of the Fish-pool beds put as Millstone Grit in section 1, p. 60, of the Report of Progress, will no longer be classed with those of McLeod's brook, or of Smoky-town, or of McLean's brook, or of Pine-tree. There can be no doubt that had Sir W. Logan himself compared the rocks below the Coal Measures of Mr. Hartley's divisions with those of his own much of the re-arrangement which now seems called for would have been avoided.

In the study of the relative position of these barren measures, a scale of hardness in the red argillites perhaps offers a rough and ready test of the age of rocks that otherwise may look identical. On exposure to the atmosphere the harder rocks, for instance, of Oliver's mill dam, present a slaty fracture, those of later origin associated with Carboniferous Limestone of McLellan's brook crumble into rhomboidal form; while in the Millstone Grit the particles have rounded edges, and in the Upper Coal measures the slickensided fracture of the marls facilitates their conversion into plastic clay.

(*To be continued.*)

CORRESPONDENCE.

Mr. J. Lainson Wills and the Walker-Carter Process.

Editor Canadian Mining Review:—

DEAR SIR,—A letter from Mr. J. Lainson Wills, M. E., dated New York, February 22nd, and published in your February issue, requires to be answered—not from any effect which that gentleman's name or opinion may have, as the one is scarcely known and the other simply worthless—but on account of the publicity which your well-known and admirable journal has given to the communication.

I need hardly point out the impertinence and presumption of a self-termed expert venturing to publish an opinion on a subject to which he has given "much study and attention during the past season of 1893," when chemists and experienced mining men have spent twenty-five and thirty years studying the same problem without satisfactorily solving the question. Probably, if Mr. J. Lainson Wills, M.E., spends five or six years longer at the task, he may, if he is wise, discover that he really knows nothing about it. It requires often considerable knowledge for a man to learn how ignorant he is. The serious part of Mr. J. Lainson Wills' letter is where he confesses to having "clandestinely obtained a sample of the tailing, by catching a few buckets of slimes outside the mill at various intervals of the operation of running off the overflow." Now, this confession is bad enough, especially when he could have gone directly into the mill and panned to his heart's content, instead of having to resort to such an underhand method of forming an opinion. The mill has been open to any and everyone for inspection for months past, and they were welcomed to pan on the tailings, the amalgamated and the roasted ore, and obtain all the information they desired. The process is no secret; it is free for examination by anyone.

The Superintendent and mill workmen inform me, however, that the tailings run out of the mill into deep water, and it would be impossible for any one to catch "a few buckets" without using a boat; and as there were no boats handy, it appears that Mr. J. Lainson Wills' confession is, after all, a bogus one.

In looking over certain correspondence with the Hastings Mining Co., I find, however, that Mr. J. Lainson Wills, M.E., was not always of the opinion regarding the Walker-Carter process that he is now.

The following letters explain themselves:—

206 ALBERT STREET,
OTTAWA, Sept. 20th, 1893.

F. B. ALLAN, ESQ.,
Pres. Hastings Mining & Reduction Co.,
Toronto Street, Toronto:

DEAR SIR,—I was very much interested when I had the opportunity of seeing the work of your plant and process for gold ore working at Marmora, and regret that circumstances obliged me to return to Ottawa without having more time to talk over details with you. Having had considerable experience in ordinary gold mill work and amalgamation, and followed up the later improvements and processes, I was able to appreciate sweet roasting effected by the Carter-Walker furnace, and the advantages to be obtained by the volatilisation of mercury in attacking the gold, and it appears to me that with certain improvements or modifications to your present plant the process may be rendered almost perfect for a certain class of gold ores. I would desire to know what is the cost of a calcining furnace of the various capacities, and what arrangements could be made for employing your patents in Canada. I should be glad to have any other information of details and record of results attained which may be useful to me in deciding the adoption of your plant in the development of a property now under consideration.

Thanking you for this information in anticipation, I am, dear sir,

Yours faithfully,
JOS. LAINSON WILLS.

OTTAWA, Oct. 11, 1893.

F. B. ALLAN, ESQ.,
Toronto.

DEAR SIR,—I beg to thank you for yours of the 6th inst. and the information regarding the Walker-Carter furnace and amalgamator. I have been engrossed during the past four days with the work of (removing) changing residence and office. (*My new address is 106 Sparks Street.*) Hence my delay in replying to your letter. My first idea referred to British Columbia gold fields as locality, but a property in Lake of the Woods district is also under my consideration. I leave to-morrow (Thursday) for Marmora where I expect to be until Sunday night. I may have the good luck, perhaps, of meeting you there; if not I will endeavor to come to Toronto shortly.

Yours faithfully,
JOS. LAINSON WILLS.

It seems that this gentleman first bargained for working a territory under the Walker-Carter process, and was desirous of getting the company to adopt "certain improvements or modifications of your present plant," which emanated from his great intellect, and that failing in both he seeks to "get even" with the company.

I leave your readers to judge of the value of the opinion of such a man. So much for Mr. J. Lainson Wills, M.E. By the way, I would suggest to Mr. Wills that he change the personal pronoun "M.E." to "I," and place it at the front instead of at the rear end of his name, so as to read I, Mr. J. Lainson Wills. It would be more in harmony with himself and decidedly more grammatical.

Regarding other processes mentioned in the letter, everyone knows that chlorination was tried under the very best conditions at the Delora mine and was a decided failure. The cost of such treatment was far in excess of the gold obtained.

As to the cyanide process, although useful with auriferous sulphides, has not been successfully applied to the treatment of mispickel ores. The best known cyanide process is now being used in Africa, but I am informed by the superintendent of one of the principal mines controlled by the Rothschilds, that they average only 70% of the assay value of the ores in gold.

The Walker-Carter process as it now stands is the result of years of hard and patient study, and of thousands of dollars of experimental work. It was in 1875 that Mr. Walker first commenced the investigation which has culminated in what is conceded by those qualified to judge, to be the only process capable of successfully and profitably treating the Hastings county ores.

The process was examined and endorsed by the late Professor Genth, probably the most able and experienced mining chemist in the United States. Prof. Riotti, of the New York Metallurgical Works, used a small Walker-Carter plant in his laboratory for several months, and stated to the writer that it was not only the best, but the only process that would treat satisfactorily arsenical ores and recover float gold.

Prof. Ricketts, of Ricketts & Banks, the best known chemist in New York, made several tests and has fully endorsed the process. The result of the last test is that a large plant is now being erected in Blacksburg, S.C., to treat the pyrites found in that district, and recover the gold, iron oxide and sulphurous acid. Acid chambers are being erected for the manufacture of sulphuric acid in connection therewith.

The following is from Walter S. Bates, a well known assayer and mining expert of Denver, Colorado, who spent two or three months at the mill at Marmora:

PHILADELPHIA, PA., 3/19/'94.

MR. ARTHUR KITSON,
Provident Building, City.

DEAR SIR,—In response to your enquiry regardinr results of the mill run of the Walker-Carter mill at Magmora, Ontario, last summer, I state: The ore treated was principally from a mine called the "Gatling Mine," adjoining the Delora, in Hastings County. The ore furnished was arsenical pyrites, or mispickel. The average assay value in gold of this ore as taken from the regular mill samples was \$8.50 gold per ton. The tailing samples taken daily from the settler discharge averaged \$1.32 per ton in gold. The average saving was 84% of the gold contained in these ores. The arsenious acid gases set free in the oxidizing furnace were perfectly condensed as arsenious oxide. Owing to the *coarse pulp* furnished by the machine used, it was impossible to obtain higher per cent. With uniform pulp, say 60 or 80 mesh, from 90% to 95% of the gold would have been recovered.

Yours respectfully,
WALTER S. BATES,
Assayer.

I do not wish to burden your columns unnecessarily, otherwise I could furnish your readers with expert opinions and tests regarding the Walker-Carter process, voluminous enough to fill the entire journal.

Regarding Mr. Harvey Beckwith's report, published in your January issue, this was not written for publication, but for some capitalists who desired to invest in the process. Mr. Beckwith had examined the process elsewhere and several times before going to Cannda, and hence did not need to make as exhaustive a report as he otherwise would have done.

I would say in conclusion that the plant at Marmora was merely an experimental one, put there for the purpose of demonstrating the success of the process in handling these ores. It is our intention to erect plants in various parts of Canada for recovering gold, silver, and manufacturing iron oxide, sulphuric and arsenious acids.

Yours respectfully,
ARTHUR KITSON.

Philadelphia, 29th March, 1894.

CANADIAN COMPANIES.

Bell's Asbestos Co., Ltd.—The Directors' report for the year ended 31st December last, shows that the result of the year's operations is a net profit of £4,683.12.8, to which has to be added the amount brought forward, £3,047.12.9; leaving for appropriation £7,731.5.5. The Directors recommend the payment on 19th March of a dividend of 5s. per share, being at the rate of 5 per cent. per annum, and £1,731.5.5 is carried forward.

United Asbestos Co., Ltd.—The Directors recommend the payment of the following dividends for the past year: 10 per cent. on the £10 preference shares, 6 per cent. on the £5 preference shares, 2½ per cent. on the ordinary shares, carrying forward a balance equal to 5¾ per cent. on the ordinary shares.

Harrigan Cove Gold Mining Co. has given notice of application for charter of incorporation with the object of carrying on mining operations in the County of Halifax and elsewhere in the Province of Nova Scotia. Authorized capital, \$60,000, in shares of \$100. Head office, Halifax; Directors, George Fawn, Halifax, E. Whidden, Halifax, A. Carter, Truro, J. G. White, Halifax, and J. N. White, Halifax.

Cariboo and Kootenay Prospecting and Mining Co. has been registered at Victoria, B.C., to purchase from the Vancouver Lardeau Mineral Prospecting Syndicate all their righrs, title and interest in certain claims or mining locations in the Lardeau district, West Kootenay, B.C., and to work same. Head office, Vancouver, B.C.; authorized capital, \$100,000 in 50,000 shares of \$2.00. Directors, Walter H. Kendall, Benjamin J. Cornish, Edward E. Penzer, F. M. Robertson and John Williams.

Intercolonial Coal Co.—The new board elected at last meeting of shareholders is as follows: J. P. Cleghorn, *President;* H. A. Budden, *Vice-President and Managing Director;* H. S. Macdougall, W. M. Ramsay, Thomas Wilson, A. Gunn, E. G. Penny, A. W. Hooper, R. MacD. Paterson.

MINING NOTES.

[FROM OUR OWN CORRESPONDENTS.]

Nova Scotia.

Caribou District.

Mr. W. A. Sanders, having thoroughly tested the old workings of the Lake Lode Co., has purchased the property, and will open up the mine and fit up the surface plant the coming season. A large body of low grade ore has been shown, which will be opened up as rapidly as possible.

The Dixon Company will erect a new 10-stamp mill this summer, and will also make some changes in other parts of the mine plant.

The Caribou Gold Mining Company have amalgamated the Truro, Caffrey and Andrews properties, and will work them vigorously this summer. Mr. Geo. W. Stuart of Truro, has been engaged as consulting engineer for the company.

Darrs Hill.

There is little new to report from this district. The manager of the Dufferin is laid up with a broken leg and little is doing at the mine.

Harrigan Cove.

A small syndicate has been formed in Halifax to test some of the properties here which have been prospected during the winter. A small steam plant has been sent down.

Stormont.

Work on the Richardson, Antigonish and Country Harbor Co's properties is being pushed, and from yields already recorded, the output for 1894 will be a handsome increase on that for 1893. Extensive improvements are contemplated in some of the properties, which, when completed, will add greatly to the output.

Lake Catcha.

Reports from this district indicate that recent developments in the Oxford property have shown new bodies of rich quartz, and that the output of the mine will be largely increased this year.

Oldham.

The companies operating here have all reduced their forces during the winter. The Rhode Island Co. now have their steam plant in running order, and a contract has been let to sink the shaft to the 400-ft. point. The Columbia Co. are driving in what is believed to be the Britannia lode, formerly very rich in pockets.

Ontario.

The Martha mica mine at Perth continues to yield a satisfactory output of mica.

The Ledyard gold mines are being opened up at Belmont. At a depth of 55 feet the vein looks up well, showing some fine gold and nice-looking sulphurets. The mill building is under construction and machinery is being put in at the mine.

Manitoba and N. W. T.

During the past year operations at Canmore and Anthracite have been prosecuted with great vigor by H. H. McNeill & Co. At the former place the consumption of coal for the use of the Canadian Pacific Railway Company's locomotives was a great factor, as the slack of the mine has been utilized to a great extent and will be during the greater part of the year, except probably in extremely cold weather. The slack has been rendered much more valuable as fuel by washing.

Lethbridge Colliery.—Owing to the depression in the Western States caused largely by the silver crisis, the demand from this mine has been materially decreased. More than 50 per cent. of the output of this colliery has, since the opening of the line from Lethbridge to Great Falls, Montana, found a market south of the line. Now that the Canadian Pacific Railway has taken over the line from Lethbridge to Dunmore and widened the gauge to standard width, it is anticipated by the proprietors of this colliery that their market in Manitoba and the Territories will be considerably improved in consequence. The cost of labor and waste of material in transferring the coal at Dunmore will thus be avoided, which will materially decrease the cost of handling the coal, and the margin thus saved will probably be an important item in the profits of this colliery.

Knee Hill Mines.—The construction of the railway from the neighborhood of Calgary to these mines has commenced. This line, known as the Red Deer Valley Railway, utilizes the track of the Calgary and Edmonton Railway line for a distance of four miles from Calgary, where it branches off. When the road is completed it is probable that mining operations will immediately be instituted. From indications the quantity and quality of coal available at these mines appear to be most promising.

Considerable mining has been done at Edmonton on a small scale, chiefly to supply local consumption. A small quantity has been shipped to Calgary; but owing to the amount of moisture contained in this lignite, unavoidable exposure to atmospheric influences considerably depreciates the value of the same, except during very cold, dry weather. Several smaller mines, chiefly in the foot-hills of the mountains, have been operated in a very crude manner, supplying fuel for consumption in the immediate vicinity. The lignites on the Souris have not been developed as far as anticipated, no doubt owing to the financial stringency of the past season.

The revenue derived by the Dominion Government from the sale of coal lands was $900, making the total revenue up to 31st October, 1893, $141,983.27.

British Columbia.

Caribou District.

Mr. John Bowron, Gold Commissioner, writes:—"In referring to some of the principal mines now in course of development, I shall begin at the southern part of the district. On the Horsefly River, the Horsefly Hydraulic Mining Co., Limited, of which H. Abbott, Esq., of Vancouver, is President, and Mr. J. S. Hobson is Manager, has acquired, either by location or purchase, a large area of hydraulic mining ground, situated immediately above the Falls, having admirable dumpage, which is of the utmost importance to hydraulic mining. This company, which kept a force of men employed during last winter in running tunnels, are well pleased with the prospects obtained, and as soon as the ditches are completed will bring in an immense quantity of steel piping, preparatory to commencing work on a scale of magnitude hitherto unknown in the district.

"I have much pleasure in reporting the success of Mr. A. D. Whittier in inducing a London syndicate to furnish the necessary capital to provide plant for working the lower part of Williams' Creek by hydraulic lift. The company is registered under the Imperial Statutes as the 'Whittier Gold Concessions Syndicate." The Williams Creek concession is the first property the Syndicate proposes to develop.

The Slough Creek Co. has been most unfortunate in losing two of its leading men. Mr. Magee, one of the contractors, and manager for sinking a working shaft, after visiting the works, had occasion to return to Victoria, where he was stricken down with diptheria, to which he succumbed in a few days; after which Mr. Gans, of Tacoma, was engaged as manager. While Mr. Gans was at Ashcroft making arrangements for the forwarding of two thirty horse power engines, boilers and appliances (which had been purchased in the east), he met with an accident which proved fatal. The machinery, however, is now on its way to the mine, at which ten men are engaged preparing for winter work, and I am assured by Mr. Fife, of Tacoma, the president of the company, that notwithstanding these lamentable drawbacks they will persevere in their endeavors to prove the value of their mine.

On Shepherd Creek, the Discovery Co. have devoted nearly the whole season to bringing up a drain, digging ditches, and constructing a dam to store water. This claim promises to be remunerative in the future. Other companies have located ground on this creek and are running tunnels or otherwise prospecting the ground, with fair chances of success.

The foregoing represents in brief some of the principal new mining enterprises started within the last eighteen months, the mention of which will at least serve to show that "Old Cariboo" is anything but a "played out mining camp,' as some may regard it. From evidences afforded me in my official position, I am led to the conclusion that the district is entering upon a new and prosperous career, scarcely inferior and certainly more lasting than the famous golden days of the early sixties.

There is another source of wealth possessed by the district, to which I referred in my last report, the development of which has not as yet been undertaken. Upon having my attention drawn to an article in Chamber's Journal for February, 1892, upon "Dredging for Gold in New Zealand," I was more than ever impressed with the adaptability of our larger streams for being worked by dredging, but as I hope soon to be in possession of all facts relating to the nature of the appliances used in the mining here referred to, I shall for the present only mention the fact of the presence in large quantities of fine gold in our river beds.

To speak of the paying claims, or those contributing to the gold product of the district for the year, would be but a repetition of my last year's report, with the single exception of Joseph Shaw & Son's claims on Hardscrabble Creek, which has paid handsomely this season, with every indication of continuing to do so for many years to come. The Nason Co., on Antler Creek, after overcoming one misfortune after another, have at last succeeded in pumping out their diggings, and are just starting to prospect the mine, which, if perseverance merits success, should prove a "Bonanza."

The total output of gold for the season is, as near as can be ascertained, somewhat greater than last season, which must be regarded as highly satisfactory, as so many white miners have been engaged in opening new mines and other non-productive works, that the Chinese have been much the larger producers.

Keithley Creek, Alexandra and Williams Lake Divisions.

Mr. Stephenson, gold commissioner, reports the mining season, although late in opening, has upon the whole been favorable for placer mining all through this section, as the supply of water during the summer was above the average. The actual number of claims producing gold has been about the same as the preceding year, while the estimated amount taken out is slightly in excess, which shows that the regularly organized companies have done quite as well as last year. This always has a good effect, even on the Chinese, as it proves they can do better by forming into companies and opening up claims which prove more remunerative than when worked individually in a desultory manner. On Keithley and Snowshoe Creeks there is very little change to report from last year; there have been no new developments that I am aware of, and but very little prospecting has been done on these creeks during the past season. On Harvey Creek there are still a few miners working, but nearly all of them are going over the old worked ground, and any prospects of new finds are very slight. On the North Fork of Quesnelle River and Spanish Creek operations have been light for the season, the greatest amount of work on the North Fork being done by the Victoria Hydraulic Mining Company in prospecting some gravel benches. As far as I could learn, the results so far are not satisfactory, and work was suspended early in the latter part of the mining season. The company on Spanish Creek still keeps going ahead with their work during the whole year. They are running a drive into the hill looking for the old channel, and are taking out some gold, but nothing like pay for their work. Still they think the prospects are sufficiently good to continue on in hopes of finding something better.

From Quesnelle Forks down the main Quesnelle, about forty miles, all the work during the season has been confined to desultory mining. The Chinese working on the small gulches while the water lasted, and when the water falls in the river they go to places along the river where they can obtain dirt that will pay for rocking. During the last part of the season there have been whites down the river looking for hydraulic claims in the vicinity of what is known as 20-Mile Creek (twenty miles below Quesnelle Forks). The result of their work I see in notices of application for leases of several locations in that section, and, as I am given to understand, they really mean business and have the necessary means to carry on the work required, it is to be hoped they will get the ground applied for. The expenditure must be considerable to any company that will bring water upon those benches in sufficient quantity to properly work them, therefore I think that any company with capital that wishes to honestly prospect and endeavors to develop the mineral resources of the country should be liberally dealt with. The means of getting down the river to 20-Mile Creek, or, in fact, anywhere down the river, are very poor, there being no trail, and boating on the Quesnelle River is at times rather dangerous work. On the South Fork of Quesnelle River the small hydraulic claims operated by Chinese have done about as well as usual, their limited supply of water necessarily makes their work light for the season. The South Fork Hydraulic Company worked on an average ten white men in opening up their claim (lease) until August last, when the property changed hands. The South Fork and the adjoining claim next below (Hop E Tong Company), a Chinese company, were both purchased by a company with ample means to develop these properties, and are under the management of Mr. J. B. Hobson, mining engineer, who is pushing work ahead as fast as possible, and will continue to do so as long as the weather permits. A saw-mill, large hydraulic plant, and other material for the working of the claims will be laid upon the ground during the coming winter, and, as soon as men and money can accomplish it, it is the intention to have these claims in working order.

On Horsefly, the Horsefly Hydraulic Mining Company, also under the management of Mr. J. B. Hobson, have been steadily pushing their work ahead during the summer with an average force for the season of thirty whites and thirty Japanese, doing contract work on a ditch, and still their remains an immense amount of work yet to be done before the property is put in shape to give returns. The expenditure of this company on Horsefly, I think, will amount to about one hundred thousand dollars before their mine is in thorough working order, while they estimate the purchase and the cost of preparing the South Fork of Quesnelle property for working at about three hundred thousand dollars. A few such enterprises as these managed by thoroughly competent and practical men will go a long way to bring Cariboo once more to the front as a mining district.

West Kootenay, Southern Division.

Mr. Fitzstubbs, mining recorder, reports: "During 1893 there were 161 mining claims recorded, 69 transfers, and assessment work has been done on 117 claims. Fourteen placer claims and five transfers of same were recorded. There are within the southern division 22 placer leases in existence, 15 of which are on the Salmon River, six on the Pen d'Oreille and one on Forty-mile Creek. One hundred tons of ore shipped from the Silver King mine was shipped to Swansea which will yield over $100 per ton.

Concentrating Plant for the Number One Mine.—The construction of the concentrating plant at the Number One Mine, Ainsworth, is being rapidly pushed forward. Most of the machinery is at the mill, and the work it is expected will be finished early next month.

NOVA SCOTIA GOLD YIELD.

Comparative statement showing the quantities of gold won and rock crushed by the principal operators during the calendar years 1892 and 1893, compiled, by courtesy of the Mines Department, from official returns.

Company.	District.	1892. Gold Won.			1892. Rock Crushed.		1893. Gold Won.			1893. Rock Crushed.	
		Ozs.	Dw.	Grs.	Tons.	Cw.	Ozs.	Dw.	Grs.	Tons.	Cw.
Anderson Mine	Lake Catcha	282	11	6	344	....	262	3	....	156	....
Antigonish Gold Co	Stormont	2191	18	14	3405	....	1966	19	18	4681	....
Boston Gold Co	Malaga	1607	18	19	1825	....	248	15	....	306	....
Columbia Milling and Mining Co.	Oldham	....	....	....	....	....	117	2	18	437	....
Cowan Gold Co	Kemptville	11	....	....	20	....	2	8	....	13	....
Dixon Gold Mine	Caribou	1118	10	....	730	....	1014	....	....	710	....
Dufferin Gold Co	Salmon River	1042	10	....	4215	....	965	....	....	3560	....
Lake Lode Co	Caribou	....	....	....	....	....	223	19	2	657	....
Mooseland Gold Co	Mooseland	373	18	....	893	....	471	2	13	1323	....
New Egerton Co.	15-Mile Stream	1229	...	....	2350	....	497	17	...	1401	....
Nova Scotia Gold Mines, Ltd.	Montagu	2201	10	....	1716	....	810	14	....	1219	5
Oldham Gold Co	Oldham	3078	14	12	2233	....	3285	11	8	2343	4
Oxford Gold Co	Lake Catcha	764	7	14	2124	2	765	9	....	1566	5
North Star Mining Co	Isaacs Harbor	165	....	....	163	....	957	5	....	890	15
Richardson Gold Co	Stormont	....	....	....	....	....	2237	18	10	6048	....
Rossignol Gold Co	Whiteburn	146	15	2	147	...	30	....	....	58	....
Salisbury Gold Co	Montagu	....	....	....	....	....	87	3	12	216	....
Symon-Kaye Co	Montagu	....	....	....	....	....	216	....	....	280	....
Thompson & Quirk	Uniacke	1803	4	18	180	....	1175	6	11	115	....
West Waverley Gold Co	Waverley	1239	12	....	4207	21	3211	0	15	8154	....

Soaking-Pits for Tyres.—At the Osnabrück steel-works soaking-pits are employed for the slow and uniform cooling of tyres after rolling. The pits are constructed in the ground in the usual manner, and are of such size that they hold twelve tyres, one placed on top of the other. The tyres are taken from the rolls to the pits by means of travelling cranes, and are left to cool for three or four days in the closed pits. Experiments have shown that tyres cooled in this way have 50 per cent. greater strength than those cooled in the ordinary manner in ashes or simply exposed to air.

1894. THE 1894.

Canadian Mining Manual

AND MINING COMPANIES DIRECTORY.

BY B. T. A. BELL,

Editor of THE CANADIAN MINING REVIEW, Secretary GENERAL MINING ASSOCIATION OF QUEBEC,
Honorary Secretary MINING SOCIETY OF NOVA SCOTIA.

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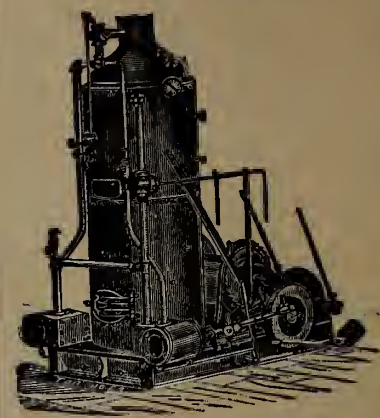

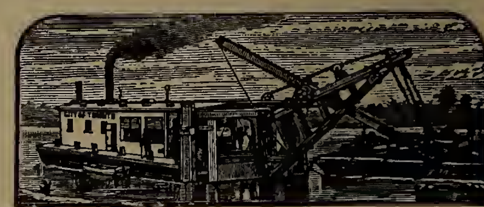

CONDUCTED BY . . . . . . B. T. A. BELL.

THE OFFICIAL ORGAN

—OF—

THE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERL MINING SSOCIATION OF QUEBEC.

OFFICES:

Victoria Chambers, 140 Wellington Street,

OTTAWA.

Vol. XIII. APRIL, 1894. No. 4

The Heavy Metal Trade Under the New Tariff.

A careful examination of the changes that have been made in the heavy metal schedule of the tariff shows that the principle pursued by the Government has been to give a reasonable amount of protection to natural or established industries, and at the same time to reduce to a merely nominal or revenue basis the duties on such articles as are not at present manufactured in the country, or can only be made here under very adverse conditions.

The careful investigations made by the Finance Minister and some of his colleagues, during the past summer, and the interviews they have had with all classes of manufacturers and consumers, have been productive of good results, for the Finance Minister has shown an intimate knowledge of the conditions of this business in its various branches of manufactory and importing.

The duty and bounty on pig iron have been maintained at the previous rates of four dollars and two dollars per ton respectively. This has without doubt been due to the strong representations made by the pig iron manufacturers, that the industry is still very young and a much longer period than seven years is necessary to establish it on a firm and safe basis. The past two or three years have shown a great advance in this manufacture, for whereas in 1891 the quantity of iron produced was only 23,891 tons, it is anticipated that the year ending 30th June, 1894, will show an output of about 60,000 tons. It must also be remembered that the competition of American iron is at present of a most exceptional character. Prices are ruling in the United States that do not begin to give any profit to the manufacturer, while in a great many cases they are admitted to be below cost. There is not the slightest doubt that the native ores of Canada can be melted into pig iron as cheaply as those of any other country, and it is to be hoped that the development of this industry will receive a fresh impetus from the settlement of the tariff question for another period of years.

A bounty of two dollars per ton has also been granted on puddled iron and steel ingots made in this country. The effect of this will, we hope, be the re-opening of the puddling furnaces of the Londonderry Iron Co. which have been closed down, owing to the almost total substitution of scrap for puddled iron by the rolling mills. The question arises here, why should not the rolling mills make their own puddled iron, as is done in nearly every mill in Great Britain? At present there is very little outlet for the mill and forge iron produced by the Nova Scotia furnaces, the quality of which appears to be eminently suited for puddling purposes. This is a question which we think should be seriously considered by the rolling mills of this country in view of the increased and increasing duty on scrap iron.

The reduction to a uniform basis of the duties on manufactured iron and steel is a very satisfactory change. Indeed it is difficult to understand why these two metals, so much alike in quality, and now so nearly the same in price, were taxed at different rates of duty. Bar iron and steel, hoops and sheets, etc., thicker than No. 17 gauge are now dutiable at ten dollars per ton in place of thirteen dollars and twelve dollars as before. This is rather a serious drop in the bar iron duties, when it is taken in conjunction with the increase on their former raw material, viz., scrap iron, which is now dutiable at three dollars instead of two dollars as before, and will be increased to four dollars after 1st January, 1895. With puddled bars down however from nine dollars to five dollars, and a strong chance of their being made in the country, it is likely that some change will take place in their method of manufacture. Bar iron rolled entirely from scrap, unless this scrap is selected in the most careful manner, is never so uniform and reliable as that rolled from puddled bar and scrap combined, and the complaint that ordinary Canadian iron was not always satisfactory for imported work, had a very large element of truth in it. We fancy also that makers will prefer the use of puddled bars as being much more convenient and satisfactory to handle and work. It is not likely however that much change will be made this year while the duty remains at three dollars, more especially as the increase of duty has been more than counterbalanced by the low prices at which scrap is offered on account of its accumulation in the United States, much beyond their power of utilizing it in the present depressed state of business there.

The tendency is now more and more for mild steel to take the place of iron, and it is in this direction that we look for a large development in the near future. The bounty which has been established for the next five years will, we think produce good results in this department. It should enable the Nova Scotia Steel and Forge Co. to supply the demand that must now spring up from the rolling mills for blooms and billets. In our opinion that company never had such a chance as now of showing what they can do in this direction.

EN PASSANT.

At a special meeting of the Council of the General Mining Association of the Province of Quebec, held at Sherbrooke on 12th instant, it was unanimously decided to abandon the June meeting at Quebec and accept the courteous invitation of the Dominion Coal Co., Ltd., the General Mining Association, Ltd. and the Mining Society of Nova Scotia, to hold a united meeting at Sydney, Cape Breton, during the week commencing 7th July. Every effort, we understand, will be made to ensure a large attendance.

We are pleased to announce to our readers that we have made arrangements with Mr. W. L. Blakemore, M.E., assistant manager of the Dominion Coal Co., Ltd., to furnish the REVIEW with a series of articles on the coal industries of Cape Breton. The series, which will begin with our next issue, will deal with: (1) Railway and shipping arrangements; (2) Surface equipment; (3) Methods of mining; (4) Hauling machinery; (5) Coal cutting appliances; (6) General development of Cape Breton mines.

Mr. A. M. Evans, M. E., lately in charge of the asbestos properties of the King Bros., at Black Lake, has accepted a position under the Dominion Coal Co., Ltd.,—we believe at their Gowrie mine, Cow Bay. Mr. Evans was one of the founders of the General Mining Association and the secretary of the hospitable Asbestos Club, from the members of both of which he leaves with heartiest good wishes.

In another place we publish a letter from Mr. J. B. Hammond. No injustice was intended, nor indeed we think done, to Mr. Hammond in our editorial comments of last issue on the meeting of the Ontario Mining Association, and we are quite ready to acquit him of any charge of dishonest dealing. Our remarks respecting the transaction in mining lands were, however, entirely founded upon the statements made in his own address. We understand Mr. Hammond's subject of complaint to be that while he was in New York in the latter part of 1890 "advertising and negotiating the sale of a large and valuable mining property" in the Sudbury district the Government without warning withdrew the mining lands in that district from sale, and that although on his return immediately at the time of such withdrawal he tendered the purchase money in person for the property in question, it was refused, and he was unable to procure a title. The point of our comment was that Mr. Hammond had, according to his own admission, offered for sale a property which he did not own, which so far as his own account goes he had not indeed taken any action to acquire. Whether he was acting in his own behalf or in behalf of others, does not affect the point; apparently the negotiations were entirely in his own hands and he knew the position in which the title stood. If the money had been paid to the Government previous to the withdrawal of the lands in December, 1890, patent would have issued as a matter of course, even after the withdrawal took effect. If a portion of the purchase money had been paid and considerable expense incurred in surveying the lands or developing the mines thereon, payment would have been accepted under the provisions of the advertisement notifying the public of such withdrawal, and of the Act to amend the Mining Act passed in the session of 1891, and patent would have issued under the old Act which imposed neither royalty nor compulsory development. It was also provided in the Act that an actual explorer or prospector who had done certain development work might procure title under the old Act to a location not exceeding 160 acres. Had Mr. Hammond's case come under any one of these classes, he would have had no difficulty in securing a patent; that it did not is proof that few or none even of the ordinary preliminary steps had been taken to acquire title from the Crown.

Mr. Hammond would probably hesitate to offer for sale property which he knew to be another's, without the latter's knowledge and consent; but in mining districts and among mining brokers the lands of the Crown, that is of the public, are looked upon as fit subjects of speculation and negotiation before any ownership whatever in them has been acquired. Such a doctrine applied to private property would probably lead to unpleasant results, and we cannot but think that upon reflection Mr. Hammond will admit that it is open to objection so far as public property is concerned also.

From a correspondent who has lately been through the Sudbury district we learn that the Wahnapitae district is attracting considerable attention as a gold field. The quartz veins (if they are veins, which the Geological Survey questions) are small, rarely exceeding twelve to eighteen inches in width, but show free gold, some of the specimens being well dotted with visible specks or "sights" of the precious metal. A three-quarters' interest in one of the properties was sold to an Ottawa party last week for $10,000. The mines in Algoma are reported as very quiet. The Vermillion remains absolutely closed, without even a caretaker on hand. The Ophir is reported as being run with a reduced force, and the Creighton has recently employed an expert to make a thorough examination, but his report is not yet made public.

Now that the prospector is again in the field in Ontario, the question has been revived as to the necessity of having some public sampling works or metallurgical laboratory in the Province to which sample lots of a ton weight or more may be sent, and for which the correct metallurgical process may be determined. It has been suggested that the Government of Ontario take a leaf out of the book opened by Victoria and New South Wales in Australia, and British Columbia in Canada, and provide the funds whereby the new mining school at Kingston may be equipped with machinery and laboratories for such purposes.

It is a fairly legitimate proposal, inasmuch as the Province will ultimately receive full value for its investment from the increased population and greatly increased taxable property that will result from a proper and healthy growth of its great mineral resources.

Mr. James Baird, whose portrait we publish elsewhere in this issue of the REVIEW, is one of those deep-chested, hearty Northmen of strong individuality, who so often make the most of unpromising surroundings, and ignoring difficulties that would dishearten less determined men, attain a measure of success. James Baird was born in Northumberland in 1840, and under his father, who had a small landsales colliery, he began work as a driver underground at the age of eleven. Later on he helped with his father's contracts, exploring and sinking, and when seventeen years of age he was accepted as a coal cutter. For a few years he varied the scene of his labors and familiarized himself with several modes of working coal in Northumbrian and Scottish collieries; the changes that he made from pit to pit were not always intentional, but were often necessitated by the strikes so rife in the labor world of that period. In 1863, hearing of the gold diggings of Nova Scotia, he decided to try his fortune in the New World, but in neither of the districts of Montagu or Waverley did he find the "strike" he then sought, so he looked again to coal and went to Cape Breton. At Sydney mines a labor strike for the seventh time directed his attention elsewhere, and the spring of 1866 found him exploring the south head of Cow Bay. His explorations led to that locality being bought up by a company, and he was appointed manager Later on, the Reciprocity Treaty with the States having lapsed, he became the company's lessee. In this position he played many parts, and in turn performed the duties of miner, engineer, wharf-builder, and shipper, thus adding to his varied experience. In the meantime he had paid England a visit and made a tour in the United States. Finally he left Cow Bay in 1883 to accept charge of the Chignecto mine, which he managed with credit for many years, though not without anxiety to himself, for he had frequently to contend with mine fires; in fact his first Sunday at Maccan was thus spent underground. On another occasion we expect to publish his experience in dealing with spontaneous combustion in pits. On the transfer of the Joggins mines in 1890 the management was put into the hands of Mr. Baird. He thoroughly reorganized the system of working and successfully adopted the longwall method. Mr. Baird is the inventor of a railway frog of much merit, and he is one of the most active members of the Board of Examiners for granting certificates to colliery officials.

Ontario is to be congratulated in having at last succeeded in organising an association of mining interests, which commends itself to the hearty support and encouragement of all in any way interested in the development of the mineral industries of the Province, and which bids fair in a short time to rival the older societies in Quebec and Nova Scotia. The initial meeting of the Ontario Mining Institute, though very hurriedly convened, was favored with a large and representative attendance, and great unanimity and enthusiasm characterised the proceedings. A detailed report of the meeting will be found elsewhere in this number.

We appeal to the mining men of Ontario of all conditions and capacities to unite for mutual benefit in maintaining this organization, which may be made the means of great individual culture and pleasure, as well as the instrument of the province's material progress in the development of her mineral wealth. If any one has a criticism to make, or a suggestion to offer, instead of uttering it in a carping manner in the press, let him show his genuine interest in the mining industry by joining the Institute and trying to make it what he thinks it ought to be. The first regular meeting for the reading and discussion of papers and the transaction of business will be held in Toronto, in September, when we understand a large and varied assortment of contributions to the mining literature of Ontario will be submitted by the best authorities.

Considerable interest is being taken in the discoveries of gold which are reported from the Rainy River district. The Huronian formation, in which all the gold reefs of the Lake of the Woods, Rainy Lake and Rainy River districts are found, strikes north of Port Arthur about six miles. It crosses the Canadian Pacific near Kaministiquia station, crops up at the international boundary near Gunflint Lake, Minn., on the line of the Port Arthur, Duluth and Western railway, and continues well along the boundary to Rainy lake. Gold veins have been tested and proved to carry free milling ore on Lake Shebandowan. The townships of Moss, Partridge and Osinawe Lake, south and west of Savanne, on the Canadian Pacific, at Lake Harold in the Atikokan region, and Lake Wabigoon. Samples of ore have been taken from all these localities carrying from $15 to $1,500 in gold per ton. The only means of access to this country will be either by steamer to Port Arthur or by rail to Winnipeg; and by Canadian Pacific to Rat Portage, thence by steamer to Rainy Lake.

The doings of the Mining Society of Nova Scotia are in the eyes of the editor of the *Journal News* of Stellarton, N.S., as the flaunting of a red garment before a mad bull. Flicks of his tail we have erstwhile noticed, followed our references to the quarterly meetings of this Society, but after our last issue, reporting the success of the annual meeting, he could restrain himself no longer. He perspired gall, and dipping his pen in the drops that caught in his beard—a beard, by the way, as false in color as

Mr. James Baird.

his assumption to be the one and only exponent of mining interests in Nova Scotia—he overflowed with personalities.

Who is this being who ventures to leave the plane of impersonal discussion when others take up matters of which he claims to be the heaven (?) sent guardian. Is *he* immaculate, a Chesterfield in manners, or a Breckinridge in tone? Does his commanding presence, the dignity of his person, the measured sweetness of his accent, the modesty of his demeanor, the scrupulousness of his dealings with the humble men whose patron he is, leave him like Cæsar's wife and unbegrimed.

Or can it be he sees not himself as others see him, as welcome as a gust of March wind in the legislative halls; respected with the respect accorded a tarantula; hailed as well met at those leaden state functions to which he is *once* annually bidden, as a blast from a charnel house would be at a funeral breakfast. He sneers, does this little blue haired terrier, at the dinner to which his master, Mr. Fielding, found time to attend even in the midst of a political campaign. Has the fellow ever really dined; does he know the meaning conveyed by the words "after dinner," or that there is a wide difference and a respectable middle ground between a dinner of herbs and drunken orgies? Nerve food he talks of—had he referred to "tangle leg" as an efficaceous stimulant for the preparation of temperance speeches he could have spoken with authority.

There is another aspect of this attack that must not be overlooked. This embodiment of envy, hatred and malice may as well at once understand that by lying and slandering the Mining Society he is not going to deter members from discussing subjects of interest to their profession. He drags in the P. W. A. for a purpose to rouse if he can class prejudice and bring him in the dues that are fast making him a man of wealth. He wants an excuse too for playing the skunk and squirting his vileness over those who do not sheer aside and leave him the full width of road his egotism demands—a line of writing that is sure to give delight to the baser sort, but which we know is deprecated by the vast majority of the working men of Nova Scotia.

The earliest known geological map is that of England, published by William Smith, in 1815-19. In a recent paper, Sir Archibald Geikie has something of interest to say regarding it. He writes—"Before geology became organized into a definite branch of science, men began to perceive that our fundamental requisites, as a grand work for the show of the rocks of the earth's crust, alike in the theoretical and industrial aspects, lay in the delineation of the respecctive areas of these rocks upon maps. At first, the maps so constructed were merely rough representations of the general distribution of the mineral masses. They were mineralogical, or as they were called then, geognostical, that is they only aimed at an indication of the relative positions of the rock at the surface. It was not until the time of William Smith that geology was supplied with the means of determining the true succession of the stratified rocks, apart from even lithological characters, which had previously been the only guide. Well may we look back upon that great pioneer as the father of English Geology. In every department of the science, we may trace the direct or indirect influence of his fruitful labors. But in no branch of investigation has this influence been more profound than in geological map-making, and in the assistance which geological maps have furnished to the onward progress of the science. The earliest true geological map, as distinguished from its geognostical or mineralogical predecessors, was the famous map of England, laboriously constructed by Smith himself, after years of patient investigation, and published in 1815-1819. The appearance of this map marks an epoch in the history of the science. It showed now for the first time how the successive stratified formations of the earth's could cover be recognized and traced, apart altogether from their varying mineral characters, and how the geological structure of one country could be logically compared with that of other countries. In fullness, accuracy, and artistic delineation, an enormorous advance has been made, during the last three generations in the construction of geological maps, but the initial impetus of this advance must unquestionably be traced to the land surveys of William Smith."

Sir Archihald has also much to say regarding the relation of a Geological Survey to the public, and points out that, from the beginning of the Geological Survey of Great Britain, it has been continually referred to by all branches of the Government Service for information regarding questions in which knowledge of geology is required. The sinking of wells, the choice of sites for forts and Government buildings, the placing of graveyards, the selection of materials for buildings or roads, or nature of soils and sub-soils with reference to matters of drainage, these and many other subjects have been reported on.

A correspondent of the Halifax *Critic* writes to that paper declaiming against a bill which was passed at the last session of the Nova Scotia Assembly, amending Chapter 121 on "The Partition of Land" by making the provisions of that Act apply to leases of mining property as well as to real estate. The reason of the amendment is patent to all our Nova Scotia friends who, in the past, have been saddled by the once absurd practice of the Mines Department with an unwished for co-ownership in mining property. Two years ago, through the efforts of the old Gold Miners' Association, a change in the wording of one of the paragraphs of Chapter 7 (on Mines and Minerals) was made which prevented any future union of unwilling co-owners and made it mandatory to sell at public auction any property for which there were two or more simultaneous applications. The effect of this change has been most salutary, and the prevention of future errors having been thus satisfactorily accomplished the next step was to provide legal and equitable means for the divorce of those owners who had been unwillingly, and in many cases, unwittingly forced into a joint ownership. The amendment spoken of (to Chap. 121) is the result. That it can be productive of anything but good, we are unable to see.

There are many cases, far too numerous in Nova Scotia to-day, where this unwilling and unequal joint ownership is directly responsible for the condition of inactivity in which these properties are found. Given diverse ownership, without any *co-partnership* by which the ownership may be dissolved, and in nine cases out of ten the natural unequal status of the owners will produce a condition of things ordinarily known as a "freeze-out," the inevitable and immediate result of which is the stoppage of work upon the property so owned. In nine cases out of ten also the disaffected parties will neither sell nor buy from each other, nor agree to sell to an outside third party. However much such a state of things may accord with the wishes of the owners, which we may be permitted to doubt in every case, it certainly is not in accord with the true development of the country, for the country's benefit as a commonwealth, particularly when, as is the case in Nova Scotia, the mineral development of the Province is perhaps its best asset.

It is not perhaps necessary to refer to the letter of this correspondent to the *Critic* further, as it is quite apparent that he has never read the Statute he refers to or he would never have written "The only fair way to do would be to sell the property at auction." It is expressly provided in the Chapter on the "Partition of Lands" that when the Commissioner cannot, from the nature of the property, make an equitable division, they are to so report to the Court, which will then order a public sale of the property for the benefit of all concerned. It is simply childish, and in exceeding bad taste, to complain of a chance of unfair treatment by Commissioners appointed by the Supreme Court of the Country, and to advise resisting such appointment is to lay oneself open to contempt of court.

The *Critic* does not publish the name of its correspondent; probably he is *non-est* and this letter, like so many others, may have originated in the editorial brain. It is in some points humourous, as for example when it says the law "is liable to be serious"—(we supposed all laws were serious)—and also when it alludes to the possible danger to "*easy-going* owners of shares in mines." If there *are* any "easy-going owners" who will be made serious and hardworking by this amendment, we think there is abundant justification for its passage without saying a word more.

A deputation interested in the production of Canadian graphite had an interview with the Dominion Government the other day and asked for a repeal of the proposed change in the tariff whereby imports of this mineral are to be brought in at 10 cents instead of 15 cents as formerly. The Walker Mining Company, which at present is making extensive preparations for a season of unusual activity at the Ottawa County mines, purpose manufacturing their well-known products on a large scale. The principals of the concern claim that the old tariff is necessary if their manufacturing business is to succeed.

The last act in the doleful history of the notorious General Phosphate Corporation (Ltd.) was played at Buckingham this month, when the machinery, plant and equipment was sold at public auction by the Receiver. The sale was insufficiently advertised, and the attendance of buyers, as a consequence, was meagre. The amount realized was a mere pittance, hardly sufficient, we should judge, to cover the expense of its removal from the mines to place of sale, and the commission of the auctioneer.

No judgment has yet been given in the suit of the Johnson's Company (Ltd.) and Bell's Asbestos Company (Ltd.). We hope to give the judgment of the Supreme Court in our next issue.

A good deal of attention is being directed just now to the Chaudiere gold district as a field of great promise for remunerative investment, and it is not unlikely that some important operations may be carried on this year by American and Canadian capitalists. By the way, this reminds us that as the DeLery leases expire this summer, a capital opportunity is afforded the Quebec Government for buying out the rights of this useless monopoly. $55,000 is mentioned as the price at which the Seigniory rights may be acquired, but this would be a bagatelle, even to an impoverished treasury, in view of the undeniable richness of the territory which would accrue to the province. By throwing this field open to capitalists the Government would quickly recoup itself for the outlay, and the benefit to the Province would be great. The opportunity is truly a golden one and we trust the Quebec government will not let it pass without an effort to its acquisition.

In this connection the services of a qualified and thoroughly experienced gold mining engineer for a few months in the field would be a great stimulus to the interest that is being excited in this direction. It is undeniable, from the best of evidence, that the quartz districts alone will amply repay investigation. The report of such an engineer, employed by the Government, would be of the greatest service and value to contemplating investors during the coming season.

Mr. John Hardman, S.B., Oldham, President of the Mining Society of Nova Scotia, passed through Ottawa this month on a visit to Sudbury on professional work in connection with certain reputed gold properties in that district.

The Hon. E. J. Flynn, Commissioner of Crown Lands, Quebec, purchased recently some fifty copies of the Journal of the General Mining Association of the Province of Quebec and distributed them among the leading mining institutes and public libraries of Great Britain and the United States. This is a practical way of advertising the resources of the Province for which the Commissioner is to be commended.

The other day we were pleased to have a call from Mr. Graham Fraser, of New Glasgow, and to find him sufficiently recovered from his recent severe illness to be moving about again. He is still, however, far from being well, and as he has been ordered a complete rest, it is not unlikely that the important iron and steel establishments of which he is the principal will have to do without his services for some time.

The construction of the magnificent coal handling plant of the Dominion Coal Company (Ltd.), at Montreal, is being rapidly pushed forward to completion. The discharging and loading capacity of these towers will exercise an important economy in time, labor and money to the syndicate.

The following table shows the number of tons of coal carried over the Intercolonial Railway from the Nova Scotia collieries to Chaudiere Junction and St. John for points west thereof, and to local stations in each year since the commencement of the trade in 1878-79:—

Year.	For the West.		To Local Stations.	Total.
	Via Chaudière.	*Via* St. John.		
1876-77	....	....	103,420	103,420
1877-78.	....	....	97,043	97,043
1878-79.	300	....	112,232	112,532
1879-80.	1,097	....	135,369	136,466
1880-81.	6,102	4,022	174,483	184,607
1881-82.	18,015	11,779	218,364	248,158
1882-83.	12,837	22,206	227,380	262,423
1883-84.	22,014	19,534	252,014	293,562
1884-85.	133,440	1,773	213,791	349,004
1885-86.	171,170	21,150	215,272	407,592
1886-87	192,871	27,536	233,178	453,585
1887-88.	183,704	36,228	309,727	529,659
1888-89.	160,026	27,923	338,538	526,487
1889-90.	164,453	25,126	366,967	556,546
1890-91.	113,996	39,213	344,829	498,038
1891-92.	35,447	5,918	382,441	433,806
1892-93.	136,868	3,775	402,653	543,296

It thus appears that the largest tonnage of coal carried over the road from the west was in the year 1886, when it reached 192,022 tons, since which the through coal traffic for points west of the Intercolonial Railway has been on the decline.

A method whereby the sulphur in coals may be estimated, and their suitability for gas-making determined before purchase, has been introduced by Herr W. Hempel, an authority on coal gas in Germany. The coal to be tested is powdered and pressed into a little platinum-wire cylinder, to which a long platinum wire is attached, and then burned. The combustion is effected in an ordinary glass bottle, which is fitted with a trebly perforated India-rubber stopper. Through this passes a tube with a glass stopcock, and which widens out into a cylinder; also two glass tubes, to the lower ends of which two thick platinum wires are fused. One of these wires carries the platinum cylinder or basket already referred to. A little mercury is poured into the tube so as to establish sure contact with the wires which lead the electricity. When the current is passed the platinum basket becomes white hot, the combination of the coal is effected, and the gaseous products containing the sulphur compounds are led off through the stopcock and examined chemically. There is practically an improvement on the more complex method originally devised by Berthelot.

The "Heathen Chinee" has no monopoly of "ways that are dark, and tricks that are vain," but he is a wily rascal all the same, and resorts to all sorts of devices for coming out on top of the Caucasian. He has been trying to palm off brass for gold in Queensland, and he has found that the trick was indeed vain, for it has landed him in jail. A splendid imitation of a 7dwt. gold nugget made of brass was recently submitted for sale by a Chinaman to several private persons at Georgetown, but they were either suspicious or without the disposition or means to buy, and no business resulted. The son of Confucius then hied him to the Bank of N. S. Wales, where he was bowled out by the experienced bank officials, and landed in limbo. He is now doing six months hard, and probably planning further schemes for turning the baser metals into gold.

We have received a copy of a photographic representation of 33,000 yards of wire rope, loaded in one length on eight eight-wheeled bogie trucks. The rope, which was manufactured by Messrs. Felten and Guilleaume, of Carlswerk, Mulheim-on-Rhine, measured 5½ in. in circumference, and weighed 210 tons.

The rate of drilling different rocks is affected by several factors, the hardness and compactness of the rock and the weight, temper and drop of the drill being most important. Still, the minerals which compose a rock may be very hard, and yet the cementing may hold the grains so loosely that the drill will make rapid progress through the rock. A feldspar cement allows of rapid progress, while a silicious binding material would resist rupture. The fine-grained rocky and steeply dipping strata are difficult to drill. The following table is given by Professor O. C. S. Carter in a paper before the Franklin Institute, to show the thickness of rock pierced by a chisel drill 20 feet long, 5⅝ inches diameter, weighing 700 lbs., guided so as to make a round hole:

Triassic Clay Slate........4½ feet in 10 hours.
" Sandstone........5 " " "
Silurian Limetone.....5½ " " "
Hydro Mica Schist.....7 " " "
Potsdam Sandstone....10 " " "

"Which is the best way to work collieries without blasting?" is the title of an article read before the Manchester Branch of the Institution of Mining Engineers, England, and is replete with good suggestions as to the manner of managing men, or, rather, their prejudices. He desired to introduce a system of mining without using powder. Eighteen years ago, he was burning 400 lbs. of powder weekly and fifteen years ago abandoned it altogether, after a battle with the employees and employers. He first experimented on piece work with increased progress. Then he extended the field of operations and the men themselves after considerable opposition consented to the trial and conceded the benefit derived therefrom. All the time he kept the men in ignorance of his design of putting the entire mine under the system knowing that they would oppose any change which seemed to be at their expense. He says, "Up to that time we had made our waggon road in the floor, which is very hard in the Cannel mine, from 2 feet 6 inches to 3 feet thick. By careful observation I found that two men could do more work by getting roof down, without blasting, and without risk and no powder to pay for, than three men could do by the old system. Now, as I have remarked before, I had to prove this to the men's satisfaction. To do this I commenced with one or two places at first. This went on for a while and proved of such interest to the men that others wished to do the same. I allowed this to go on until, instead of 20 or more shots a day being fired we had only six." Now, he thought was the accepted time. He called the men together and suggested the change, but was met with resistance and a demand for an increase of 1s. per yard. He abandoned the plan, though he permitted such as desired to adopt the new system to do so. "As is always the case, some men went on the old system, but on more strict lines. Up to that time, shots had been fired day and night, whenever the men were ready. After the meeting, we allowed no shots to be fired between 12 o'clock at night and 6 in the morning, and then only by one man; if the men were not ready when he went, they had to wait till the next round. This state of things went on till 1878, when the men who were using powder asked me to allow them to work on the new system and cease blasting, as, they said, they could not keep up with those who had already abandoned its use. I very readily consented and we have not fired a shot in that class of work since, and we have not had one case where a man has asked to fire one." He employs picks, steel wedge, hammer and water. The use of compressed lime was not successful, but he was satisfied with quicklime and water especially where a large surface was to be lifted. In a strong floor, he puts holes 3 feet down, 3 inches in diameter and 2 feet apart. In these are placed tapered prickers in quicklime 2 feet deep and under 1 foot of clay. The pricker is drawn, water poured on, a wooden plug driven and in twelve hours the coal can be "got" with pick and bads. The lessons drawn from a study of the report are trenchant; first it shows that the average per cent. of coal won from the commencement of mining to January 1st, 1893, is about 44, if it is assumed that the buckwheat size had been prepared during that entire time. It states, however, that the conclusion reached by it is rather a saving of not more than 30 per cent. of the coal originally contained in the areas mined over. This may be increased to 40 per cent. by the utilization of the coal contained in the culm banks, and by the reworking of a part of the territory mined over. An estimate is made of the available marketable coal now still in the ground at 6,898,000,000 tons. One statement is made that should be impressive; *i.e.*, that some of the collieries are using, under their boilers for pumping and hoisting purposes, from 15 to 25 per cent. of their production.

According to M. Eiffel the cost of any big engineering work in lives can be estimated with at least as much accuracy as the cost in money. "It has been ascertained," he said, "by statistical observation, that in engineering enterprises one man is killed for every million francs spent on the work. If you have to build a bridge at a cost of 100,000,000 francs, you know that you will kill 100 workmen." The argument, while rather an ingenious one, is not, we believe, borne out by facts. Take the Eiffel Tower, for example. Six and a half millions worth cost only four lives. The Forth Bridge, on the other hand, a contemporary points out, cost 45 million francs, while the lives of 55 men were sacrificed in connection with its construction. Then in regard to the Manchester Ship Canal, only 130 lives have been lost against an expenditure of 325,000,000 francs.

In the Ontario Legislature the Hon. A. S. Hardy, Commissioner of Crown Lands, gave notice of a resolution setting apart $25,000 per annum for a term of five years from the 1st of July, to be paid as a bounty to miners and producers of iron ore upon all iron ore mined and smelted within the Province. The bonus will be paid at the rate of $1 per ton of pig metal produced from such ores.

The British Columbia Legislature has passed a resolution, praying the Dominion Government to give a bounty on pig lead. "Whereas, by the Dominion Tariff a bounty of $2 per ton on pig iron is allowed; and whereas there is a large quantity of lead ore in the Province which might be mined and become a valuable industry and source of profit: Therefore be it resolved, that the Dominion Government be urged to make a similar regulation in the tariff, and allow a bounty on pig lead."

The Hon. A. S. Hardy's amendment to the Ontario Mines Act will have passed its third reading by the date this issue is in the hands of our readers. It will, we understand, do away with all royalties heretofore reserved, and all lands sold or leased within five years from the passing of the Act will be exempt from royalties. It is quite evident that the Ontario Government is alive to the importance and well being of its mineral resources. The old law was a fair measure, to which no one acquainted with mining legislation in other countries could raise objection, but the amendment, if it will conduce to more liberal investments of capital, will achieve a very desirable end.

We are sorry to see our friend Captain R. C. Adams of Montreal, involved in a law suit over the acquisition of his "Bon Ton" silver claim, Slocan District, in British Columbia.

The complaint sets forth that the initial post of the Bon Ton is on grounds occupied and known as the Diamond Cross claim and also that neither number one or number two post is in place, and there are no monuments or witness stakes to prove that such posts ever stood. The third and principal reason is that the record made by the defendants makes the course of the line from number one to number two post south-east, while the line as run by the Government surveyor is northeast, which brings the Bon Ton on the same ground as the License, the claim owned by the plaintiffs. The Bon Ton and the adjoining claim, the Big Bertha, have been very unfortunate for their owners. The Big Bertha was famous at one time as being one of the richest properties in the Slocan District. Four and one-half tons of ore that were milled at the Tacoma smelter carried 376 ounces in silver and 45 per cent. lead to the ton. In the summer of 1893 the ownership of the ground was disputed by the owners of the Bon Ton and after making a survey of the properties, the development work on the Big Bertha was found to be on the ground now claimed by the Bon Ton. Since then little or no work has been done on the latter mine, although it was the intention of the owners to put on a large force of men this spring. The suit promises to be a very complicated and interesting one as it involves several very fine points of law which have never come up before in a British Columbia court.

In a recent discussion of the work of the Geological Survey of Great Britain by members of the Mining Institute of Scotland, some pertinent criticisms were made which can with all truth be applied to the work of our own institution in this city. In most mercantile businesses it is the custom to advertise the articles sold and increase the agencies for their sale in different parts of the country. The opposite principle seemed to actuate the Geological Survey; advertising a new map or taking any means to push the sale of a publication was apparently a departure too sensible to be dreamt of. No wonder that the general public knew scarcely anything about the Geological Survey and its work. The work of the Survey in the mineral districts of Canada demands more attention. Instead of pushing on, at considerable expense, explorations in the "Barren Lands" and other outlandish sections of this great continent of ours, greater energy was desirable in the collection of mining information and the publication of new editions of mineral map with sections and accompanying memoirs, which would be of greater public utility than the almost purely scientific branch of the work. A vigorous stirring up of the dry bones in the Mining Bureau is urgently required if this section of the public service is ever to attain the respect and confidence of the people of this country.

Exhibit of Canada's Iron Ores and Iron and Steel Manufactures in the Main Entrance, House of Commons, during the Debate on the Tariff.

CORRESPONDENCE.

The Stellarton Journal and the Mining Society of Nova Scotia.

Editor Canadian Mining Review:—

SIR,—The *Journal* of this place comments on my address to the Mining Society at the annual meeting. The comments call for some notice. In the first place the Society is classed as a rival of the P.W.A., which has the *Journal* for its organ. This, as a study of your columns would make clear, is an entire misapprehension. No reference has been made to the P. W. A. at the Society's meetings, and no antagonism should arise. Clear and clean legislation is to be desired by those of both institutions who study the necessity of legislative interference. In the second place, my contention for a reconsideration of parts of the Mining Acts is based largely on those parts not expressing quite the intention of the framers of the Acts. Many of the working miners who have looked into the law find the difficulties I have already enumerated, though some of them, like the editor of the *Journal*, have been misled into believing the "intention" would supersede the strict letter of the law on a question arising in court. Finally, I may suppose, on the truth of the well known advice, "When your case is bad abuse your adversary," that I should be flattered at the personalities that garnish these comments.

Yours, etc.,

H. S. POOLE.

Stellarton, N.S., April 12th, 1894.

Mr. J. B. Hammond and the Review.

Editor Canadian Mining Review:—

SIR,—In your last issue you publish an article commenting in a rather unusual way on the work of the Provincial Mining Association of Ontario at the annual meeting here on the 14th of February last. You do not attempt to disprove a single statement made in any of the papers you refer to, which would have been more to the point than a stormy tirade of personal abuse.

This young Association does not claim to have a worldwide fame, but it does claim to represent the mining interests of this disttict, which is the principal mining centre of the Province. In its membership are included the ownership of at least three-fourths of the best mining properties on the whole nickel range here, and who have, therefore, a perfect right to condemn the mining policy of the Government, as their interests are affected so disastrously by it.

Strangely enough, in another article in the same issue of your paper you denounce the Government for the unprogressive state of the mining industry in Ontario, and then slander us for doing the same thing in our own way. You must surely know that the dissatisfaction with the present mining policy of the Ontario government is not confined to this district or to a few men in it, but extends from the Ottawa River to Lake of the Woods, and includes all classes of the community. We have been struggling here for several years in trying to induce the Government by all legitimate means to adopt a more enlightened and progressive mining policy in the interests—not of the speculators and mining brokers, as you state—but of the country at large. All our efforts having been in vain, we are now going to appeal to the people of Ontario, and have no fear of the result.

Your peculiar criticisms of myself and other leading members of the Association we do not heed. But, when you charge me with having sought "to make the sale of a large and valuable mining property of the lands of the Crown as if they had been my own," and then endeavoring "to make a public grievance of my own failure to carry out a crooked deal," my personal honor is at stake. You entirely misunderstood that part of my paper. The lands referred to in that case were held by other parties—including a member of the Ontario Legislature, and who is a supporter of the Government—and I had no interest in them whatever, outside of my commission if I made a sale. I must, therefore, request you to withdraw this charge in your next issue, and to apologize for the publication of such a false and libellous statement, or I shall be obliged to take proceedings against you for criminal libel.

Yours faithfully,

JAMES B. HAMMOND.

Sudbury, Ont., April 6th, 1894.

[We comment on the above elsewhere.—EDIT.]

Mining in the Slocan District, B.C.

Editor Canadian Mining Review:—

SIR,—The period of activity which the Slocan district has experienced during the winter has been brought to a close by the approach of spring and consequent breaking up of the Kaslo-Slocan sleigh road.

The further drop in silver to 59 cents had caused one or two mines to reduce their working staff some few weeks ago, and now all the mines have ceased producing ore for shipment and are confining themselves to development work. Of the 12 or 15 mines which were shipping ore during the winter, the Washington was one of the first to stop producing.

This mine, the most prominent in the district for the active manner in which it has been worked, reduced its force from 50 men to 10 just about the time that silver reached 59, in the beginning of March. The Noble Five and Mountain Chief reduced their forces also about the same time, and now that ore hauling has stopped there are only about 150 men left in the hills doing development work in some 20 mines.

The business portion of Kaslo was burnt down six weeks ago, and on account of the extremely hard times has not been rebuilt, almost all the firms finding premises in other parts of the town in which to carry on their business.

Everything in the district is at its lowest ebb and times should indeed be discouraging. This district is nothing if not a mining district, and at present nothing if not a silver producer. It is dependent wholly on the silver question; not on the high or low price of silver, but on the settling of the question—even if only temporarily—in one direction or the other. As has been so often stated, this camp would be a flourishing camp with silver at 50 cents if there were no prospects of its rising much higher, but with the present confidence of a decided increase in the price within the next year or two, mine owners feel they are deliberately throwing away money in producing silver at its present value.

Neither despair nor hope show up at all prominently in the faces or conversation of the men of the district; they are determinedly and quietly confident. "The mines are all right; they can't run away," they say; "silver is all right; we have simply to wait." But there's the rub.

A good many men are here waiting for the snow to leave the hills to enable them to prospect. Besides the prospectors many men will find work on the Nakusp-Slocan Railway, upon which the rails will be laid this summer.

In one direction there certainly will be some activity, and it is already commencing. Capitalists from the States are realizing the fact that the holders of mining properties in the Slocan are in many cases very hard up—in a phenomenally hard corner—and they are taking advantage of this.

The Slocan must await patiently the settling of the silver question. When that time comes it will be in the very best shape to take full advantage of it. The mines are being opened up ready for extensive working and the necessary railway communication is being built, a sure foundation is being established which will stand the coming boom without fear of reaction.

Yours, etc.,

WAITER.

Kaslo, B.C., 19th April, 1894.

The Walker-Carter Process at Marmora, Ont.

To the Editor of the Review:

SIR,—The bee of hard facts in Mr. Kitson's bonnet is an insect of large dimensions. Its buzz is so loud that he is deaf to any consideration of the only points which can be of interest to your readers. I will pass over the personal abuse which forms two-thirds of his letter in your last issue, and confine any further remarks to the more useful occupation of time and your space by consideration of the point at issue, namely, the *successful* treatment of the Marmora gold ores.

The point I take exception to is the too glowing statements brought forward in your January issue of the *Review* concerning this process as exemplified by the working results attained at Marmora last year, statements which I repeat are misleading and unwarranted. If Mr. Kitson or other interested promoters of the extension of the application of this process have any fresh facts in connection with their Marmora record to adduce, why does he not state them, instead of wasting your space by endeavoring to throw mud at me? Mr. Kitson has left me very little to reply to, and I hope he will stick to his text better next attempt.

Regarding the exit of the tailings at the Marmora mill last fall, these were pouring out of the end of a launder at the S.W. angle of the building on the verge of the river's bank, and accessible then to any one on foot; the superintendent who informs Mr. Kitson that the tailings *now* "run out of the mill into deep water," etc., probably found it desirable to make this *improvement* to their process after my visit, and thus displayed his zeal for Mr. Kitson's interests, in the same manner as when he affirmed to me that the mill was effecting a 90 per cent. "duty."

By my correspondence with Mr. F. B. Allan, reproduced by Mr. Kitson, I was endeavoring to conscientiously investigate the results attained by the Walker-Carter method at the Marmora mill, and having now completed that investigation I have formed my opinion regarding it, and am also ready to express it frankly, but I am still looking for the *successful* method of gold extraction for certain types of so-called refractory ores and am open to conviction only when I see the right kind of evidence and undisguised facts.

Mr. Kitson dismisses the important question of *chlorination* methods in a very summary manner, "everybody knows," he says, "that chlorination was tried *under the best conditions* at the Deloro mine, and was a decided failure." But thereby hangs a tale. Who said it was carried out there under the best conditions? If Mr. Kitson understands anything of the subject of which he is talking, without placing himself at the mercy of superintendents and experts, I recommend him to make a trip to the monumental Deloro property as I have done, and after he has duly seen and investigated the ore, the plant or its ruins, and the tell-tale tailings, which in this case were *not* carefully dumped into the river, he may get his eyes opened a little, and perhaps sympathise with this unfortunate district, which is still suffering from the moral effect of the Deloro collapse.

The cyanide treatment is demolished with equal facility by Mr. Kitson, and with apparent satisfaction to himself.

In conclusion, Mr. Kitson has failed to give to your readers the very information which I now demand, namely, the tests and results attained by the Walker-Carter process upon the mispickel ores at Marmora. We know what the process has done upon other types of ores, these have been published and discussed elsewhere, and have nothing to do with our present subject. Mr. Kitson says, "*I could* furnish your readers with expert opinions and tests," etc. Please give them, Mr. Kitson, although do not present others similar to that of Mr. Beckwith, which you very frankly admit "was not written for publication, but for some capitalists who desired to invest in the process!" That is just what I concluded before Mr. Kitson admitted it, and it would be interesting to know if said capitalists invested on the strength of it.

J. LAINSON WILLS.

New York City, April 25th, 1894.

A comparison of some Systems of Machine Screening, with a description of the screens lately put down at the Foxes Bridge Colliery, Forest of Dean.

G. E. J. McMURTRIE, ASSOC. M. INST., C.E.*

The subject of the best and most economical method of screening coal, has of late years received much additional attention. It is hardly possible to overate the importance of this branch of Mining Engineering; as on the condition in which the coal of a colliery is despatched, its sale must largely depend.

The early form of screening coal can still be seen at work in some districts, and may be called the Hod and Rake system; the coal being tipped out of the tub down a bank, and the large raked into boxes, called Hods in the Forest of Dean, and carried by the men and thrown into the truck. This method of screening was very far from perfect, as it limited the coal to three sizes, and was very expensive, often costing 5d. per ton.

Passing the coal over stationary bars was the first improvement on this, and effected a very considerable economy and improvement in the quality of coal made, while enabling additional qualities to be made. Stationary screens are now being replaced by some system of machine screening. Of these there are several, comprising among others—

1. The Jigger Screen with lengthway motion.
2. The Jigger Screen with cross motion, or the patent Lyall Screen.
3. The Greenwell Screen, consisting of a number of endless chains travelling between stationary bars of varying widths.
4. The Chambers Screen, as lately seen by the Members of this Scoiety at Denaby Main Colliery.

The last consists of a number of parallel longitudinal meshed bars, carried on pins rocking in inverted steps provided in the bars, and connected to a rocking shaft at either end. A vertical and lateral movement is imparted to the bars, through rods and levers from eccentrics on a revolving shaft.

The gentle rocking motion of this screen causes very little shock to the coal, probably owing to the addition of the cast steel Tee levers **D** for working the bars vertically, and the cast steel levers **E** for working the bars laterally. It is thus a very suitable screen for a soft coal.

As seen by us it was only making two qualities of coal, and consequently all that passed through had to be further treated in a revolving riddle with varying mesh, or in some other way. It can, however, be arranged to make any number of qualities.

The accompanying drawings, for which the author is indebted to the patentee, Mr. Wm. Hy. Chambers, of Denaby, Maine, fully show this screen. Some of the special advantages claimed for it are—

(1) Large capacity, four tons per minute being effectively separated, therefore saving bank room, distance in tramming, multiplication of screens, &c., and reducing labour.
(2) Regular delivery on to the picking bands.
(3) Saving of breakage, only sufficient movement being imparted, to cause the small to separate from the large and fall through the meshes.
(4) The material is carried horizontally or at a very slight gradient, thereby saving height in bank above wagons.
(5) The bars can be any length to suit wagons, position or picking bands, tipplers, &c., and if necessary the coal can be picked on the screen.
(6) Any number of mesher can be used in tiers for screening into various sizes, all working from the same set of levers with adjustable throw to suit material, each tier only occupying a space of about 12 in. in height.

* The British Society of Mining Students.

(7) The bars can be taken out and others substituted for a different size of coal in a few minutes.
(8) Few wearing parts, and these all removed from contact with the coal and dust.
(9) Not liable to get out of order, and easily repaired.
(10) It is perfectly noiseless in operation.
(11) No vibration to cause heapstead to rock.
(12) Very little power required for driving.

5. The Bascoup system, also specially devised to deal with very tender coal, has been very ably and minutely described in No. 3, Vol. XIV., by Mr. H. W. Hughes.

Before describing the screens put down at the Foxes Bridge Colliery, a few notes on these different systems should be of general interest, and will show the reasons guiding us in our choice of screens.

In reading Mr. Hughes account of the Bascoup system, one cannot help feeling that the Briart Screen is a very complicated one; and while admittedly expensive in first cost, has probably a high cost of repairs. The use of longitudinal bars in place of meshes is objectionable, as it must let much long thin coal pass through, which ought to be retained in the higher priced coal, and must mean a money loss in this way. Were the bars replaced by meshes the principal complication in this screen would be eliminated, as also probably its principal advantage. Its great advantage is that it may be placed horizontally—though this is not always taken advantage of—and consequently is very suitable for low heapsteads. In the Jigger Screens put down by myself are riddles at an inclination of only 2½ inches per yard or barely 4 degress, which is very little from being horizontal. If meshes replaced the bars in the Briart Screen, the inclination would probably have to be increased to this.

The Briart Screen appears to have this advantage over the Jigger, that on account of its two sets of bars and eccentrics, or elbows, it has double the throw of the Jigger with single eccentric, and should, and presumably does take consequently twice the quantity. This may not, however, be always taken full advantage of, for before the coal leaves the screens it should be completely divided up into its different sizes, and the speed the screen is driven at has to be regulated so as to to ensure this. In common with the Jigger system of screening, manual labour is diminished and all small coal removed. The cleaning bands employed are very different from what are used in this country, and cannot last as long, while apparently they are liable to give trouble from expansion and contraction.

The loading shoot appears to be an improvement on the usual screen door or balanced shoot working on a fixed axis, and rather more than balanced with weights when empty of coal. This delivers all the coal in the centre of the truck, and does not distribute it quite so fully as the Bascoup shoot. The height the coal falls, however, which after all is most important, appears to be the same in each case.

The means adopted for weighing at Bascoup, while expensive in first cost, must be exceedingly convenient and economical of labour, especially where trucks have to be loaded to a certain weight.

The simplest way of correcting this, where all the trucks have to be weighed over one machine, is to have a platform opposite the machine, upon which a certain amount of coal is kept.

This system of weighbridges also enables every truck to be tared, which is certainly generally neglected at small collieries, and sometimes at large ones; where it is done, a separate machine and clerk have to be kept for the purpose. The yearly loss to a colliery from want of taring is often very considerable, and many, if not all complaints of short weight are due to this cause.

The Greenwell screen was fully described in No. 4 of Vol. XIII. by myself. Its great advantage is its very great simplicity, carrying with it the very small first cost of £100 per screen, and an almost inappreciable cost of repairs: repairs and labour together being said to cost but ¼d. per ton. No other system has yet approached this. The Poynton collieries, where it is in use, largely supply nut fuel for the Stockport cotton mills, which require very careful screening, and it appears to give satisfaction in that district. All the cleaning has to be done on the small coal or slack portion of the screen, and in the case of a dirty seam this must require to be of considerable length. As the chains travel 70 ft. per minute, or approximately at twice the usual speed of a travelling band, additional care is required to clean it; otherwise dirt must be carried into the nut coal. This can no doubt be modified to suit individual circumstances.

The weak point in this, as in all bar screens as compared with the Jigger is, as before stated, that the sizing is not absolutely exact, some thin flaky pieces slipping through the bars into the wrong truck. It does not take up even the height occupied by the Briart screen, as 3 ft. plus hopper height is sufficient for it, and the screen is absolutely level. The quantity it can deal with is 50 tons per hour.

The Lyall screen appears to me to have this serious disadvantage, that while gravity is dragging the coal lengthways the engine drives the screen crossways, thus retaining the coal much larger on the riddle, and bringing into play a conflict of forces which must surely try a coal in any degree tender or jointy.

The fewer shakes given to a coal the better, and the flatter the riddle, the less must be the shock or blow per shake. Being a patent screen too, adds apparently a good deal to its cost.

Having taken all these things into consideration, and while admitting that the Briart screen can take a greater tonnage per hour, and that the Greenwell screen is stated to be cheaper in first cost, repairs and labor, yet the Jigger screen with lengthway motion, associated with a proper system of picking bands, appears to combine the most perfect system of sizing the coal yet adopted, together with an excellent system of cleaning the coals and conveying them to the different trucks. This system was consequently selected for the Foxes Bridge screens.

The Scottish Institute Report on Screening (part of Vol. XI.) is, as far as dry screening is concerned, very largely a report on the lengthway Jigger system of screening, either alone or united with travelling picking bands. Its very general adoption in all the English and Scotch coalfields, attest the value of this system of screening, modified or adapted to suit the requirements of the different seams and districts.

The accompanying drawings, which comprise sections of both of the screens, together with a plan of them and the picking bands, are the original drawings, and have been since somewhat altered in details.

This, however, does not affect the general arrangement, The quantity to be screened is 500 tons per day, got from five thin seams. One screen would be sufficient to deal with this, but on acconnt of difference in the quality of the seams worked, the coals have to be differently screened and treated. So two Jigger screens were put down and picking bands. See Plates VI. and VII.

On the first or block coal screen four qualities are made, viz.:—

No. 5. Coal over a riddle with a mesh 4 in. square.
No. 2. Coal over a riddle with 1½ in. square mesh.
No. 3. Coal over a riddle with ¾ in. square mesh, and
No. 4. Coal or the dead small is what passes through this last riddle.

On the second or Best Forest screen three qualities are made, viz.:—

No. 1 Coal over a riddle with 1½ in square mesh.
No. 3 Coal over a riddle with ¾ in. square mesh, and
No. 4 Coal what passes through this last riddle.

1. Looking at the Block screen we see that the No. 5 coal passes off the riddle and down a stationary shoot with balanced mouth direct into the truck, as it requires very little cleaning. Chains enclosed in leather are hung across this shoot to check where necessary the speed of the coal.

2. The No. 2 coal passes off the jiggers in the opposite direction and down a short jigging shoot to a picking band, along which it is conveyed to the truck, and on which any dirt is picked out. The fact of the fall from the end of the No. 2 riddle to the No. 2 band being insufficient to carry the No. 2 coal down a stationary shoot, necessitated this shoot being made to jig, although a stationary shoot would have been preferable.

3. The No. 3 coal passes off the No. 3 riddle on to the No. 3 band, on which it is cleaned.

4. The slack passes down a stationary shoot into the truck.

If we turn now to the Best Forest Jigger we find:—

(1) The No. 1 coal passes down a stationary shoot on to the No. 1 band, on which it is very carefully cleaned. It passes off the band and down another short stationary shoot into the truck.
(2) A stationary shoot delivers the No. 3 coal into the No. 3 band.
(3) The first portion of the slack shoot of this screen had to be made to jig, as the fall into the truck from the riddle end was found insufficient to deliver the coal into the truck.

The great saving in height obtained by machine screens as compared with stationary screens, is well shown by the fact that one of the riddles is inclined only 2½ in. per yard or barely 4 degrees, while the slack coal shoot dips 1 ft. 11 in. per yard or 33 degrees.

The inclinations of the various riddles, together with their areas, entirely depends upon the amount of coal put upon the screen at one time, and the amount of small coal in it. This has to be arranged to suit individual circumstances.

The tippler in use is Rigg's Patent tippler, with a heavy flap, retaining the coal till close down upon the screen and thus reducing breakage. The average weight of a cart of coal is 23 cwts., which is a considerable quantity to pass down a screen at one time. In such a case it is best to pass it down a stationary shoot at least 6 ft. long before it passes over the jigger.

The riddle are all woven on frames, except the No. 2 riddle, which is ½ in. square iron riveted in a frame, and fastened to the jigger frame by four or six ⅝ in. bolts. Under every riddle is a wide sheet iron shoot, carrying all the coal that has passed through the upper riddle, to the head of the lower riddle.

The picking bands are all 44 ft. in length, the No. 1 band is 3 ft. wide, and the Nos. 2 and 3 bands 2 ft. It would have been much better had these been respectively 4 ft. and 3 ft. The plates consist of ⅛ in. steel 12½ in. long. In each case the plates are riveted by means of angle iron and six ⅜ in. rivets, to two endless chains consisting of steel links 2 in. deep and ½ in. wide, by 12¼ in. long, connected together by strong ⅞ in. rivets. The steel links, in the case of the two narrow bands, form a guard on either side of the band to keep the coal on it. The 3 ft. band has the steel links underneath it, and no guard on top, the maker's idea being probably to save an extra drum at either end, and the accompanying extra endless chain.

When this band has to be replaced this will be altered as suggested, as while the narrow bands have given no trouble at all, this has. The large rivets fastening the steel links together wear very badly against the angle iron frame, and frequently require renewal, and the plates are more liable to catch and to rip off than on the other bands, which are obviously stronger to resist this. Each band travels along the top on 2½ in. angle iron, and returns over some five 4 in. cast iron rollers. The drums are in every case hexagonal and 2 ft. diameter. The whole band is built up on a pitch pine frame 12 in. by 4 in., and in each case a pair of 1 in. screws tighten or slacken the band, by moving the delivery drum out or in.

The thickness of the No. 3 coal allowed to travel along the No. 3 band, is strictly regulated by a board placed across the band; this forms one side of a small box arranged to hold any temporary accumulation of No. 3 coal that may take place from this.

No regulation is necessary in the case of the No. 1 or No. 2 coals.

All three bands are driven off one common shaft. This reduces the shafting and gearing required, and the consequent expenditure. So far this has not caused inconvenience, but a better arrangement might have been, to have opposite each band a small wheel on this main shaft, gearing into a second wheel on a short drum shaft on the driver end of the band, fitted with a clutch for throwing it in and out of gear.

In the Forest of Dean it is the custom to cobble or top the No. 5 and No. 1 coals off; when the trucks are nearly full and the coal lies high in the middle of the truck, the coal will not discharge itself from the delivery shoot, as this has been kept down within one foot of the top of the ten ton truck, to reduce as far as possible the fall and consequent breakage. The band has then to be frequently stopped to clear the shoot and cobble the truck. Consequently this governs the working of the screens. For this reason in our own case a clutch arrangement is unnecessary for the No. 1 and No. 2 bands; though possibly it would be an improvement to the No. 3 band, as No. 3 coal is made on both the screens. It is clear, too, that it would not do to work the screens and stop the bands; as should this be done the coal would be delivered in a heap on whatever band was at rest, and would give no chance for examination and cleaning. This custom of cobbling keeps a man in both the No. 1 and No. 5 trucks, consequently after passing off the No. 1 band, the coal has a second examination. In the case of the No. 5 coal, the coal is entirely examined in the truck itself by one man, or, if much No. 5 coal has to be made, by two men.

Two men are kept upon the No. 1 band, 2 boys on the No. 2 band, and four boys on the No. 3 band, which carries the bulk of the dirt. Two men are required to chip and clean the coal picked out of the No. 5 truck and off the No. 1 band. No one is kept on either screen, though one man is required for each screen to put the coal into the tipper. One man is necessary to regulate the supply of trucks and to finish off the slack waggons.

In consequence of frequently having to start or stop the screens and bands for cobbling, an engine-man is necessary; although the engine is fitted with a Pickering high speed governor, which would but for this make a driver unnecessary. An official called locally a "cropper," whose duty is to watch the carts and see that an unfair proportion of slack is not put into a cart, and if so to "crop" or take off what is considered fair, supervizes the whole of the screening, and regulates the coal passed over either screen.

The engine driving both screens and bands is a single 14 in. horizontal with 2 ft. stroke, a light fly-wheel, and 3 in. steam pipes. As will be seen from the plans, a belt driven off the fly-wheel shaft drives a 3⅜ in. shaft, on which are the four cams of the two jigger screens. Off this shaft a second belt drives a 2⅞ in. shaft, on which is a bevel wheel gearing into a second bevel wheel on the main 3⅜ in. driving shaft of the bands.

Both these driving belts are 6 in. Gandy Cotton belts with patent Lagrelle fasteners, and have so far answered very well. They bear exposure to weather well, and do not slip even when a stream of water is running off them.

The engine is driven at 60 strokes, the jiggers go 100 strokes, and the bands travel 30 ft. per minute. Both jiggers are suspended from a pitch-pine framing 12 x 12 in. by means of four 2 in. round iron rods.

All the woodwork carrying the jigger screens, bands, etc., consists of strong pitch pine balk 12 x 12 in., strongly bolted and braced together. The stroke of the cams can be varied from nothing to 6 inches, the original idea being to give as short a stroke as possible; it has been found necessary, however, to utilize the full 6 in. stroke.

Heating of the cams has given some trouble, and several of the original cast-iron eccentric straps have been broken, owing to this. These are being replaced by wrought iron of stronger section, welded to the connecting rod instead of bolted as formerly, when the bolts occasionally gave way.

Possibly the cams are of too small a section, but most of the heating is due to dust getting between the cam and the eccentric straps, which cannot be prevented. Sometimes towards the end of a day a strap will suddenly get hot after working cold all day.

As the new screens had to take the place of two stationary bar screens, it was important to utilize as far as possible the old framing and shoots. This added considerably to the difficulty of putting down these new screens, and caused certain modifications which would not otherwise have been adopted.

These screens have now been working since the commencement of the year, and have so far given every satisfaction, for while the different qualities are strictly screened, every possible care is taken also to despatch the coal free from stone or other impurity.

The entire absence of complaints from those trading with the colliery bears eloquent testimony to this, while the cost of screening and cleaning the coal has been reduced, and this too at a very moderate outlay.

Ontario Mining Institute.

—

Successful inauguration of a new representative mining organization in Toronto.

—

A large and representative gathering of gentlemen interested in the development of Ontario's mineral resources was held in the Rossin House, Toronto, on Tuesday, 10th inst. Mr. James Conmee, M.P.P., Port Arthur, was called to the chair, and Mr. G. R. Jones elected Secretary to the meeting. Mr. B. T. A. Bell, Ottawa, being called upon, explained what had been accomplished by mining organizations in the Provinces of Quebec and Nova Scotia. The Chairman then asked those who were desirous of becoming members of an Ontario organization to come forward and sign the roll of membership.

The following were enrolled :—

Prof. Nichols, School of Mines, Kingston.
Prof Miller, School of Mines, Kingston.
A. Blue, Director of Mines, Toronto.
J. W. Gibson, Bureau of Mines, Toronto.
W. Hamilton Merritt, A.R.S.M., Toronto.
B. T. A. Bell, Canadian Mining Review, Ottawa.
G. A. Spotswood, M.E., Kingston.
Folger Bros., Kingston.
J. B. Carruthers, Kingston.
J. M. Machar, Kingston.
J. Bawden, Kingston.
T. Birkett, Kingston.
W. A. Allan, Ottawa.
James Conmee, M.P.P., Port Arthur.
J. M. Clark, Toronto.
Thos. Shortiss, Toronto.
L. A. Morrison, Toronto.
D. F. Burk, Port Arthur.
Ian Cameron, M.E. Sudbury.
R. H. Ahn, Toronto.
John McKellar, Fort William.
Peter McKellar, Fort William.
Thomas Marks, Port Arthur.
Edgar J. Jarvis, Toronto.
Dr. Coleman, School of Practical Science, Toronto.
B. J. Townsend, Toronto.
J. W. Brown, Toronto.
J. F. Latimer, Toronto.
W. T. Newman, Toronto.
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 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:

J. W. Gibson, Toronto.

Secretary:

B. T. A. Bell, Ottawa.

Council:

Prof. Coleman, Toronto,
Peter McKellar, F.G.S.A., Fort William,
Prof. Nichol, 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 unanimously 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 refractory 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.

A Deputation waits upon the Government.

—

On Wednesday afternoon, 11th inst., a deputation from the Institute was favoured with an interview with Sir Oliver Mowat and the Hon. A. S. Hardy. There were about twenty present. Mr. D. F. Burke and Mr. J. M. Clarke explained the operation of the Provincial Campanies' Act in so far as it related to mining companies, and urged that an Act should be passed which would permit mining companies to issue shares at a discount, Mr. Burke calling attention to the beneficial mining companies legislation existing in several of the States. Mr. B. T. A. Bell directed attention to the value of diamond drilling as a means of determining the value and extent of mineral deposits, urging that the Government might with advantage to the Province, expend an appropriation of a few thousand dollars in the acquisition of a drill, and in the employment of an expert operator.

The stablishment of a Metallurgical Works in connection with the School of Mines at Kingston, would also be of great service, not only to the students but to the mineral operators, many of whom had been compelled for lack of such works to ship carload lots of ores for treatment to other countries. He concluded by citing a number of figures, showing the appropriations made by other countries to aid the development of mining.

Notes on Coal-Getting by Machinery.

—

By T. H. Wordsworth.*

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The increasing demand for large coal (even at a higher price) in preference to small coal ; the fact that the production of coal per man employed is decreasing ; the exhaustion of many of the thicker seams and consequent opening out of thinner ones ; the working of seams at greater depths and increased temperatures ; all tend to the substitution of machinery for hand labor.

A large number of holing machines have been constructed, amongst which may be mentioned the Firth pick machine ; the Rigg and Meiklejohn, the Winstanley, and the Gillot and Copley disc or wheel machines ; the Bower and Blackburn rotary bar machine ; the Ingersoll sargent percussive machine ; and the Jeffrey machine. These machines, with the exception of the last named, have been in use in this country for many years, and their general principles and adaptations are familiar to most mining engineers. The Jeffrey machine has been in successful use in recent years in the United States of America. It consists of a cutter-bar, 3 to 3½ ft. long, mounted on the end of a steel sliding frame, on the opposite end of which is fixed the electric motor or compressed air engine (the machines being adapted for either). This frame slides inside a stationary one built of two channel-irons ; the frames being connected by rack and pinion gear. The cutter-bar is revolved by chain gearing, and is at the same time advanced by the rack and pinion into the coal, making a cut 3 to 3½ ft. wide, 5 to 6 ft. under, and 4 inches high. The time occupied in each case for each cut is said to be from 3 to 6 minutes.

It is not intended in this paper to enter into a comparison of the various machines, since what may be economical in one seam with a good roof and other favorable natural conditions may be both costly and dangerous under other circumstances. The paper is simply the description of the application of a machine to a particular seam, together with a statement of facts connected therewith, which it is hoped will be of some value to members who may contemplate the introduction of coal-cutting machinery.

The Middleton main or silkstone seam at Messrs. Pope & Pearson's collieries, Altofts, lies at a depth of 960 ft. from the surface. This seam has been worked at these collieries for upwards of thirty years at a depth of 1,260 ft. up to a large fault. The method of working at the lower level is longwall with pack gates, the line of face being half end and bord. The chief reason for this is the presence of certain slips which run almost parallel to the bordline of the coal and extend into the overlying strata. The seam is practically level, although there are occasional undulations. The total thickness of merchantable coal is about 3 ft. 10 in., and consists of 10 in. of top hard coal and 3 ft. of gas coal, underlying which is about 10 in. of inferior coal and dirt bands (whetstones) containing a large quantity of iron pirites.

On proving the seam on the higher side of the fault, it was found to be comparatively free from the above mentioned slips. The absence of these slips and a consideration of the nature of the roof and floor, the depth from the surface, etc., led to the adoption of the system of working from which it will be seen that the line of face is plumb end. The main-endings are driven in pairs, 7½ and 7 feet wide respectively, with 1,980 feet between each pair. The main bords (each 9 feet wide) are driven in pairs, 1,650 ft. apart. The endings are all 7 feet wide and driven 132 ft. apart, and about 675 ft. long to the covering-bords. Each working face is about 1,710 ft. long, leaving a coal-pillar about 120 ft. thick next to the main endings.

When this seam was opened out, an attempt was made to hole by hand, but the cost of working was high. The holing is now cut by machinery in the whetstones immediately below the good coal, the remaining portion of the inferior coal and dirt being removed after the good coal is got.

Description of the Coal Cutting Machine—The coal cutting machines are made by the Yorkshire Engine Co. (see Trans. Fed. Inst., Vol. I., page 138, plate III). The first machine supplied was made from an old pattern, and undercut to a depth of 3 to 3½ feet, with a height of 3½ inches. This cut did not give sufficient leverage to break off the coal, besides which, to allow for a corve road, the props had to be set almost in the main breaks. Mr. Garforth then suggested that a wheel should be made to undercut to a depth of 4 to 4½ feet. This was then tried with a cut 3½ inches in height, and it was found that the coal often settled down on to the dirt before it could be filled out, thus entailing a considerable amount of extra work. The height of the cut was consequently increased to 4½ inches. Experience has proved that the improved machines work more easily with the larger height of cut, as there is more room for the wheel. The cutting wheel is 68 inches in diameter, and undercuts to a depth of 4 to 4½ feet, with a cut 4½ inches high, which, it is believed, is the greatest depth and height which has yet been done by a disc machine. The cutter wheel is carried by a strong cast steel triangular shaped bracket with phosphor bronze bearing. This is attached by T-headed bolts and set screws to a strong steel frame carried on three adjustable wheels, two being placed in front of the machine and one behind. On this frame are fixed the engines, second motion shaft and feed drum. There are two cylinders, each 9 inches in diameter and 9 inches stroke, fitted with reversing gear. The second motion shaft is driven by wheel gearing in the reduced

* Read before the Federated Institute of Mining Engineers.

proportion of 3 to 1. A small bevel wheel on the end of this shaft is geared into a rack near the periphery of the cutting wheel, the gearing being in the proportion of 8 to 1. The engines thus make 24 revolutions to 1 of the cutting wheel. The cutters are fixed into pockets on the periphery of the wheel, and are each held in position by a pin and set screw. Three sizes of cutters are used, one single and two double, the latter being 3 and 4½ inches wide respectively.

As a result of the deeper cut, the number of shots used to detach the coal has been reduced about one-half; the breaks are further apart, thus allowing the props to be set between them and the face, and this, together with the fact that a greater weight of coal is undercut for each time the machine is removed, has considerably reduced the cost. The machine is drawn along the face by means of a steel rope passing round a pulley block several feet in advance, and attached at one end to the bridle in front of the machine, the other end being wound round a small drum which is actuated by ratchet gear worked by a small crank on the end of the crank shaft. By using two pawls and having three points of attachment for the connecting rod, the feed can be regulated ½ tooth to 2 teeth per revolution of the engine.

The road for the machine consists of three pairs of flat bottomed rails each 15 feet long, weighing 28 pounds per yard, laid on special sleepers and spragged against the props. The joint sleeper was made in the colliery shops and is the best which has yet been tried, the rail ends sliding into a small chair and being held in position by a pin. It will be noticed that there are 4 pin holes in each end of the sleeper, two for each rail. If the outside holes are used, the road may be laid on a slight curve, which is of considerable advantage in straightening the road, should it by accident be moved out of line. The pulley block is attached by a hook to a D-link rivetted to a 28 lbs. rail, which is set as a prop, at an angle of about 20 degrees from the vertical.

Some difficulty was at first experienced owing to the cutting wheel dragging, but this was overcome by balancing the machine, the goaf side of the machine being kept 1 inch higher at the back and the front end being ½ inch higher at the face than the front goaf side wheel.

The machine is worked by two workmen, one in front to set any necessary timber and lay the road, the other, who is in charge of the machine, takes up the rails, clears away the *debris* from the machine and puts in the sprags. In addition to these two workmen there is an official, Mr. W. Buxton, who superintends the machines and work connected therewith, to whose exertions the success of the working of the coal cutting machines in this seam is largely due.

The rails may be passed forward under the machine whilst it is in motion, but it is found advantageous to stop the engine when this is being done, as it gives an opportunity of observing the roof, which is of a brittle nature, and the weight comes on suddenly.

With two men and under favorable conditions of roof, etc., the machine will cut a length of 180 feet in one shift of 8 hours, but if an extra man is sent to assist in removing the *debris* a greater length can be cut. The average for some time past, including removals of the machine and taking off pipes, is 135 feet per shift of 8 hours.

On reaching the end of the face the wheel is detached and loaded on to a special trolley, the machine being placed on another. They can then be taken along the ordinary road to the other end of the face. By using the small drum on the machine as a windlass in loading-up the machine, two men can load, take it 3,000 feet and get it ready for work in about 6 hours.

The coal-cutting machine is worked by compressed air. The compressors placed on the surface are on the wet principle, and consist of two air cylinders 26½ inches in diameter, with water towers placed behind the steam cylinders, which are 24 inches in diameter and 5½ feet stroke. The air pressure at the surface is 45 to 50 lbs. per square inch. The pressure at the machines varies from 40 to 50 lbs. per square inch. The air compressing engines work continuously for haulage purposes during the morning shift, and for working the pumping engines and coal-cutting machines during the afternoon and night. The compressed air is taken down the pit and along roads through 5,760 feet of 8 inches, and 3,600 feet of 6 inch pipes, and 4 inches pipes are used along the main-bords. A receiver is placed about the centre of each bord. Wrought iron pipes are laid up every alternate ending, 2½ inches pipes being used for one-third of the length, and 2 inches pipes for the remaining distance, so that the coal cutting machine is sometimes worked at a distance of 2½ miles from the air compressor. Flexible hose-pipe (5 ply) is used from the end of the 2 inches pipe to the coal cutting machine. Valves and taps are placed at various points to reduce leakage.

Filling out the Coal—After the coal is under-cut, it has been the custom to employ workmen to remove the small coal made by the machine, and throw it into the goaf. Two men are employed on each side of each ending, to get down and fill the coal, to get up and pack the dirt and do the timbering.

With the exception of the first fall after a heavy weight the greater part of the coal can usually be got down with bars and wedges. If this is not possible, it is detached by ardeer powder. Where shots are necessary, the holes are put in by machine drills, weighing 38 lbs., the maximum length being 6 feet. The time occupied in setting the machine and drilling a hole 4½ feet deep is about 7 minutes.

By the increased depth of cut the number of shots has been reduced in a face 1,710 feet long from 30 to 12 per day. It is hoped by still further increasing the depth of cut to 5 feet to entirely dispense with blasting. A machine with a cutting-wheel, 6 feet 1 inch in diameter, designed from the experience gained in this seam, has recently been started with this object, and the results will be communicated to the members at a later meeting.

The best results are obtained when the holing is done as early as possible after the last fall has been removed, as this relieves the pressure on the face of the coal, and by getting the full advantage of the weight the main breaks are regularly formed near the back of the holing.

Timbering and Packing.—Packs are built 9 ft. wide, with wastes between 24 ft. wide. Care is taken that these packs are well built and tight up to the roof. Two chocks are placed in each waste and at each gate end, and are moved forward alternately, thus always keeping one on each side of the main break.

Props are set 4 ft. apart and 4½ ft. between the rows, there being always two rows. Bars are set from the props into the coal 8 ft. apart or oftener If required.

Conclusion.—The advantages obtained by the use of the coal-cutting machine will vary in different seams, one amongst others being the reduction in the number of men employed. In this case it was found that 120 men could do the same amount of work as that done by 173 men working by the old method.

Notes on Blasting in Coal Mines.

By H. Bigg-Wither.*

With the enormous strides made of recent years in scientific inventions has come, at the same time, an outcry for the safer working of all branches of industry. The voice of the public has found expression in various legislative enactments, which it would be superfluous to mention in this paper as it is confined more particularly to blasting in coal mines.

With the greater depths at which some pits are now worked the dangers of explosion increase, and most modern appliances, such as safety-lamps, ventilating fans, safety explosives or contrivances for rendering them safe, have been introduced in order to minimize these risks. Up to a certain point it was supposed that the danger of explosions arose solely from fire-damp, but for many years some mining engineers have recognized that the mixture of coal dust with fire-damp was responsible for the extension and violent destructive effects of some great colliery explosions. In more recent years the theory has been advanced that coal dust alone, without any mixture of fire-damp, is capable of causing a most disastrous explosion. One of the great exponents of this theory is Mr. Henry Hall, H. M. Inspector of Mines, who for the past two years has been carrying out experiments on a large scale, in a disused shaft. The results of these experiments, so far as they have yet been published, seem to prove that the flame produced by a blown-out gunpowder shot may cause an explosion of coal dust in the entire absence of fire-damp. Meanwhile, the Royal Commission on Explosions from Coal Dust in Mines have been collecting information, and their final report, when published, cannot fail to throw much new light on this most important subject. The attention of practical mining men having been called to a danger not fully recognized hitherto, a number of methods have bee proposed for rendering the dust less dangerous by watering or otherwise.

As blasting is responsible for many of the great explosions, it will be well to consider some of the types of explosives used for this purpose.

Chief amongst these comes, of course, gunpowder, both in the loose and compressed form. As an explosive for getting coal, gunpowder will still hold its own for efficiency against high explosives; but the great dangers arising from its use are being gradually appreciated, and H. M. Inspectors of Mines, in their last annual reports, almost unanimously agree that the time has come for the absolute prohibition of the use, in fiery and dusty mines, of gunpowder and dangerous dynamite compound, especially as there are now in the market other explosives which are relatively very much safer, more particularly when detonated by electricity.

In France the mining authorities are more advanced on that subject than in this country, inasmuch as their Ministry of Public Works issued a decree dated August 1st, 1890 (see Trans. Fed. Inst., vol. ii, Appendix, page 161), prohibiting the use of blasting powder in any fiery mine or in any dusty mine whose dusts are inflammable. The assigned reason for this prohibition being that:—

In consequence of the experiments carried out under the superintendence of the Explosive Substances Commission it has been found possible to procure for use in mines, explosives which, although not capable of giving absolute security (which one can hardly hope to obtain from these materials), permit the attainment of a degree of safety which was hitherto deemed inapproachable. (Ibid., page 159.)

Dynamite, gelignite and other forms of gelatine explosives, when used bare, are as dangerous in the case of a blown-out shot as gunpowder; hence various contrivances have been suggested for reducing the temperature and quenching the flame given off at the moment of detonation. Chief amongst these contrivances is the Settle water-cartridge. This system of blasting may or may not be comparatively safe, but its main defect is that to insure safety two separate elements are necessary, viz., the explosive and the bag containing the water. It can be easily understood that unless the greatest care is taken the element of safety may be wanting at the time the charge is fired; either the water has been omitted entirely, as appears to have heen the case in the explosion which took place at Apedale colliery on April 2nd, 1891, whereby ten lives were lost; or it may have leaked away because the water-bag was burst or pierced while charging. Besides the above-named defects there is the necessity for drilling extra large holes and carrying a pail of water to fill the bags.

We now come to the more modern explosives: these are known as dual explosives, having nitrate of ammonium for their base. The decree of the French Minister of Public Works, previously referred to, permits the use of four different classes of mixture attaining "to a degree of safety which was hitherto deemed unapproachable."

The first, second and third mixtures are respectively dynamite No. 1, blasting gelatine, and gun-cotton, each mixed with nitrate of ammonium, whilst the fourth is a mixture of dinitro-benzole and nitrate of ammonium. (Ibid., page 160.)

As regards the first named mixtures the Home Office authorities refuse to license explosives of this kind, and report thereon as follows:—

It will be noticed that, while the addition of various ammonium salts to dinitro-benzole has been sanctioned, the addition of ammonium salt, other than the carbonate, to explosives containing gun-cotton or nitro-glycerine, has always been reported against. The reason is this: all ammonium salts, especially when exposed alternately to moist and dry air at slightly elevated temperatures, lose traces of ammonia and become acid. Now, nitro compounds, like dinitro-benzole, are little, if at all, affected by traces of acid, and under such circumstances show no tendency to spontaneous decomposition which might lead to ignition or explosion. Nitro compounds like gun-cotton and nitro-glycerine (more strictly speaking, nitric ethers), on the other hand, are seriously affected by traces even of acids, especially strong mineral acids, and decomposition once started goes on and ultimately leads to total decomposition, which may end in ignition or explosion. Hence ammonium salts exert no dangerous action on true nitro compounds, but may fatally affect the stability of nitric ethers, like gun-cotton and nitro-glycerine. (See Report of H. M. Inspectors of Explosives, 1890, page 19.)

The above extract, although bearing purely on the chemical aspect of the mixtures first referred to, is interesting, inasmuch as it only leaves the fourth mixture, consisting of dinitro-benzole and similar compounds with nitrate of ammonium, available for producing an authorized safety explosive of this class in the United Kingdom.

Before proceeding, the author would like to name certain other regulations in the French decree, which have an important bearing on the use of safety explosives:

The worker is forbidden to use . . . any explosives other than detonating explosives complying with the following conditions: 1st. The products of their detonation should not contain any combustible matter, such as hydrogen, carbon monoxide, solid carbon, etc. 2nd. Their temperature of detonation . . . should not exceed 1,900 degs. C. for explosives used in stonework, not 1,500 degs. C. for those employed in coal getting.

The stemming of the explosives . . . should be carefully made with plastic matter, so as to avoid blown-out shots; the length should not be less than 8 inches for the first 1,543 grains of charge, with the addition of 2 inches for each 1,543 grains additional, and should at all times exceed 20 inches.

The detonation of the cartridge should be caused by a detonator strong enough to assure the detonation of the explosive even when unconfined. (See Trans. Fed. Inst., vol. ii., Appendix, page 162.)

The author will now consider a safety explosive of the fourth type officially recommended in France, which, as explained before, consists of a mixture of dinitro-benzole and nitrate of ammonium, and is the only one of the four types recommended which can at present be legally manufactured in the United Kingdom. As an example of this type, the author will describe roburite for the following reasons: (*a*) because it was the first of this type of explosive manufactured in England, and is now very extensively used, and (*b*) because this explosive has been the subject of several scientific and impartial investigations, and therefore more is known about its properties than of any similar explosives.

Roburite was invented by Dr. Carl Roth, of Berlin, in 1886, and was patented and its use authorized by the Home Office in this country in 1887. A factory was erected for the manufacture of the explosive in the same year, was fully licensed by the Home Office in May, 1888, and started the manufacture and sale of ruburite at once.

Roburite consists of an intimate mixture of chloro-dinitro-benzole and nitrate of ammonium. The chlorine is intended as an additional flame quenching gas. The explosive is put into waterproof cartridges to suit all requirements, and the sizes range from ⅞ to 1¾ inches in diameter, and weights vary from 1 to 16 ounces.

As might be supposed, the introduction of a new explosive (although mining engineers and the public had been long clamouring for a safer explosive than powder or dynamite), was not all that was required to ensure its success. Colliery managers before introducing it into their mines put it to many severe tests, and an apparatus was erected near Wigan to produce the effect of a blown out shot into an artificial mixture of fire damp. The results ot these tests are recorded in a paper by Mr. Jas. Hilton (see Trans. Manchester Geol. Soc., 1889, vol. xx., page 92). These tests were made at night, and seven shots of roburite tamped with from 4 to 7 inches of clay, and sometimes coal dust, were fired into the fire damp without igniting it. In looking through the details of

* Transactions Mining Institute of Scotland.

these experiments, such remarks as the following are appended to each test :—

Gas not ignited ; no flame or spark seen ; gave a light but no flame, etc. The author would call the particular attention of the members to the latter remark, as some experiments with roburite were made at the Bent colliery before a committee of the Mining Institute of Scotland in 1888 (see Trans. Min. Inst. Scotland, vol. x., page 132), and a blown out shot was purposely produced when a light was seen. Whereas experiments have been made when fire damp was known to be present, and a light was seen, but was not followed by an explosion of the fire-damp, it seems to the author that the light is not due to a true flame, but to the reflection of a halo of light formed at the moment the detonating wave is started, and that this is incapable of igniting an explosive mixture of gases. That this is true may be proved by taking a cartridge one-half filled with gunpowder and the other half filled with roburite placed directly on the top. On suspending the cartridge and detonating the roburite, the gunpowder does not become ignited, but is scattered about by the force of the explosion.

We have seen from the extracts already quoted from the French decree that the conditions specified for a safety explosive are that the calculated temperature of explosion must be below a certain temperature. From this it would appear that even although a flame should be seen, if such flame were below the given temperature, still no ignition of fire damp would follow. Another point, too, in the French report is that the duration of the temperature has an important bearing on the subject, and even although hot enough to ignite gas, would not do so if not long enough in contact with it. The writer has been told that it is possible to ignite fire damp with heated gases which give no visible appearance of heat.

Much has been said about the fumes of roburite, and at several places the workmen raised objections to the use of the explosive on that account, although from more recent experience there can be no doubt that prejudice in favour of blasting powder was at the bottom of these complaints.

The question of fumes has been investigated by two separate scientific committees—the first in Lancashire in 1889, the members of this committee being Dr. N. Hannah, Dr. C. J. Mouncey, and Prof. Harold Dixon, of Owens College, Manchester ; (see Trans. Manchester Geol. Soc., 1889, vol. XX., page 329) the second committee, appointed in 1889, by the Durham Coal Owners' and Miners' Associations, with Mr. T. Bell, H.M., Inspector of Mines, as chairman, and Prof. Bedson and Drs. Drummond and Hume as professional advisers. (See Trans. Fed. Inst., vol. II., page 368). Both of these committees arrived at practically the same conclusions, viz. : that the fumes of roburite were not more injurious to health than those of gun-powder. The report of the Durham committee, moreover, called attention to the fact that the fuze was responsible for some of the deleterious fumes, and many members will no doubt have noticed the difference in the quantity of smoke between a roburite shot fired by fuze, and one fired by electricity.

As to the efficiency of roburite in mines, it may be stated, that by the kind permission of the owners and managers, trials have been made of roburite in about fifteen of the coal mines in Lanarkshire, as well as at the shale mines at Broxburn and Pumpherston, in West Lothian, and in all cases with marked success.

The question of safe method for igniting the detonator in firing a safety explosive is a very important matter. It appears on the face of it absurd to fire a safety explosive by fuze, which is practically the same as a naked light, as the spit of the fuze will easily ignite gas, and indeed has been known to do so on many occasions, and moreover, the tape fuze gives off noxious fumes.

The Bickford shot ignitors were introduced to make firing by fuze safer, as the first spit of the fuze takes place in the tin cap which contains the igniting composition. Still, even supposing that this contrivance is otherwise efficient, is there no risk of the smouldering fuze being projected when the shot is fired? The writer believes it to be a fact that this does take place, and that the fuze may brighten up in its flight and be a source of danger.

Another method suggested in Austria, but not to the author's knowledge used in the United Kingdom, is the Lauer frictional detonator. By this method of firing, an action somewhat similar to that used in the Christmas cracker produces the explosion, only the operator stands at a distance and pulls a string. (See Trans. Fed. Inst., vol. II. *Appendix* page 153).

Firing the charges by electricity is, the author thinks, admitted on all hands to be the safest, and besides the other advantages it possesses, a very important one is that shots cannot hang fire as is sometimes the case when using fuze, and there is less smoke.

There are two distinct types of electric fuses used to produce an electric detonator, viz., high and low tension. In the former case the priming composition is ignited by a spark, in the latter the heating of a hair-like platinum bridge by the resistance offered to the passage of the electric current ignites the composition which fires the detonator. The high-tension fuze is best known to mining engineers, but the low-tension fuze is now coming into more extended use. (Ibid., vol. ii. p. 553). Some authorities advocate the latter, because it can be tested by galvanometer, whereas the high-tension fuze cannot. This facility of testing would certainly be of great advantage in firing a large blast, where a number of charges had to be fired simultaneously, but in colliery work where only single shots are fired as a rule, the author thinks that either class of fuze is equally good.

In order to secure the best results from electric blasting too much attention cannot be paid to the electric appliances. The exploders should have a good surplus of power, so as to minimize the risks of a miss-shot, and should be kept in good condition. The cable should also be good and, in case of a miss-shot, should be overhauled to see whether either of the wires has been broken or short circuited. In making the connections the wires should be clean, so as to obtain good metallic contact, and should be twisted firmly together. If proper care be taken, the writer believes that there would be fewer failing shots with electricity than with fuze.

All high or detonating explosives are fired by a detonator, some explosives are more sensitive than others, hence they require different powers of detonator to fire them efficiently. It is a waste of energy to use a detonator very much stronger than is necessary to start the detonation of the explosive, but it is far better to err on this side than to attempt to use with an inert explosive a detonator intended for a sensitive explosive. Thus, while a roburite detonator could be used to fire dynamite efficiently, a dynamite detonator would probably only scatter the roburite without detonating it. The French Government recognized the importance of this point in the regulations issued for the use of safety explosives in lieu of blasting powder when they said :—

"The detonation of the cartridge should be caused by a detonator strong enough to assure the detonation of the explosive even when unconfined." (See Trans. Fed. Inst., vol. ii., *Appendix*, p. 162.)

The author desires to lay special stress upon this matter as to his knowledge many complaints as to miss-fires of some of the more inert explosives have certainly been due to the use of too weak detonators.

Iron Exhibits.

Fine Display of Canadian Iron Ores and Manufactures in the House of Commons Ottawa.

During the recent budget speech of the Hon. G. E. Foster, Minister of Finance, and the subsequent debate on the new Canadian tariff, the REVIEW, acting for the various companies interested, had a fine display of the products of our iron mines and the various iron and steel establishments of the country. The exhibit, which was tastefully displayed in the main entrance to the House of Commons, was a great attraction to the crowds of people who daily and nightly thronged the House. Our engraving shows a section of the exhibit. The following is a list of the exhibits which were on view :—

Canadian Iron Furnace Co., Ltd.—(a) Bog ore, heavy vein ; (b) bog ore, lumpy ; (c) bog ore, fine shell ; (d) bog ore, fine gravelly ; (e) hard ore, St. Jerome ; (f) lake ore, heavy sheets ; (g) lake ore, cakes ; (h) lake ore, lumps ; (i) lake ore, fine, deep dredging ; (j) lake ore, shore ore.

Montreal Car Wheel Co.—Sections of chilled car wheels made from "C.I.F." Three Rivers charcoal iron.

New Glasgow Iron, Coal and Railway Co., Ltd.—(a) Iron ore, brown hematite, from East river mines ; (b) red hematite ; (c) East river specular ; (d) Guysborough county specular ; (e) Brown limonite ; (f) limestone ; (g) Iron ore, brown hematite, from East river mines ; (h) Manganese ; (i) unwashed coal ; (j) washed coal ; (k) coke.

Nova Scotia Steel and Forge Co., Ltd.—Large collection of samples of Canadian steel made from Canadian ore and fuel by Siemens-Martin open hearth, including steel bars, shapes, angles, shafting, etc.

Londonderry Iron Co., Ltd.—Case of samples of coke pig iron (Siemen's brand) and fine collections of ores and fluxes.

Cockshutt Plow Co., Brantford.—Fine specimen of plow manufactured from Canadian steel.

Mica Deposits of the Ottawa District.

BY TR. R. W. ELLS, OTTAWA.*

Occurrence of Apatite and Mica.—It has been already pointed out in a previous paper† that the deposits of apatite are confined entirely to the pyroxene dikes of this system, and that the mineral occurs for the most part near the contact of these dykes with the gneiss or near the intersection of cross-dykes of intrusive dolerite or felspar. The occurrence of mica in these rocks presents almost identically similar conditions to the apatite as regards its presence in workable quantity, but differs in this respect, that while the apatite is found exclusively in pyroxenic rocks, the mica is often associated with other kinds of intrusives. It is, however, more particularly found in two varieties, namely, the pyroxene which varies greatly in color and hardness, and in a coarse admixture of clear quartz and grayish felspar, which is generally styled a pegmatite, and which contains also crystals of tourmaline, garnet, etcetera. This quartz-felspar rock differs, however, very greatly from the usual varieties of pegmatite found in the Laurentian, which is usually very much finer-grained, and occurs generally as veins intersecting the gneiss as one approaches the great masses of anorthosite or gabbro. The quartz-felspar those of pyroxene, frequently cut the gneiss along the line of strike of dikes, like the latter, but its intrusive character is clearly evidenced in most cases by the sending off of spurs into the mass of the gneiss in contact, as well as by the fact that it frequently cuts directly across the gneiss and interesects the pyroxene as well, thus showing it to be a later intrusion. Inclusions of the grayish or reddish gneiss which is penetrated by these rock are also frequently found caught in the mass, both of the pyroxene and felspar, and furnish further evidence of the intrusive character of these rocks. In some places the presence of three distinctly intrusive dykes is recognized in the same opening, the oldest being the pyroxene, the second cutting the pyroxene, is a quartz-felspar, and the third is a black trappean rock.

It has been stated by some writers that the apatite and mica occur in the Laurentian limestone, as well as in the gneiss and pyroxene. This view has doubtless arisen from an imperfect study of both the limestones and pyroxene, the latter in the earlier stage of the investigations on these rocks being regarded as a peculiar variety of the sedimentary gneiss formation, as already pointed out, while concerning the former it is found that in many of the pyroxene dykes, more particularly near their contact with the grayish gneiss, an irregular development of calcite, generally of pink color, occurs, which by the miners is styled a limestone, and has thence been confounded with the distinctly different limestone formation which forms the upper portion of the Laurentian system. In no case can this calcite, in which very frequently the mica crystals, as well as crystals of apatite, are disseminated, be regarded as a member of the sedimentary or stratified Laurentian series, but is always found as an irregular, generally pockety, mass in the intrusive pyroxene.

Mica-Apatite Horizon.—The horizon of these deposits, both of mica and apatite, can now be clearly defined. They are for the most part confined to the series of gneisses which constitute the upper portion of the Laurentian silicious rocks and which underlie the limestone proper. These gneisses are generally of some shade of grey, with reddish grey, reddish and hornblendic bands, some of which are garnetiferous, and nearly all of which contain a large percentage of silica in the form of quartz. These beds, as already pointed out, graduate upward by regular passage through the interstratification of calcareous layers into the massive crystalline limestone formation. In the Buckingham and Templeton areas apatite and mica are rarely found in dikes cutting calcareous strata, but in the Gatineau area several localities are known where large dykes of pyroxene in limestone carry mica in workable quantity.

Mica deposits generally occur in the form of crystals, some of which reach an enormous size, instances being lately reported of single crystals measuring nearly eight feet across the face. These crystals sometimes occur in the pyroxene in pockety masses distinct from each other, or in somewhat irregular deposits near the contact of the enclosing pyroxene and the gneiss adjacent or as scattered crystals through the mass of the dike itself, but generally near the contact. In many cases of pyroxene dikes where the mica occurs as a contact deposit near the gneiss it is found associated with masses of pink calcite, some of which are but of small extent, while others have a thickness of several feet and are traceable for some yards. The mica found in the calcite is, as a rule, in well formed crystals disseminated through the mass and often associated with well terminated crystals of apatite. In some cases the latter penetrate the former, while frequently inclusions of calcite or apatite are found in the centre of the mica crystal. Of the mica found in the mass of the pyroxene it may be said that the crystalline structure is rarely perfect.

Mode of Occurrence of the Micas.—From recent observations it may be stated that the merchantable micas of the district occur under six principal conditions, thus :—

1. In pyroxene intrusive rocks which either cut directly across the strike of greyish or other colored gneisses or are intruded along the line of stratification. Some of these deposits have been worked downward along the contact with the gneiss, where the mica is most generally found, for 250 feet, as at the Lake Girard mine, and irregular masses of pink calcite are abundant. In certain places apatite crystals occur associated with the mica, but at other times these are apparently wanting. As in the case of apatite deposits, mica occurring in this condition would apparently be found at almost any workable depth.

2. In pyroxene rocks near the contact of cross-dikes of diorite or felspar, the action of which on the pyroxene has led to the formation of both mica and apatite. Numerous instances of this mode of occurrence are found, both in the mines of apatite and mica, the deposits of the latter in certain areas being quite extensive and the crystals of large size.

3. In pyroxene rock itself, distinct from the contact with the gneiss. In these cases the mica crystals, often of large size, but frequently crushed or broken, apparently follow certain lines of faults or fracture. Some of these deposits can be traced for several yards, but for the most part are pockety. Some of these pyroxene masses are very extensive, as in the case of the Cascade mine on the Gatineau river and elsewhere in the vicinity. In these cases calcite is rarely seen and apatite is almost entirely absent. When cut by cross-dikes conditions for the occurrence of mica or apatite should be very favorable.

4. Dikes of pyroxene, often large, cutting limestone through which subsequent dikes of diorite or felspar have intruded, as in Hincks township. The crystals occurring in the pyroxine near to the feldspar dikes are often of large size and of dark color, resembling in this respect a biotite mica.

The mica found under the conditions stated above in one, two, three and four is all amber-colored and of the variety known as phlogopite or magnesia mica.

* Paper read before the Geological Society of America.

† Canadian Mining Review, Ottawa, March, 1893.

5. In felspathic-quartzose rocks which constitute dikes often of very large size, cutting red and greyish gneiss, as at Villeneuve and Venosta. These are distinct from the smaller veins of pegmatite which occur frequently in the gneiss as the anorthosite areas are approached. In this case the mica is muscovite or potash mica and is i variably found in that portion of the dike near the contact with the gneiss. The crystals frequently are of large size and white in color, associated with crystals of tourmaline, garnet, et cetera, but with no apatite, unless pyroxene is also present.

6th. In quartz-felspar dikes cutting crystalline limestone, in which case the crystals are generally of small size, mostly of dark color and of but little value.

In the case of the amber micas this peculiarity was noted that when the pyroxene was of a light shade of green or greenish gray and comparatively soft, the mica was correspondingly light colored and clear, and in some places almost approached the muscovite in general appearance. As the pryoxene became darker in color and harder in texture, the mica assumed a correspondingly darker tint and a brittle or harder character, and in certain cases where dikes of blackish hornblendic diorite were present, the mica also assumes a black color as well.

Differences observable in the Mica-Apatite Deposits.—There is one feature observed in the deposits of mica and apatite which is not yet explainable from the study of the rocks in the field. Thus in the apatite mines along the Lièvre river while the deposits of that mineral are sometimes very extensive and can be traced downward for hundreds of feet, as proved by the workings of the North Star and the High Rock mines, the occurrence of mica in quantity with the apatite is rare, though in certain areas both are present. In the Templeton or McGregor Lake belt of apatite mines the two minerals frequently occur together, in quantity sufficent to be profitably worked in both cases. Thus at the Blackburn and Jackson Rae mines, the former especially long celebrated for its great yield of apatite, the mica also occurs in considerable quantity and in crystals of large size and good quality. In both the Lièvre and Templeton areas the apatite is rarely found in crystals, occurring for the most part in pockety bunches which vary in size from insignificant deposits to masses of a thousand tons.

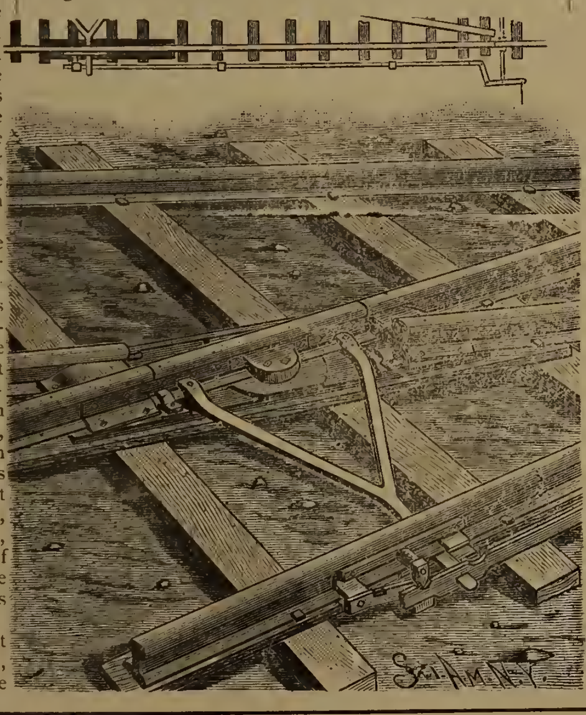
In the Gatineau area the quantity of pink calcite in the pyroxene becomes much greater. There is often an admixture of mica and apatite crystals, the latter in quantity sometimes sufficient to be worken profitably, while in other areas the mica occurs without the apatite or with the latter only in very limited development. Very often quantities of crystals of pyroxene, sphene and zircon, occur in these deposits with the mica. Of the apatite associated with the mica in the Gatineau belt it may be said that it presents generally features distinct from that occrrring on the Lièvre. The reasons for these different modes of occurrence and association are not, as already remarked, very clear, unless it be due to some feature depending upon the stratigraphical relations of the containing beds or some peculiarities regarding their exact horizon. The difference in the character of the micas themselves is presumably due to the difference in composition of the containing rocks.

Mica Localities.—As regards the portions of the Laurentian from which mica might be obtained, it may be said that its occurrence in economic quantities is now known at certain points over a very extended area. Thus in Ontario the mines of Burgess and the adjacent townships yield large quantities, generally of the phlogopite variety. Along the Ottawa river it is found from a point nearly 100 miles west of Ottawa to the township of Grenville, 60 miles east of that city, while on the Gatineau river, which flows into the Ottawa at the city of Ottawa, mines have been located and worked for 80 miles north from its mouth, and the mineral is reported from points many miles further north along that stream. To the east of Quebec it is known on the branch of the Saguenay, called the Manouan and in the townships of Escoumains, Bergeronnes and Tadousac, situated east of the mouth of that river, as well as at several other places along the river Saint Lawrence. The mica found in this district is chiefly muscovite.

The principal areas where this mineral is at present worked are in the belt which extends from North Burgess, in the Province of Ontario, approximately along the strike of the gneiss, into the territory adjacent to the Gatineau and Lièvre. Over much of this area south of the Ottawa river the Laurentian is concealed by the mantle of Cambro-Silurian rocks belonging to the Ottawa River basin, but it may be said that the geologic conditions and the stratigraphic sequence in the area south of the Ottawa and in the rear of Kingston are the same as those found in the mineral-bearing belts north of the Ottawa, and that the deposits of mica and apatite may be looked for occur in those areas occupied by the upper portion of the Laurentian, where traces of igneous agency are visible in the presence of dikes of pyroxene and quartz-felspar, though it should be stated that the mere occurrence of these in geniss does not warrant the presence of either of these minerals.

Baird's Improved Railway Frog.

Mr. James Baird whose familiar face we reproduce in our portrait series this month, and to whose work as a colliery manager we have already referred, has displayed much ingenuity in his invention of a railway frog, for which he has taken out a patent in Canada and the United States. In this invention, which is illustrated by the annexed engraving, at the point of intersection of the inner rails of the two tracks, the rails are removed and a pivoted track section or frog is placed, to which is attachehed a forked lever for turning it on its pivot so as to cause it to coincide with either of the track rails. The forked level extends underneath the outer rail and is connected with a rod which extends to an angled switch lever, so that the frog is made to move simultaneously with the switch rails. A stop is provided for holding the frog-operating rod in one of the two positions in which it may be placed. The pivoted rail section or frog is supported by a heavy metallic plate resting upon two or more ties, and the ends of the converging rails adjoining the frog are held in proper relation to each other by wedge shaped distance pieces. The details of the frog and switch operating rods and levers are shown in the smaller view of the engraving. One of Mr. Baird's frogs has been doing excellent service for nearly two years on the Intercolonial railway at Maccan station. Besides obviating the disagreeable noise and jar of car wheels, Mr. Baird's frog reduces to a minimum the danger of accidents to brakesmen from getting caught in the ordinary frog. We understand it has also given first-class satisfaction at Chignecto mines.



A Fire-Damp Indicator.

Mr. Chesneau (*Annales des Mines*) after describing the dangers and inconveniences connected with the use of the Pieler alcohol lamp and of different improved models of that lamp, describes an alcohol lamp of his own invention.

It is composed of a brass reservoir for the alcohol, surmounted by a circular crown for the admission of air (which can be regulated) through double gauges. Resting on the crown and surrounding the wick-tube is a solid cylinder of sheet-iron which serves as a screen. Above this screen, and resting on it, is an iron-wire gauze 5½ inches high. The gauze is surrounded by a sheet-iron shield furnished with an observing-window, completely closed by a sheet of mica, on which a scale is engraved. The shield is fitted at its base with an annular diaphragm which closely surrounds the base of the gauze so that the exterior air can never arrive directly to the gauze. The diaphragm rests on an asbestos washer for the purpose of diminishing the heating of the lower part of the lamp when it is in a gaseous mixture and the shield gets hot. The top of the shield is furnished with openings, protected by screens to prevent currents striking the gauze. An outer moveable screen of sheet-iron having a window, protects, when required, the base of the observation-window in the shield against currents, and this prevents the deposit of dew which tends to form on the interior of the mica by outside cooling.

To make an observation, it suffices to bring the window in the moveable outer shield in front of the mica observation-window. In a calm atmosphere the dew disappears of itself some minutes after lighting, and only re-forms when the lamp is brought into a cold current.

The interior of the reservoir contains a small piece of cotton-wool under the wick-tube to prevent the rapid escape of alcohol if the lamp is overturned. When the reservoir of the ordinary Pieler lamp is tightly packed with cotton-wool it only gives a cap in gaseous mixtures for some minutes, because the alcohol retained by the cotton ascends the wick with difficulty, and the flame soon lowers, and the wick carbonizes. The almost total suppression of the cotton-wool in the new lamp offers no danger, because the lamp goes out, when laid horizontally, before the alcohol can spread in the lamp. It is not so with the ordinary Pieler lamp, where the alcohol can spread and burn on the gauze when they are filled and much inclined. The alcohol is introduced by a hole, fitted by a screw, a tight joint being obtained by means of a washer of lead or leather. The weight of the lamp, full of alcohol, is 3.2 lbs.

The entry of the air and the exit of the products of combustion being absolutely separate in the new indicator there can be no mixture between them as in the Pieler lamp, in which air charged with gas may come in and burn the whole height of the gauze and heat it strongly. Placed in stationary gaseous mixtures of increasing percentages, the lamp gives caps which only reach the top of the gauze with about 3 per cent. with the alcohol flame regulation adopted. With from 3 to 5.5 per cent. the alcohol flame elongates, the cap enlarges, becomes cylindrical, but lowers more and more from the snmmit, the lamp being unable to emit the increasing products of combustion. A little above 5.75 per cent., the alcohol flame elongates towards the top of the gauze, but without sensibly heating it, the quantity of air drawn in being insufficient for the complete combustion of the gas, and the alcoholic vapour liberated by the heating of the lamps. Above 5.75 per cent. (proportion inferior to the limit of inflammability of air and fire-damp, which is produced with 6.1 per cent.) all flame disappears in the lamp, and the gas burns with a very pale flame in the crown only without considerably heating the reservoir. All is extinguished after some seconds very rapidly if the inlet regulator is closed. The alcohol flame of the lamp reduces rapidly to its initial height when removed to pure air. Tested in explosive currents the lamp appeared as safe as ordinary safety-lamps of good construction.

The height of the caps vary considerably, according to the volatility of the alcohol employed, and to obtain comparable results the same alcohol must be used. The alcohol giving the best results is wood spirit or methylated alcohol of 92·5 degrees by the Gay-Lussac alcohol-meter

EXPORTS OF CANADIAN ASBESTOS.

(Compiled from Trade and Navigation Returns.)

The following are the official returns of the exports of Canadian Crude Asbestos for the fiscal year ended 30th June, 1893:—

Exported to	No. I. Grade. Tons.	No. I. Grade. Value.	No. II. Grade. Tons.	No. II. Grade. Value.	No. III. Grade. Tons.	No. III. Grade. Value.
Great Britain	74	$ 8,660	77	$ 3,120	222	$ 8,270
Germany	4	975	49	2,070	20	600
Holland	20	3,200	....	....	27	1,050
United States	1,301	101,223	3,947	262,328	137	4,822
Belgium	....	....	....	....	20	400

Exported by	No. I. Grade. Tons.	No. I. Grade. Value.	No. II. Grade. Tons.	No. II. Grade. Value.	No. III. Grade. Tons.	No. III. Grade. Value.
Ontario	165	$12,770	....	....	115	$ 4,265
Quebec	1,234	101,288	4,073	267,518	311	10,877

at 59 degrees Fahr. To increase the visibility of the caps chloride of copper may be dissolved in the alcohol with a little hydrochloric acid to maintain it in solution. The proportion recommended is about 17 drops of a saturated solution of crystallized chloride of copper in concentrated hydrochloric acid per pint of alcohol; this gives the alcohol flame a green tinge. In this way caps may be seen with from 0·1 to 0·2 per cent. of fire-damp. They are easily seen with 0·5 per cent. or more.

The proper methods of regulating the alcohol flame and the appearance of the caps are minutely described.

Diamond Drilling in South Africa.

Mr. R. A. S. Redmayne, *(Journal British Society of Mining Students)*, contributes a readable paper containing much valuable matter on this subject. The price of boring by diamond drills is, to a great extent, dependent on the price of carbonates. In 1889 Kimberly bolt cost in Natal 7s. to 8s. per carat, in July 1890, this had risen to 60s. per carat. During the year 1890-91, in Natal, four of these drills (three hand and one steam drill) bored 5,621 feet, (the steam drill bored 1,945 feet 2 inches of this depth at a cost of £773 6s. 5d., or 7s. 11¼d. per foot), at a cost of 5s. 9d. per foot, which amount would be slighty increased, if an allowance was made for a percentage representing the annual depreciation of plant. This cost compares favourably with that of boring in other parts of the world. In one of the Australian Colonies, the cost of boring was (as per the annual reports of the Mines Department): In 1884, 11 drills bored 9,864 feet at a cost of 12s. 10d. per ft.; in 1885, 12 drills bored 11,325 feet at a cost 19s 1d. per ft.; in 1886, 10 drills bored 6,539 feet at a cost of 14s. 11¾d. per ft.; in 1887, 5 drills bored 3,097 feet at a cost of £1. 2s. 4½d. per ft. The loss in diamonds during the year 1890-91 (Mines Department of Natal) was only 4⅛d. per foot, which is highly satisfactory when the large amount of diorite passed through is taken into consideration. A company in the Transvaal bored 3,744 feet. (? steam or hand drilling) at a cost of 13s. 4d. per foot *in diamonds alone*, and a single boring by the same company cost £1. 13s. 7d. per foot. The nature of the strata drilled through, however, was very different from that of the coal measures, being quatzites, hard quartz conglomerates, and hard sandstones; the conglomerates would prove especially destructive to the diamonds. During the year 1891-2 the Natal Mines Department bored a total depth of 6,171 ft. 1 in. at a cost of 5s 8d. per foot; the loss of diamonds was, however, greater than in the previous year, amounting to 7d. per foot drilled.

The Mining Press and Bret Harte.—The February *Idler* contains an amusing sketch by Bret Harte of the reception of his first book from which we quote: A well-known mining weekly, which I here poetically veil under the title of the Red Dog *Jay Hawk*, was first to swoop down upon the tuneful and unsuspecting quarry. At this century-end of fastidious and complaisant criticism, it may be interesting to recall the direct style of the Californian "sixties." "The hogwash and 'purp' stuff ladled out from the slop-bucket of Messrs. ——— & Co., of 'Frisco, by some lop-eared Eastern apprentice, and called 'A Compilation of Californian Verse,' might be passed over, so far as criticism goes. A club in the hands of any able-bodied citizen of Red Dog and a steamboat ticket to the Bay, cheerfully contributed from this office, would be all-sufficient. But when an imported greenhorn dares to call his flapdoodle mixture 'Californian,' it is an insult to the state that has produced the gilted 'Yellow Hammer,' whose lofty flights have from time to time dazzled our readers in the columns of the *Jay Hawk*. That this complaisant editoral jackass, browsing among the dock and thistles which he has served up in this volume, should make no allusion to California's greatest bard, is rather a confession of his idiocy than a slur upon the genius of our esteemed contributor. We doubt if a more feeble collection of drivel could have been made, even if taken exclusively from the editor's own verses, which we note he has, by an equal editorial incompetency, left out of the volume. The Mormon Hill *Quartz Crusher* relieved this simple directness with more fancy: "We don't know why Messrs. ——— & Co. send us, under the title of 'Selections of Californian Poetry,' a quantity of slumgullion which really belongs to the sluices of a placer mining camp, or the ditches of the rural districts. We have sometimes been compelled to run a lot of tailings through our stamps, but never of the grade of the samples offered, which, we should say, would average about 33⅓ cents per ton. We have, however, come across a single specimen of pure gold evidently overlooked by the serene ass who has compiled this volume. We copy it with pleasure, as it has already shone in the 'Poet's Corner' of the *Crusher* as the gifted effusion of the talented manager of the Excelsior Mill, otherwise known to our delighted readers as 'Outcrop.'"

Nickel Steel Guns in Germany. *(Eng. and Min. Journal.)*—Two ¾-inch shells, each loaded with 6 oz. of picric acid, were placed, one in a gun of ordinary Krupp steel, the other in a gun of nickel steel 12 inches from the muzzle, and exploded. The muzzle of the ordinary steel gun was blown to a number of pieces, but the only effect on the nickel steel gun was a local enlargement of about ¼ inch in the bore.

Placer Mining on the Fraser, B.C.

Activity Fast Assuming Control in the Old Time Placer Camps.

M. H. Gibbs, a former Colorado miner but who for the past few years has been prospecting in the country which recognizes Spokane as its central city, has recently returned from Yale, B.C., where he spent the winter doing a little placer mining and picking up information. Mr. Gibbs says that the gold fever has struck our northern neighbors and there is more activity along the Fraser river and its principal tributaries than there has been since the "golden days of the Cariboo." The industry, however, has assumed a different form from that practiced in the early days when the rocker, pan and sluices constituted the method of gold saving, although there can still be seen at various points along the rivers, small squads of men panning, rocking and sluicing; the returns are however, small and the bars are one after another being deserted by these stalwart pioneers to give place to more modern devices.

Dredging.—For 300 miles, from Hope to Quesnelle on the Fraser, the ground has been leased and is being worked or preparations are being made to work it. There are now in operation or building not less than a dozen dredging machines, owned by men of means who have leased large tracts of ground, or more properly speaking water, (for the dredges are all built on the centrifugal principle) with a view of working it this season and thereafter so long as it will pay.

Between Hope and Yale Messrs. Bell, McCaskell & Shehan have a dredge, the largest on the river, and a strongly constructed boat, with a centrifugal pump to suck the sand and gravel up from the bed of the river, which with the water, passes through a receptacle charged with quicksilver which catches the gold and allows the debris and other minerals to pass out. As is the case with all other dredges, nothing is attempted on the banks or above the water-line.

At Boston Bar, which is about 25 miles above Yale, another dredger is working. The principle is the same as the one below but the capacity is less.

At Kanaka Bar, 35 miles from Yale or about 10 miles above Boston Bar, another strong company is operating with a channel dredge. At Lytton and again near Ashcroft, dredges are working or in course of construction. What the cost of construction or of operation, the capacity or per centage of value which is saved by the process is as yet known only to the operators themselves; it is to be presumed, however, that the results are satisfactory as several more barges are contemplated at other points along the Fraser.

Hydraulicing.—There are several hydraulic companies working or preparing to begin on numerous tributaries of the Fraser. On the Lilooet, Bridge river, and Cayuse creek, a tributary of the former stream, where the Horsefly company is putting in nine miles of iron pipe. There is considerable work also going on at Wilson creek and Willow river. The distances of these streams from railroad connections are: from Ashcroft to Quesnelle, 185 miles; to Horsefly creek, 150 miles; to Wilson creek, 285 miles; and to Willow river 300 miles. Although the distances named may not be quite correct they are nearly so.

Barkersville, at one time a live town where flour and bacon was worth almost its weight in gold, and the rendezvous and trading point of the miners of the entire Cariboo country, is assuming some of its former activity. This little frontier post is on the 53rd parallel, is on the old Cariboo trail and on the survey of the Cariboo railroad which leaves the Canadian Pacific at Ashcroft. The distance from Ashcroft by air line is in the neighborhood of 150 miles but the routes traveled are much longer. The distance from Vancouver is 200 miles farther than from Ashcroft.

Miners are going into the country already in limited numbers, and it is expected that there will be an increasing number as the season advances. There are many of the smaller streams which empty into the upper Fraser, which have never been mined systematically. The seasons are somewhat shorter than along the lower river and in the days when no ground was worked unless it paid very high wages large tracts of good ground was entirely overlooked.

The Cassiar district which is immediately west of the Cariboo, extends westwardly to the Alaskan boundary line and the Pacific coast, has produced considerable gold but the greater portion of the territory embraced within its limits is entirely unexplored, and may or may not be rich in gold treasure. It is reasonable to suppose, however, that there is a large and rich gold field covering a greater or less portion of it, for so far as explored from the Cariboo side, from the coast and from the south, together with the evidence of rich placers along the Yukon, some of the sources of which rise in this great unexplored territory, it can scarcely cease at the imaginary line of its boundary or at the limit of its explored district. In fact the recent surveys made by the Canadian Geological Engineers along the Yukon and MacKenzie basins, bear us out in this assertion, for gold was found at several points and in paying quantities. That prospecting in this far northern and isolated region, which is devoid of roads or trails, will be laborious and dangerous, will not deter the prospector but will add new zest to the task which he lays out for himself. The gold output in British Columbia no doubt will be greatly augmented during the next few years.

CANADIAN COMPANIES.

Bell's Asbestos Company, Limited.—Dividend for year 1893, 5 per cent. Net profit, £4,683, exclusive of £3,048 brought forward. Only £1,731 left to carry to new year, so whole dividend not earned last year. Reserve fund £55,000, a mere book entry, as "goodwill," patents, etc., stand for £69,102, and no attempt is made to write this off. Company is owing £61,300 on mortgage debentures and its property in Southwark Street is mortgaged for £25,167. The financial position is thus precarious. A most meagre report accompanies the balance sheet.—*Investor's Review.*

Marmora Mining and Milling Co. (Ltd.)—Applying for Ontario charter. Authorized capital, $24,000, in shares of $10. Directors: John Parry, George E. Keith, James Murray, and Robert Rae. Head Office: Toronto. Operations to be carried on in the counties of Peterborough, Hastings, Addington, Frontenac, Lanark and Renfrew, Ont.

Otterville Brick and Tile Manufacturing Co. (Ltd)—Incorporated 11th April, 1894. Capital, $5,000, in shares of $25. Directors, A. B. Moore, C. B. Purves, J. Wyatt, Samson Simley, T. J. Pennington and Robert Paxton, all of Otterville, Oxford County, Ontario.

Ledyard Gold Mines (Ltd.)—Capital, $100,000, in shares of $10.00. Head office: 56 Colborne Street, Toronto. Directors: T. D. Ledyard, T. H. Yeomans, Chas. Henderson, and E. D. Ledyard. Operations are being carried on in the township of Belmont, Ontario.

Strathroy Petroleum Co. (Ltd.)—Capital, $90,000, in shares of $100. Directors: G. A. McGillivray, W. B. Lindsay, Chas. Grist. Head office: Strathroy, Ontario. Operations to be carried on in the counties of Lambton and Middlesex and elsewhere in Ontario."

Stevenson Gold and Platinum Hydraulic Mining Co. (Ltd.)—Formed to acquire and work placer mining claims, etc., on the banks of Granite Creek, Yale district, B.C. Authorized capital, $1,000,000, in shares of $100. Directors: Robt. Stevenson, J. H. Thain, W. Lovitt Hogg. Head office: Vancouver, B.C.

Canadian North-West Mining Co. (Ltd.)—Registered 31st March, '94, under the Foreign Companies Act, B.C. Head office: Helena, Montana. Capital, $2,000,000, in shares of $5.00. Formed to operate mines in B.C.

Bear Lake Consolidated Mining Co. (Ltd.) is applying for charter, under the B. C. Companies Act, to acquire and work the Snowshoe mineral claim, situate in the Slocan mining district, West Kootenay division, British Columbia. Capital, $500,000, in shares of $5.00. Head office: Victoria. Directors: George Riley, Gustav Leiser, and Gordon Hunter.

MINING NOTES.

[From our own Correspondents.]

Nova Scotia.

Caribou District.

The Dixon property has well under way the new mill and hoisting works now being erected by the management. It is to be regretted that the mill plant is not of the approved modern pattern, but it is being solidly built and will be a great advantage to the district.

The Burgess-Neilly group of mines will be outfitted this spring, and work pushed to bring them as rapidly as possible into the ranks of the producers.

Sherbrooke District.

The old mines at Goldenville remain very quiet, little or nothing is doing. During the winter an effort was made to sell some of the small holdings, but prices asked were too high to ensure sales.

At Cochrane Hill mines, which belong to the group of Burgess-Neilly mines, so-called, preparations are being made for the equipment of the property with a large plant for mining and milling work. A contract has been let to the Truro Foundry and Machine Co. for the erection of a 20-stamp mill of that company's best design, and the plans have been prepared. A power drilling plant has been purchased, and plans are ready for a hoisting and pumping gear.

The Canadian Mining Manual, 1894.—The fourth edition of this useful reference book has been issued.

Stormont.

At Country Harbor the Antigonish and Country Harbor properties are steadily pursuing the even tenor of their way, and prospects were never brighter.

At Isaac's Harbor the management of the Richardson Co. has nearly perfected extensive plans for the improvement of the plant now on the mine, and for an increase in the milling capacity.

At the Crow's Nest mine work is being prosecuted by the parties who have an option on the property, and developments are awaited with interest.

Darrs Hill.

Work at the Dufferin mine was practically suspended on the first of this month. Several experts and promoters have recently visited the mine, and rumor hath it that the property will soon change hands.

Killag.

The foreman reports all the headings of the Old Provincial Co. in good rock, and that there is now no question but that the lode worked is the "Stuart" lode so-called. This property is being opened up with a view to showing fully its resources and capabilities.

Renfrew.

The work done by the Pictou company in this district is creating considerable excitement. Rock taken from near the boundary of the Empress or North property has shown some remarkably fine specimens of coarse or nugget gold, and the company is pushing work on that section.

The Turnbull mill has been put in order and is now crushing quartz.

The Free Claim property remains idle.

Montagu.

This district remains quiet, but a good deal of fine work is doing.

Mr. W. R. Thomas has bought the plant of drills and air compressor ordered originally for the East Waverley Tunnel but never used there, and has introduced power drills in the stopes of the De Wolfe lode.

Mr. Thomas has also thoroughly re-timbered and systematized the work at the Symon-Kaye mine, formerly managed, in name, by Alfred Woodhouse. Under Mr. Thomas the mine has been made practically safe to work in, and a proper system of underground work introduced.

Utilization of Peat in Iron Smelting.—It has long been regarded as probable that the many acres of peat to be found on the moors at Dartmoor can be utilized in a manner that will make it available as a fuel for iron smelting purposes. The first attempt at this novel procedure was made some 2 years ago, when machinery was erected near Bridestowe by the Dartmoor Peat and Iron Smelting Company, Limited, which also acquired the right of working 2 square miles of peat deposit. Several difficulties, however, where found to exist in bringing the peat to the combustible condition which has been bespoken for it. Nothing daunted, however, the company has now erected a plant at Bridestowe in order to practically test an invention of Mr. J. D. Brunton, C.E., of London. In order to witness the new system in operation, the directors and others, including members of the press, were recently invited. From what was fully explained at the time, we learn that peat, when first removed, is practically full of moisture, but by Mr. Brunton's arrangement he proposes that the drying of this shall be by means of evaporation. The peat is first of all delivered by means of a revolving band into a hopper, from whence it is pressed through a perforated iron plate, by which the fibres are destroyed and entirely macerated, bringing the peat to a condition of soft mud or clay. By means of revolving bands this substance is then carried to moulding machines, where it is shaped into bricks, and afterwards delivered automatically into a drier, by which means the moisture is evaporated. During these processes, however, the bricks shrink in bulk so much as to lose something like six-sevenths of their weight. The inventor claims that these bricks, when properly prepared, will be found superior to coal for the purpose of iron-smelting. A considerable quantity is now in course of manufacture for the purpose of forwarding it to Birmingham, where it will undergo severe tests in the blast furnaces. In the event of these experiments turning out a success, blast furnaces will be erected at Dartmoor, and the many thousands of tons of iron ore now being taken from the works in Cornwall and Devonshire will be smelted there, thus saving the present heavy costs is trans-shipment to the Midlands.

The Destruction of Blast Furnace Linings.—F. W. Lürmann (*Stahl und Eisen*, vol. xii., pp. 336-338) discusses the question of the lining of blast furnaces. This lining is worn away owing to one or other of the following causes:—(1.) Actual wear produced by contact with the descending charge; (2.) By the action of the constituents of the blast furnace gases, especially of cyanogen or of its salts; (3.) By the action of sodium chloride contained in the coke; (4.) By flaking owing to the deposition of carbon from carbonic anhydride, caused by the iron particles formed from the iron pyrites existing within the material forming the lining. The first of these only accounts to a slight extent for the wear actually observed, and although the action of the cyanogen or volatile alkaline cyanides is likely to account for a considerable portion of the destruction, yet this still requires experimental proof. The water used for cooling purposes takes up large quantities of cyanides from the walls of blast furnaces, and fused cyanides may even be occasionally observed to drop away from such walls. The third source of wear, the salt present in the coke, is undoubtedly an important cause. Coke-ovens are frequently rapidly destroyed by the salt present in the coal coked, the quantity of this salt having in one case, to which the author refers, reached as much as 48½ lbs. in the charge of six tons of coal. An examination of the coke recently charged into a blast furnace showed it to contain 0.062 per cent of sodium sulphate and 0.119 per cent. of sodium chloride, or for 100 tons of coke nearly 140 lbs. of the former and over 260 lbs. of the latter; and quantities such as these charged daily into a blast furnace would soon exert a marked destructive action on the lining. The fourth cause of wear is a most important one when, as is nearly always the case, the fire-resisting material used in the manufacture of the furnace lining contains iron sulphides. These lead to the formation of metallic iron, which in turn causes the deposition of carbon within the masonry, which then splits away and is destroyed. The author recommeads the use of carbon bricks.

K. Sorge (*ibid*) questions whether the lining of blast furnaces should be of fire-resisting brick work. He concludes that this is not necessary, and that instead of such a mass of brickwork as is usually employed, a sufficiently strong iron casing well cooled with water is all that is really necessary.

What is a Living Wage?—Writing in the February number of the *National Review*, Mr. Hugh Bell discusses a couple of very pertinent questions. "What is a living wage?" he asks, and "Out of what fund it is to be paid?" With regard to the first, he says a living wage "is at least as much as is now paid, and as much more as by hook or by crook—by strike or by legislation—can be screwed out of a body of men who, it would seem, only require to be sufficiently pressed to be able to pay anything which may be demanded of them." In dealing with the second query, Mr. Bell gives a variety of figures connected with the iron trade in North Yorkshire, Eng., and utilizes them very effectively to show that capital can bear no further strain. In view of this fact, he is driven to the conclusion that higher wages will mean fewer men in employment, and that the laborers are sadly deluding themselves if they think the effects of competition can be avoided by legislation. For the rest, Mr. Bell's forecast is far from hopeful. "I foresee," he says, "a time of great suffering—with a very uncertain issue—both for those who are engaged in providing wages for the artisans of the country and for the artisans themselves."

Effect of Flux upon Iron.—In an address delivered before the Philadelphia Foundryman's Association on the fluxing of iron in cupolas, Dr. Edward Kirk stated that many of the lime stones and mineral substances employed as cupolas fluxes contain more or less finely divided oxides, silicates, etc., in combination with earthy materials. The flux is often reduced in a cupola and its component parts separated and in minute quantities they alloy with the iron and injure its quality. The conjoined effect upon iron of these diffused oxides, silicates, etc., liberated in a cupola from their native elements in fluxes, is to prevent the metal running clean in the mold or making sharp round castings and the tensile and transverse strength is frequently impared by them. When the oxides, silicates, etc., are not separated in the cupola from their native elements, they do not impare the quality of the metal, nor do they improve it. The tendency of the cupola furnace is to clog and bridge over the tuyeres and concentrate the blasts upon the iron through a small opening in the centre and injure its quality. If by the free use of limestone we prevent bridging and keep the furnace working open and free we avoid injuring the iron in melting by the concentration of a strong blast upon it. The effect, therefore, of limestone in a cupalo is not to improve the quality of iron but to prevent its deterioration in melting.

Petrolia's Shipments for 2 Years.

We give below the shipments of petroleum from Petrolia, Ont., for each month of the two past years and the totals for the same:

	1892 Crude.	1892 Ref'd.	1892 Crude Equiv.	1893 Crude.	1893 Ref'd.	1893 Crude Equiv.
January	17,441	24,751	79,218	23,671	28,834	96,756
February	14,577	18,073	29,759	22,905	19,807	77,070
March	16,570	19,469	65,217	17,891	22,405	73,903
April	12,542	15,145	51,704	16,131	16,532	57,460
May	15,045	8,665	61,897	19,031	10,476	67,721
June	15,225	17,510	58,000	16,023	16,783	58,025
July	13,289	29,562	62,193	16,845	19,510	67,520
August	15,370	28,077	85,562	17,511	26,860	84,661
September	17,264	39,736	117,605	19,109	35,967	109,027
October	20,517	44,010	130,542	23,407	49,266	146,672
November	21,787	39,905	129,299	26,455	39,766	125,870
December	19,011	30,383	95,168	25,685	30,354	100,570
	198,409	308,910	1,007,271	244,763	225,572	1,066,155

The Use of Fluor-Spar in the Metallurgy of Iron.—Dr. Foehr (*Chemiker Zeitung*) discusses the possible use, on a large scale, in the future, of fluor-spar in the metallurgy of iron. Its use as a solvent and fuel-saving ingredient is most marked, and in the manufacture of ferro-silicon its use is almost a necessity. Similarly, in the manufacture of ferro-manganese and spiegeleisen, it tends greatly to increase the ease of the reduction.

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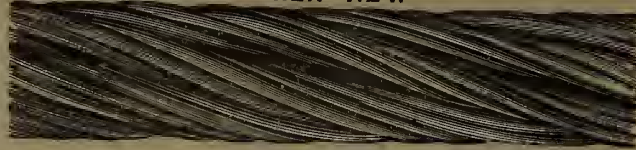

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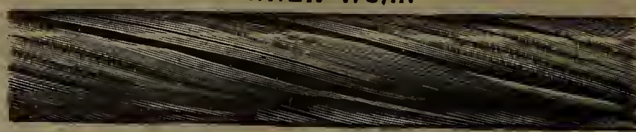

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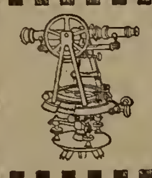

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Vol. XIII. MAY, 1894. No. 5

Badly Amuck.

The *Halifax Colliery Guardian and Critic*, ı its issue for May 18th, contains a remarkable rticle on the "deposition and treatment of old-bearing ores"; remarkable for the intense ;norance of the writer thus displayed to public iew and comment.

It is of course well known that the phenomenal enius who edits that paper knows absolutely othing about the precious metal; but he should now (and if he does'nt it it is herewith pointed out › him) that the gentlemen representing the gold ıdustry in Nova Scotia, cannot possibly be exected to swallow such mental pabulum as the rticle referred to without intense intellectual ausea.

The amount of chemical, geological and metllurgical knowledge stored in the brain of the riter of this contribution to the *Critic* is most equal to that shown by Mr. Mark nthony in some of his most valuable geological ontributions to the same paper, and we propose › treat our readers to some of the choicest ıorsels.

This encyclopædic writer tells us in the first ace what the "bottom fact now known about ›ld" is, and it is this: that all "original iron yrites of *small grain* texture" contains more r less gold. We can with difficulty appreciate ıe immense satisfaction and relief of all metalırgists and gold mine operators at learning at st the real "bottom fact" about this metal f "lordly appearance." As to the value of ıis "bottom fact" we prefer to leave them › judge. Then, after a dozen lines of searching ıalysis of the disputed point as to whether ›ld in pyrites is in chemical or mechanical ›mbination, the author discomposes the quietde following the announcement of his "bottom ıct" by telling us that gold is not only in yrites, but is "also in the crystalline or quartz ıd composite veins formed during the disıcation and upheaval of rocks."

We have before this called the *Critic's* attenon to its bad punctuation, and it may be due to efective punctuation that we here have presented to us the alternative of "crystalline" veins and "quartz and composite" veins. We frankly have to admit that now we need a glossary—we are in water too deep for wading and we cant swim. The authorative way in which the whole phenomena and causes of vein formation are grouped into the delightfully simple and intelligent clause "the dislocation and upheaval of rocks" leaves us speechless.

The following paragraph deserves to be reproduced entire :—

"Quartz that looks like coarse-grained white sugar is a a good sign, but clear rock crystal quartz, or quartz with a glassy vitreous lustre, with no grains in its texture, never holds gold. The granular quartz in veins, badly stained with iron rust, and full of little sharp-cornered cells with iron dust in them, is the best prospect, and when this quartz is in streaks or sheets standing on edge, and intercalated between sheets *of all sorts of yellow and brown minerals*, and some sulphides of iron and copper, all filling up a vein which has masses of brown spongy iron ore or 'gossan' scattered over the surface at its outcrop, then the prospect requires *immediate attention*."

"Sheets of *all sorts* of yellow and brown mincrals" like *millerite, sulphur orpiment, mimetite and willemite* to say nothing of gold, topaz and yellow diamonds would, we are very ready to admit, require the most "immediate attention" possible to give it.

The writer then proceeds to tell us of the "original home of the gold," and points out how "comfortably things go on" until the zone of unoxidised ore is encountered, and that when the sulphides are "hard, and light, and sharp cornered, it is more than time for the mining engineer to cease."

This great truth about the "sharp corners" had hitherto escaped our attention; we strongly urge our gold mining readers to look sharply after "sharp corners," to be unremitting in their attention to these corners, and at the first sympton of "sharpness" call in a mining engineer immediately.

We must admit too that our knowledge of lithology, hitherto complacently believed to be rather good, is really trivial and elementary. For we are told that sometimes "slate beds are filled with small grains of quartz * * * this slate being simply an old bed of sand, mud, etc."

Shades of Bischoff and Sterry Hunt! How ignorant we mortals be. Listen ye ignoramuses and learn of "another obscure point in the history of gold"—

Another obscure point in the history of gold is that in the quartz veins, free from sulphur, the gold is sometimes found in grains, nuggets, sheets or strings, looking as though it had been melted, leading to the conclusion that *these quartz veins have been reduced by heat from very silicous sulphide veins*, or that the quartz has come up from below in a melted state, and *after passing through sulphides and driving off the sulphur has brought the gold up with it*. Something of this kind is indicated by the fact that auriferous quartz contains no water of crystallisation, differing in this respect from the crystalline varieties with shining surfaces or transparent bodies. Free gold quartz veins, when washed down, yield gravel diggings containing coarser wash gold than gravels derived from sulphide veins.

It would have been very pleasant if the author of this remarkable contribution had signed his name to it, for then the suspicion engendered by the closing paragraph might never have arisen. The fact is, that the concluding paragraph, advocating the use of dry crushing and amalgamating, looks suspiciously like the veiled advertisement of some of the new patent dry processes, like the Walker-Carter, which are now trying to force their claims upon public notice.

The Heavy Metal Trade under the New Tariff.

Since the last issue of the REVIEW the tariff has undergone some changes in committee, but without altering in any material degree the principle of the new rates of duty which were first announced.

The rate on pig iron, etc., has been confirmed, and in connection with this manufacture in Canada, it is satisfactory to note that the opinion of members on both sides of the House was favorable to its continued encouragement. The action of the Ontario Government also in its bid for the production of pig iron in that Province appears to have met with general approval, and shows that, apart from politics, Canadians are now realizing that the manufacture of iron is one of the natural industries of this country.

As was to be expected, the increase of the duty on wrought scrap created a good deal of discussion, but it was shown that the rolling of foreign scrap into a quality of bar iron, which was certainly inferior to imported material, was clearly an anomaly in the iron trade. The price of bars has not changed since the duty on bar iron was lowered, showing that internal competition had been sufficient to keep figures a good deal below the cost of imported iron. Indeed it is difficult to see very much money in the manufacture of bar iron at present prices, but the mills are now getting some excellent scrap from the United States at very low figures, and this, with increased economy in manufacture, and the prospect of using at an early date puddled bars made from Canadian iron will certainly enable them to compete more satisfactorily with imported iron, and there is no doubt they will come out all right.

The items of wire and wire nails have been adjusted to the satisfaction of the manufacturers. In the case of wire, gauges 11 to 14 inclusive, had been reduced to 15%, as these are the gauges used in the manufacture of wire nails, the duty on which had been reduced considerably. On the other hand, it was evident that this was an injustice to the wire drawers, as the great bulk of their product is used in the manufacture of wire nails, and they have certainly not taken advantage of the difference in duty over imported wire. It has been settled by these gauges of wire being rated at 25%, as on the other sizes, and the duty on wire nails increased to one cent per pound, which is a reduction of one-half cent per pound on the rate under the old tariff. A good deal has been said on the subject of the low prices for wire nails in the United States, and there is no doubt that these have been selling at a basis price of under $1 per keg, but the American basis is a 6″ nail, with an extra of 50 cents per keg on 3″, which is the common size used, while in Canada the extra on 3" is never more than from 20 to 25 cents per keg, on account of the difference in the list. Taking into account the difference in the cost of manufacture, owing to the extra expense incurred in making small quantities, it cannot be said that the wire nail manufacturers have hitherto taken any undue advantage of the protection they enjoyed.

The proposed reduction of the duty on iron bridges and structural iron work to 30% *ad valorem*, from its former rate of 1¼ cents per pound, would have told heavily on Canadian bridge makers, in view of the fact that a considerable part of the material they use, such as beams, large angles, channels, etc., are not at present made in Canada. This has, however, been amended by making the duty 1 cent per pound, but not less than 30 per cent.

Boiler tubes, which are not made in Canada, have been reduced from 15 to 7½ per cent, while wrought iron pipe 2" and smaller, the bulk of which is made in Canada, has been reduced slightly. This is an industry which has made considerable strides during the past year or two. The quality of Canadian pipe was at first admittedly poor, but things are now changed in this respect, and Canadian pipe is generally placed on the same basis, in point of quality, with any imported material.

Iron and steel chains have been placed at 5 per cent. for all sizes over 5-16" diameter, a much needed change, for hitherto the rate was 5 per cent. on all sizes over 9-16" diameter, while smaller sizes were dutiable at 30 per cent, as manufactures of iron and steel not otherwise provided for The ordinary short link coil chain is not made in this country, and the change of duty will be welcomed by lumber men especially, who use large quantities of chain in connection with their operations.

There is no doubt that under the changes originally proposed, many industries were placed in a very awkward position, as they were quite unable to compete with foreign goods. The abnormal depression in business in the United States has resulted in large quantities of goods being thrown on this market, at prices very much below their actual cost, and it would have been in the highest degree unjust to manufacturers who had invested large amounts in manufacturing in Canada, to find their capital suddenly useless, on account of this exceptional state of affairs. Canada has always been considered a sort of dumping ground for excess products from the United States, and this is one thing that must be kept in view in all legislation on tariff questions.

The changes made in Committee have been made mainly with a view to correct this state of affairs, and there is no doubt that when the Tariff Bill is reported to the House, it will be more generally acceptable to manufacturers and to all classes than it promised to be when first brought down

Nova Scotia Strikes and Arbitration.

A brief reference to two coal strikes in Nova Scotia may interest students of social economy. A few short newspaper paragraphs told that the coal miners at the Joggins and at Springhill had come out on strike, and were followed by the announcement that all was amicably settled. The hardworked clerk or salesgirl doubtless wish they could improve their positions by a few days holiday and a refusal to work.

It is stated the miners struck work, and that shortly after masters and men met amicably under the ægis of the Secretary of the Provincial Workmen's Association and parted good friends, doubtless wondering what the trouble was about. Without wishing to decry the good services of the Association's Secretary, the question arises why could not the parties to the strife have met and settled their differences without requiring a third party, and what was the need of a strike at all?

The Statutes of Nova Scotia contain an Arbitration Act, but as yet no proceedings have been carried out under it. The formalities of procedure under an untried Act, and the delays incident to Statute law, are not palatable to parties who consider that they are in the right, and the report of the English Labor Commission is in this line, and their recommendations appear from the summaries made public to be unfavorable to any form of compulsory arbitration. To no business of the present day does some form of amicable arbitration seem more essential than to coal mining. The varying conditions of roof, coal, etc., their hardness or softness, all present frequent changes in the wages the average miner earns. To his mind, intent on his daily toil, and anxious for no reduction of his reward, the broader questions of the selling price of coal, the costs of pumping, maintenance, etc., are not presented as they are to the mine manager. The mine owner has to get the best price he can for his product against competition in the market, and his price frequently leaves a non-dividend margin. Naturally he considers that he looses enough when his costs increase and his margin of profit diminishes on account of stone partings, etc., without having to pay an increased price for cutting the coal.

It is reported that the two strikes in question arose upon this and similar matters, not upon any general reduction in wages. These points of difference are those that should be settled from a standpoint of reason and mutual concession.

Admitting, as is reasonable, that the capital invested should receive a fair return, the surplus profit should be shared between the partners in the enterprise, the capital that provides and the labor that enriches. It is upon some basis such as this that the mutual interests of both must be best provided for. Attempts have been made in some districts to reach this by means of sliding scales; they are, however, more applicable in large districts having assured markets than in the small districts of Nova Scotia. Official machinery has been applied in some European countries for the establishment of tribunals for dealing with wage questions, and they are found to work fairly well until a general depression or increase of price occurs, when drastic measures are appealed to. What power in the United States could compel the thousands of miners now on strike to resume work before they chose to, even if the fact were undeniable that they were offered the highest wage possible under the present conditions of trade?

The consideration of the question of a fair day's wage for a fair day's work can be arrived at only by both parties considering all the facts bearing on the price the consumer will pay. He buys in the cheapest market, and master and man must fight the cheapest producer or give up the struggle. For this reason the loss directly sustained in a strike by companies and men is often increased at a future date by a loss of market, and the joint interests demand that the laws of reason and common sense be invoked; that personal feelings and the British love of winning in a fight be subordinated to friendly discussion, amicable adjustment, and the stern fact that the world will buy the cheapest coal, regardless of masters' profits and workmen's wages.

Bloom, Billet and Slab.

One of our readers in the iron and steel trades writes: "If it were proposed to define the terms Bloom, Billet and Slab as such are now commercially known, would the following definitions be fairly accurate and expressive? The expression Bloom and Billet when applied to iron and steel means such unfinished material as intended to be re-rolled, the combined measurement of the width of the four sides of each being not less than fifteen inches and the length not exceeding sixty inches. The expression Slab, when applied to iron or steel, means such unfinished material as is intended to be re-rolled, the combined measurement of the width of the four sides of each being not less than fifteen inches and the thickness not less than one and one-half inches, the length to be not less than twelve nor greater than sixty inches. If in your opinion these definitions are not fairly accurate, would you be good enough to give us your ideas on the subject?" As the matter has some importance in view of Tariff changes, we took the liberty of referring our correspondent's enquiry to Mr. C. Kirchoff, the editor of *The Iron Age*, New York, one of the foremost authorities on questions of this kind. Writing under date of 19th, Mr. Kirchoff advises: "In our opinion your definition of the expression Bloom and Billet is not comprehensive enough. Your definition would exclude from the classification of Billet all unfinished material intended to be re-rolled less than three and one-half inches square. Now, as a matter of fact, Billets are rolled from the initial heat down to one and one-half inches square. As a matter of fact, the dimensions of a Bloom or a Billet overlap and depend chiefly upon the character of the

MR. GEORGE STUART, M.E., TRURO, N.S.

machinery of the rolling mill producing them. Thus, we have in this country, mills which on the blooming train roll down sixteen to eighteen inch ingots to four inch blooms, the bloom being really the product of the first rolling on what is called the blooming train. The majority of mills, however, do not break down or bloom in the first rolling to much less than six or seven inches square, the billet train rolling them down to four inches or less. You see therefore that a 4 x 4 piece of steel may be the Bloom of one works and yet the same sizes may be the Billet of another establishment. Where the two are brought together under one classification in one paragraph and intended to cover the general merchantable article of unfinished steel intended to be re-rolled, a very much wider range of sizes is to be expected. We would place the minimum at one and a quarter inches square, and would certainly increase the length to ten feet, instead of five. Your dimensions on Slabs seem to us also to be too restricted. We would make them at least twenty-four inches combined measurement, with thickness not less than one-half inch and length not less than twelve nor greater than one hundred inches. Recent rolling mill practice has very largely changed the range in sizes, as you may observe, and has made it a good deal easier for the works re-rolling purchased steel to get nearer to the dimensions of their finished product."

EN PASSANT.

Mr. George W. Stuart, Truro, the subject of our portrait this month, has been a prominent figure in Nova Scotia gold mining for more than twenty years. A Nova Scotian by birth and education, he came to the front with the discovery of the Rose Lode at Montagu in 1879. In 1880 he also prospected in the Salmon River district and located the celebrated Dufferin gold mine. The story of the discovery of this property reads like a page of fiction and has been told already in these columns, (see also *Canadian Mining Manual*, 1893). The success of the Dufferin mine, in its protracted litigation as to title, and in its early years of productive working was largely due to the ability of Mr. Stuart. His unremitting efforts during the progress of the suits ultimately told upon his health, and he was compelled in 1883, to go to Mexico for a rest. Genial, modest, and of a warm impulsive nature, George Stuart has cut out for himself a standing in the esteem of the gold mining community of Nova Scotia that is excelled by none. His merits as a mining engineer are untiring energy, keen perception, good executive ability and economy in workings and plant. Mr. Stuart has several interests in gold mining properties in the province, and occupies the position of Manager to the Caribou Gold Mining Co., Ltd.

We are pleased to observe the Stellarton *Journal* giving prominence to a flat contradiction of the caddish and untruthful story that the recent trouble at the Joggins colliery was largely due to the new manager's unpopularity with the men. Mr. Archibald is a capable, experienced manager, and a gentleman who, though with us but a few months, has earned the esteem and confidence of all with whom he has come in contact.

The annual gathering of the members of the Royal Society of Canada, has just been held in Ottawa, and the proceedings remind us that this remarkably exclusive body bleeds the Dominion treasury every year to the extent of $10,000. This seems a big price for the country to pay for an annual volume of dry-as-dust, doubtless of value in its way, but comparatively insignificant in its practical service to the country. We say comparatively, for we have in our mind's eye certain mining organizations which are accomplishing good work in promoting the development of the resources of the Dominion to whom the tenth portion of this truly royal grant would be a boon—but then, as everybody knows, all mining men are millionaires, and they *do* pay their annual subscription, which the royal pundits don't. One cannot refrain from reproducing in this connection the graphic picture given in *Nature* by Prof. Tilden, of the productive performances of these organizations. Referring to his experience with the work of the British Association for the Advancement of Science, he writes: "As a sectional secretary I have read papers (other people's) at three o'clock in the afternoon to an audience consisting of a vice-president, impatient to follow the president to lunch, two reporters who were not listening, and my wife making signals of distress from a back bench." As a sectional president I have sat at the same hour, luncheonless and weary, while a paper which seemed as long and discursive as the story of the Ancient Mariner, was droned forth by the author to an audience of about three persons fidgetting like the belated wedding guest. I wonder whether this sort of thing is supposed to be of any use to anybody?"

Mr. J. B. Tyrell is reported to be moving heaven and earth, metaphorically speaking, to renew those heroic exploits in the "barren lands" of which we have all heard so much from stud-headed newspaper interviews and platform discourses. Perhaps it would'nt be a bad scheme to send him back to the wilds of Chesterfield Inlet, if only to recover the instruments and equipment which he abandoned in his frantic rush from 'starvation' (sic). At his own expense, however, as we hardly think the Government can afford to cripple the real work for which the Survey exists by another lavish expenditure, a fraction of which, if spent where it ought to be in investigating the geology and mineral occurrences of our new mining fields, would be of benefit to the country.

The Geological Survey was never meant to father budding explorers thirsting for notoriety.

Talking of the Geological Survey reminds us that the Museum has been enriched by a very fine series of photographs of our nickel phosphate and asbestos mines. Also that Mr. Coatsworth, M.P., has asked the Government to produce a return showing: 1st, what number of its reports have been gratuitously distributed each year? 2nd, what number have been sold each year, and what amount has been realized from such sales? 3rd, what number of these reports for each year, now remain in the Department for sale, and at what price they are held. All of which should produce a discussion that will be interesting.

The Copper Creek Mining Company has authorized an expenditure of an additional $10,000 for further development work on its property at Point Mamainse, Ont The location covers about 11,000 acres, and has been well tested by the diamond drill A shaft now down 300 feet will be continued, and other work will be done during the season, which, it is hoped, will further demonstrate the extent and value of the veins already cut. The work is under the the superintendence of Captain Tom Tretheway an old experienced miner in the Lake Superior country.

This is what the *Murchison Miner* says about mining experts: "We have been asked fo a definition of an 'expert.' The contract is a big one in the face of the varied species rife on this field. But if anyone wants an idea of mining experts, let him send a messenger to this office, and we will supply him with at least ten mining experts an hour—an inexhaustible supply. But for the definition. Experts are men who write lying reports to mislead the public, and the expert that fails to secure his bit when his pocket of lies are handed in, is not very smart in finance, however proficient he may be at whoppers!"

The proposed exhibition of Canadian minerals by the Dominion Government at the Antwerp exhibition has been abandoned.

Prof. A. P. Coleman, of the school of Practical Science, Toronto, lecturer in assaying and metallurgy, has, we understand, been delegated by the Ontario Government to conduct a course of lectures in the North Shore region, for the benefit of the prospectors and miners of Nipissing, Thunder Bay and Rainy River districts. The class will be opened about the first of June, and the professor will show the prospectors the simpler methods of testing and identifying the different species of ore. Each prospector will be expected to provide himself with a blow-pipe at a cost of $3.

The Hamilton Iron and Steel Co., Ltd., now building a furnace at Hamilton, Ont., has, we understand, contracted with the Philadelphia Engineering Company of Philadelphia, for the construction of the machinery and plant. The contract price is stated to be $360,000.

The Dominion Coal and Coke Co., Ltd., which has been mining on a limited scale at Estevan, in the Souris district, Province of Assiniboia, produced last winter about 14,000 tons for local consumption. The management is at present negotiating for the erection of a briquette making plant for which the lignites of that section are admirably adapted.

On the 15th inst. an effort by the Ontario and Quebec members of Parliament, to have the coal duty reduced to forty cents was vigorously opposed by the Nova Scotia representatives and proved abortive. An alternative suggestion that a reciprocity clause giving the Governor General in Council authority to place coal on the free list in the event of coal being placed on the free list by the United States Government, also fell to the ground. The duty must be maintained if the measure of prosperity that has hitherto attended our Nova Scotia coal mining is to be continued.

The appeal of the Bell's Asbestos Co., Ltd., and the Johnson's Co., Ltd., has been dismissed by the Supreme Court. This was an action *en bornage* taken in the Supreme Court for the district of Arthabaska, on the 9th February 1889, to establish the boundary between the two companies' asbestos properties. On 30th November, 1891, this court ordered the bornage to be made according to the claims of the Johnson's Company, and a surveyor was appointed to draw a line between the properties. This was done, and on 9th February, '92, the court homologated the report of the surveyor, and condemned the Bell's Company to pay $7,145 in damages for the value of the asbestos which they had taken from that part of the property which the court decided belonged to the Johnson's Company. From this judgment the Bell's Company appealed to the court of Queen's bench, and the judgment as to the line was unanimously confirmed; but the damages allowed by the Superior Court were reduced to $3,586.59. From this judgment the Bell's Company appealed to the Supreme Court, but the Johnson's Company made no cross appeal against the judgment reducing their damages which therefore is finally settled. By the judgment of the Supreme Court recently given the boundary line as determined by the Supreme Court of Arthabaska is sustained in favor of the contentions of the Johnson's Company.

The International Asbestos Mining & Manufacturing Company, Ltd., has commenced mining on its Denholm property, county of Ottawa, and about 20 tons of good fibre are ready for shipment. The Company has commenced manufacturing at its Newark works a new design in asbestos steam packing for which a Canadian patent has been taken out.

The Ingersoll-Sergeant Drill Company is putting in another 20 inch air compressor at Westville for the Acadia Coal Company to convey power to a pump 4,000 feet down the slope. We understand the same company is figuring on the necessary plant to enable Sydney mines to do away with the use of steam underground.

One R. R. McLeod, who was blackballed when a candidate for election to membership in the old Gold Miners' Association of Nova Scotia vents his spleen, in the *Critic*, against that organization, long since merged into the Mining Society, by objecting to their custom of an annual dinner, and calls it a piece of "recklessness that seems wedded to the business." The man who cannot see his neighbour loose the reins once a year without attributing to him habitual recklessness is of too narrow a gauge for success in this world. In other respects Mr. McLeod's letter has some very apposite remarks, particularly his reference to the folly of a managing director of a local mining company, in inaugurating the starting of a very flimsy mill (upon a very uncertain mine) with a public 'spread.' But that he should turn and expose the doings of his *quondam fidus achates*, Mr. Gilbert Parker, the very man who proposed McLeod's name for membership in the G. M. A. is astonishing, and we imagine will provoke an "et tu, Brute.," from Mr. Parker. Nevertheless we are constrained to say that Mr. McLeod is probably writing of what he knows to be the truth.

Apropos of this letter, it is unquestionably a fact, that nine out of every ten failures that have been made in gold mining ventures are to be attributed to ignorant or incompetent management. This is true not only of Nova Scotia but of the other provinces of our Dominion. And to capitalists who may come in with their money we would say "choose for your manager, not a commercial traveller, nor a farmer (who may *think* he's a miner), but a man who can show you proofs of his training and his ability and his *success* in mining heretofore; and then you will start with a fair chance."

The Pictou Development and Mining Co. owning some 385 areas in Renfrew District, N.S., has recently struck some very rich quartz in the McLeod lode of the Colonial block. Specimens shown resemble the rich pockets characteristic of the Montagu mines. Work is also being carried on in the Foundation lode of the Empress block of areas, and mechanics are now at work on a scheme for driving the mine pumps from the water power in the New Haven property. From present indications Renfrew is entering upon a period of prosperity which it has not known for many years.

The Columbia Gold Mining and Milling Co. Ltd., of Attleboro' and Providence, operating at Oldham, N.S., have lifted their pumps and closed their works after expending over $50,000, and obtaining a gross yield of less than $3,000. This mine was sold through the efforts of one Edward Whidden, and the REVIEW for October, 1892, commented upon the property at that time.

In the same district the Rhode Island Company now have their shaft on the Dunhack vein down to the 300 foot mark, and propose sinking another 150 feet.

Reports from the Montagu district are to the effect that quartz coming from bottom slopes are looking well, and have the appearance that usually precedes a batch of "nugget quartz." The Rand air drill plant has now been in commission for some weeks and is giving great satisfaction.

From Gold River we learn that prospecting was carried on to a late date last fall by Mr. T. N. Baker in a large block to the north of the main workings. Reports coming from the mines this spring indicate the speedy discovery of a large and paying lead at an early date.

At Lake Catcha the Oxford Gold Mining Co. under manager J. M. Reid, is working quietly but steadily, and the output of gold is increasing. From latest reports the yield for 1894 will be double that of 1893.

It is reported that a rich strike has been made on the property of Dr. Cogswell, in the same district.

The Harrigan Cove Gold Mining Co. Ltd. has suspended operations, and Edward Whidden has been relieved of the management.

The Wine Harbor district has been very quiet for some months, but a new impetus has been given by the starting of work on the old Eureka property, and the formation of a company with $160,000, nominal capital to operate the mines formerly worked by Mr. H. T. Harding, of Truro. It is proposed to thoroughly treat the workings of the old and rich "plough" lead, on both sides of the large fault.

Little is doing at Goldenville. Mr. McNaughton is reported to have made a valuable find on the "Springfield" at the eastern end of the district, but the report lacks confirmation.

The consolidated properties, operated at Fifteen Mile Stream, are offered for sale by tender. It is believed that this is simply a preparatory step to reorganization, when, if the plan is successful, operations will be carried on as before.

The subject of our next portrait will be Mr. F. A. Halsey, M.E., manager of the Canadian Rand Drill Company, Sherbrooke, Que.

We are informed that an effort is likely to be made shortly to treat the tailings in Nova Scotia. There are immense quantities of tailings in different parts of the province that ought to pay well for treatment, and although we might not achieve anything like the wonderful results that have been achieved in South Africa, we ought to recover an appreciable quantity of gold which has been allowed to flow away owing to poorly equipped batteries or to special difficulties in the way of saving fine gold. The Witwatersrand mines are now getting nearly 40,000 oz. per month from tailings, and some of the companies put through many thousands of tons of stuff every week, and make a handsome thing out of the 5 dwt. average returns.

The following extract from the inaugural address by Professor Arthur Smithells to the Yorkshire section of the London Society of Chemical Industry, is one which may be laid to heart by the various mining companies, and should be inscribed upon the walls of the board roams where mine directors meet. After speaking of the training needed for a duly qualified chemist, Professor Smithells says:—"To finally equip him for the difficulties of his post, there should be in it some model British workmen, a model foreman or manager armed with his father's ignorance and who regards your chemist as a mischievous interloper, and last of all there should be a principal ignorant of science, but dimly conscious (whilst distrustful of all that is new fangled) that there is something in science that can help him, yet fatally impatient of experiment or investigation. Fortunately there are business men who can be business-like even on the question of availing themselves of scientific help. They will invest their money in a chemist's brains as they will in a new departure in their works. They do not simply turn on the steam and execrate if the machine will not work instantly to the advertised standard of efficiency. They are content at first with a small or imperfect output. But soon by a reasonable regard to functions and adaptabilities, by giving the thing fair play, it rises to its reputation and more than repays the costliness of its early days. It is precisely thus that a reasonable man treats his chemist and secures the return on money invested in the machinery of a trained chemical intelligence."

The principals of the Dominion Coal Co., Ltd., have been greatly annoyed by the blatant assertions of the Halifax *Critic* to be the organ of the company. The statement, as we have already pointed out, is absolutely untrue, and the proprietor of the *Critic* has been notified by the company that legal proceedings will be instituted against him if he persists in this reprehensible conduct.

The Jeffrey Asbestos Mine at Danville, Que., has been taken over by J. N. Greenshields, Q.C., Feodor Boas and others, on royalty, with a view to ultimate purchase, and a large force has been put to work within the last few days. The property is one of exceptional value, and will be exploited vigorously during the summer.

The Danville Slate Co. has a strong force at work. The output last year was 5,000 squares and about 2,000 cases school slate. The product is, we believe, finding a ready market.

Within a short distance from Johannesburg some 60 to 70 gold mines are now being developed or are already producing gold, remarks the *Johannesburg Star*. Fully 40,000 tons of coal are being consumed by these mines, at an average cost varying between 15s. and 20s. per ton delivered at the mine. It is estimated that 5,000 cases of dynamite are also consumed monthly, the average price of which it would be difficult to arrive at. Probably it ranges between £4 and £5 per case of 50 lbs. The labor bill, black and white, must absorb fully two millions of money per year. The annual outlay in machinery and stores is difficult to estimate, but will no doubt range between a half and one million sterling. The gold output is now valued at about five millions annually, and the dividends declared in the same period amount to about 1¼ millions from the mines. Great reductions in the cost of working are anticipated shortly by a readjustment of the wages question. The wages at present are unquestionably excessive for both black and white labor; seeing that blacks get £3 to £4 a month, and it costs them practically nothing to live, and the whites get £20 to £30 per month, and it costs many of them only half this amount to live, under better conditions as regards board, and with some companies possibly lodgings also, than they have hitherto been accustomed to. At most mines, three good meals are served daily for about 25s. per week. The coal bill will be reduced by the introduction of railway sidings, delivering coal direct in bulk, instead of in sacks, and last, but not least, the community should shortly profit largely from fair competition in dynamite being introduced. Reduction in the rate of native wages is now receiving attention.

With a view to encouraging investment and facilitating the development of its iron industries the Ontario Government has appropriated the sum of $125,000, to be known as the Iron Mining Fund. Out of this fund it will pay upon all ores mined and smelted in the province for a period of five years from the 1st July next, a bonus of one dollar per ton on the pig iron produced, but the yearly grant is at no time to exceed $25,000. Provision is also made for the purchase of two diamond drills for exploratory purposes. These are to be operated under direction of the Bureau of Mines or may be leased to applicants at a fixed rental, which we presume will be merely nominal.

The royalty has also been reduced from three to two per cent, such charge to be calculated on the value of the ore, less the actual cost of raising it to the surface and its subsequent treatment for the market. But it is important to remember that this purely nominal impost is not to be made until after seven years from the date of the patent or lease.

Some reductions are made in the price of mining locations as follows: On all Crown lands, sold as mining lands or locations, in the districts of Algoma, Thunder Bay, Rainy River, and that part of the district of Nipissing which lies north of the French river, Lake Nipissing and the river Mattawa, the price is to be:—

(*a*) If in a surveyed township and within six miles of any railway	$3 00
(*b*) If elsewhere in unsurveyed territory	2 50
(*c*) If within six miles of any railway but in unsurveyed territory	2 50
(*d*) If situate elsewhere in unsurveyed territory	2 00

The price per acre on all other Crown lands, sold as mining lands or locations, and lying south of the aforesaid lake and rivers, shall be:

(*a*) If in a surveyed township and within six miles of any railway	$2 00
(*b*) If situate elsewhere	1 50

An important provision has also been made to the Ontario Joint Stock Companies Letters Patent Act, whereby any mining company may from time to time dispose of shares and stock at a premium or discount, and in such manner as the directors may seem advantageous to the company. Clauses are also inserted limiting the liability of shareholders, regulating the sale of stock on non-payment of calls, etc.

Altogether, the Government is to be congratulated on having endeavored to meet the requirements of the mining industry in a liberal spirit.

The programme for the fourthcoming united meeting of the members of the Mining Society of Nova Scotia and the General Mining Association of Quebec, to be held under the auspices of the Dominion Coal Company, Ltd. and the General Mining Association, of London, Ltd., at Sydney, Cape Breton, during the second week in July, has been drafted, and special arrangements for transportation of members by rail and water are nearly completed. The proceedings will open on Tuesday 10th July, and be continued until the end of the week. The collieries of the Dominion Coal Company, Ltd. and the General Mining Association, Ltd. will be visited, and there will be an excursion by boat to Louisburg. Visiting members will be entertained at a public dinner, in Sydney, and luncheons at Glace Bay and Sydney Mines are on the tapis. Papers will be contributed by Messrs. Hugh Fletcher, B.A., Ottawa; J. S. McLennan, Boston; F. S. Pearson, Boston; W. Blakemore, M.E., Glace Bay; Thos. Johnston, Glace Bay, and others. Altogether a programme of unusual excellence is being prepared and the attendance promises to be large. Members who propose being present should notify their respective secretaries early. A special number of the REVIEW, handsomely illustrated, will give our readers a full account of the meeting and verbatim reports of the papers and discussions.

The Geological Survey has, we believe, arranged that Mr. R. G. McConnell, will spend the summer in the Kootenay country investigating the nature and occurrence of the silver-lead deposits, which are attracting so much attention just now. This will be good news to the mining men in this promising new field for, beyond Dr. Dawson's report, published before any of these mines were opened, investors have absolutely no official data. We are waiting to hear if the mineral producing regions notably of the Lake of the Woods and Hastings County, are to receive any attention this year from the staff?

It is certain that the Lake of the Woods mineral district will receive a deal of attention during the present year. This district has been known as a mineral region for many years, but development, owing to various causes, has been slow, the greatest drawback having been the dispute between the Federal and Ontario governments as to the ownership of the lands and minerals. Owing to the dispute capital was driven out and the development of the district was prevented at a time when considerable interest had been taken in it. When the dispute was finally settled, interest in the gold mines revived. Work has been going quietly on for some time, some valuable properties have been acquired, and are now in workable shape.

With the opening of navigation a large number of prospectors and investors have gone into the new Rainy Lake gold region.

Prof. John Bell, a geologist, familiar with the mineral territory of West Verginia, in an article dealing with the coal resources of that state, has something to say respecting the self-styled "mining expert" which will bear repetition. He writes:—

"In the development of our coal fields, after the particular coal desired has been located and identified by the practical geologists, we utilize, as is done elsewhere, the services of the regular mining engineer. He is generally a man of scientific attainments in his profession, indispensable in large mining operations, but usually, and for good reasons, makes no claim to a knowledge of geology other than as a science. His business, being to deal with the airs, gases, drifts, machinery and the practical working of mines, is necesarily of a nature entirely different from that of the regular geologist. Such flaming reports of rich finds as we hear and read about are often innocently set in motion by so-called 'mining experts,' from the want of a technical knowledge of the geological formations. While these men are sometimes expert at opening coals or minerals which have already been by the practical geologist identified and located, yet, when solely depended upon, their inability to idenitfy the flora of the coal measures, or to classify the groups and rocks in the formations from their position and lithology, frequently lead to mistakes that result in large waste of capital. We have an instance of this in the expenditure by a firm in this state of some $10,000 in useless mining from having depended on a 'mining expert' to locate and identify a seam of coal. He had been unable to identify the rocks or flora, or to distinguish between sandstones and slates occupying different horizons in the formations, which led to opening a worthless coal in the barren measures, instead of at the horizon of the 'coking ven,' which latter they supposed they were on."

An American writer has something very pertinent to say upon the too frequent association of the terms mining and gambling. "Mining is not a gamble," he says. "I denounce the expression inapplicable to any such legitimate business as mining. No business ought to be considered so safe or so profitable as mining. And the time will come very soon when mining will not be called gambling, but when the miner will have as good credit as the fruit grower, the wheat producer, the cattle raiser, or men engaged in any of the other ordinary occupations of life." Shut down the mines, take off the supply of gold, and then there will indeed be talk of "hard times."

A recent issue of the *Australian Mining Standard* gives a description of a hand-power stamp for quartz crushing, which may prove of interest to our gold mining readers Briefly stated, the object of the patentees has been to produce a powerful and portable single-stamp battery capable of being easily manipulated by two men, and possessing the maximum of power in combination with minimum in weight. The machine is strongly built, only weighs 4½ cwt., and is adapted to the requirements of prospectors unable to avail themselves of the facilities of large milling plants. The framing of the machine consists of wrought iron hollow tubes clamped together, so as to easily admit the mortar-box. The two clamps embracing the vertical columns are light steel castings of girder section, with central holes for the shafting to have unimpeded vertical motion. The clamps are split on the extreme edge, and are loosened or tightened as occasion may require by bolts and nuts. The cam-shaft is a light steel casting clamped to the vertical columns. The shaft is provided with two fly-wheels with handles, by the aid of which a rotary motion is imparted to the cam-shaft. The mortar-box is of steel, the upper portion carrying the punched plate, through which the crushed ore passes.

Mr. F. J. Carrel who has been representing the Selby Smelting and Lead Company of San Francisco, in the Slocan district, B.C., was found dead in his bed at the Spokane Club on 30th inst.

Fifty-three car loads of ore from the LeRoi Mine, Trail Creek, B.C., are reported to have given $54 gold per ton. A new hoisting and pumping plant is being put in.

The Hall Mines, Limited, is equipping its Silver King mine with an extensive mining plant purchased in Chicago.

The Victoria Gypsum Mining and Manufacturing Company has resumed work at its Port Bevis quarries, Cape Breton.

Mr. E. B. Haycock, Ottawa, who has been quietly opening up his various gold properties on the DuLoup, during the past two seasons, has resumed operations with a good working force. The veins so far opened have proved to be large, yielding respectively by mill tests 11½ dwt., 15½ dwt., 19 dwt. and 22 dwt. per ton. The alluvial ground, also being worked by Mr. Haycock, has been sufficiently encouraging to warrant more extensive development during the summer. A number of capitalists have their eye on the Chaudiere gold district just now, and it will be strange if mining on a larger scale than hitherto is not done very soon.

The smelter returns of the 40 ton shipment sent by the Hall Mines, Limited, to Denver, show 90 odd ounces silver and 11 per cent. copper. No report has been received yet of lot sent to Swansea.

Mr. W. J. Goepel has been gazetted Gold Commissioner for the Nelson Division, West Kootenay, B.C.

At all times the annual report of the directors of world's greatest copper mine—Rio Tinto is of interest. The bare figures indicate the size of the undertaking, besides which they demonstrate that this mine can be made to pay, almost irrespective of the price of copper. The quantity of pyrites extracted during the year was, for shipment 477,656 tons, and for local treatment 854,946 tons—of an average copper content of 2·996 per cent. There were invoiced to consumers in the United Kingdon, Germany, Belgium, and the United States 469,339 tons, or 33,581 tons more than in 1892, and that excess would have been greater but for the coal strike in England last year. The production of copper at the mines last year was 19,990 tons, and the copper in the pyrites shipped was 11,964 tons, making the total copper 31,954 tons. There were sent to market 18,858 tons of refined copper, and 11,265 tons of copper in pyrites, giving a total of 30,123 tons. The reserve heaps of the company now contain 101,867 tons of fine copper, which stand in the books at £5 0s. 6d. per ton. At that price it is quite clear the company can sell copper at figures entirely out of the reach of any other mine in the world.

A circular letter from Richard Baker, Sons & Co., London (Eng.), gives the requirements of the British mica trade as follows: That the plates or sheets should be smooth and flat, of even and uniform thickness, not ridged, wrinkled or buckled, but perfectly sound and free from cracks and flaws, not cross grained or striated, and what is indispensable, should split easily without tearing; there is little or no sale for plates smaller than seven inches in length by three in width, they may be any thickness or shape, but smooth well trimmed edges are preferred, color is immaterial, they may be white, ruby, amber, green, black, spotted, or stained; these are all useful for manufacturing purposes, but plates entirely free from color when split are most valuable, the largest, soundest plates increase in value according to sizes, except that beyond about fourteen inches square, the demand is somewhat slow. Where labor is cheap, the mica should be cleaned, split and trimmed where found, and packed in boxes not exceeding fifty pounds in weight. When taken from the surface, it is usually decomposed, weather-stained and of no value; what is required must be prepared in a merchantable shape, and this cannot be done without systematic mining, when the loss in weight from inferiority, striated and cross-grained slabs will probably range from fifty to ninety per cent. Stained, unsound and cracked sheets are saleable, according to the extent of their stains and unsoundness; these should not be packed or mixed with sound plates. Mica should not be cut into square or rectangular plates without previously ascertaining sizes required or the mode of papering and packing wanted by buyers; nothing smaller than 2 x 3 inches in cut mica is saleable. A vast amount of rubbish called mica has recently been received in London from Australia, selling from threepence to five shillings per cwt.

Enquiry failed to confirm a story which has been going the rounds in Ottawa of a cash sale of mica aggregating $15,000. The market still remains quiet. Some improvement in the quantities shipped from the Ottawa County mines is, however, noticeable.

The official returns of the output of the Lake Girard Mica Mining System, whose headquarters are at Ottawa, will be of interest. The figures are given from the commencement of operations to August last year, when owing to the business depression and consequent cessation of demand for mica, operations were suspended on most of the properties operated by the System:—

	Lbs.
Total from June, 1891, to Dec. 31st, 1892....	288,000
Total from Jan., 1892, to Dec. 31st, 1892....	2,454,448
Total from Jan, 1893, to July 31st, 1893....	1,909,562
Total block mica as raised from the shafts..	4,652,010

The following table gives the exports of petroleum from Petrolea, Ont., for the first 4 months of 1894, compared with those for the same period in 1893:

	1893			1894		
	Crude.	Ref'd.	Crude Equiv.	Crude.	Ref'd.	Crude Equiv.
Jan...	23,671	28,834	96,756	25,575	32,605	107,087
Feb...	22,905	19,809	77,070	20,295	22,355	76,182
Mar...	17,891	22,405	73,903	16,935	17,490	60,660
Apr...	12,542	15,145	51,704	15,125	19,335	63,463

Parliament on 1st inst. reduced the import duty on illuminating oil from 71·5 to 6 cents per gallon, and that on crude, fuel and gas oils, when used for other purposes than refining, from 3⅗ to 3 cents per gallon.

If the Nelson Hydraulic Mining Company makes a success of its venture on Forty-nine creek, an impetus will be given hydraulic mining that can only result in the expenditure of hundreds of thousands of dollars in opening up ground in southern Kootenay. The company has made no parade, but within four months has expended over $10,000 in plant. Water is conveyed to the ground through 1,500 feet of ditch, 2,600 feet of flume, and 1,100 feet of steel pipe ranging in size from 19 inches to 11 inches. Five hundred feet of sluice-boxes have been put in and three giants purchased. At present ten men are at work on the waste ditch. Within a week everything will be in readiness to begin sluicing.

"A forge manager," says the *Ironmonger*, "received a somewhat novel application the other day for an advance of wages. The request was put into rhyme, and the point lies in the fact that the author's work is to superintend the puddlers, and see they do justice to the iron. He is an old puddler, past his ordinary work, and a little more responsibility has been thrown upon him through the rather sudden death of the foreman under whom he worked. Here are the verses *verbatim et literatim*:—

"Sir,—It always makes me feel so sad
When I see the iron shingle bad,
But when the iron works nice and kind
None of us have no fault to find.
Sir, my duty I will try to do,
And melt the iron till blaze comes through.
If the iron will not shingle well,
The cause of it, sir, you can tell.
One word, please, sir, I wish to say,
For twelve long hours I'm here a day;
My wages, sir, are rather small—
Scare eighteen bob, sir, that is all."

The owners of the Noble Five group, in Slocan district, B.C., have let a contract to extend the Bonanza King No. 2 tunnel 50 feet. The tunnel is now in 240 feet. "Jack" Hennessy was awarded the contract at $11.50 a foot. No. 3 tunnel on the same mine is in 110 feet, the face showing 7 feet of vein matter, from which assays as high as 140 ounces silver have been obtained.

The new international shipping pier being constructed for the Dominion Coal Company at Sydney, C.B., is rapidly nearing completion. Its entire length is 1,200 feet, width 94 feet, height above tide, 32 feet. There are two grades each 1 foot to 100 leading down to the end of the pier, this being just sufficient to allow of the cars running down on the side by their own weight, and at the same time giving them no greater impetus than will allow of the controlling of six cars by one man. The third grade, the middle one, upon which the empties return, is 12 feet to 100, which gives these cars a velocity of twenty miles an hour at the rear end of the pier proper this being sufficient to carry them nearly a mile back on the grade to within a few feet of the switch. There are to be two towers by which the whole contents of a car, six tons, will at once be conveyed to the hold of the vessel in a shovel of two sections, which, when at the bottom of the vessel, operate and discharge their contents. Full details of this work accompanied by suitable illustration, will be given in our July number.

Some interesting details indicative of the value of the ores of the Kootenay country, B.C., are given in a sketch in the Nelson *Tribune*, of the No. 1 mine, near Ainsworth. The mine was discovered in 1888, and passed through various hands before it was acquired by Howland Stevenson. In June, 1893, he commenced work cleaning out the old shafts and levels, and on August 1st made his first shipment of 31 tons, which sold at the Tacoma smelter for $2,688.85; on September 26th a 30-ton shipment sold for $2,385.65; November 1st, 20 tons yielded $1,459.79, and on November 25th, 12 tons netted about $1,000. At this time all shipments were suspended as it had been demonstrated that the ore could be more profitably worked by the erection of a concentrating plant. Up to this time three carloads of the ore shipped had been concentrated at the mine by hand jigs. This product ran respectively, as follows: 253 7.10 ounces silver, 5 2.10 per cent lead, 28 6.10 per cent silica, 10 per cent zinc; 368 ounces silver, 7 8.10 per cent lead, 27 per cent silica, 17 per cent iron, 12 per cent zinc; 266 ounces silver, 5 3.10 per cent lead, 26 3.10 per cent silica, 16 per cent iron, 14 per cent zinc. A general concentrating test was made on 12 tons of ore shipped to Bossburg, Washington, and run through tbe concentrator at that place. This ore assayed before concentrating 49 ounces silver. The 12 tons of crude ore yielded 2½ tons of concentrates, which assayed 197 ounces in silver per ton, and showed a saving of 80 per cent of value contained in ore. At this point Mr. Stevenson sold his interest in the lease to Messrs. Bright and Braden, who with Messrs. Carter and Clark are the present owners. These gentlemen immediately purchased the Bossburg concentrator and shipped it to Ainsworth. Its capacity is 60 tons crude ore per 24 hours. During the summer months the works will be run by a Pelton wheel, steam power being provided for the winter. The water power is taken from Cedar creek through a flume 1,500 feet in length, which carries 250 inches. The fall from the penstock to the wheel will be 169 feet. There are now on the old dumps 6,000 tons of concentrating ore, which will run seven into one. Blocked out in the mine ready for stoping there are about 2,000 tons more. The only serious feature about this enterprise, is the fact that all machinery is second hand, which, under the most favorable circumstances, can not be expected to be as satisfactory as new machinery. However, the first venture at concentrating in Kootenay will be watched by mining men in general with interest.

A statement by Sir Henry Tyler at a recent meeting of the Grand Trunk Railway, that "Sir John Thompson, adopting the pledge of the late Sir John Macdonald, had assured Mr. Seargeant, General Manager of the road, that if the United States removed the duty on coal, Canada would do the same," was promptly challenged and repudiated by the Premier in a statement made in the House. The duty, no matter what other countries may do, should not be disturbed.

In an interesting article dealing with silver and exchange, the *Times of India* anticipates a great falling off in the shipments of silver to India. "In future," says that journal, "silver will scarcely be imported except for the purposes of art, hoarding, bartering, and possibly for illicit coining. The quantity that will be absorbed in the arts can hardly be large enough to interfere seriously with the sale of Council Bills. As a bar of silver weighs nearly 85 lbs., it cannot be taken to an up country railway station without attracting attention, so it will not suit the party intending to bury it underground to expose his wealth to his neighbors. It may be asked why he should not have his bar cut into pieces before taking it away from the Presidency town? The reply is that a bar which is cut up when put on the market fetches less than an entire bar, and as by settlement regulation the bar must be of nearly 2,800 tolas, the purchaser cannot resell at a considerable profit if this metal is cornered." This places difficulties in the way of hoarding the uncoined metal. As for the illicit coiners, the same authority says that they generally do their work by hand, and although expert enough at turning out imitation mogul and other native coins, they cannot imitate the milling of the rupee. The danger from this source would seem, therefore, to be rather less than was anticipated.

The advance sheets of the second volume of Rathwell's "*Mineral Industry*" quote the production of asbestos in the United States for 1893, at 120 short tons of a value of $6,000 as against 100 tons valued at $5,000 in 1892.

The adjourned annual general meeting of the members of the Asbestos Club, was held at Black Lake, Ont., on 25th inst., when the officers and council for the ensuing year were elected.

The following has being going the rounds of the Canadian press:—

"It has been ascertained that in the extraction of nickel from the matte a very valuable constituent is lost, and it was probably for this reason that some experiments made in the United States seemed to indicate that nickel plate was not likely to turn out in point of strength quite as successful as the original inventors anticipated. The American Government, however, sent an expert metallurgist to Germany, where for some six months he studied the processes there employed for the production of nickel. His investigation resulted in the discovery that to obtain the highest quality of nickel, it is necessary that it be extracted directly from the ore and without the intermediate process to which all along it has been subjected on this continent. So satisfactory have been the results under the new process that the government at Washington recently obtained from Congress an appropriation of $300,000 for the purchase of a suitable site, and it is said to be their intention shortly to erect works for the treatment of ores by the direct method, at a cost of probably a million dollars. In all probability the works will be located, as stated, near the international boundary, since the supply of ore must be drawn direct from the Canadian nickel deposits. This action of the United States government is taken in mining circles to indicate an immense revival in the very near future of the nickel mining industry in the Sudbury district. Tests made recently with plate composed in part of nickel produced by the new process have been so satisfactory that there can be no doubt that the authorities at Washington contemplate its extensive use not only for the armour of warships but for the strengthening of land fortifications as well. It may be remarked in this connection that another and perhaps even more extensive use for nickel-steel is in a fair way of being opened up by its employment in the manufacture of nickel-steel rails. Improvements in the construction of locomotives, both for speed and power have all along tended to increase the weight of the engine, and it would seem as if the only solution of the difficult problem of a more substantial rail than that produced by the Bessemer process, lies in the utilization of nickel-steel. It is expected that with this material a rail can be produced as mmch superior in strength to the steel rails now in use as are the latter compared with the iron rails which they superseded only a few years ago."

An enquiry regarding the above was sent to the head office of the Canadian Copper Company at Cleveland, the largest producers of nickel in the Sudbury district, with a view to ascertaining the truth of the remarkable statement. Here is the reply under date of 21st inst. "We know nothing about this except what we have learned from the article, but will immediately endeavor to procure authentic information about this and inform you. At the same time we have no hesitancy in saying that we think some one has been working his imagination, for we do not think our Government contemplates embarking in an industry of this kind; and further that there is no royal road to the manufacture of refined nickel as suggested in the article."

Mr. Byron N. White, one of the principals of the Byron N. White Company, operating the Slocan Star, Slocan District, B.C., reports work at the mine as follows: "Three tunnels have been driven and a fourth is going ahead rapidly. In these the ore veins had been struck with unvarying richness and increasing width. The lode averages 12 feet, with heavy companion ledges of concentrates. A fifth tunnel is to be started 500 feet lower down the mountain. Hugh Mann has completed his contract of hauling 1,000 tons from the mine to the store house at Three Forks, whence it will be shipped over the N. & S. R."

The Tacoma Smelting and Refining Co. last week received 53 car loads of ore from the Le Roi mine on Trail Creek, B.C. The ore carries four ounces of gold, six of copper, eight to ten of silver and 35 per cent. of iron, with no galena. It is excellent for smelting. Manager I. M. Payton says that the company will probably ship $1,000,000 worth of ore to Tacoma this season.

The satisfactory result of the 36 hour clean-up by the American company operating below Yale of some 17 ounces of gold, serves to prove Dr. Dawson's assertions, that the richest deposits of gold would likely be found in that vicinity owing to the widening of the river after passing through the canyons above. That Yale will again become an active mining town there now remains no doubt, and both American and local capitalists have secured every foot of available mining ground, both in hydraulic and deep workings.

Much interest is being taken in the developments of the Prince Albert Flat Hydraulic Co., situated a few miles below Yale. This company, although not one year old, are decidedly in the lead, their object being to hydraulic out the old river bed, which appears to have changed its course at that point. They are at present engaged in running an open cut some 60 feet in depth and 400 feet long, to run off their tailings, and will in a short time be into their pay ground. This company enjoys all the natural advantages for hydraulicing, having abundance of water and a comparatively light ground. It is expected that with the addition of another monitor, which they purpose putting in, they will make good returns.

The Kaslo Smelting and Reduction Company, Limited, is the designation of an organization of New Kaslo citizens, to erect smelting and reduction works there. D. C. McGregor, W. O. Clymo, J. L. Retallack, Byron White and G. O. Buchanan, are to be the incorporators of the concern.

The Consolidated Kansas City Smelting and Refining Co., of Salt Lake City, U., has a representative in the Kootenay country buying ore.

Fifty-six tons of ore from the Washington mine, Slocan, B. C., valued at $6,720, was shipped last week. The total shipments for the month amounted to 1,199 tons, valued at $69,680.

Letters from Florida indicate that the phosphate industry of that State is in a very bad way. Some of the large mines have closed down and many others are contemplating the same action. The present market price of 8d. per unit on the basis of 75% minimum bone phosphate and 3% maximum iron and alumina is altogether ruinous. Those who even get their money back are the fortunate few. In the words of our correspondent "the state of the industry is best represented by the word *chaos*."

A dividend of 3 per cent. for the year 1893 is recommended in the report of the New Vancouver Coal Mining and Land Co., Limited, which will leave £1,303 to be carried forward. "The net output for the past half year was 179,675 tons, making a total for the year of 409,696 tons. The sales for the past half year were 177,231 tons, making a total for the year of 407,869 tons. The market has continued dull, and prices have not improved.

The following new companies were registered during the month to operate in British Columbia: The North Star Mining Co., Ltd.; authorised capital $100,000, in shares of $100; head office, Vancouver. Directors: J. M. Browning, E. P. Davis, and C. B. MacNeill; operations to be in the East Kootenay district. The Canadian Pacific Mining and Milling Co., with headquarters in the city of Minneapolis, U.S.A., and a capital of $100,000.

After carefully studying the question as to whether gold nuggets "grow" by the deposition of gold from solution, Professor A. Liversidge, of New South Wales, finds that, while lumps of gold can be artificially produced in this way, those of nature in alluvial diggings have been derived from gold bearing rocks, and rounded by abrasion.

The advance sheet, summarizing the mineral production of Canada for the year 1893, has been issued by Mr. E. D. Ingall, M.E., chief of the Division of Mineral Statistics, Geological Survey. The figures given are incomplete in many respects, but are published subject to revision, which will be made in the annual report of the Division. The totals so far published indicate a production of a value of $19,250,000, as follows:—

Metallic minerals	$ 4,582,166
Non-metallic	10,922,034
Structural materials	3,469,257
Products not returned (estimated)	276,543
Total	$19,250,000

Excerpted from the above we find: Copper, $875,864; gold, $927,244; iron, $298,018; lead, $80,996; nickel, $2,076,351; platinum, $1,800; silver, $321,423; zinc, $470; asbestos, $313,806; coal, $8,422,259; coke, $61,078; felspar, $4,525; petroleum, $834,334; phosphate, $70,942; mica, $69,622; pyrites, $175,626; salt, $195,926; soapstone, $1,920; gypsum, $196,150; manganese, $14,458; precious stones, $1,500; natural gas, $366,233; ochres, $17,710; fireclay, $700; grindstones, $38,379.

The output of the Joggins Colliery is about 400 tons per day. A new lift is to be sunk at No. II, which will carry the slope down to 2,700 feet, its present depth being 2,300 ft. The coal to the deep is said to be improving, and the clay has thinned down to 20 inches. Three hundred persons are on the pay sheet.

Further evidence of the Halifax *Critic's* ignorance of all that pertains to Canadian mining affairs is to be found in its last issue, where it informs its rapidly diminishing circle of readers of the doings in Ontario of what it calls the "English Fertilizing Co." and the "Canada Plumbago Co." Needless to say no such companies exist. Possibly the items may be intended to refer to the work being done in *Quebec* by the Phosphate of Lime Co. (Ltd.), and the Walker Plumbago Mining Co. As we expected from one so adept in the use of the scissors, due prominence is also given, without credit as usual, to the clipping from the daily papers containing that sensational nickel yarn, repudiated as a myth elsewhere in this issue. The *reductio ad absurdum* is reached, however, when it gravely announces the startling discovery of gold at *Brandon, Manitoba?* This erratic, irresponsible and unreliable sheet certainly maintains its monumental reputation for idiotic utterance.

The first shipment of baryta from the property now being opened on McMullen's Island, near Port Arthur, was made to Duluth this month. The deposit is said to be large.

A meeting of the shareholders of the Middle River Alluvial Gold Mining Co., was held at Pictou, the 16th inst., when the following directors were appointed: Capt. Watt, Dr. Wright, A. D. Ross, E. G. Treen, G. W. Fraser, G. G. Copeland, of Antigonish and Jas. McLeod, of Westville. The company is incorporated and was to commence work about the 1st instant.

Application for charter of incorporation under the statutes of Nova Scotia, is made by the Wine Harbor Gold Mining Company Limited. Authorized capital, $160,000. Directors: T. G. McMullen, A. S. Archibald, H. T. Harding of Truro, and Jas. T. Kirkpatrick, of Shubenacadie. The property is at Wine Harbor, N.S., and the promoter is understood to be Mr. H. T. Hardng, of Truro.

The following table shows the number of acres of mineral lands sold in Ontario, and the prices realized by the Ontario Government therefrom, during the past seven years:—

Year.	Acres sold.	Amount of Sales.
1886	21,460	$30,125
1887	27,098	46,629
1888	33,174	62,620
1889	30,226	55,828
1890	41,462	78,085
1891	45,594	89,207
1892	5,440	13,366
1893	3,625	10,141

The *Coal Trades Journal*, in a recent issue, contains a long article on the coal trade of Winnipeg. The past season, it says, has been much milder than the average, and the sale of coal has suffered accordingly. There have been shipped of Pennsylvania antharcite to Winnipeg and tributary territory, 27,000 tons, the greater proportion of which comes via Fort William. In addition to this coal the Canadian antharcite coal from Antharcite, 917 miles west of Winnipeg, has become an active competitor with the United States article. The rate over the Canadian Railway for the 917 miles is $5, with a substantial rebate, while the rate from Fort William for Pennsylvania coal is $3 net for 423 miles. It is estimated that there have been shipped this season 18,000 tons of native coal, 7,000 of which were consumed in Winnipeg. The Alberta Railway and Coal Company, with mines at Lethbridge, mine a large quantity of "Galt" coal, which has almost entirely taken the place of United States soft coal as a steam producer. They ship largely over the Great Falls and Canada railway, way to points south of the boundary, and it is estimated their tonnage to Montana is 25,000 tons; to points west of Dunmore, the junction with the Canadian Pacific railway, 5,000, and to points east of Dunmore, 15,000. This is exclusive of the coal they sell the Canadian Pacific railway, which will reach 60,000 tons. In addition to this, the Canadian Pacific railway brings to Fort William for use east and west of that point 11,000 tons of Pittsburgh soft coal.

Our remarks elsewhere respecting the sensational nickel story have been confirmed by a further communication from Mr. H. P. McIntosh, Sec-Treas. Canadian Copper Co., Cleveland, Ohio., received just as we go to press. He says:—

We have to inform you that we referred your inquiry to Com. W. F. Sampson, Chief of the Bureau of Ordnance, Washington, D.C., and to-day are in receipt of his reply as follows:—

"Referring to your letter of tha 21st instant: So far as this Bureau is informed, no such action as that described in the clipping from the "Toronto Empire" has been taken, nor has the Government in contemplation anything of the kind."

We regret to hear that owing to the depressed state of the phosphate market the British Phosphate Company, Limited, have decided to suspend mining operations on the River Du Lievre for the present. They are therefore disposing of a large quantity of well selected mining machinery and plant (see advt.) which from personal knowledge we are able to state is in first-class condition.

CORRESPONDENCE.

Importation of Mining Machinery.

The Editor:

SIR,—We have read the leading article of your January impression with astonishment. We are wholly unable to understand why an article in the Canadian *Manufacturer* should be made a text for a broadside attack upon Canadian manufacturers of mining machinery, or for flings and sneers at their products. We have done nothing to merit such treatment, but on the other hand, we have seen protection entirely swept away from us, and in our own judgment, have been as meek as lambs under the process.

Under the construction of the Mining Machinery Act which has prevailed, mining machinery manufacturers have no protection whatever, and this it is idle to deny. If every American or European mining machine bearing a different name plate from those made in Canada is to be admitted free, it is simply puerile to claim that Canadian manufacturers are protected. As to the wisdom of this course in its relation to the welfare of the country at large, we will not argue, but the fact no candid man can fail to see. Meanwhile, we are taxed upon every pound of material that enters our products, and upon every pound of coal that goes into the cupola or under the boiler, and we are thus taxed for the benefit of Canadian mining interests. Under these circumstances we believe we have a substantial grievance.

We say here, as we have always said, that what we believe to have been the intent of parliament in passing this Act, has, and always has had, our cordial sympathy and support. We say freely and frankly that if the miners of Canada cannot supply their legitimate needs at home, they should be allowed to supply them from abroad, without being taxed in doing so, but we do not believe they should be allowed to import free of duty any machine they see fit, provided only it bears a different name plate from those made here. On this point you differ from us, but we have no quarrel with you for this or any other difference of opinion. Our count against you is, that without cause you have deliberately endeavored to discredit our products, and to excite opposition to us amongst our customers.

Your statement that Canadian miners prefer to buy at home because of convenience of inspection, is simply a manifestation of ignorance. Not one in twenty of our machines is ever inspected before shipment. Our goods are bought on the makers' guarantee, which would indicate that Canadian miners have some confidence in us, if you have not. Your talk about our "easy profits" and "abundant custom" is rubbish, and again shows ignorance of the facts.

While we have never hesitated to express our views regarding the construction of the Tariff Act, we have carefully and consistently refrained from entering upon any controversey over it. We recognize that the miners are our customers, and, we believe, our friends, and we have considered that their good will was worth far more to us than any concession that might be obtained after acrimonious controversy. This, as we believe, enlightened and liberal policy, will however, come to naught, if such articles as the one opening your January impression are to continue.

We have thus refrained from controversy in the past, and it is not our purpose to enter upon it now. Whatever you may say, we shall pursue the subject no further, but as patrons of your paper, we ask you to publish this remonstrance in your next impression, and with it, a retraction of the reflections upon us and our products.

(Signed.) THE JENCKES MACHINE CO.
S. W. JENCKES.

INGERSOLL ROCK DRILL CO. OF CANADA,
E. W. GILMAN, Sec. and Man.

CANADIAN RAND DRILL CO.,
F. A. HALSEY.

MILLER BROS. & TOMS.

THE NORTHEY MANUF'T'G CO. LTD.,
H. S. PELL, Secy.-Treas.

JOHN BERTRAM & SONS.

[We cheerfully give space to this letter. In justice to ourselves and in fairness to our correspondents it should be explained that during the illness of the editor, the article in question, which was intended to be published as a signed contribution from one of our mine managers, inadvertently found space among our editorial comments. As our readers are well aware, it is very far from the policy of the REVIEW to publish anything that might be regarded as a slur upon our Canadian manufacturers or their products, and we take pleasure in publishing this explanation together with an expression with our regrets at the unfortunate occurrence.—EDITOR.]

THE IRON TARIFF.

Lively Discussion in the House of Commons. Verbatim Report of the Proceedings.

(In the Committee.)

"Wrought scrap iron and scrap steel being waste or refuse wrought iron or steel, fit only to be re-manufactured, the same having been in actual use, not to include cuttings or clippings which can be used as iron or steel without re-manufacture, and steel bloom ends and crop ends of steel rails, three dollars per ton; and on and after the first day of January, eighteen hundred and ninety-five, four dollars per ton."

HON. MR. LAURIER—We expect from the Minister of Finance some explanation of this increase of 100 per cent. on the heavy duty which was put on five or six years ago. I would remind the Minister of Finance that when he made his Budget exposé, he merely stated what his intention was, but never gave any reason for the change of policy he intended.

HON. MR. FOSTER—I regret very much that I am not physically very able to moke explanations to-day. I forget almost what I did say in regard to the matter in the Budget speech.

HON. MR. LAURIER—Nothing.

HON. MR. FOSTER—I have no doubt it was, as usual, something very wise and pithy. What the hon. gentleman asks me now is as to the reason for the increase on scrap. That probably necessitates a few words on the general subject. What the Government had to face, in considering the iron and metal schedules, was, in brief, a very general demand for a lessening of the cost of merchantable iron, such as is used in the different subsidiary but very widely distributed industries founded upon pig iron, puddled bar, and bar iron, but especially upon the latter. The price of iron entering into these industries was thought to be high—too high to make it possible to reduce to any extent the protection which these industries had; and the problem to solve was to make this commodity cheaper, and at the same time not to destroy the development of the iron resources of the country, which in 1887 had a large protection granted for their development. The only way the Government could see of bringing these two things about was to adopt in part an extension of the system of bounty which should compensate the iron industry for the lessening of the protection upon bar iron and steel and puddled bar. So it was decided to keep the bounty system as applied to pig iron, and also to leave the protection given to pig iron, and then, in working up to the bar iron, to grant a reduction upon puddled bar and afterwards a reduction upon bar iron. Ever since 1887, although there has been a fairly strong protection in customs duty added to the bounty on pig iron, unfortunately the door was left open in the allowing of scrap to come in at a duty of $2 per ton, whilst puddled bar had a customs duty of $9 per ton. Chiefly, I think, for that reason, this fact seems to be clear, that, although from 1887 up, for a number of years, the iron industry, in regard to the making of pig out of the iron ores of the country, developed fairly well, and during the last three years has developed largely, I may say rapidly; yet the process stopped at that point, instead of being carried from the pig iron to the puddled bar, and from that to the bar iron, and bar iron came to be made almost entirely, and in the last two years I may say entirely, from scrap instead of from puddled bar. This had a bad effect in two respects. It discouraged the working up of iron from the pig into the puddled bar; it placed scrap where puddled bar should have been; and it also had a bad effect upon the iron of the country, because it is impossible to make a good quality of iron, of certain sizes and kinds, out of scrap, and for that reason a great deal of bar iron had to be imported. It was felt necessary, therefore, that this should be stopped; and the only way to do that was to raise the duty on scrap, so that there might be inducements to make puddled bar from pig iron, and thereby obtain a better quality of iron. After all, while there is a certain amount of scrap which is a good and in some cases an unused iron, it is in most cases, as everybody knows, a used iron, having been used twice over, often a dozen times; and all authorities go to show that after iron has been worked and reworked a number of times, it loses its vitality, its strength and its fibre; it is too dead for a good many processes, and a proper quality can only be successfully obtained by the use of puddled bar or an admixture of puddled bar. So that the Government had these three things in view; first, to keep the protection and encouragement which was necessary for the iron industry as a whole; in the second place, to reduce to the makers of iron materials the cost of their bar iron and steel which were their raw materials; thirdly, the working of pig iron from ore, and from that into puddled bar and bar iron. This latter process it is proposed to encourage by increasing the duty on scrap, making the transaction as easy as possible, by raising it by $1 a ton to the end of the present year, and thereafter having a uniform duty upon it of $4 per ton. This, it is hoped, will induce the maufacture of puddled bar from the pig, and the better kinds of iron from the puddled bar. It will not, however, make it necessary that the refuse iron, a great deal of which we have in this country, which every country has, and which ought not to be allowed to go to waste, shall be allowed to go to waste. A large proportion, probably one-third of the scrap which is worked up into iron in this country, is domestic scrap. That is increasing from year to year, and though there may not be an importation of scrap—it is not probable that there will be a large importation of it—there will yet be a large quantity of scrap iron in the country, which will be made up by the rolling mills, and which will supplement the puddled bar in the making of a higher and better class of iron. I do not know that I have anything more to say upon this special point at the present time. I shall be happy to give any information I can as the debate progresses.

HON. MR. LAURIER—I am sorry that the hon. gentleman is not in his usual state of health, because apart from the general sympathy that we all feel with him, there is no part of this tariff that his ingenuity would be more required to defend than the iron duties. There is nothing, in my estimation, which shows more clearly the fallacy and danger of a protective tariff than the increase which the hon. gentleman is now making in the duty on scrap iron. Everyone remembers that five or six years ago the duties on iron were remodelled by the then Finance Minister (Sir Charles Tupper) with a great flourish of trumpets. His object, he declared, was to develop the iron industry to an extent of which the country had no conception. We were to have charcoal furnaces and iron furnaces, and two hundred thousand men at least earning a living out of the smelting of iron in this country. That was why such an onerous duty was put upon scrap iron at that time. To-day, after six years' experience, far from having realized these expectations, the Government admit their failure by coming down for more duty. The protection then given was not sufficient.

HON. MR. FOSTER—We are coming down for less duty.

HON. MR. LAURIER—Not on scrap iron.

HON. MR. FOSTER—It is not used by anybody for making articles.

HON. MR. LAURIER—Then why not leave it as it is? If the hon. gentleman will give us the details of the numerous interviews he had with different persons during the recess, he will be forced to tell us that there were remonstrances from day to day against the increase of duty on scrap iron. If he will be candid and tell us about the interviews he had with those who use iron in their manufactures—and their name is legion—he will have to admit that he had remonstrances from all these against the duty on scrap iron. I am sure he must have had the most active and vehement remonstrances from the manufacturers of agricultural implements. He has decreased the duty on agricultural implements from 35 to 20 per cent., and of this I do not complain. But the manufacturers have remonstrated with the Government, on the ground that while reducing the duty on the finished article they increased it on the raw material.

HON. MR. FOSTER—Quite the other way.

HON. MR. LAURIER—If the hon. gentleman has been informed the other way, his information is altogether at variance with that I have received. I have heard vigorous complaints on the part of the manufacturers of agricultural implements. They complain that they are hit both ways—in the first place, by the reduction of the duty on the finished article, and then by the increase on their raw material. The hon. gentleman says that raw scrap iron is not used. What then is the object of raising the duty? He must see that such a reason cannot be accepted by the country.

HON. MR. FOSTER—My hon. friend must certainly be mistaken. If there is any point in his argument it is this: that while we have lowered the duty on agricultural implements from 35 to 20 per cent. we have raised the duty on the raw material. We have done nothing of the kind. The manufacturers of agricultural implements do not use scrap iron. They use pig iron, and on that there is no increase of duty. They use steel, and upon that there is a reduction of $2. They use bar iron, and on that there is a reduction of $3 a ton. There is no iron product, outside of pig iron, which goes into the manufacture of agricultural implements that has not been lowered, so far as the duty is concerned. The only men who have a quarrel with the increase of duty on scrap iron are those who roll the scrap into bar iron, but that is their quarrel, and not the quarrel of the agricultural implement men, because the latter benefit by the reduction of $3 per ton on the bar iron which is made out of the scrap. So that the raising of the duty on scrap iron, though it may be argued by certain persons as a hardship, cannot be a hardship to the men my hon. friend is speaking for, because it does not make any difference to them whatever.

MR. MULOCK—Was not a request made that all iron should be put on the free list?

HON. MR. FOSTER—They would like to have bar iron and steel free, of course, but that has nothing to do with this argument.

MR. McMULLEN—The whole question of the duty on iron is an exceedingly important one. I can well remember the manner in which the question of increased duty was brought before the House by Sir Charles Tupper, when that hon. gentleman was Minister of Finance. We were then promised a very large and desirable development of our iron industries. We have not experienced any thing of the kind. The fact of the matter is that the duties then imposed for the purpose of developing our iron resources have fallen very heavily upon the consumers of iron, of which the farming class is the largest. If we are anxious to develop our iron resources we should do it entirely by a bounty and not by the imposition of duty. In the United States they did it almost entirely by bounty, and the result was that the tax did not fall entirely upon the consumers of iron, but on the whole population. The man wearing a broadcloth coat and a tall hat paid his percentage of the duty just as well as the farmer who used the iron. If it is considered a national necessity that we should develop our iron resources, let us do it at the expense of the whole community and not at the expense of of any particular section of it. All classes, of course, use iron to some extent, but the great consumer is the farmer. If the hon. gentleman would remit the duty or fix it at the lowest possible rate, consistent with the necessities of the country, and then grant such a bounty as would secure that industry the necessary encouragement, there could be no objection to his course. But to levy the duty on those who consume the iron and then allow the others to go scot free, is an unfair method of proceeding.

HON. SIR CHARLES HIBBERT TUPPER—I would like to mention that the farmer has not complained so very much about the effect of these duties. When the last iron furnaces were built—the Ferrona iron furnaces in Pictou—pig iron was selling at $32 a ton in Toronto. Since those furnaces have been at work, whether on that account or not, that article is now selling at $15 a ton, so that there could not be a very great complaint with regard to the burden of these duties. There has been an extraordinary drop in iron.

HON. MR. MILLS (Bothwell)—Mr. Chairman, hon. gentlemen on the Treasury benches some years ago put up the duty on pig iron to a very high figure in order to encourage the production of pig iron in this country. They left the scrap iron duty at a lower figure than that upon pig iron, which is a coarser article. I suppose the idea was not to interfere with the rolling mills. Well, the rolling mills now import a good deal of scrap iron, and the producers of pig iron complain, and so the Government find themselves between the deep sea and a certain party whom I need not name, and they are obliged to legislate now against the rolling mills so as to allay the complaint of those who are engaged in producing pig iron. The hon. gentlemen said that the scrap iron produced is not of very good quality. I daresay that is the case. When you have English iron and Swedes iron, and American iron, soft iron, hard iron, tough iron and brittle iron, all mixed together and rolled out into a new bar, you have iron of a very unequal hardness, and very unequal tenacity, and, thus, not a very good article for use for many purposes. The hon. gentleman still adheres to the idea of helping by undue taxation those who are engaged in the production of pig iron. Now, the hon. gentleman can stimulate the manufacturing interests of this country a great deal more by giving them an opportunity to get iron at a reasonable figure than by keeping up taxation that enormously increases the cost of the iron, and then the hon. gentleman says it does not increase the price. Then what is it for? What is the object of this taxation? Let any one compare the prices of pig iron in Scotland with the price in Canada, and he will see whether this duty increases the price or not. The hon. gentleman, if he looks at the figures, will see that the price here is enormously greater than in Scotland, and the reason is the existence of this duty. If the hon. gentleman had decreased the duty on pig iron, he could have done a good deal to help the iron manufacturers and could have enabled them to enter into competition with their neighbours over the way, and he could have granted reciprocity in these articles with perfect safety and in the interests of the manufacturing classes. The hon. gentleman is vainly striving to establish an industry in this country which is altogether in advance of the accumulation of capital here, and the general circumstances of the population.

HON. SIR CHARLES HIBBERT TUPPER—Does the hon. gentleman happen to remember—I ask for information and because my own recollection is not clear—what is the price of the Scotch iron? I think there is not very much difference in the prices here and the prices in Scotland.

HON. MR. MILLS (Bothwell)—There is some six or seven dollars a ton difference.

HON. SIR CHARLES HIBBERT TUPPER—I am quite sure it is not so much as that.

MR. MACDONNELL (Algoma)—The difference in reality to-day, taking the price at the city of Hamilton, or the city of Toronto, is $2 a ton.

MR. MULOCK—Between what two points? I did not understand the hon. gentleman.

MR. MACDONELL (Algoma)—Scotch or American iron—the difference is about the same. The question that appears to be at issue between the two sides of the House is this: Whether there shall be no protective duty on pig iron, or whether the Government shall give that protection to the iron industry that all parts of the country feel at this time is absolutely necessary for our success and welfare. Now, Sir, if we look at the history of the iron industries of the various countries of the world that have become prosperous and influential and important through their production of iron, I think our hon. friends opposite cannot but agree with us on this side of the House that the iron industries of the Dominion of Canada should have that protection that is absolutely essential to make them what they should be, the producers of, as nearly as possible, the quantity of iron that our people consume. What is $2 per ton bounty or $4 per ton duty on pig iron, or what is a bounty on pig iron if we can succeed in establishing these industries that will employ labour, give a market for the produce of the farm, add materially to our national wealth and prosperity, and advance the interests of the whole country? When we think of the results to be achieved, the question of a duty or a bounty such as has been given, is seen to be a comparatively trifling one. Let us look at the history of the countries that I speak of. In Great Britain, during the days of protection, when the iron industries of that country attained that magnificence that they have held ever since, the import duty was from 130 to 140 shillings a ton. If our hon. friends who are always pleased to look to the other side of the line for an example of what we shall do, will examine the history of the United States, they will find that the duty on iron has been from 30 per cent. ad valorem up to $9 per ton, varying according to the desire of the people to afford protection to these industries. I do not wish to take up the time of the committee with a long explanation of these things. No doubt we shall have an opportunity of discussing the subject at greater length, and discussing it more intelligently. I can only say that I am glad to see the Government lay down the principle that the iron industries of the Dominion of Canada, in which every province in the Dominion is interested, the development of which will enable every province to add to its wealth, shall be encouraged. The Dominion of Canada consumes yearly about 600,000 tons of iron, of which we are obliged to import more than four-fifths in value, notwithstanding that we have the ore and the different kinds of ore that are necessary to mix together in order to make the very best quality of iron that can be made—stated by experts to be equal to the best Swedes iron—we have the coal in the east, and, in the west, illimitable forests of timber, suitable for the production of charcoal. When we take these things into consideration, the opportunity that awaits us is manifest. If we made but one-half the quantity of iron consumed in the country, we should add at least $20,000,000 to our national wealth. We should spend $5,000,000 in wages that would go into circulation, helping not only the artisan actually engaged in the production of the material, but helping, also, the farmer and those engaged in cutting and hauling the wood, and giving such an impetus to business as would benefit all classes. But already the development of the iron industry is surprising. During last year we produced something over 55,900 tons of pig iron. But there is one thing that retards the development of this industry, and that must retard it so long as this unfavorable condition exists. Considering the uncertainty that has existed with regard to the encouragement to be given to the iron industry, considering the changes that might take place on account of commercial union or continental free trade, or unrestricted reciprocity, how can we expect that any capitalist will invest his money in this country to establish such an industry? Until the question of the iron duties and bounty is put upon such a basis, so that there can be no doubt whatever in the minds of capitalists, we cannot look for them to invest their money in this country. There is an immense field for capitalists if they would only come in, but with the uncertainty I have spoken of, there is no chance in the world, to my mind, that we are going to get capitalists to come in and engage in this industry, from the old country, or even from the United States, where they have a mint of money now invested in iron industries. I am sure that if our friends on the opposite side of the House went to their constituents and consulted them on this matter, they would receive but one answer. The reason is that for every ton of pig iron produced in the country, the quantity of labor involved in that production is so great that a greater amount of money paid is for labor, and goes into general circulation, than perhaps in connection with any other article manufactured in Canada. So I feel that instead of lowering the duties, or the bounty, on this material, the Government should increase it. Now, one word with regard to scrap iron, the article now under discussion. Scrap iron has undoubtedly been brought in by the rolling mills people. Why? Because up to this time we have not produced, for the reasons I have mentioned, the iron that is necessary to be used in the rolling mills; consequently, their rolls, as I understand, were made for that purpose. But every ton of scrap iron that came into this country and did not pay one dollar to the national wealth of the conntry, dispossessed just that much pig iron that should have been manufactured in this country and have gone into general consumption.

Mr. Casey—The hon. Minister must be aware that in increasing the price of the raw material out of which other classes of iron are made, he must increase the cost of the production of these articles. If he has taken off protection from the finished articles made out of scrap or pig, such as rolled bars, he must, of course, do so at the expense of the manufacturer of these articles. It happens that upon this tariff becoming known, the rolling mills in the city of Hamilton were compelled to call upon their workingmen to take reduced wages, and a strike of several hundred men occurred in consequence, the owners giving the change in the tariff as the reason for having to reduce the wages. The strike, I believe, has been settled since, the men having accepted the reduced wages—so far as I have seen in the papers. It certainly appears strange that a Government which professes so strong a desire to help the laboring man, should in this case have reduced his profit to that extent. But the hon. Minister was mistaken in saying that the amount of scrap iron imported was inconsiderable.

Hon. Mr. Foster—I said it probably would be, after this duty was imposed.

Mr. Casey—I think the Minister is probably right in that assumption, it will probably prove to be a prohibitory duty. But the quantity of wrought scrap imported last year was 15,000 tons, about half the amount of pig iron produced in the country. Although my hon. friend from Algoma (Mr. Macdonell) stated our production last year was over 50,000 tons, I find that bounty was paid on only 30,500 tons of pig iron produced in Canada during the fiscal year ending last June, and I prefer to take that estimate of the quantity. Now I find that the ad valorem effects of the old duty on wrought and cast iron, lumping them together, amounted, in round numbers, to a taxation of 16 per cent.; that was at the rate of $2 per ton. The $3 per ton rate will amount to 25 per cent, and the $4 per ton rate will amount to 33 per cent. Now, Mr. Chairman, fancy a Minister who says that he wishes to allow raw material to come in free of duty, or at low rates, for the purpose of manufacture, taxing the raw material to the extent of 33 per cent. He tells us, of course, that his object is to encourage the pig iron industry. All I wish to say about that now is that in the year in which Sir Charles Tupper made the changes in the iron duties which were intended to encourage that trade, and when he made the prophecies which he then made, the production of pig iron was 39,800 tons, on which bounty was paid, whereas, during the last fiscal year it was only 30,500 tons. So that Sir Charles Tupper's attempt to increase the amount of pig iron made in the country resulted in a diminution of over 8,000 tons in the amount produced, with the additional cost to the country of a great many thousand dollars by the increased duty and the increased bounty which he then imposed. My hon. friend the Minister of Marine thinks this duty on pig iron won't increase the price. We must quote to him his master in this connection; undoubtedly the Finance Minister is his master in dealing with a question of this kind. He says:

"Another objection which has been made to the National Policy and to the protective principle in it, is, that the cost of many manufactured goods has been enhanced to the consumer on account of the rates imposed. Now, sir, I grant that argument at once to a certain extent."

Then he goes on to say that in the initial years of a protective policy this would be the case:

"I say that in the initial years of a National Policy with a protective principle in it, will have the effect of enhancing the cost of goods, and that at the first the cost of goods will be very closely up to this measure of the protection which was given. If it does not have that effect, why should it ever be adopted at all, and what is the good of it?"

The very answer made to the Minister of Marine and Fisheries by the hon. member for Bothwell (Mr. Mills.) What is the use of a protective tax on those articles if it does not raise the price? That is what is wanted. There is no use pretending that prices will be reduced by increasing the tax on the imported article. The Minister of Marine says that before the last manufactory, the Ferrona, was started in Pictou County the price of pig iron in Toronto was $22 per ton, and now it is down to $15.

Hon. Sir CHARLES HIBBERT TUPPER—A little over.

Mr. CASEY—During what length of time?

Hon. Sir CHARLES HIBBERT TUPPER—Recently.

Mr. CASEY—How long a time between the two prices?

Hon. Sir CHARLES HIBBERT TUPPER—I think a couple of years.

Mr. CASEY—In a number of years we reduced the product of pig iron, and the prices also fell in spite of the protective duties. If that be the case, it must be that the price of iron has fallen tremendously all over the world, and that the price in Canada has been compelled to fall in sympathy, notwithstanding the protection afforded both by duty and bounty. The hon. gentleman cannot claim that any advantage arises either from the new companies or from the duties, because these have not increased the product of pig iron, which is the only way that prices can reduced.

Mr. MACDONELL (Algoma)—Where did the hon. gentleman get his figures in regard to the product of pig iron?

Mr. CASEY—Out of the Auditor-General's report, from the statement showing the amount paid out for bonus.

Mr. MACDONELL (Algoma)—The hon. gentleman's figures are inaccurate. The figures I quoted were from a statement as to the mineral productions of Canada.

Mr. CASEY—That statement does not cover the same period.

Mr. MACDONELL (Algoma)—The statement from which I quoted shows an output of 75,000 odd tons for the year.

Mr. CASEY—That is not for the fiscal year.

Mr. MACDONELL (Algoma)—It is for the full year; it is stated that was the product of the year 1893.

Mr. CASEY—That return was not for the fiscal year, in the first place. In the second place, it is admitted that those returns are not invariably accurate, whereas the returns for the amount paid for bounty are accurate, as a man is not likely to produce a ton of pig iron and not claim bounty.

Hon. Sir CHARLES HIBBERT TUPPER—It will be of importance to the committee in considering the whole question that they should be furnished with an accurate statement of what the furnaces are doing. The returns of the officers of the different companies for the current year, 1893, (Canadian Mining Review) show the following:—

Company.	Situation of Furnace.	Quantity of Pig Iron manufactured.	Value at Furnace.	Total Ore Charged.	Quantity of Fluxing Material.	Quantity of Fuel Charged.	Number of Persons employed.
		Tons.	$	Tons.	Tons.	Tons.	
Londonderry Iron Co. (Ltd.)........	Londonderry, N.S..	23,474	275,366	56,390	13,500	34,484	400
New Glasgow Iron, Coal and Railway Co. (Ltd.)	Ferrona, N. S......	22,500	270,000	44,856	12,890	30,846	480
Canada Iron Furnace Co. (Ltd.)......	Radnor Forges, Que.	7,422	185,575	16,700	1,680	750,000 Bush.	600
Pictou Charcoal Iron Co. (Ltd.)......	Bridgeville, N.S....	*498	not given	853	124	68,220	100

*It should be stated that this Company only resumed operations towards the end of the year, and the furnace was only in blast for a few months.

I desire to add, as my remarks in reply to the hon member for Bothwell (Mr. Mills), touching the extraordinary results as regards prices go, may have been misunderstood, that I did not mean at the time to state that the effect of the duty was to reduce the price, or would reduce the price, but I remarked that the result had been, no matter what the cause, an enormous reduction in a very short time since the erection of the last iron furnace in Ferrona, I mentioned that, according to my information, there had been within a short time a drop from $22 to about $15 in Toronto for the same class of pig iron.

Hon. Mr. MILLS (Bothwell)—I have looked at the Economist,' and I find the price of Scotch pig iron was 42 shillings 10 pence, or $10.50 a ton, which is $4.50 less than here.

Hon. Sir CHARLES HIBBERT TUPPER—I am glad the hon. gentleman has mentioned that price, for it is about the price at which it is selling in Nova Scotia. I have found the authority on which I based my statement in the Mining Review, a journal given to investigation of prices and mining matters, it is stated no later than March this year, as follows:—

"It is satisfactory to know that pig-iron can now be produced and sold in Nova Scotia"—Not in Toronto, where I gave the price at $15—"at prices quite as low as the same grades of Scotch iron are sold in the centre of the Scotch iron trade, Glasgow."

That is a very extraordinary and gratifying statement.

Mr. MULOCK—I should like to ask the hon. Minister of Marine, and also the hon, member for Algoma (Mr. Macdonell), whether I understood them correctly. I understood the hon. member for Algoma to give certain prices, and to state that the price of pig iron in Toronto is not more than $2 per ton greater than Scotch manufactured iron at the same point?

Hon. Sir CHARLES HIBBERT TUPPER—I said nothing of that kind.

Mr. MULOCK—I am sorry that the hon. member is not in his seat, for I think he is in error on that point. The hon. Minister has mentioned that in Nova Scotia pig iron is now produced at about the same price as Scotch pig iron in Glasgow. A short time ago, since the duty was under consideration, a delegation of iron men came to Ottawa, and I was informed by one of the largest iron users in Canada that it is possible to lay down pig iron from Alabama in Toronto at $5.50 per ton cheaper than Nova Scotia pig iron could be sold there. I asked if the cause of that difference was cheapness of production?

Hon. Sir CHARLES HIBBERT TUPPER—It was due to demoralization, I think.

Mr. MULOCK—He told me that pig iron was produced in Alabama at over $2 per ton less than in Nova Scotia, and that the rest of the difference was made up in freights which were against Toronto. He was a practical man who gave me the information. No doubt the hon. Minister has heard the same statement.

Hon. Sir CHARLES HIBBERT TUPPER—Hear, hear.

MR. MULOCK.—It was not an individual statement, but it was the statement of the trade, and I suppose the Minister of Finance had that communication made to him in connection with the deputation that came to Ottawa to press that pig iron be placed on the free list. If that information is correct, the hon. Minister is quite incorrect in his figures that pig iron is now produced in Nova Scotia as cheap as elsewhere.

HON. SIR CHARLES HIBBERT TUPPER—I was careful to specify only the price in Scotland. I did not refer to a market that is demoralized: I did not refer to the United States where many of the iron furnaces are stopped altogether, and where there exists a very serious and extraordinary condition of affairs. The *Globe* the other day summed up the situation very well in the reference it made to the condition of the United States market. It said:—

"The prices for all descriptions of iron and steel are away below any prices ever dreamed of. There is apparently no room for further reduction in prices without going below the cost of manufacture."

No doubt if we wished to destroy our iron industry here we could get cheaper iron, probably from the United States. It would, however, in my opinion be cheap only for a very short period, and the only point of my reference was that the reduction here, without creating any extraordinary disturbance in Canada, had been such that we could compare favorably with an old established industry which is not demoralized, and that is the iron industry of Glasgow.

HON. MR. DAVIES (P.E.I.)—If the hon. gentleman is correct in his figures, he desires to leave the impression on the House that pig iron is now produced and sold in the province of Nova Scotia for the same price as pig iron is bought in England and Scotland.

HON. SIR CHARLES HIBBERT TUPPER—In Glasgow.

HON. MR. DAVIES (P.E.I.)—So that if any one imported from Glasgow he would have to pay in addition to the cost price, the freight and duty.

HON. SIR CHARLES HIBBERT TUPPER—Yes.

HON. MR. DAVIES (P.E.I.)—Then how is it that we imported from Great Britain last year 31,308 tons of pig iron, which were valued at $346,000, and on which we paid a duty of $135,250?

HON. SIR CHARKES HIBBERT TUPPER—The hon. gentleman will see that a great deal of the answer would be based on the fact that the furnaces were not running at that time. The furnace to which I referred had just been started, and they had not got well on their feet. I wish to be thoroughly frank with the hon. gentleman. It may be said: if Scotch pig iron is so low, and you can make the article in Nova Scotia at the present moment at something like the same cost as they do in Scotland, what do you want with protection? The answer is, that this comes out in ballast, and it can be put on the Canadian market at the present time for a mere song as regards the freight. The difficulty with the iron trade in Canada was the transport to the markets, but its price of course fluctuates greatly. Nevertheless, the point was fairly made, that we had reached in March that condition of affairs where the protection was absolutely essential to the Canadian manufacturer in connection with the extraordinary small charge for the transport of the Scotch pig to the market here.

HON. MR. LAURIER.—The only point made by the hon. gentleman is simply this: That in the opinion of some man, at a certain time, pig iron in Nova Scotia would sell at about the same price as it sold in Glasgow. The hon. gentleman will not go to the length of saying that that is the normal rule.

SIR CHARLES HIBBERT TUPPER.—No; I am not able to.

HON. MR. LAURIER.—Then if it be the exception what is the value of the point?

MR. McMILLAN.—The Minister told us that the farmers of the country did not complain of the high duties placed on iron and of the high duties they were paying on their implements. He does not know the feeling of the farmers or he would not make such a statement in this House. I know the feelings of the farmer, and I know that their grumblings are long and loud, and justly so. I heard the same statement from one of the gentlemen in connection with the iron exhibit in the corridor of the House at the commencement of the session, that they manufacture pig iron in Canada as cheaply as they can in my native country, Scotland. If that is the case, why impose a duty of $4 a ton and give a bounty? It is time, in view of that condition of things, to relieve the people of the heavy burthens placed upon them in this matter. I hold that the Government cannot defend their position with regard in this matter. Iron in Scotland is about $10 a ton, or something under, and if it can be produced for $10 a ton in Canada, why is the duty $4 a ton and the bounty of $2—$6 a ton upon an article that is only worth $10? I hold that the Government should reduce the duty on pig iron, even if they retain the bounty. I do not believe in either the bounty or the duty, but let them retain the bounty for a time if they will, in order that the pig iron manufacturers might have the advantage for a certain length of time.

MR. CASEY.—I did not understand the Minister of Marine distinctly as to whether the figures which he gave were the prices at which iron was sold by the manufacturers, or whether they represented the cost of production.

SIR CHARLES HIBBERT TUPPER.—If the hon. gentleman will come over to my seat, I will tell him all about it. It is not interesting to the public at the present moment.

MR. CASEY.—Oh, no. I want the information publicly, as it is a matter in which the public are interested.

SIR CHARLES HIBBERT TUPPER.—It would be a waste of time to repeat statements over and over again. I will very gladly discuss it with the hon. gentleman, if he wants the information, and the committee can proceed with its business.

MR. CASEY.—I want the information openly. The Minister did not make it clear whether he gave the cost of production or the selling price. The hon. gentleman says that it does not interest anybody to know which he meant. I do not suppose it would, as far as his own personal opinion on the matter goes, but as he professes to speak from authoritative figures, it is interesting to know all about it.

SIR CHARLES HIBBERT TUPPER.—I think the hon. gentleman will have to ask some one to move the adjournment of the House.

MR. CASEY.—I do not think so. The hon. Minister says he will give the information privately in his seat.

SIR CHARLES HIBBERT TUPPER.—Or outside.

MR. CASEY.—That will not do. I want the statement made publicly in the House. I want the Minister to make the statement clear with regard to this.

SIR CHARLES HIBBERT TUPPER.—I have stated it twice.

MR. CASEY.—The Minister has not. The figures he gave were, 23,474 tons, valued at $275,000. He has not stated whether that is the cost of production, or whether they are ready to sell it for that.

SIR CHARLES HIBBERT TUPPER.—That is what they charge at the furnace.

MR. CASEY.—We have that part of the information at last, but we do not know what the cost of production is, and what profit they make. The manufacturer has $2 a ton bounty, and if he sells at $12 a ton he is getting $14 for it, but we do not know how much it costs him. Perhaps one of the members from the city of Halifax (Mr. Stairs) could tell us exactly what the cost of production is at the Ferrona works. I am told that pig iron can be produced in certain parts of the western states at $4 or $5 a ton, and, from the account Sir Charles Tupper gave us of the special conveniences for producing iron in the county of Pictou, I think it could be produced there as cheaply as anywhere. He told us that the flux, and the ore, and the coal, were together in one valley, and that the pig iron could be loaded right into the ships from the smelting works. Now, Sir, if they cannot produce it as cheaply there as elsewhere, I would like to know where the other place is. There is certainly one gentleman in the House who could tell us approximately what it costs to produce it. Above this bounty there is the duty of $4 per ton; but in spite of all that the price of iron abroad is so low that we have been importing the quantities quoted by my hon. friend from Queen's. The Minister did not quote the quantity imported from the United States, which was 25,000 tons, valued at $331,000. It is absurd and ridiculous to talk of these people furnishing iron cheaper than, or as cheap as it can be purchased abroad. They do not do it; they would get no benefit from the duty if they did, and the duty is for their special benefit. The hon. Minister of Marine said that he did not refer to the American market for Alabama iron, because that market was thoroughly demoralized, a great many of the furnaces were closed, the prices were all gone to pieces, and a most extraordinary state of things prevailed. We have the hon. member for Algoma (Mr. Macdonell) telling us how much higher the protective taxes are in the United States than in Canada. If it is the case that still more highly protected manufacturers go to pieces occasionally, it would not seem that a protective system was of much use even for the manufacturer. Whatever the cause of the disorganization of the market there may be, I do not know; the main point is that in spite of the one or two instances that the Minister quoted, however correctly he may be informed in regard to these, he himself admits that as a rule iron is not sold as cheaply here as in other countries, and, as we make a very small quantity compared with what we import, the maker obtains the whole benefit of the $4 duty, as well as the $2 bounty, all of which the consumer has to pay.

HON. MR. DAVIES, (P.E.I.)—I wish to call the attention of the hon. Minister of Finance to the important statement made by his own colleague, the hon. Minister of Marine. However much he may be disposed to dispute statements made on this side of the House, he will certainly accept those made by his fellow Minister. The hon. gentleman will see, therefore, that we have now reached that stage in this business where the Government has done all that he thinks they ought to do. They have developed the industry sufficiently. The process of the development is complete, so complete that iron is produced in this country at as low a price, if not a shade lower, than the price in England. The obtaining of revenue is a subordinate and indifferent point; the main point is the development of the industry, and that, it is alleged, has been reached and completed, and therefore there is no further reason for the continuance of these iron duties. Last year we paid $226,816 on pig iron, and some $23,000 on charcoal iron. In addition to that the hon. gentleman has paid $93,800 in bounties. Now that the policy has yielded its fruits, that the system has been developed, I want to know how you can justify taking $350,000 out of the people's pockets for further gratuities to this already developed industry. Why continue the duties? I would like to get an answer?

SIR CHARLES HIBBERT TUPPER.—The hon. gentleman is always ingenious. While he has tried to knock my head and the head of the Minister of Finance together, I can return the compliment by knocking his head with that of the hon. member for North York.

MR. MULOCK.—Our heads are very hard; we can stand it.

SIR CHARLES HIBBERT TUPPER.—I have no doubt of it, and they have stood the operation well. I refer to the hon. member for North York, because he explained quite clearly what the hon. member for Queen's did not catch from me; that is, while I referred to the one market of Glasgow, the hon. member for North York pointed out that our industries still had to meet the lower prices of the iron of Alabama. The hon. gentleman will see, therefore, that if we undertake to throw down the bars it is not the Scotch pig that would meet us.

MR. MILLS, (Bothwell)—But the Alabama factories are closed.

SIR CHARLES HIBBERT TUPPER.—Some are left, and they are dangerous.

MR. DAVIES, (P.E.I.)—And demoralized. Those which are open are hardly sufficient to supply the home market, so there is very little danger of an overflow into this country.

SIR CHARLES HIBBERT TUPPER.—I do not speak as an expert; but I would like to refer to the condition of the Pittsburg market, as reported in the Toronto 'Globe.' The hon. gentleman must know why I turn to his friends for information in this respect. No doubt he knows the prominence which the 'Globe' is giving to the policy that Sir Oliver Mowat has entered upon for the development of the mineral resources of Ontario. He is going, as far as possible in a Local Legislature, to take that industry under his wing, and the 'Globe' shows that he has reason for assisting it in some form. In this connection it says:

"Prices quoted at Pittsburg show a falling off in proportion to the decline in the output. This was shown by the following figures from the 'Engineering and Mining Journal' of 3rd February, 1892, 1893 and 1894:—

	1892	1893	1894
	$	$	$
Bessemer Pig, per ton....	15.25 to 15.60	13.20 to 13.40	10.60 to 10.75
Gray Forge Pig.........	13.30 to 13.50	12.25 to	9.85 to ....
Steel Billets and Slabs...	24.50 to 25.40	21.50 to 21.75	15.85 to 16.00
Steel Rails..............	30.00 to	28.00 to 28.50	24.00 to ....

"It would be impossible to prevent the causes which led to such results from affecting the mining industry of Canada, but the relief from royalties and the lessening of prices will tend to minimize the depression."

The Ontario Government jump into the gap as far as they can; but we were here in advance with another remedy, and I only hope that the hon. gentleman will see, from the extraordinary competition now to be met in the country to the south of us, that we should not remove the protection that has already done so much good, and has been attended with a reduction in prices.

HON. MR. DAVIES (P.E.I.)—The hon. gentleman has very cleverly avoided answering the question I put. He has stated that we can purchase iron in Nova Scotia as cheaply, if not more cheaply, than in Glasgow. Why, then, does he wish to continue a policy which gives a direct bonus to the Londonderry Iron Company of $49,906, and to the New Glasgow Iron and Coal Company of $25,871? Is not that a pure gratuity? If, as he says, pig iron can be purchased as cheaply in Nova Scotia as in Glasgow—and the House is bound to accept his statement, for the nonce, at any rate—how can he justify giving a bounty of $2 per ton on every ton that these companies produce. That is the point for the committee.

HON. SIR CHARLES HIBBERT TUPPER—I speak of the price of Scotch pig in Glasgow, and not as sold in Canada.

HON. MR. DAVIES (P.E.I.)—Then there is less reason for it, because if you import from Glasgow, they would have the protection of the extra freight and insurance crossing the Atlantic. The Scotch pig, when landed in Nova Scotia, must, perforce, if the hon. gentleman's statement be correct, cost more than the pig iron produced by the Londonderry Iron Company and the New Glasgow Iron Company.

HON. SIR CHARLES HIBBERT TUPPER—In the same market, for market consumption, Scotch has the advantage in freight—an extraordinary advantage.

MR. CHESLEY—I have been waiting with some patience to make a few observations on the resolution now before the House, and now that the friendly spar between the hon. member for Pictou (Sir Charles Hibbert Tupper) and the hon. member for Queen's (Mr. Davies) is over, I shall ask the indulgence of the House while I briefly discuss the subject. The question is whether a duty of $2 per ton shall be added to that already in existence on scrap iron, and the discussion, instead of being on the propriety of doing that, has turned on the question of the development of pig iron in this country. A certain policy was adopted by the Government some years ago, with the view of developing iron mines and the production of pig iron from our own ores. That policy was established in two ways—by duty and by a bounty. I find, on examining the returns, that, during the past two or three years, the increase in the production of pig iron in this country has been over 100 per cent., and in that way it will be seen that some development of our iron mines and the making of pig iron has taken place. I perhaps might say that no industry, no avocation, followed by the people of this country, is deserving of more attention and consideration at the hands of Parliament than the iron industry. If it be true that we have all the ores experts say we have, and all the different qualities of iron, all that is required for the thorough development of these ores and the making of pig iron, from which all other irons are produced, is technical knowledge and the investment of capital and time. This industry is entirely different from a great many others. You invest your capital in a cotton mill, and buy your raw cotton, and once the mill is started you can make your product. But in the production of iron from the ores the process is much slower. It requires much longer time and a very considerable amount of capital to change the ores into the merchantable commodity. However, the Government adopted a policy of a duty and a bounty, and the result has been that within the last two or three years the output of pig iron in this country has increased a little over 100 per cent., which shows that this policy has induced capitalists to invest their money in the iron mines of the Dominion. But when you have succeeded in producing your pig iron, you are only on the threshold of supplying iron for general consumption. The next move is to turn this pig iron into what is known as puddled bar. From these bars is made what is known as merchant bar iron and iron for other purposes, which goes into general use throughout the country. It has been said that the reason this has not followed the production of pig iron is that the raw material can be had cheaply from outside—notably scrap—and that the rolling mills have been fitted up, for the purpose of utilizing this scrap, with a special class of machinery, from which they make bar iron, and that, therefore, the industry of producing puddled bars has not been entered into. I think that that statement is entirely inaccurate, because any man who knows anything about the manufacture of iron must certainly know that in all countries, wherever the manufacture of iron has attained a large degree of development, it has only been attained by a judicious mixture of the various grades of pig iron produced from the different ores, to bring about a certain result or to produce a certain quality of iron suitable for general consumption. And I say that in Canada, with all the pig iron that has been made, no such result has yet been obtained. There has not been made, and, I venture to say, there will not be made, for some time, puddled bar from the pig iron produced in Canada. I do not mean to say that the ores are not good enough in quality for that purpose, but there is no single ore from any particular mine from which you can make puddled bar suitable for iron that enters into general use. You must mix the different grades of ores, containing different qualities, together, and in this way you will produce a certain quality of iron, suitable for merchant bar. That has not been done as yet. I think I can see, in the adjustment of the tariff, so far as the scrap iron business is concerned, an effort perhaps on the part of parties who may be very largely interested in iron mines and the making of pig iron, to compel the rolling mill people to erect puddling furnaces and make from this pig iron puddled bars for their raw material. If the different grades of pig iron suitable for that purpose were made in this country, there could not be so much fault found with the idea. But they are not made yet, and will not be made for some time. Therefore, scrap iron has entered largely, if not wholly, into the manufacture of merchant bar iron, and will continue to do so for some time to come. Last year there was imported in this country wrought scrap to the amount of 45,226 tons, and wrought steel scrap, or steel cuttings, to the amount of 4,450 tons. This was used as raw material in the rolling mills, and from that a very fair and suitable merchant bar iron has been made, and the country has been fairly well supplied with it. These mills have worked up a prosperous and successful business, so far as I know, wherever they are located. If the duty on scrap iron is increased and the duty on puddled bar from abroad remains as it is, the only thing I can see that will follow will be, until such time as you produce puddled bar in this country from your own ores, to increase the cost of bar iron made from this scrap. That will surely follow, at all events for a time. We all know that Great Britain and the United States, greatly as their iron industries have been developed, not only import, but export ores. They import and export pig iron simply because each country possesses different qualities and grades of ores, and to produce certain results you must have a mixture of the various grades. Great Britain imports very large quantities of iron ore from Spain, notwithstanding the great variety she has at home. And in the Wilson Bill, it was determined that ores should come into the United States free, because they are required to produce a proper mixture for the making of certain classes and grades of iron. That will apply to all countries, and Canada is no exception. Then the question arises, who is to erect these puddling furnaces to make these puddled bars; shall it be the men producing the pig iron, or shall this be imposed upon the rolling mill men? In that connection, I will read a short extract from a pamphlet by Mr. George E. Drummond on that point:

"Unfortunately the Dominion Government made one mistake, viz., the admission of wrought scrap iron, as the raw material for the manufacture of bar iron, at a less rate of duty than puddled bars, blooms and billets, with which it came into competition.

"The admission of scrap iron at a low rate of duty has resulted in two evils. First, it has retarded the progress of the manufacture of pig iron from Canadian ores, inasmuch as the ironmasters cannot afford to produce puddled bars or steel billets at competitive prices with cheap wrought scrap. Secondly, it has caused the Canadian Rolling Mill proprietors to make investments in special plant for the manipulation of scrap, and brought about a condition of affairs in the rolling mill business that will be greatly disturbed by any sudden change in the tariff with regard to the admission of wrought scrap."

Then he goes on to show how this may be remedied. He says:

"This may be done in several ways, for instances, by naming a definite date, say within from three to five years, when wrought scrap, the present raw material for Canadian bar iron, shall be placed at the same rate of duty as puddled bars or steel bars with which it comes into competition, and that in the meantime a sufficient bounty be granted, either to the rolling mill companies on such iron and steel as they may produce from the products of Canadian blast furnaces or to the blast furnace companies direct, as an inducement to them to produce steel billets and puddled bars, so that they may shortly be in a position to supply the mills (at a reasonable living profit to themselves) with all the raw material necessary for the manufacture of bars and other finished iron."

So you see, this gentleman, who has said some very good things on this subject and has given us a great deal of information on the iron industry, sees the very difficulty I am trying to point out—that is, that before this pig iron can reach the consumer in the form of merchant bar, a certain other process must take place which is not only expensive, but takes time, and requires a large investment of capital. Mr. Chairman, I might say that last year the production of pig iron in this country was about 47,000 tons, at least that is the amount on which the bounty was paid. Mr. Drummond shows in his report that the total production was about 60,000 tons. I presume he makes up his statement to the end of the calendar year, while the other figures are made up to the end of the fiscal year, the 30th June. The total consumption of the products of iron in Canada was 600,000 tons. We are thus very far from supplying ourselves with all the iron and products of iron that are consumed in this country. The rolling mills last year turned out, in the products of iron, about 80,000 tons. That quantity was almost, if not quite all, produced from scrap iron. The iron foundries turned out about 80,000 tons of castings—these would be for stoves, agricultural implements, and other heavy castings. The quantity of pig iron manufactured in the country was, as I stated, about 47,000 tons. The imports of charcoal pig iron amounted to 5,944 tons, and of pig iron other than charcoal iron, 56,703 tons. In addition, 729 tons of cast scrap iron were imported, making a total of 110,324 tons of pig iron consumed in the country during the past year. On this point, I will read another short paragraph from Mr. Drummond's pamphlet which bears and goes to strenghen what I have said:

"Within the past two years Nova Scotia has made great progress in the erection of modern plants and improved appliances. She must continue on this course, for the time is past when iron can be successfully produced without improved appliances both in construction and modern methods of operation. The blast furnace must meet the consumer's wants, in quality of iron and technical knowledge, and administrative ability must be joined together in Nova Scotia just as in the United States to secure the increased output and high quality of iron which the times demand."

I think that Mr. Drummond is entirely right on that point. But, apart from all this, Mr. Chairman, I may say that, in my humble judgment, the increase of the duty on scrap iron at the present time is a mistake. I think that if the duty had been left as it was, \$2 per ton, with a lowering of the duty on the bar iron produced from the scrap, from \$13 to \$10 per ton, as provided for by the revised tariff, perhaps it would have been more satisfactory. But if it is expected by the Government that by the increase of \$2 per ton on scrap iron, an influence will be brought to bear that will induce capitalists or the rolling mills to go into the puddling of iron, I think they are entirely mistaken—that is an industry that it will take years to establish satisfactorily. It has been stated that these rolling mills have been fitted up with a peculiar class of machinery for the manipulation of scrap iron. That is not correct; the same rolls, the same machinery will roll the puddled bars into merchant iron as are used in the rolling of scrap bar into merchant iron. This scrap iron is first put into bars of the same shape and size as the puddled bars made from pig, and in that shape both scrap bar and puddled bar would enter the heating furnace. So there is nothing in that statement whatever. Then there is another item in the tariff concerning which I wish to say a few words. I refer to the second item in this schedule:

"Iron or steel being pieces, punchings, or clippings of boiler plate or other plates, sheets or bars of iron or steel, whether the same have had the ragged or cropped end or edges sheared off or not, and crops from iron and steel rails having both ends sawn or sheared off, the same not having been in actual use and being fit for re-rolling or re-manufacture only, four dollars per ton."

That duty is increased. Now, I wish to explain to the House what all that means; I think it is well that hon. members should have the information. In Great Britain, where iron ship-building is, of course, a great industry, there is much waste in the sheets used in the construction of these vessels. From these sheets, pieces are frequently cut, known as clippings. These are utilized by putting them into the shears and trimming them up into squares of whatever size the several clippings will make. They are very good material, being of new steel. These clippings have been sold in our province in very large quantities to the rolling mills as scrap, and they are a cheap and good raw material. They are simply thrown into the heating furnace, and, with one heat, passed through the rolls and made into sheets of beautiful steel nail plate.

MR. CHARLTON.—At what price per ton are these clippings bought?

MR. CHESLEY.—They are bought at the price of scrap, or, perhaps, at a slight advance.

MR. CHARLTON.—What is the price of scrap?

MR. CHESLEY.—From \$10 to \$14 per ton. Large quantities of these clippings thus trimmed have been brought in by our rolling mill men, and, as I say, made into plate from which nails are made. It is proposed to put a duty of \$4 per ton on these clippings, which, I think, is another mistake. As I said before, you will have to continue the use of this class of raw material for a long time to come. We cannot hope to reach the point of development where puddled bars would enter as a raw material into manufacture for all these purposes, this scrap iron and scrap steel will continue to be used by the rolling mills, and the only effect will be to increase the cost to the consumer of the article produced. While I am in sympathy with the policy of the Government in developing the iron mines, I think when they come to connect the two things, when they try to get from the pig iron puddled bars, and when they try to put these puddled bars into general use, there is a gap that they cannot bridge over as easly as they think by legislation. It requires some time and a large capital, and a better understanding of the whole subject ought to be had before the attempt is made. It is well known—at all events I know it, and all others engaged in the iron business, know it—that notwithstanding the large increase in the production of pig iron, there has been no attempt yet to make puddled bars from it. The producers of pig iron do not want to make puddled bars from it. Their policy would be to sell their pig iron to the rolling mill men, and for the rolling mill men to erect puddling furnaces and produce puddled bars as their raw material. I may further state that none of the ores of the Londonderry mines, or those in Pictou County, N.S., will produce merchant bar iron alone; they must be mixed with some other grades of pig iron. There is too much phosphorus in the Londonderry iron. This renders it very valuable for stove castings or any other like castings where you wish a metal to run freely, but not for other purposes. When you come to the Ferrona ore of Pictou County, you have a different grade of iron entirely. To make the matter clear, the Londonderry iron is thin, more like water; the other is more like molasses when it melts and runs. That is the difference between the two irons. Neither of them alone, as any man of experience knows, will make puddled bars suitable for the making of merchant iron. So that whoever may make an attempt to produce puddled bars from pig iron must not only use the pig iron produced at either one or other of those mines, or perhaps both, but he must also import other pig iron to mix with the Canadian product before a satisfactory result can be obtained. I think that is about the way the matter stands in Canada to-day. I do not think any increased duty should be placed on the raw material that the rolling mills use in this country. These rolling mills have grown up as successful industries, and I am proud of the fact that to-day we are able to supply nearly all the wants of this country in what is known as merchant bar iron; I am proud of the fact as a result of the tariff policy inaugurated some years ago. But I regret that any steps should be taken to-day to cripple that industry for the purpose of helping some other interest. That is where I think a mistake has been made. Where the Government got the information on which they were acting, is more than I can understand, because if they had got correct information with reference to this matter, the story would have been about as I have told it. I well remember that about 25 years ago, in the city of St. John, it was attempted to import pig iron and to make puddled bars, and from them to make merchant iron. The attempt was a complete failure. The men who put their capital into the business lost everything. The works were idle for many years, and finally were sold to pay the ground rent under the buildings. A new company, at the head of which was the late James Harris, bought the property for a mere trifle, and at once commenced the manufacture of iron from scrap, and from that date to the present they have gone on successfully, and increased the output over 100 per cent. Last year these works were running night and day, making all the bar iron and nail plate they could turn out and finding a ready market for everything they made. The same thing applies to the Hamilton mills, to the Montreal mills, and others. Now, if these people are to be met with a duty of this character—of course one man will be in the same position as another—the inevitable result must follow, that they must all pay more for their raw material in consequence of this additional duty, and the price of iron must be increased to the consumer. Now, I feel there is no necessity for that. I would very much sooner offer a bounty to people who are producing this pig iron, as an inducement to produce puddled bars, than to do as the Government propose. It is true the Government have taken the duty off puddled bars, or, in other words, have reduced it from \$9 to \$5 a ton. With puddled bars at \$5 a ton and scrap iron at \$4, it is easy to see which material will be used by the rolling mill men. Where there is a difference in price on the other side of about \$4 to \$6 a ton between the cost of scrap iron and the cost of puddled bars; therefore, scrap iron will continue to be used here, and puddled bars will not be made. I thought it well to make these few explanations in reference to this matter, because I have some knowledge of the practical side of this question, having had a good deal to do with it in my lifetime. I think if the Government had left the duty as it was on scrap, it would have been entirely satisfactory to the people, as I think the duty and bounty on pig iron are satisfactory to the country at large. I believe the great bulk of the people are satisfied with the present development of the iron industry, and the way our own rolling mills are supplying their wants. I may further add that bar iron has been produced almost as cheaply for the last year or two in Canada as you could buy it anywhere else; therefore, under these circumstances, I think it is impolitic, not to say unwise, on the part of the Government to do anything that will interfere with the success and prosperity of these rolling mills. They employ a very large number of men, they consume all the scrap the country produces, besides making large importations. They are successful, let them remain successful, and try some other way of producing puddled bars from pig iron, adopt some other means of bringing about the end you have in view. I feel that under all the circumstances I ought to say at least this much. The people in my constituency are much interested in this question, we have two large rolling mills there, which employ a large number of men, and circulate a great deal of money. There has been some feeling and a good deal of talk in reference to this matter, and that is my justification for making these observations.

Mr. McMullen.—The House is unquestionably indebted to the hon. gentleman who has just taken his seat (Mr. Chesley) for the valuable information he has given us, and I earnestly hope the Finance Minister will see his way clear to meet, in some way, the suggestions of the hon. gentleman, who is evidently possessed of a good deal of personal experience in regard to the production of iron. Now, I find the production of pig iron, from the inception of the bounty system down to the present time, has been as follows:—

1883-84	29,388·16	$44,089·91
1884-85	25,769·13	38,654·91
1885-86	26,179·19	39,259·56
1886-87	39,717·00	59,576·00
1887-88	22,209·00	33,314·00
1888-89	24,822·00	37,333·00
1889-90	24,373·00	25,697·00
1890-91	20,153·00	20,153·00
1891-92	30,289·00	30,294·00
1892-93	35,268·00	67,590·00

In addition, during the period from 30th June, 1892, to 4th March, 1893, 47,155 tons were produced, on which a bounty was paid of $94,201. So that from the inception of the bounty system down to the present time there has been produced 325,322 tons, on which has been paid $490,045, or we have paid about $500,000 in bounty for the purpose of placing this industry on its feet. We have now over 11 years' experience. I quite agree with the remarks offered by the hon. gentleman who preceded me, to the effect that if we are going to develop the iron industry we should do it by bounty and not by duty. Some hon. gentlemen opposite, notably the Minister of Marine, have pointed to the action of the Ontario Government in granting a bounty of $1 per ton on iron production. If this industry is to be encouraged, let it be fostered by a bounty; I do not believe in placing the onus on men who are obliged to use the iron, if its production is one of national necessity. I admit that it is desirable we should produce iron in this country, and viewed from that standpoint I commend the course taken by the Ontario Government. If it be a necessity, let its development be at the expense of every one, and not merely at the expense of those who use iron. If hon. gentlemen opposite are disposed to continue the system which has been in force in the past, I prefer they should reverse the order of proceedings. It would be in line with their policy to make the bounty $4 and the duty $2, and at the same time we would be giving iron to consumers at less price. I think the statement of the Minister of Marine with respect to prices of iron in Glasgow is erroneous.

Sir Charles Hibbert Tupper.—The low price at Glasgow is largely due, if not wholly, to the very bounty which the hon. gentleman commends.

Mr. McMullen.—It is quite clear that the hon. Minister of Marine rather gave himself away in the statement he made, and is now showing his facility to extricate himself from a corner.

Sir Charles Hibbert Tupper.—The mistake I made was in the use of the word "produce." If I had said at the price at which pig iron was sold at New Glasgow or Ferrona, I would have been correct. I used the word "produce," and it was erroneous to say that it was "produced" at the same cost. I am much obliged to the hon. gentleman for allowing me to make this explanation.

Mr. McMullen.—I merely considered it to be my duty to point out that this industry has cost the country $500,000, and it does not appear now to be in a better condition than before. We produced more pig iron in Canada some years ago than we do now; production reached its highest point in 1886-1887, when the output was 39,717 tons.

Mr. Charlton.—I am quite convinced that the position taken by the hon. member for St. John (Mr. Chesley) with regard to this subject is the correct one, and that the Minister of Finance has sacrificed one interest to benefit another. I observe by the Wilson Bill that scrap iron and steel are dutiable at the rate of 10 per cent., which, according to the figures given by the hon. member for St. John (Mr. Chesley), namely, $10 per ton, would be about $1 per ton, as compared with the present duty of $3 per ton on scrap iron in Canada, to be increased to $4 per ton under the tariff now proposed by the hon. Finance Minister after the first of June next. Consequently, our duty will be about three or four times as high as the duty proposed by the Wilson Bill of the United States.

Sir Charles Hibbert Tupper.—What is the duty on pig iron?

Mr. Charlton.—It varies from 25 to 35 per cent. So that the duty proposed on scrap is relatively twice as high as that imposed on other grades of iron. No doubt in the United States, with the vast development of that industry there, they have placed a duty on scrap iron and steel at a point more in consonance with the interests of the trade than the Finance Minister has done, and I am convinced a mistake has been made here, and that this duty is relatively too high. It would be absurd to sacrifice the rolling mill interest here for the blast furnace interest, and the latter has received consideraton at the hands of the Government that the rolling mill interest has not obtained, because it has received, besides the protection of the customs duty, an addition in the shape of bounty. While adverting to this matter I desire to say that from the best information I was able to obtain when chairman of the Mining Commission of Ontario, there is no point in America where iron can be produced cheaper than in Nova Scotia. I visited Birmingham, Ala., in company with the secretary of that commission. We found that at Birmingham they were producing iron from a low grade of ore, an ore running 30 to 40 per cent. of iron, at a cost of from $6.50 to $7.25 per ton at that time—1889. Being brought into contact with iron men and men experienced in the business, I ascertained that it was the opinion of iron producers familiar with the locality that iron could be produced more cheaply in Nova Scotia, at New Glasgow, than at Birmingham.

Sir Charles Hibbert Tupper.—You did not visit New Glasgow?

Mr. Charlton.—No; but I obtained the opinion of men competent to judge, and I found that the opinion prevailed that while iron could be produced at Birmingham, Ala., at from $6.50 to $7.25 per ton, yet with the same appliances and with a similar investment of capital it could be produced at New Glasgow at a lower cost.

Sir Charles Hibbert Tupper.—They did not propose to invest.

Mr. Charlton.—No, they did not propose to invest. It is an unfortunate thing that the condition of affairs in this country does not seem to invite investment.

Sir Charles Hibbert Tupper.—But others did.

Mr. Charlton.—As chairman of that commission I ascertained that charcoal iron could be produced in this country at a lower price than it could be imported for. We had before us Mr. Massey of Toronto, who informed us that charcoal iron at $4 a ton more than pig iron, would be used by himself and by a majority of founders for strong castings; that he would use 2,000 tons per annum in his own business at $4 per ton higher than imported Scotch pig. We had estimates furnished and data given as to the cost of the manufacture of charcoal iron in Ontario. The Madoc furnace had been producing charcoal iron at $12 per ton, and the details of the cost were as follows: Cost of ore $3 per ton, cost of fuel $3 per ton, flux 30 cents per ton, labour $3.10 per ton, wear and tear $1 per ton, and general expenses $1.60. We had the report of Mr. John Birkenbine of Philadelphia, who is considered the best authority on iron matters in the United States, as to the cost of producing charcoal iron in the townships of Darling and Levant, and its estimated cost was $12.85. Mr. Birkinbine's estimate went into details as to the cost of plant, cost of mineral lands, cost of developing mines, and all the expenses connected with the investment and creation of the plant. We had an estimate of cost of producing charcoal iron made by Mr. J. C. Pusey, a practical iron worker in the township of Snowdon, and his estimate was $13.80. We had an estimate that at the Haliburton Imperial Mines it cost $9.08 per ton; another giving an estimated cost in another locality of $11.46, and another giving the estimated cost of producing charcoal iron at $11.92. These are undoubtedly figures that would approximate very closely to the actual cost of the production of charcoal iron. The best authorities believe that iron can be produced at New Glasgow cheaper than at any other point in America. Under these circumstances, having pursued the policy of bonusing iron establishments for many years, it strikes me that the policy is not an efficient one. We want a change in our trade relations; we want the introduction of more energy and more capital, we want to adopt a policy that will give the country general growth and that will bring into it the infusion of new ideas and the infusion of new energies. This bonusing policy pursued by the Government is to a great degree inoperative. At all events, in connection with the item under consideration, the policy adopted by the Government, judging by the course taken by the United States, is one which is likely to prove injurious to the rolling mills, and the duty imposed is too high. Either the Government here is wrong or the framers of the Wilson Bill are wrong, because the conditions of the trade in the two countries are relatively much the same, and the United States would not be likely to adopt a policy injurious to the iron-producing interest.

Mr. Maclean, (York)—I would like to point out, for the information of the hon. gentleman (Mr. Charlton), and for the information of the hon. member for Queen's (Mr. Davies), that while iron may be produced in Nova Scotia at a very low rate, we in Ontario desire to see iron produced in our own province. I would especially point out to the hon. gentleman for Norfolk (Mr. Charlton), that the very commission that he was appointed a member of is now bearing fruit, and that the Government of of Ontario, which sent him to make this inquiry, have now adopted an iron policy and have become protectionists.

Mr. McMullen.—No, no.

Mr. Maclean, (York)—Yes; They have come to believe in the doctrine that it is essential to national greatness to have an N.P.; a policy that will give us iron production in this country. No country has ever become great, no country has ever become a leader among the nations of the earth, that had not an iron industry of its own, and that did not try to build up an iron industry of its own. We are now trying to do that in Canada, and the Reformers of this country who have always opposed protection have come at last to the view that they in Ontario will try to create an iron industry in this province, and for that purpose they employed the gentleman who has just addressed the House (Mr. Charlton), and they are now about to act upon his suggestion. Another thing I wish to point out is this; that the greatest mistake ever made in this country was, when we were building the great Canadian Pacific Railway, that we neglected to provide that every rail which entered into the construction of that road should have been rolled in this country and made from Canadian iron.

Mr. Davies, (P.E.I.)—Has the hon. gentleman calculated how many millions of dollars more that would cost, above what it did cost?

Mr. Maclean, (York)—Even if it did cost more, this country would be just that many millions of dollars better off.

Mr. Davies, (P.E.I.)—There would be a charge on the North-west and on the transportation trade for all time to come.

Mr. Maclean, (York)—I deny that. I say that before the Canadian Pacific Railway was built, we should have provided that that road should be built entirely of Canadian iron. I hope in future that in the case of all roads bonused out of the Federal Treasury it will be made a condition of the bonus that they will employ Canadian iron and Canadian rolled rails in their construction. There is another thing I wish to point out in connection with the iron policy of Ontario—and I wish to point it out especially to the member for Huron (Mr. McMillan), who says that the farmers do not wish an iron policy in this country. It is the best thing that could happen the farmers of this country to have an iron policy, and the farmers of Ontario believe in an iron policy, and they believe in it because it will give them the best home market that they possible could have, for there is no home market equal to that that is made by a mining population. We in Ontario hope to see an iron policy there, and we are prepared to support this Government in maintaining an iron policy. I wish to repeat the hope that I expressed before: that it will be a condition of all bonuses granted to railways in future that they shall be built of Canadian iron rolled in Canadian mills.

Mr. Mills, (Bothwell)—You are defending the Ontario Government now. They have converted you

Mr. Maclean, (York)—We have converted the Ontario Government, and at a time when they are in the throes of a great struggle the Ontario Government has reached out its hand for this policy of protection, and it is the only hope they have of saving their lives in the electoral struggle that is about to take place.

Mr. Mulock.—I have been waiting for some time to come back to the point at which this discussion diverged. There is a controversy between some members here as to whether the Government's policy had sufficiently developed the industry; but here we have this fact staring us in the face; we have a tariff now which is in some respects more onerous than ever upon the consumers of iron. I do not myself give my own opinion or knowledge as to what price iron can be produced for in Canada or elsewhere. What I stated was: that large users of iron, men engaged in the manufacture of machinery and implements of various kinds, whose raw material is iron, had waited upon the Administration after their proposed tariff had been given to the public, and, as I understand, asked the Government to reduce the duty upon iron, and in some cases to have it made free. But, instead of reducing the duty on this article, the Government has raised it. I now come back to where the discussion was left off, and I ask the Minister of Finance, why he does not apply his policy to iron, which is the raw material of these manufacturers? I understand his policy to be, to admit the raw material free. Is not iron in various forms the raw material of manufacturers of implements of different kinds? If that is his policy, how comes it that he does not apply it to the case of iron? It is idle to say that the imposition of this duty is not going to enhance the cost to the consumers of iron goods. Now, I ask the Minister of Finance what the effect is going to be upon the manufacture of agricultural implements, which subject has been so ably dealt with by the hon. member for St John. The agricultural implement manufacturers have called upon the Government to make certain changes in the duties upon their raw material, in the shape of iron of various kinds. I ask the Minister, if he is free to give me an answer, if that is not the case? Have not the manufacturers of agricultural implements, and the users of iron for the manufacture of various necessaries of life, asked the Government for a reduction of the duties on iron?

MR. FOSTER.—Yes.

MR. MULOCK.—I thought so; and the reason assigned was that it was necessary for them to get their raw material cheaper. But the Government turned a deaf ear to them. In some cases, I admit, the duties have been lowered; but the hon. member for St John cited a case in which the Government turned a deaf ear to the application that was made. The result is that one of the most widely used manufactures of iron is made dearer to the consumer.

HON. MR. FOSTER—How is it made dearer?

MR. MULOCK—By increasing the duty on scrap and leaving the duty on pig iron at $4 a ton.

HON. MR. FOSTER—It is made no greater.

MR. MULOCK—Is not $4 a ton something? The change is going to cause a larger importation of pig iron or make scrap more expensive.

HON. MR. FOSTER—Not at all.

MR. MULOCK—The hon. gentleman must see it. The hon. member for St. John has stated that it is necessary to import pig iron to produce certain grades of iron.

HON. MR. FOSTER—Not necessarily.

MR. MULOCK—The hon. member for St. John said that we do not produce certain grades of iron without using imported pig.

HON. MR. FOSTER—He did not say we could not.

MR. MULOCK—He said we do not, though; and he said that at the present time scrap forms a valuable mixture in the production of certain grades of iron.

HON. MR. FOSTER—Mixture? What for?

MR. MULOCK—Puddled bar. That is what he stated—and that, as you are now making this scrap more expensive, it will be necessary, in his judgment, to import more pig.

HON. MR. FOSTER—It is only steel scrap that is used to make billets, and that is cheaper than it was before.

MR. MULOCK—I am repeating what the hon. member for St. John has said. He says that scrap is melted up in St. John for the manufacture of cut nails, and that the increased duty will make them dearer.

HON. MR. FOSTER—Cut nails are made cheaper. The duty on them is reduced nearly one-half.

MR. MULOCK—I am not speaking of the nails. I am speaking of the scrap that enters into their manufacture. The maintenance of these duties and their increase in certain places increases the cost of the manufactured article to the consumer.

HON. MR. FOSTER—How?

MR. MULOCK—I would like to ask the Minister why he does not apply his policy generally? If he is in favor of cheap raw materials, why does he maintain these high rates on raw materials?

HON. MR. FOSTER—We have reduced them.

MR. MULOCK—You have not reduced them all; you have increased some and reduced others to a trifling extent. To say nothing of the freight, there is a duty of $10 a ton on bar iron—that much additional charge to the consumer on all classes of goods into which bar iron enters.

HON. MR. FOSTER—It was $13 before.

MR. MULOCK—Why should it be $10? To-day you are posing as the farmer's friend; but your tariff shows you to be the farmer's enemy. What is going to be the effect of your iron policy upon agricultural implements? Your whole policy is a mass of inconsistencies?

HON. MR. FOSTER—What would be your policy with regard to implements?

MR. MULOCK—I am not making a policy; I am trying to point out the absurdities and inconsistencies of the Government's policy, and the disasters that must flow from it. They have announced the making of raw materials cheap to the manufacturer as the foundation of their policy; but they have not carried out that policy with reference to the iron duties. Since they undertook to tinker with these iron duties, they have paralyzed the iron industries of the country. What have become of the prophecies of Sir Charles Tupper, made in this House in 1887, when he told us of the great natural advantages that Canada had for the building up of a great iron industry if she would only adopt the excessive scale of duties which he proposed? Ever since that policy was introduced, the consumers of iron goods have been great sufferers; and because the Minister is able to point to trifling reductions in one or two points, he thinks he has done all that the condition of the country warrants. Now, that the hon. member for Algoma is in the House, I would ask him if I correctly understood him to say that Canadian pig iron was as cheap within $2 a ton in Toronto, as Scotch or American iron? Was that what he wished the House to understand?

MR. MACDONELL (Algoma)—Go on.

MR. MULOCK—I understood the hon. gentleman to make that statement, and if so, I would reply both to him and to the hon. Minister of Finance by saying that I do not profess to give any evidence myself on the point, nor do I think that the evidence I did give had reference to a demoralized state of the trade. I understand that pig iron of the very best kind is produced in Alabama at $2 a ton less than in Canada—not at demoralized prices, but at normal prices. Then, owing to railway freight, we are handicapped to the extent of $3.50 per ton, say at Toronto a leading centre, where iron is required, so that pig iron would cost in Toronto, under your tariff, $5.50 per ton more than it can be laid down for, even brought up from the east. Now, the effect of it is this: The American farmers, owing to cheaper raw materials, will get their agricultural implements cheaper, and you are handicapping our Canadian farmers in their competition with the Americans, because if you make the raw material which enters into the manufacture of their iron goods dearer, you will make it more expensive for them to carry on their industry, and in this way this Government, which pretends to have introduced a farmer's tariff, are imposing a tariff directly antagonistic to the interests of the farmers.

Item agreed to.

Iron or steel, being pieces, punching, or clippings of boiler plate or other plates, sheets or bars of iron or steel, whether the same have had the ragged or cropped ends or edges sheared off or not and crops from iron or steel rails having both ends sawn or sheared off, the same not having been in actual use and being fit for re-rolling or re-manufacture only (39 per cent.) four dollars per ton.

HON. MR. FOSTER—This is the other form of steel scrap. I think the hon. member for St. John (Mr. Chesley) was in error in the matter of the steel scrap. In the old tariff, the duty was 30 per cent. The average price of that which came in was $15.90 per ton, so that the duty of 30 per cent. amounted to $4.80. The duty now is $4. It may be that steel scrap sometimes came in under the preceding section at $2 a ton, but if so it slipped in where it had no place.

MR. CHESLEY.—What is called steel scrap in the item before the House was simply imported as scrap iron always. It is nothing but scrap anyway.

MR. FOSTER.—It should not have been.

MR. CHESLEY.—It is the leavings from the sheets where boilers are made and vessels are built. These are the cuttings and ends of sheets brought into the country as scrap and rolled into nail sheets. It was brought in at first without any trimming, but finally the people on the other side, interested in the trade, commenced clipping—what they called clipping or trimming these pieces; and these came in as scrap steel. It was used for the manufacture of nail sheets. From these sheets cut nails were made. The same remark applies to your steel rails which you have in this item. There have been thousands of tons of old steel rails rolled this very past season in St. John into steel sheets or nail plate. I know of a contract which the Harris people had for three thousand tons of steel sheets made from old steel rails, and these steel rails are their raw material. There is any number of these rails in the country at present on railway lines, but after a time, when the rails have to be renewed, there will be a great quantity of this cheap raw material in the country. The rolling mill owners went to considerable expense and trouble to get the necessary machinery for converting these old rails into sheet and nail plate at one heat. After going to all this expenditure and trouble, you are going to prevent them bringing in this material unless they pay a duty of $4 per ton.

MR. FOSTER.—Wrought iron or steel sheet or plate cuttings or clippings as got at the rolling mills or shipyards, fit only for rolling, and to be used for such purposes, had to pay 30 per cent. That was steel scrap and was the item under which it came in. If any steel clippings came in at $2 the importer got the advantage to that amount.

MR. CHESLEY.—All I have to say is that these people were importing the article as scrap, and it is nothing but scrap.

Item agreed to.

Iron in pigs, iron kentledge and scrap iron, ($4 per ton); ferro-silicon and spiegeleisen ($2 per ton), four dollars per ton; ferro-manganese ($2 per ton), 10 per cent. *ad valorem.*

MR. FOSTER.—Allow me to make it 5 per cent. instead of 10 per cent. on ferro-manganese.

MR. SUTHERLAND.—The hon. Minister of Finance has had representations made to him with regard to the steel or iron used in the manufacture of windmills. Is it the intention of the Government to make any change in the direction asked for? What they ask for particularly is that the material not manufactured in Canada be allowed in free for the manufacture of windmills. They also complain that the duty on the raw material is too high, higher than the duty on the manufactured articles allowed into the country. So that the Americans or other producers of these windmills can export into this country at a lower rate of duty than the duty on the material which is used by our own manufacturers. They ask in order that they may be enabled to compete with outside manufacturers to have the raw material brought into Canada admitted free. Is it the intention of the Government to grant any relief?

MR. FOSTER.—I can hardly tell what it will be until we come to the free list.

MR. SUTHERLAND.—If the item of steel and iron is passed, and no attention paid to their representations, we can hardly expect a change.

MR. FOSTER.—An item in the free list would quickly take it out of that.

MR. SUTHERLAND.—I do not understand the reply. I ask the hon. gentleman frankly, in the interest of those parties, who have given him full information with regard to their business, whether he intends to do anything to encourage their industry? The duty on the raw material used in the manufacture of the article is higher than that on the finished product.

MR. WALLACE.—It is not higher.

MR. SUTHERLAND.—I beg the hon. gentleman's pardon, it is higher.

MR. FOSTER.—The hon. gentleman will understand that I could not say to him, on representations made by friends of his, whether I am going to put it on the free list or not. We will have to wait till we come to the free list, and if there are any other items to be put on at that time, they will be put on together, on the revision.

MR. SUTHERLAND.—I simply asked whether it was the intention to give any relief in regard to that industry? I did not mean to ask for any information I should not receive.

HON. MR. FOSTER.—I could not say at present.

MR. CASEY.—It has been the contention that nobody is unduly favoured by this tax on pig iron. Now, the amount of iron imported last year in the shape of scrap, common pig and charcoal pig, was 78,847 tons, which, at $4 a ton duty, would yield $315,388. Our blast furnaces, according to the Minister of Marine, made 55,000 tons. In addition to that, we gave $110,000 bounty, of which, seeing that we imported such a very large surplus of iron, they must have had the full advantage; they must have had the full advantage of the $4 per ton duty, and so they got $220,000 increased price on that point; in other words, we paid in duties $313,000, and gave a bonus and protection to the blast furnaces, of $330,000, in all, $643,000 in round numbers, to encourage the production of pig iron in Canada. Now, the Minister says that 55,000 tons were produced by this encouragement. I think it was less, but take it at his figure. The country paid out $643,000 to secure the production of 55,000 tons of pig iron, or about $11.50 for every ton produced by the blast furnaces. Can any one say that that is a reasonable state of things? The hon. Minister has taken the line all along of saying as little as possible. He cannot deny these figures, he cannot assert that the encouragement of the production of pig iron, at the rate of $11.50 per ton, at the expense of the consumer, is reasonable, defensible, or proper. We were not led to anticipate any such result as this when these duties were first proposed by Sir Charles Tupper. He told us that the imposition of these duties would lead to vastly increased production in the country, and to a reduction in price. I should notice, however, that in producing these 55,000 tons of pig iron, about a thousand men were employed, as near as I caught the figures given by the Minister of Marine and Fisheries (Sir Charles Hibbert Tupper). Now, Sir Charles Tupper estimated that in the production of pig iron, as encouraged by his duties, 20,000 men would be employed in a very short time, making with their families, an addition of 80,000 or 100,000 to the population of the country. We see that the estimates then made of the great progress of this trade, were falsified, as I believe the anticipations entertained by the Ministers now with regard to this trade in the future, will be falsified. But apart from the question of the amount of the product, I must call the attention of the House to the promises made concerning the production of charcoal iron, not only in Nova Scotia, which seems to be the only place where iron is produced now, but throughout Quebec and Ontario. Sir Charles Tupper pointed out the advantages of charcoal iron in these words:

"The experiments recently made by some of the great lines of railway in the United States have shown, as the result of scientific analysis, that the mode of making the life of a rail infinitely greater than it is, is to have incorporated in the rail a large portion of charcoal iron, and under this recent discovery, there is a field for the development of charcoal iron, that will go far to make it one of the leading industries of Canada. There is at present, as you know, in Ontario, running through a large number of counties and townships, a most valuable deposit of iron ore. A railway has been built to Central Ontario, over 100 miles long, to carry this ore to Weller's Bay, to be shipped across the lake to Charlotte, Oswego, and other points on the American side. Well, from Oswego and Charlotte on the American side to the anthracite coal field is only 150 miles, and I say that, under a policy which will give iron the protection we give to everything else in Canada, under the National Policy, you will have the ships that convey the ore to Oswego or to Charlotte, or to any of those places from Kingston, Cobourg and Weller's Bay, bringing back the anthracite coal, and you will have the establishment of blast furnaces at Cobourg, Kingston and Weller's Bay, that will give the iron industry of Ontario the same position it occupied years ago."

Admitting by that last sentence that the iron industry had fallen off. Now, this is a beautiful example of the humbug of all the promises made on behalf of the National Policy, and of this latest excrescence upon it. Sir Charles Tupper promised wonderful things, and not one of them has come to pass. No blast furnaces have been started in Ontario, whether by anthracite coal or charcoal. No vessel brings coal from Oswego or Weller's Bay to the consumers of Canadian ore; even the export of ore itself has been stopped. The people of Cobourg, Kingston, Weller's Bay, Belleville, and other points in Ontario must realize how they were humbugged before the elections of 1887, by the promises made by Sir Charles Tupper. Then he went on to point out that he was going to take the duty off anthracite coal, and he referred again to Weller's Bay, Kingston, and Coburg, and to these cargoes of coal they were to bring across:

"There is nothing to prevent it but one thing, and that is the duty upon the anthracite coal; and what I propose to ask this House to do, in adopting the policy of vitalizing this great industry of Canada, is to take the duty off anthracite coal and make it free. The moment that is done we shall have blast furnaces at Cobourg, Weller's Bay and Kingston, at all events, served by anthracite coal, making that description of anthracite iron which is so highly valued by gentlemen connected with foundries.

Now, there is no such a thing as anthracite iron made in Canada to this day, although it was promised to us at that time to induce us to impose these heavy burdens upon ourselves to secure it. In regard to charcoal iron, he urged the same thing in very strong terms. He proposed to encourage the production of this iron by a heavy duty and pointed out that, as a result, we would all be engaged in this manufacture in a short time. As a matter of fact what is the state of things to-day? Not a single ton of charcoal iron is made in Canada to-day. Plenty of charcoal is made in Canada in the western pensula of Ontario; but it is exported to the United States and used to smelt iron taken from Amerian mines.

MR. CHESLEY.—I beg to correct the hon. gentleman's statement. They are making charcoal iron in Quebec now very successfully. They made over 7,000 tons last year.

MR. CASEY.—I accept the hon. gentleman's statement, as he seems to be well informed upon these subjects. But we have had no official statement to show that this manufacture is going on, and I was not aware of the fact. But I know well that in Ontario, of which I am now particularly speaking, there is none made, and that our charcoal is being exported to Detroit to smelt iron on the other side of the line, instead of bringing the ore over to be smelted here with our charcoal.

MR. CASEY—Mr. Chairman, when you left the Chair at six o'clock I had been quoting from the prophecies indulged in by Sir Charles Tupper as to the prosperity of the iron industry, especially the pig iron industry, under the tariff which he then proposed, and I will have to trouble the House with another quotation or two. After dealing with charcoal iron, Sir Charles Tupper said:

"Well, Mr. Speaker, twenty years ago iron rails were made in Toronto and Hamilton, and within the next twenty years we will make all our own rails."

He went on to say that the Government proposed to except steel rails from the tax, and continued:

"We propose that they shall come in free as they have done in the past, because we consider that should be made an exception. I do not hesitate to say that the adoption of this policy, in my judgment, will place Canada in a position where she will be able to provide her own rails, and that at no distant period, at as reasonable a rate as any country in the world. Why should we not do so? Show me any country possessing as many miles of railway as Canada does that does not manufacture its own rails? It cannot be done. There is no country in the world with 12,000 miles of railway in operation that does not manufacture the rails used there."

Now, sir, in spite of that hopeful assurance, we do not make our own steel rails yet; I do not know that we are making any rails at all. If we are making any, they must be very few indeed. It is only where we have an almost prohibitive customs barrier against the importation of iron that we are making anything in the way of iron as raw material for manufacturers. We are not making rails, for there we have to enter into competition with the world. Sir Charles Tupper went on to refer to eertain steel industries that looked promising, using words which I quoted at another time and which I need not now repeat. Then, sir, after promising grand prosperity to Nova Scotia, Quebec and Ontario from the growth of the iron industry, he asks:

"And what more? Across the Rocky Mountains, need I tell you that in British Columbia you have one of the magnificent deposits of iron ore on Texada Island—(30 miles long and 5 miles wide)—that is to be found in any place in the world, rich in the highest degree in jron, and that you have the Nanaimo coal field to furnish fuel to put blast furnaces in operation at an early day, lying within 30 miles of Texada Island. I say, that with the prospect of opening up trade with Australia, with China and Japan, although I am not a prophet nor the son of a prophet——"

I notice that he did not deny the possibility of his being the father of a prophet——

"I believe that at no distant day you will have in the province of British Columbia an iron industry built up which will compare favorably with that of any other industry in this country."

Now, sir, we still have the iron ore at Texada Island; we still have the coal at Nanaimo—and the coal is being mined, but not being taken to Texada Island to smelt the iron ore—we have our attempt to open trade with Australia and China and Japan; but we have no smelting industry in British Columbia yet. I must skip a great deal that is interesting in Sir Charles Tupper's speech and refer finally to his estimate of the addition that would be made to the population. I quoted a little while ago remarks which show that he expected twenty thousand men to be employed in making pig iron—which would mean an increase of 100,000 to the population. Now, seven years afterwards we have about a thousand men employed in this industry:

"Now this estimate of an increased population of 100,000 souls does not take into account the manufacture of castings and forgings, cutlery and edged tools, hardware, machinery and engines, or steel rails. Were we to manufacture these articles now imported, and there is no reason why we should not steadily progress to that point —the population I have mentioned of 100,000 souls would be no less than trebled.

Let us see how the production has increased; let us see how the employment for men has extended. Sir Charles Tupper states that our consnmption of pig iron, leaving steel rails out of the question, was 250,000 tons in 1887. Last year, according to the statistics given in this House, we only used 133,000 tons of pig iron. Instead of the business increasing, instead of the consumption of pig iron increasing, it has decreased to the extent of 117,000 tons, if the figures given by Sir Charles Tupper in 1887 and by the Finance Minister now are correct. Now, Mr. Chairman, this is the last quotation with which I need trouble the House. I have gone into it at some length for the purpose of showing how fallacious were the promises by which we were induced to place these burdens upon our shoulders. The production of pig iron has averaged less since that time than before. We were promised a very large increase in population in connection with the making of this iron. It has not come to us; we have not had that benefit. We have only employed one-twentieth of the men we were promised would be employed in that industry. We were promised that this would not be a heavy burden on the consumer. We find that it has been so heavy a burden that it has retarded very seriously the development of industries using pig iron. And, beyond all this, the ordinary consumers of iron, amongst whom the farmers, I think, hold the first place, who were promised a market for their productions in return for the burdens laid upon their shoulders, have been obliged to bear those burdens, but they had not had the additional market. The whole scheme is proven to be a failure, for we are not securing a home markct for Canadian produce. For all these reasons, Sir, I cannot see that we are in any way justified in maintaining these heavy burdens upon the people. It is purely a tax for the benefit of four concerns mentioned by the Minister of Marine and Fisheries—Londonderry, Ferrona, Radnor Forges, and one other. For the beaefit of these four institutions employing about a thousand men we are taxing the country in one shape or another to the extent of over $600,000. It is, as I have said with regard to the tax on coal oil, one of those instances in which the most private negotiations and consultations between the Government and the parties interested should be laid before the House and the country, and it should be made clear to us for whose benefit these taxes have been imposed. It has been clearly shown that they are not imposed for the benefit of the country at large.

Item agreed to.

Commercial Mining.

By MR. F. DANVERS POWERS, F.G.S., M.A.I.M.E.

(Australian Mining Standard.

I.

That a large percentage of the world's population is interested directly or indirectly in mining may be accepted as a truism. Whether that interest is confined to the fuel and light employed, or the various metals and rocks used in everyday life; whether we spend our money in mining ventures, or whether we gain our living by the actual extraction of minerals from their natural repositories, it all tends to help on our modern civilisation, and adds to our comfort and welfare.

At present we have to deal with what are sometimes termed "market miners"—that is, those persons who are concerned, not in the practical winning of ores, but who, having assisted to find the necessary capital for working them, are naturally interested in the successful carrying out of mining operations; and it is desired to point out a few ways by which good money is frequently lost, or rather thrown away, in so-called mining, to the detriment both of the legitimate industry and of the capitalist. The reasons people give for investing or speculating in mineral properties are about as various as the temperaments of the individuals themselves. Of course their main object is to follow the advice of the Scottish father to his sons, to make money honestly if they can, but to make it; still, in selecting a means for making money, some find a pleasure in the excitement consequent on risk. It may be they are comfortably off, and have no immediate necessity to invade the commercial ranks, but wishing to add to their comfort, or requiring a larger income to carry out some ambition, they look to mining to assist them. Others, again, who have lost fortunes, hope by a lucky turn of the wheel to recoup themselves. Such people think and speak of mining as a means of gambling, and in the way they affect their arrangements they are not far wrong, but they forget that the same argument would hold good for any other industry, if prosecuted in a similar manner. Some persons, sane enough in other respects, are easily carried away by the excitement of a boom, and behave in a manner that would astonish them them if applied to their ordinary daily life, and since the chances are against them no cool.headed onlooker is suprised to note their frequent ruin.

It is on occasions such as these that unprincipled men, taking time by the forclock, and applying their knowledge, not so much of mining as of human nature, appeal to the cupidity of mankind, and by flattering the vanity of their victims, as well as by taking advantage of their ignorance, seize the opportunity of swindling them. When at last it is forced upon a man that he has become undeniably entangled in the meshes of a rogue, and that he has exchanged his money for an inadequate amount of experience, he seldom considers it desirable to throw away good money after bad, or to expose his folly by means of a prosecution, and so the depredator escapes scot free. In Melbourne, during the late silver boom, even the little street arabs denied themselves the pleasure of their favorite game, pitch and toss, so as to be able to speculate the pennies thus saved in impossible silver mines.

Whether rich or poor, high or low, there is one failing common to all, and that is the laxity with which they carry out their mining transactions, which lay them open to the machinations of any sharper who crosses their path. The reason of this is not far to seek: The public do not believe there is much known or to be unknown about minerals, and look upon anything to do with them as governed by laws of chance. Being ignorant of geology themselves, or nearly so, they cannot understand how anybody else should be able to deduce facts from the examination of rocks, and their knowledge of scientific matters is, as a rule, too slight to encourage them to take a lively interest in any explanations offered. The very fact of anythtng connected wtth mining requiring an explanation is sufficient to condemn it in the eyes of many, and should a technical word or expression slip in by any chance, it is at once construed as a desire to confuse the hearer, under cover of which it is supposed the geologist hopes to back out. It is this want of faith and the knowledge that some rich finds have been discovered by pure accident, that make people look upon mining as a lottery. Since no two mines are exactly alike, it is impossible to draw up a code of precautions that will suit all cases; still, they have some things in common, and it is as well that these should be reviewed.

Given a valuable mineral deposit, there are many circumstances that may crop up to nullify its worth. The value of a mineral, like other commodities, depends on its supply and demand, and the difficulty of attainment governs that supply, for if easily obtained, competition is sure to set in, the market will become glutted, and, although the industry may be bolstered up by "rings" for a time, the fall in value must come sooner or later. There are several substances the present market values of which are greater than gold, but to start a mine for some of these would be a dead loss, as a few ounces per year is all that the world consumes, and a greater output would at once diminish their value. The utility of a metal is not governed by its monetary value; it depends on other qualities, *e.g.*, weight, ductility, color, magnetic properties, etc., supposing it to be found in sufficient quantities. So we find that iron, though much cheaper than gold, is at the same time more useful. We thus clearly see that before investing in mines, we should be satisfied that not only does the metal sought fetch a fair price, but that there is a market for the quantity also.

The value of necessary substances may be increased by reducing their output, but a small supply does not necessarily mean a higher value, as the demand of any particular substance may be limited. The value of a deposit is greatly influenced by its locality; many mlnerals are worthless in the places where they naturally occur, but, if the drawbacks are not too great, may more than repay the cost of extraction and transport to a locality where they can be utilized; on the other hand, an ore that would pay handsomely if found near the sea coast might be utterly useless from a commercial point of view if its deposit was situated in some arid spot. A former valuable deposit, the quantity of which remains as good as before, may become valueless for a time owing to similar deposits being found in other parts, either richer, or under such favorable conditions that they can be wrought more cheaply. For instance, the Norwegian apatite deposits have given way to the Canadian ones, and these in turn have given place to the Florida phosphate deposits.

The value of a deposit may be greatly increased by working it at a proper time, and, therefore, it is sometimes advisable to hold back supply for a higher market, or to put on more men to increase the output when the price of metal rises. Valuable minerals are the natural wealth of the country in which they are found. As a mineral is removed so its supply becomes diminished; even in cases where fresh crops are formed—*e.g.*, salt, lake iron, soda, etc., the deposit becomes impoverished, and the formation is slower than its extraction. The more easily wrought portions of mineral deposit being taken first, the last part robbed is more expensive to win owing to difficulties that have to be overcome, which depend on circumstances, such as the greater depth from which the ore has to be raised, the necessity for artificial ventilation, increased flow of water to be drained, the poorness of the stone, or the hardness of the rock. A faulty method of opening up a property, perhaps owing to the lack of funds to commence with, may hamper a mine throughout its life, and oblige one to waste, or bury for ever, pillars of valuable mineral, which does no good to the individual, and is a dead loss to the country. Poor ores that are worthless to-day may in the future, with improved appliances, which enable one to work on a gigantic scale, be the salvation of a property. The same argument holds good for new processes, increased supply of water in dry countries, better means of transport, etc., therefore such stone should not be stowed away in accessible places from which it will later on have to be re-mined.

An interesting and instructive chapter might be written on errors committed in the performance of mining operations, how some men have a mania for sinking shafts in mountainous districts where adits could be more advantageously driven, or where others, to gain a few feet more "backs," commence an adit from the summer level of a creek, which at every freshet flows into and drowns out the mine. But, although the prosecution of such engineering feats is outside the province of this article, the effects are not, for the results of such misplaced energy may be offered to you for hard cash, or, in other words, you are asked to pay for the blunders of those who have sunk money in next to useless work. Since those who cause unminerlike excavations to be made are solely responsible for such work, they should be the ones to suffer for their folly; the buying public should not be made the scapegoat. We are generally informed in prospectuses that the line of lode passes through the property in question for so many feet, and that it averages so much in width. Now it is very important to know the position a lode holds on a certain area. If close to a boundsry line, it may, at a shallow depth, run into you neighbour's property, even if dipping in the contrary direction on the surface; for it is well known that the underlie of a lode is not always regular, and that at times it turns around, even at right angles to what it was higher up, or again a vein may be faulted and thrown considerably out of the course it was expected to take. This shows the necessity, when about to purchase an undeveloped property, of obtaining all possible information from surrounding mines working similar deposits, or in default of this, where circumstances permit, a thorough geological survey. Anyhow, when investing in an undeveloped property, the vendor, though frequently asking, cannot reasonably expect the same price that a mine with preliminary works and the nature of the lode proved would fetch. The underlie of a vein affects its market value, as does the depth at which a bed of valuable minerals occurs from the surface. In the former case, if flat, it cannot be worked so economically with a perpendicular shaft as if it were more vertical, for either the cross-cuts will be of excessive length, which is not only expensive in their first construction, but also in the subsequent items for truckings and upkeep, or else shafts will have to be sunk at more frequent intervals than usual; besides, if there is not plenty of land taken up on the underlie, the lode will run out of the claim.

(To be continued.)

Mining in Kootenay, B.C.

(From the Nelson Tribune.)

The 10-stamp mill on the Poorman mine on Eagle creek, six miles southwest of Nelson, has been started up, and will be run as long as the water supply lasts. Ore is being stoped from both the north and south drifts. Twelve men are employed.

J. G. McGuigan, of the Noble Five mines, in Slocan district, has returned from Omaha, where he took 51 tons of high grade ore. The returns received go to show that the ore was the richest yet shipped in large quantity from the Slocan country. It ran 549 ounces silver and 51 per cent. lead.

Phil Aspinwall is up from Trail Creek district. He reports that the force on the Le Roi is now larger than ever before, and that while the men are not working by the day, they are making $3.50 a day on contract work. Trail Creek is to be a $3.50 camp.

The owners of the Last Chance claim on McCulloch creek, in the Big Bend country, although they have spent $22,000 in running two tunnels that did not strike bed rock, have still faith in the ground. One tunnel is in 1000 feet and the other in 1500. The lease expires in July, but it will be renewed. The owners are Josiah Fletcher, T. J. Lendrum, G. C. Tunstall, Jr., W. M. Brown, William McKenzie, John Bell, Thomas Ardeil, Alex. Bilsland and John Sanderson.

Twenty tons of ore valued at about $3,000, from the Northern Belle mine passed up on Thursday, bound for Omaha. It had been shipped from Kaslo. This marks the opening of the season's ore traffic by the Revelstoke route.

Parties from the Big Bend country report it useless for prospectors to go into that section earlier than July 1st, as the snow is yet very deep in the mountains.

The Consolation claim on French Creek is paying well. The pay gravel is not more than 6 inches, but the bed rock is worked to a depth of 2½ feet, it being coarse slate. The face is about 30 feet in width, and the dirt is run some 600 feet and hoisted 50 feet to the surface. It will, however, soon be hoisted through another shaft nearer the surface, and a considerable saving will be made in labor. The dirt pays about $30 to the yard, and the dust is worth $18.75 an ounce in San Francisco.

A party is at work on ground four miles from the mouth of Carnes Creek and reported taking out good pay.

The quartz ledges in the Big Bend are from 15 to 20 inches wide, and it is claimed the ore runs from $30 to $50 in gold to the ton.

John Boyd has bonded a claim located about ten miles up Carnes Creek, and is now cutting a trail to it. The vein is said to be 9 feet wide, and in slate, granite and phorphyry. The ore runs from $10 to $40 in gold.

The "Polyphloisballsanskittlograph;" or, A Machine that Nobody could Understand.

A Souvenir of the Royal Society Soiree.

(From the *Pall Mall Gazette.*)

"Vez, dat vos ein clefer machine. Da vos nossin at all to com near him," said the Professor with a benignant smile of self-complacency.

"I spent half the evening trying to make out how it worked," said I.

"Aud you vos not the only von who did so. I tell you, da vos clefererer men als you trying to see how dat machine she work."

The apparatus in questi on stood silently by on a ledge in the Professors laboratory, bearing with equanimity its blushing honours and the card of identification, which had not yet been removed. On the card I read once more, and puzzled over, the following inscription:—

No. 47. *Exhibited by Professor G. von Sniggersdorf.* The "Polyphloisballsanskittlograph."—For tracing and analysing hypermetropic or isoperimetrical vibrations of more than one phase. By adjusting the disintegrator in harmonic relation to the vascular function of the spherulitic index a vector equation is obtained which gives the torsional flux in terms of the differential logarithm.

Strong men and men of learning had pored over that card the night before, and had mopped their brows in sad despair. Mathematicians, physicists, engineers and biologists had all had a try at it by turns, and had been beaten back like waves against a jagged rock. To all questions and comers the Professor had replied with patient and lucid volubility.

"You ask me vich ze disintegrator it is. It is he. I pull her so, and the lever she work dat train of wheels, mit ze cam dat engage in ze second train. (How you say —'engage?' No, 'book.') Ze one train go fast, ze ozer slow. I call zem se 'eggspress' and ze 'petite vitesse.' Vell, zare, you as a gompound harmonic motion of two dialyzers, vich ven it com into gontact mit ze index makes ein duplicate rotation of ze primordial spring. Do you not now gomprehend.? I pull ze lever so, and then . . ."

But visitors could seldom stand the explanation twice They preferred to try and think it out whilst watching the operation, which, it must be confessed, was complicated. The interior of the machine appeared to be a mass of cog wheels, cranks, levers, springs, dials, cams, eccentrics and pins crammed as tight as it would hold. The pull of a handle set these in motion at once, and had some effect finally upon a pointer moving across a scale. But what this effect was bothered all the scientists to explain. The "Polyphloisballsanskittlograph" was the hit of the Royal Society *soiree*. It was a nut that took more cracking than all the other scientific curiosities put together.

"You say," plaintively moaned a well-known biologist, that the disintegrator is adjusted in harmony to the *vascular* functions; now what, if I may ask, is the vascular functions?"

"Ach I thought I explain dat. Ze storing up of ze energy in ze resultant gompound motion of two semi-harmonic vibrations is aggomplished by the interaction of two perimetrical lever cranks, A and B, vich in ze manner of a vascular organism of ze human being between zemselves ze necessary operations subdivide."

Then the biologist retired from the fray and sought solace in a microscope full of wonderful "eosinophile or non-phagocytic leucocytes," on the neighboring table.

The next who tackled the Professor was a venerable mathematicion, who himself was exhibiting three highly complex counting machines and a harmonic integrator that was all strings and pulleys. He was jealous of the success of his rival, round whose exhibit a crowd was persistently gathered. I heard the Professor explaining to him, with great rapidity and wealth of gesture, something about "ze multiplication of diatonic coefficients in terms of Fourier's expansion," and then I saw a cloud come over the great man's face as he withdrew once more to his own comparatively simple inventions. I thought he gazed at them with a disappointed and dissatisfied air.

As I was leaving *soiree*, one of the last, and sunrise was glinting the gorgeous uniforms of the departing guests who had come from the *levee*, I perceived Lord Kelvin stealing shyly towards the Professor's machine, now disengaged, which he stood for some time time admiring, with a rapt expression on his face.

"It reminds you, nicht wahr, of zom of your own models you exhibit last year," the Professor said, "vo instance, dat 'homogeneous equilateral azzemblage of 512 points red und green, mid stretched springs and struts between each point, to show ze appligation of Boscovitch's theorem?'"

The President of the Royal Society looked round to see if anyone was watching. Then he winked slowly, as much as to say: "That was not bad, as mere ingenuity goes; but *this* lays over everything."

I heard him still chuckling as he left the building ten minutes afterwards.

Grading of Pig Iron.

The grading of pig iron was the subject of a paper by E. A. Barton, superintendent of Ensley furnaces, read at the fall meeting of the Alabama Industrial and Scientific Society. Mr. Barton began by stating that many consumers of pig iron are now looking more to the chemical constitution of the pig iron than to the fracture of the same as the latter is often misleading. About 6 years ago there were 15 recognised grades of southern irons as follows: Open and close silvery, open bright, medium bright, close bright, No. 1 foundry, No. 2 foundry, 2½ foundry, 3 foundry, extra 1 mill, 2 mill, silvery mill, mottled and white. At a meeting of the southern ironmasters 5 years ago, the grades were revised and the following were adopted: Silvery grey, No. 1 soft, No. 2 soft, Nos. 1, 2, and 3 foundry, gray forge, mottled and white. This grading gave, sometimes, cause of complaint, as some of the silvery iron appeared mixed. To meet the wishes of a certain class of customers the two grades of silvery iron were re-established, called No. 1 and No. 2 silvery iron, corresponding to the old open and close silvery. In soft irons the openest pigs were graded No. 1 soft and the remainder called No. 2 soft. The latter cannot be graded so uniformly as desired, and is, therefore considered, by many buyers as an off grade. Soft iron should contain from 3 to 4 per cent. silica, ½ per cent. combined carbon, 2 to 2¼ per cent. graphite in No. 1 soft, and 1 to 1¼ per cent. graphite in No. 2 soft. The graders make often the mistake to class as No. 2 soft some chilled pigs from a foundry cast having a light colored appearance with a close edge. These pigs contain about 2 per cent. silicon and should be graded either No. 2 or 3 foundry. The grading of the 3 straight foundry grades does not require much comment. The standard amount of silicon in each grade should be about as follows: 1 foundry, 2.75 per cent.; 2 foundry, 2.5 per cent., and 1 foundry, 2 per cent. It was in forge iron that the change in the grading caused the greatest trouble. Sufficient forge iron was made in the endeavor to make foundry iron to meet all demands and the forge iron thus made was apt to be high in silicon and very wasteful for rolling mills, though suitable as a mixture in pipe works. Complaints from both kinds of consumers came and graders saw soon the impracticability of having only 1 grade of pig forge, and made inquiries before shipping if the the iron was to go to rolling mills or foundries, shipping accordingly No. 2 mill or No. 1 mill. These two grades are now called grey forge and foundry forge. The furnace practice in the South is improving and a more even grade of iron is now made than ever before.

A Lady Engineer—When Miss Philippa Fawcett, the daughter of the late British Postmaster-General, came out above the Senior Wrangler in the Mathematical Tripos at Cambridge, there was considerable speculation as to the profession which the clever lady would select. The problem has now been solved by the announcement that Miss Fawcett will henceforth practise as a civil engineer. It is very seldom that two families, almost equally notable for intellectual capacity, become so closely identified as the Fawcetts and the Andersons. Miss Philippa, like many of her relations, is very fond of outdoor sports, and is in other respects far removed from the typical "blue stocking." She is an adept fencer, as well as tennis and hockey player.

The Macbeth "Pull Up" Blasting Machine Wins—A patent infringement suit which has been pending for three years past in the United States Circuit Court, brought against Messrs. James Macbeth & Company, manufacturers of the "Pull Up" Blasting Machine, by H. Julius Smith, for alleged infringement of his patent for Magneto-Electro Machine for Firing Fuses in Blasting, has just been decided by Judge Wheeler in favor of Messrs. James Macbeth & Co. Regarding the outcome of the suit, Mr. James Macbeth says: "The decision is a very just one and what I expected. Further, I do not believe that any person ever thought my machine infringed any other. It is built on an entirely different principle, and our increasing sales show that the people like it.' The popularity of the Macbeth "Pull Up" Blasting Machine is unquestioned, as is shown by the steady extension of business in foreign countries as well as at home. Messrs. James Macbeth & Company are the sole manufacturers, with headquarters at 128 Maiden Lane, New York City. Their works are at Jamaica, Long Island, N.Y.

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TORONTO, May 25th, 1894.

The Canadian Mining Review
Established 1882

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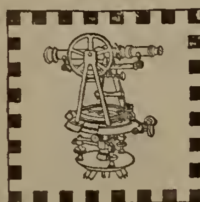

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CONDUCTED BY - - - - - - - B. T. A. BELL.

THE OFFICIAL ORGAN

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THE UNITED MINING SOCIETY OF NOVA SCOTIA,

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The Cape Breton Meeting.

As announced in previous issues the members of the General Mining Association of the Province of Quebec and the Mining Society of Nova Scotia will meet at Sydney, Cape Breton, during the week commencing 10th July next. The programme of the proceedings is as follows :—

TUESDAY, 10TH JULY.

At 10 a.m. the party will leave the Landing Stage, near the New Sydney Hotel, on the Dominion Coal Company's steam tug for the International Pier.

The approaches to the Pier and the grading of tracks are well worthy of attention. The whole of this work has been carried out under the personal superintendence of Mr. Hiram Donkin, C.E.

The party will return to Sydney and lunch at the Hotel at 12 o'clock.

At 1 o'clock a special train will be in attendance at Sydney Station to convey the party to the Dominion Coal Company's Caledonia Mine, which is equipped with patent self-dumping cages, and screening and loading arrangements of the most complete kind. The iron pit-frame and landing stages, upwards of 80 ft. in height, are a special feature.

The large Compound Air and Compound Condensing Steam Rand Compressor, which was exhibited at the World's Fair, has recently been laid down at this pit to work coal cutting and pumping machinery.

A range of Babcock & Wilcox boilers, working at a pressure of 100 lbs., is in operation, and below ground, endless Cable Haulage, Ingersoll Coal Cutting machinery and Stanley Coal Header.

The whole will be inspected under the guidance of D. McKeen, Esq., M.P., General Manager, and Mr. W. Blakemore, Mining Engineer to the Dominion Coal Company.

Return to Sydney from Glace Bay Station at 6 o'clock.

A meeting will be held in the Assembly Room of the Sydney Hotel, promptly at 7.30 p.m., for the transaction of business and reading of papers.

WEDNESDAY, 11TH JULY.

Leave the Landing Stage, Sydney, on the ordinary Ferry Boat at 10 o'clock, arriving at North Sydney at 10.30 a.m., where the party will be met by R.H. Brown, Esq., M.E., and conveyed over the private line of the General Mining Association to the old Sydney Mines, which present many special features of interest. These mines have been in operation longer than any other in Cape Breton, having been established upwards of 100 years. The workings extend some distance under the Atlantic Ocean, and the coal is hauled to pit bottom by main and tail rope.

After inspecting the mines, the party will be entertained at luncheon by R. H. Brown, Esq., and will return to Sydney by the afternoon boat, leaving North Sydney at 3 o'clock. In the evening, D. McKeen, Esq., M.P., will entertain the party at dinner at the Sydney Hotel, where they will meet some of the leading gentlemen of the district.

THURSDAY, 12TH JULY.

The party will leave Sydney Station at 9.45 a.m. for Cow Bay, where the Dominion Coal Company's Gowrie Mine and Pier are situated. After a brief inspection of these, they will, if practicable, and arrangements can be made, proceed on the Company's steam tug to Louisburg, a distance of about 30 miles. This will be a most enjoyable excursion, and will afford an opportunity of inspecting the old French fortifications, and making the acquaintance of a town which possesses great historic interest. The party will return from Louisburg by the same tug at 4 o'clock, arriving at Sydney about 8 p.m.

FRIDAY, 13TH JULY.

The Eastern Development Company, through Mr. Isaac P. Gragg, President and General Manager, has very kindly invited the party to visit the Coxheath Copper Mines, either as a body or as individuals, during the week of this meeting. Further details of this excursion can be learned at the headquarters at the Sydney Hotel during the meetings.

Should the day prove propitious, it has been proposed on Friday afternoon to take a steamer on Little Bras d'Or for an excursion through some of the beautiful bays of the Bras d'Or Lake, terminating at Grand Narrows Friday evening.

A large party of delegates from the Quebec Association will sail from Montreal at daybreak Thursday, 5th July, on the steamer "Bonavista," which has been kindly placed at their disposal at a greatly reduced fare for the round trip by the courtesy of Messrs. Kingman, Brown & Co., Montreal. The Intercolonial Railway will also carry members from Levis to Sydney and return at a single fare, while the Canadian Pacific, Grand Trunk and other railways will issue tickets at a fare and one-thied to delegates travelling from points on their lines to the place of meeting. Those members going by boat are requested to be on board ship at Montreal on Wednesday evening, the 4th July, but members who cannot join the party at Montreal may do so at Quebec, on the evening of 5th July, by communicating with the agents of the Black Diamond Steamship Company in that city. Immediately after the meeting the "Bonavista" will sail from Sydney for Montreal.

The members of the Mining Society of Nova Scotia will leave Halifax at 8 a.m. local time on Monday, 9th July, reaching Sydney same evening at 9.30 p.m., a drawing room car for their accommodation being provided by the courtesy of the Intercolonial Railway, which will also carry them for a single fare Both societies will rendezvous at the New Sydney Hotel, where special rates for their accommodation have been provided by Col. Brownell Grainger.

Every effort has been made by the local committee, notably Mr. David McKeen, M.P., Mr. R. H. Brown, M.E., and Mr. W. Blakemore, M.E., to ensure the comfort and enjoyment of those members and guests who may be able to avail themselves of this opportunity to visit an Island which possesses many features of interest to those associated with mining, together with rich and varied scenic attractions and historical associations, which cannot fail to render the visit one of great profit and enjoyment to all who may be able to go. Every mining engineer in Ontario, Quebec and Nova Scotia who can spare time for a couple of weeks' holiday should avail themselves of this excellent opportunity to visit and inspect the largest and most important coal field in the Dominion.

Our next issue, profusely illustrated with portraits, photographs of the collieries and other works to be visited, and a complete geological map to date of the Sydney coal field specially prepared for this number, will contain as usual a verbatim report of the proceedings of this exceptionally attractive and important occasion.

The American Society of Mechanical Engineers—Montreal Meeting.

The twenty-ninth meeting of the American Society of Mechanical Engineers was held at Montreal during the week commencing 5th June. About 200 ladies and gentlemen participated in the proceedings.

The first event was a drive around Mount Royal Park. Unfortunately the weather was stormy, but the drive took place nevertheless in closed carriages. The magnificent view from the mountain was of course obscured, but a champagne lunch in connection with the vivacity of Col. Stevenson, did much to enliven the occasion.

The opening session was held Tuesday evening at Molson Hall, McGill University, and was presided over by Mr Herbert Wallis, of the Canadian Pacific Railway, chairman of the local committee of entertainment. Addresses of welcome were made by Mayor Villeneuve, Sir Donald A. Smith, Professor Bovey (of McGill), and Mr. Geo. Hunt (on behalf of the local association of Stationary Engineers. A graceful response was made by the Society's President, Mr. Eckley B. Coxe, followed by his formal presidential address. Mr. Coxe is a man of distinguished attainments, both in a scholastic and practical sense, and of equally distinguished achievement, than whom no one is better able to deliver weighty sentiments on his chosen subject. The address displayed a breadth of view such as might have been expected from such a source

He outlined the great advance that had been made in this branch of education in recent years, and commented upon the well-known fact that in the United States the command of the industrial army is rapidly drifting into the hands of technical school gradnates, in spite of which, however, there is a widespread feeling that the methods and programmes in use are not wholly satisfactory This he considered inevitable, in view of the fact that the whole subject of technical education was a new one, almost without precedent or guide. A most healthy sign, however, was the fact that those conducting these schools are themselves aware of their shortcomings and alive to determine the reasons and remedies.

He proceeded to classify engineers, placing at the head of his classification the business engineer, by which he meant not simply an engineer who had drifted into business, but one whose range of vision was large enough to include business and financial considerations in forming his judgment, and thus at times decide upon courses of action which from a purely technical point of view might seem wrong. Such men, he said, were very rare, and when once known were sure to command high salaries. He then went on to describe the changes that had come over the engineer's work of late years in the direction of specialization, and enlarged upon the fact that this rendered it more difficult than formerly for the young engineer to acquire an all-around line of experience.

His contention was that the schools should so far as possible supply this all-around knowledge, that is, direct their energies toward the development of men well grounded in those fundamental principles which lie at the base of all specialties, and not attempt the training of specialists. He also animadverted against the practice of making higher mathematics the one great feature of an engineering education. Though an accomplished mathematician himself, Mr. Coxe has sufficient breadth of mind to recognise that many of the most successful engineers have not possessed the mathematical faculty except in a moderate degree, and to make mathematics the one criterion of the course was in his mind clearly a mistake.

Following the presidential address, the Society made an inspection of the equipment of the Engineering Building, and from all sides were heard words of unstinted praise and admiration for Canada's great technical school.

The regular business of the reading of papers was taken up Wednesday morning, when the following list of papers was gone through :

A. K. MANSFIELD : Notes on the Theory of Shaft Governors.
ALBERT F. HALL : Heat Units and the Specifications for Pumping Engines.
W. H. BRISTOL : A New Recording Pressure Gauge for Extremely High Ranges of Pressure.
FRANK RICHARDS : A Note on Compressed Air.
A. W. ROBINSON : The Relation of the Drawing Office to the Shop in Manufacturing.

It should be stated that under the system developed by the Society's mose efficient Secretary, Prof. T. R. Hulton, of Columbia College, the amount of work performed is very great. All manuscript is required to be in the Secretary's hand some weeks before the meeting. The papers are at once put in type and printed copies are sent to all members, who signify (by a blank postal card sent out for that purpose), their intention of attending the meeting. Each member attending is then presumed to have read the papers which interest him before the session opens. Consequently the paper is not read except by brief abstract, and almost the entire time of the sessions is thus available for discussion. The discussions are thus very full and are often of far more value than the papers which call them out.

Of the papers on the above list, that by Mr. Mansfield called out the most animated discussion. Mr. Mansfield's paper was chiefly an exposition of the "inertia effect" and its combination with the usual centrifugal effect. The inertia governor is a comparatively new development, which has been the subject of several previous papers before the Society, and it is a subject which is sure to give rise to a warm discussion. A leading part in the discussion was taken by Prof. Jocobus, of Stevens' Institute, who proceeded to demonstrate that unless handled with great intelligence the inertia governor was one of those things which had best be let alone. He produced some extremely interesting diagrams taken in the course of extended experiments on an engine fitted with an inertia governor, which showed plainly enough that it was very easy to apply an inertia in connection with a centrifugal governor in such a manner that the inertia governor should injure instead of improve the regulation.

The paper by Mr. Bristol also called out an animated discussion, and one which brought out some interesting facts, although the remarks drifted a long way from the subject of the paper. Among the more interesting remarks were those by Mr. Almond, of Brooklyn, N.Y., who gave an account of some unique experience in making spiral springs of steel. The steel wire was required to be extremely hard—so much so that it was found impossible to coil it to the required size without repeated breaking. This was finally overcome by running the wire through boiling water and immediately cooling it, the low heat of boiling water being sufficient to soften the wire so as to permit coiling.

Wednesday afternoon was occupied by an excursion down the Lachine Rapids, by a steamer furnished by the harbor commissioners —the trip to the head of the rapids being by special train tendered by the Grand Trunk Railway. After "shooting" the rapids the steamer took the party down the river past the city, finally putting about and landing the excursionists at Lachine basin.

The evening was occupied by a charming social function—a reception at the residence of Sir Donald A. Smith. A pleasant time was spent in inspecting Sir Donald's superb collection of paintings and curios, the japanise collection receiving, perhaps, the greatest expressions of appreciation.

At Thursday morning's session the following papers were discussed :

R. H. THURSTON : The Theory of the Steam Jacket ; Current Practice.
D. S. JACOBUS : Results of Experiments with a 50 h. p. Single Non-condensing Ball & Wood Engine to determine the Influence of Compression on Water Consumption.
FRANK H. BALL : Cylinder Proportions for Compound Engines, determined by their Free Expansion Losses.
F. M. RITES : A New Method of Compound Steam Distribution.
JESSE M. SMITH : Tests of a Small Electric Railway Plant.
W. S. ALDRICH : Power Losses in the Transmissive Machinery of Central Stations.

The first paper was extensively long, after the manner of Prof. Thurston's papers, and was expected to lead to a battle royal. Prof. Thurston is an ardent and uncompromising advocate of the steam jacket, and other equally able members are well known to be equally pronounced opponents. Those who enjoy a wordy passage at arms were, however, disappointed, as Prof. Thurston had unavoidably been detained from attending the meeting.

The paper by Mr. Ball, (well known as the inventor and builder of the Ball engine) was an explanation of a method of proportioning the cylinders of a compound engine, with reference to minimising the bed losses rather than the equal division of the load as has heretofore been done.

The paper by Mr Rites commands attention as does anything from his hand. Mr. Rites is well known as the inventor of the system of steam distribution employed in the Westinghouse engine—a system which has peculiar and unique advantages when employed non-condensing and under extremely varying loads—as for instance, in electric work, which in fact, first furnished the incentive for its development.

After adjournment the party assembled at the power house of the Montreal Street Railway Company, where luncheon had been proposed. The plant was much admired as an illustration of thoroughly high grade engineering, without the gilt edged and silver plated accessories that now-a-days are too often brought in where they have no proper place. Following this a visit to the Grand Trunk Railway shops had been planned, but had to be omitted as the shops were closed by reason of the coal famine, and in lieu thereof, the members attended a very pleasant garden party, tendered by Mrs. Frank Redpath and Mrs. Bovey at the residence of the latter.

Thursday evening was occupied by a professional session, at which the following papers were taken up :

M. P. WOOD : Rustless Coatings for Iron and Steel.
JAS. MCBRIDE : Corrosion of Steam Drums.
C. W. HUNT : A New Mechanical Fluid.
F. R. HUTTON : First Stationary Steam Engines in America.
DECOURCY MAY : Cost of an Indicated Horse Power.
JNO. R. FREEMAN : A New Form of Canal Waste Weir.

The paper by Mr. Wood went into the various processes for protecting iron and steel from corrosion, and enlarged upon the reasons which had lead to the commercial failure of some which had been technically successful. His conclusion was that the best available protection was first-class paint—linseed oil and pure white or red lead. Mr. Hunt's paper was a description of a new method of adjusting connecting rod ends to take up wear by means of a cavity behind one of the brasses filled with small steel balls. The screw enters this cavity and displaces the balls much as a pump plunger displaces water in a pump barrel. Mr. Hunt stated that the construction was cheap and satisfactory, the adjustment being very delicate and permanent.

At the conclusion of this session Prof. Bovey tertained the members in the testing labora-ry by showing the operation of the various ting machines.

At the Friday morning session the concluding pers were taken up as follows :

W. Bissell : Effect of Varying the Weight of the Regenerator in a Hot-air Engine.

R. Roney : Mechanical Draft for Boilers.

C. Carpenter : The Saturation Curve as a Reference Line for Indicator Diagrams.

nton-Jacobus-Rice : Results of Measurement of the Water Consumption of an Unjacketed 1600 h. p. Compound Harris-Corliss Engine.

F. B. King : Notes on the Corrosion of a Cast Steel Propeller Blade.

Of the above, the paper of most general terest, was that by Mr. Roney. Mr. Roney is ell and favorably known as the inventor of a ccessful mechanical stoker, which is "handled" mmercially in connection with the Westing-use engine. The paper here presented urged e abandonment of chimneys, except so far as necessary to get rid of deletérious gases, and e substitution of a fan for producing draft, in onnection with a fuel economizer to save the eat still in the gases after passing the boiler. n this way the temperature of the gases can be educed to a point which would give no adequate raft with a chimney, and the claim is that the eat thus saved gives a much greater amount of ower than is necessary to drive the fan, in other ords, the fan draft is produced at a smaller xpenditure of heat than the chimney draft.

This closed the professional sessions. In the fternoon many of the members visited the vorks of the Canadian Rubber Company, while thers attended a very pleasant garden party at he house of Mr. J. H. R. Molson.

The programme provided for an excursion to Ottawa on Saturday by special train over the Canadian Pacific Railway. A considerable number, however, manifested disappointment hat Quebec city had been omitted from excursions, one gentleman remarking that "Canada without Quebec was like Hamlet without Ophelia." In consequence, a party was made up o visit that famous city. The main contingent however selected the Ottawa trip, where the Ottawa Electric Railway Co's power house, the sawmills of J. R. Booth and the Parliament Buildings were inspected. Luncheon provided by Ottawa citizens was served on the grounds of T. C. Keefer, and a garden party at Rideau Hall on the invitation of His Excellency the Governor General completed the entertainment.

On all sides and throughout the convention constant expressions of appreciation at the generous hospitality extended were heard, as well as remarks showing the extremely favorable impressions made by Canada, Montreal, and especially McGill University. This convention was heralded by less blaze of trumpets than some previous meetings, but it is safe to say that none has resulted in furthering to a greater degree that mutual acquaintance of these two sister peoples, which is after all the greatest good accomplished by these international meetings.

EN PASSANT.

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We understand that the Dominion Government has under consideration an appropriation of $7,000 to be applied in drilling the enormous area of tar sands discovered by Mr. R. G. McConnel, B A., in his geological survey of the Athabaska Country, N.W.T. The tar sands have been estimated by Mr. McConnel to have a minimum distribution of fully 1,000 square miles. They vary in thickness where the section is complete from 140 to 225 feet. The following calculations extracted from the Summary Report of the Geological Survey for 1890, although it can only be regarded as an appropriation, will serve to give some idea of the enormous outpouring of bituminous substances which has taken place in this region :—

"An analysis by Mr. Hoffman of a specimen collected some years ago by Dr. Robert Bell, gave by weight :

Bitumen	12.42
Water (mechanically mixed)......	5.85
Siliceous Sands.........	81.73

A cubic foot of the bituminous sandrock weighs, according to Mr. Hoffman, 117.5 lbs. This figure multiplied by the percentage of bitumen, 12.42, gives 14.59 lbs. as the amount of bitumen present in a cubic foot, or $\frac{14}{63}$: $\frac{59}{7}$ 22.9 per cent. in bulk. Taking the thickness at 150 feet, and assuming the distribution as given above at 1,000 square miles, the bituminous sands in sight amount to 28.40 cubic milcs. Of this mass, if the preceding analysis is takcn as an average, although it is probably rather high, 22.9 per cent. in bulk, or 6.50 cubic miles is bitumen. The amount of petroleum which must have issued from the underlying limestones to produce 6.50 cubic miles, or by weight approximately 4,700,000,000 tons of bitumen, cannot now be estimated, as the conditions of oxidation and the original composition of the oil is unknown. It must, however, have been many times greater than the present supply of bitumen."

"The commercial value of the sands themselves as exposed at the surface" says Mr. McConnel, "is at present uncertain." But the abundance of the material and the high percentage of bitumen which it contains, makes it probable that it may, in the future, be profitably utilized for various purposes, when this region is reached by railways. Among the uses to which it is adapted may be mentioned roofing, paving, insulating electric wires, and it might also be mixed with the lignite which occurs in the neighborhood, and pressed into briquettes for fuel

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We understand that an experienced well driller has received the contract, and that work will be proceeded with just as soon as the appropriation is ratified by parliament. The tar sands evidence an upwelling of petroleum to the surface unequalled elsewhere in the world, but the more volatile and valuable constituents of the oil have long since diappeared, and the rocks from which it issued are probably exhausted as the flow has ceased. In the extension of the tar sands under cover the conditions are different, and it is here Mr. Mc Connel points out that oils of economic value should be sought. In ascending the Athabasca, the tar sands are overlaid at Boiler Rapid by a cover of shales sufficient to prevent the oil from rising to the surface, and in ascending the river, this cover gradually thickens. The geological attitude of the shales is not the most favorable, as the beds dip away from the outcrop at the rate of five or ten feet to the mile, and it is possible that a part, or even the whole of the oil may have flowed northwards and eastwards through the sands, and escaped where these come to the surface. It is unlikely, however, that all the oil has escaped in this manner, as small anticlinals in the covering beds are almost certain to exist, and a differential hardening of the beds themselves may serve to inclose reservoirs or inverted basins of large capacity. It is also possible that the sands at their outcrop, may by the deposition of tarry substances be plugged tightly enough to prevent further egress. Favourable indications of the presence of oil in the vicinity of the Athabasca, are also afforded by the existence of natural gas springs.

The question of the continuity of the tar sands and their petroliferous character under cover, can, however, only be settled in a decided manner by boring. At the mouth of Pelican river where the drilling will be done, the tar sands are probably covered by about 700 feet of strata, and this amount increases as the river is ascended. At the Athabasca Landing, if the formation extends to that point, it probably lies at a depth of from 1,200 to 1,500 feel below the surface, but the distance of the landing from the outcrop of the tar sands, and the variability of the thickness of the cretaceous formations make it impossible to give more than a rough estimate.

Tenders are asked for 300 feet of tunnelling on the Canadian Pacific Mining and Milling Co's gold property, on Woodberry Creek, near Ainsworth, B.C.

The *Nakusp Ledger* reports that an American syndicate is negotiating for control of the Noble Five group of mines, in the Slocan county, B.C. Price : 300,000.

A recent discovery of coal on Buffalo Point, Lake of the Woods, the extreme south-eastern part of Manitoba, is reported to have been acquired by a Winnipeg Company for $30,000. A prospecting outfit has been sent out.

Mr. J Keith Reid, C.E , Montreal, who has spent the past two seasons in the Kootenay County, B.C., has returned to Montreal. He has completed a very handsome wall map showing the mines and mining camps, roads, trails, railway and water routes, and other features of much interest to mining men interested in the Kootenay County. The original of Mr. Reid's map, will in all likelihood, be acquired by the British Columbia government, or the Canadian Pacific Railway, and the reproductions on the smaller scale should find a ready sale From personal examination we can confidently recommend this excellent piece of work to our readers.

MR. F. A. HALSEY, Sherbrooke, Que.,
Manager of the Canadian Rand Drill Co.

Mr. E. W. Gilman, Montreal,

Managing Director and Secretary, The Ingersoll Rock Drill Co, of Canada.

Messrs. Henry Barber & Co., Toronto, have been appointed liquidators in the estate of the Drury Nickel Company, Ltd., of Sudbury, now being wound up. Liabilities, $61,000. The assets are estimated at $100,000, and consist of the mining property, machinery plant, buildings, and nickel ore on hand.

"It is certain that when the much and long-wished-for-revival comes, no industry will feel its beneficial results more quickly or more deeply than will that of the manufacture of all kinds of electrical machinery and appliances. The great activity in this industry, that had only gotten fairly under way when the reaction set in a year ago, was a very genuine one, and when the times are again better it is morally certain that the business in this line will be greater than ever before. The demand for the projected electric roads, for the new lighting plants, for the new motors and dynamos, is a growing one, and if for a time suppressed, is sure to rise again like a hidden stream, with greater force than before."—*Boston Manufacturers' Gazette.*

And when it does come look out for a boom in Canadian mica.

The coal shipment from British Columbia for the month ending 31st ulto, were :

	tons.
New Vancouver Coal Mining and Land Co..	29,110
Wellington Colliery..........	23,269
Union Colliery..........	17,046

Our portrait series would be incomplete indeed did it not include a representation of those important manufacturing industries which have sprung into activity with the steady growth of mining affairs in Canada. The foremost of these, as all our readers know, are the Ingersoll Rock Drill Company of Canada, and the Canadian Rand Drill Company, operated respectively under the energetic and enterprising management of two very good fellows—Mr. E. W. Gilman, Montreal, and Mr. F. A. Halsey of Sherbrooke, Que., both of whose photographs are reproduced in this month's REVIEW. Mr. Gilman who is the son of the Hon. F. E. Gilman, a member of the Legislative Council of Quebec, is a native of Montreal, having been born there in 1867. He was educated in the Polytechnic School at Worcester, Mass., where he graduated as a Mechanical Engineer in 1888. After some time spent in visiting different shops and mines in the United States, he accepted a position with the Ingersoll Rock Drill Co., being elected secretary and managing director to the company in 1893. Mr. Gilman is a member of the General Mining Association of Quebec and other organizations. The large establishment over which he presides has its headquarters at St. Henry Station, a suburb of Montreal, and is running full time, employing a large number of skilled mechanics on those special lines of rock drills, air compressors, coal cutting machinery, and other mining appliances for which the Ingersoll Company enjoys a world-wide reputation.

Mr. F. A. Halsey, like Mr. Gilman, is too familiar a figure in the mining districts of the country to require any introduction from us, but a few lines respecting his career will not be without interest. Born at Madilla, N.Y., in 1850, he pursued a full course of mechanical engineering at Sibly College, Cornell University, from which he graduated in 1878. After a year's practice as a working machinist in local shops, he made his first business connection with the Brush Electric Co. of Cleveland, Ohio, in 1879. This was at the very beginning of commercial electric lighting and but for untoward circumstances he would undoubtedly have been a specialist in electricity. At the Brush Works he had charge of the testing room which, however, unfortunately resulted in such a violent attack of inflamation of the eyes that Mr. Halsey was compelled to abandon the work. In 1880 he entered the service of the Rand Drill Co. of New York. In 1890, on the occasion of the organization of the Canadian Rand Drill Co. he was appointed its manager, with headquarters at Sherbrooke, Que.; still, however, retaining his connection with the parent company in a consulting capacity. In connection with his present position, Mr. Halsey has had a very congenial work—one that all mechanics covet but seldem get—the organization of a new machine shop "out of the whole cloth," with the result that there has been established at Sherbrooke, Que. a "factory" shop probably unsurpassed in Canada, in the ingenuity and completeness of its equipment,—by a "factory shop" we mean a manufactory for certain specialties only, as distinguished from the general or jobbling shop. Special tools, jigs, fixtures, and gauges are provided for almost every operation, incidental to the work and as a consequence the Canadian Rand Drill Company enjoys a high reputation for the excellence and thoroughness of the work it accomplishes for the mining men of the Dominion. In 1893, the Canadian Rand Drill Company acquired the Canadian rights, and entered upon the manufacture of the Harrison Coal Mining machine.

Mr. Halsey is a member of the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the General Mining Association of the Province of Quebec, of which he is a member of Council. Among other contributions to the literature of mechanics may be mentioned his papers on "A New Rock Drill," being a description of the "Slugger" of which he is the inventor, and "The Premium Plan of paying for labor," a novel and original method of enlisting workmen in the effort to increased output—a system, by the way, which has been found to work admirably in his shops at Sherbrooke. These papers have been published in the Transactions of the American Society of Mechanical Engineers. Before the General Mining Association of Quebec he has also contributed a valuable paper on "Modern Practice in Economical Air Compressors." In addition to this he is the author of a distinctly valuabe work on "Slide Valve Gear," a treatise on steam engine valve motions which has been adopted as a test book in several engineering colleges, including his *Alma Mater.*

Gold Mining in Nova Scotia.

[By a Correspondent.]

South Uniacke District.

The Golden Lode.—This property under the management of Mr. Hayward, one of the owners, is being opened up rapidly. It adjoins the famous Thompson-Quirk mine, and the shaft at a depth of 300 feet, should strike the rich pay streak known to exist therc, and which has been worked by the Thompson-Quirk people to the dividing line. The shaft is now down 170 feet, and when com_ pleted the mine will be equipped with mill and suitable plant.

Malaga District.

Fisk Areas.—The development work on the Fisk Block here, owned by J. H. Austen *et al*, has already exposed four "leads," all of them showing gold. One lead in particular from 8 to 10 inches wide (where cut) shows very rich quartz. Within ten feet of this rich vein another lead of 4 feet has been struck showing fine gold well distributed. So good is the showing that the parties having the option on the mine, now hold the property at double the amount for which it has been bonded to them.

Minneapolis Mine.—This mine is now being prospected with very favorable results. As it is already well equipped with mining machinery, it will within a few weeks be on the list of producing mines.

Parker-Douglas Mine.—The lawsuit as to the ownership of this mine will soon be determined, and in the event of the plaintiffs substantiatıng their claim to the mine (everything up to date has been in their favor) active operations will be commenced immediately.

Caribou District.

Touquoy Mine.—This mine is pursuing the even tenor of its way and the usual quota of gold is finding its way to the already well filled pockets of the owner. It is reported that the mine is being examined by some English investors, with a view to purchase. There are on the property large quantities of low grade ore which have never yet been worked.

Lake Lode Mine.—Mr. W. A. Sanders is still working on this property with fairly good results, and he contemplates in the near future thoroughly equipping it with an up to date plant.

The Truro Mine.—This property under the able management of Geo. W. Stuart, is still being sunk upon to strike the rich pay chute, known to exist there, and we hope to report soon another rich strike on this mine, which has a high record.

Guysboro County.

Cochran Hill Gold Mining Co., Melrose.—The extensive new plant on this property is rapidly nearing completion. A 20 stamp Homestake mill of latest design is being erected by the Truro Machine Co. A large and commodious boarding house for the miners, and the mine itself is being equipped with a fine air compressor, drills, and Lidgerwood hoisting engine, built by the Ingersoll Rock Drill Co., Montreal. Manager McQuarrie reports that a large body of fair grade quartz has been opened and there is upwards of 800 tons on the dump ready to mill. The mill will be in operation about the middle of July.

Crows' Nest, Melrose.—Mr. Whitner a mining expert, representing the owners of this mine, spent some weeks in and around this district, and he says that considering the amount of development done on the property he is very pleased with the showing. A small mill is on the property, but a new and adequate plant will be installed, on the mine proving equal to anticipations.

Renfrew District.

Dr. C. D. Jenkins of Boston, the patentee of the Jenkins Mill and Amalgamator, has purchased and is now working on the tailings of the "North" mill. His mill is somewhat of a new application to an old principle, similar to that of the Gates Crusher, but which crushes very fine. At present we are unable to say with what result the tailings are being worked, as the clean up is to be monthly and it has not been in operation that long. Dr. Jenkins recently bonded the areas owned by Musgrave *et al* at Mooseland.

Asbestos Mining in Quebec.

Respecting the state of the asbestos market a prominent shipper writes: "I am glad to be able to report some improvement in the condition of trade. We have recently booked several orders in addition to our regular contracts; and I understand others in the trade have also had a good many enquiries and have had some sale. Manufacturers stocks, so far as I can learn, are fairly well depleted, but in the depressed state of trade generally, there is no disposition to contract ahead for any large supplies, and orders are consequently small, all the way from a carload to 25 and 50 tons, the latter figure being the maximum quantity we have sold to any one concern, outside of contracts."

Thetford District.

The Bell's Asbestos Co., Limited, who have been working extensively during the past winter have increased their force, and are operating very extensively this season. An entirely new system of cleaning lower the grades has been introduced, and a large output for the year is anticipated.

Messrs. King Bros. have reopened there mine but are operating only a small force. Their crushing mill is at present closed pending the introduction of new plant for cobbing and cleaning certain portions of their product.

The Beaver Asbestos Co., Limited, has reopened their pits, and employ a large force and increased plant over last year.

The Johnson's Co., have not yet reopened their mine, though some stripping work is being done. The crushing and cleaning plant which has worked continuously throughout the winter is still in operation. A great portion of the old dumps is being put through the mill and a large output of the lower grades is produced.

The Ward Bros. mine has not been reopened this season.

Black Lake.

The Reedsdale mines are still shut down and are likely to remain so this season.

The Anglo Canadian Asbestos Co., Limited, has 80 men on its pay roll and work will be continued vigorously during the season.

The American Asbestos Co. has a large force at work in the upper pits. A steam plant has been installed further back on the hill and mining operations are carried on entirely by steam, the compressor plant being idle. A large output will be made here.

The Glasgow and Montreal Company's pits remain closed pending improved market.

The United Asbestos Co. is in full operation. Since last season a large storage shed has been erected, and a very complete crushing and cleaning plant installed. A tramway system has been constructed to remove all debris to the back end of their property. This line is operated by a Bacon double cylinder double drum link motion winding engine and gives every efficiency.

Ottawa County.

The International Asbestos Co., Limited, of Newark, has a small force at work opening up their mine.

LEGAL INTELLIGENCE.

Attempted Gold Brick Swindle.

On Tuesday 12th instant, Martin C. Hoyt, who claimed to hail from New York, was charged at the Hamilton Police Court with being implicated with others in a conspiracy to defraud Mr. J. H. Smith of Grimsby, out of several thousand dollars, which he was asked to advance on certain gold bricks alleged to be bogus. It appears that a person named Bradley, who claimed to be a an Arizona gold miner, called on Mr. Smith, who by the way, is a retired western miner reported to have made his pile, and after introducing himself was invited to spend the night. During the evening Bradley in a burst of confidence exhibited a copy of the Arizona Flag (a bogus newspaper) containing his portrait and an elaborate description of the big strike he and a Mexican named Gero had made, at the same time producing samples of the quartz. Finally he tells Smith that he has several gold bricks hidden in the neighbouring woods upon which he would like an advance of $8,000 or $10,000. The upshot was that next day a visit was paid to the woods. The gold was there—bricks of it. Would Mr. Smith come up to the city and have it assayed? Certainly. They start to drive to the city; pass a man on the road near the race track. Carriage stops. Does he happen to know a good assayist in the city? Well, he should smile; has the card of one in his pocket now darndest finest assayist outside of Washington; name, Rolston, temporarily stopping at the Royal hotel. Carriage drives on with polite thanks to the opportune stranger.

They arrive at the Royal. W. Rolston is in his room; most polite and affable of assayists. Assay most satisfactory, gold worth $20 an oz., as shown by neatly printed assay form. Mr. Smith notes that this opportunely met assayist has furnace, bellows, all apparatus in his room, and is quite prepared to assay at a moment's notice, though professedly a transient guest. Most opportune and affable of assayists! Perhaps it is at this point Mr. Smith's able-bodied suspicion begins to assert itself, or perhaps it had existed from the first, for Mr. Smith got experience as well as gold in California, and is not easily deceived.

The bricks of gold at the camp Bradley were valued at $25,000, and as the plot developed he wanted to take it down to Mr. Smith's house, and entrust it to his care while he and the Mexican went back for $20,000 more that they wanted to get out of a country plunged in civil war and anarchy, into the Lord's own country, where a policeman's uplifted finger embodies more power than a battalion of militia with Gatling guns in the mob-ridden states of Colorado and Arizona. Smith suggests that it be stored in a bank; but that does not suit Mr. Bradley. He also wants an advance of $8,000 or $10,000 on the gold; part of which the Mexican wants to send to his mother, and the rest is to be used in the expedition back for the rest of the gold. Will Mr. Smith bring that much money to the camp, and then they will take the gold to his house? The ignorant Mexican must see the money for his mother before he will let it out of his sight. Cautious Mr. Smith doesn't see the point of going to a lonely camp in the woods with so much money on him, even to meet a shock-headed Mexican and his now quite confidential friend, Mr. Bradley. Bring the gold to his house and he will draw the money out of the Grimsby bank, and hand it over. Wednesday night Bradley stayed at Smith's again, and it was arranged they should go for the gold in the morning.

The upshot of the matter was that the police were communicated with, but before any arrests could be made the principals had flown. The man Hoyt, who was arrested, was let off, there being insufficient evidence to prove his identity with the gang.

The following judgments involving the interests of miners in the West Kootenay silver county, have been given by Judge Spinks, at Nelson, B.C. :—

Ennis vs. Startsman—Dolly Varden and Archie Mineral Claim.

This was a case heard at the September court of last year, and judgment was reserved until this court. The point on which judgment was reserved was whether a purchaser of an interest in a mineral claim who had not at the time of his purchase and delivery of the bill of sale a free miner's license, but who subsequently on the same day obtained a license, could hold his purchased interest in the claim without forfeiture or otherwise. Judge Spinks held that a free miner's license taken out at any hour of the day reverts back to the inception of the day on which it was issued and therefore the plaintiff's bill of sale of an undivided one-quarter interest in each of the above claims was valid, and he was by the decree of the court held to be legal owner of the same. The judge held further that a free miner's license was not necessary to a purchaser or a devisee under a will, or to the heir in case of intestacy of the owner of a mineral claim or an interest in one until he asserted some right in connection with it.

Cummings et al v. Northern Belle Mining Co.

This was an action brought by a number of miners against the company for unpaid wages aggregating about $2,500. Objection was made on behalf of the company to the service of the summons on the ground that it was made on the superintendent in the company's office at the mine, and not on the registered agent of the company at Kaslo, under the Companies Act. The judge held the service good. The case proceeded to trial, but owing to the fact that all the plaintiffs, except Cummings, were not in court to prove their claims, their counsel was obliged to adjourn their cases until next court. Cummings, however, got judgment for his claim, some $240.

Dawson v. R. C. Adams.

This was a rather complicated case, involving the well known claims Bon Ton and Big Bertha and License. The Bon Ton owners, the defendants, have applied for a certificate of work, so as to obtain a crown grant. The plaintiff, who is the owner of the License claim, seeks to intercept the granting of this certificate, and fyled his affidavit of adverse claim as required by the Mineral Act. This action was intended to be brought to determine the adverse claim. Serious objections were raised by defendant's counsel to the form of the action, and after a lengthened argument the court held the action was not one on the adverse claim, but was one on ejectment. Then the defendant's counsel objected that the summons issued was not one of ejectment at all. After further argument the court dismissed the action with costs. The plaintiffs immediately brought a second action, and on the following day the defendants obtained an order for a stay of proceedings until the costs of the former action are paid.

Mr. Robert Stevenson *President* and Mr. W. L. Hogg *Secretary* of the Stevenson Gold and Platinum Hydraulic Mining Company, Ltd., gave us a call the other day. This company has been incorporated under the statutes of British Columbia, with an authorised capital of $1,000,000, in shares of $100, to develop a placer mining claim, situated between the town and first fork of Granite Creek, Similkameen division of the Yale district, British Columbia, containing in all about 640 acres. Tests on the upper benches, which average from 30 to 150 feet in depth, have given returns as high as $1.50 per cubic yard, but the average is expected to run from 25 to 35 cents to the cubic yard. Both gentlemen appeared satisfied with their efforts to obtain eastern capital to develop their property. Some 3,500 shares being for disposal at $10, for the purpose of obtaining the requisite sluicing machinery and running expenses.

The Halifax Mining Syndicate, Ltd., has been registered, in London, Eng., with a capital of £1,200, in shares of £100.

In our notes in last issue respecting the Renfrew mining district, N.S., we credited the McLeod lode to the Colonial property. The strike made was on the New Haven property, and the extension of the McLeod lode on the Colonial area has not yet been traced. All these properties, however, are now consolidated by the Pictou Development and Mining Co., Ltd., who are working the "Foundation," "McLeod" and "Clement" lodes, the latter being a large vein from 20 to 30 inches, and milling from $5 to $7 per ton.

Late advices from the Pend d'Oreille Country, B.C., gives an interesting report of a recent clean up by the Kootenay Hydraulic Mining Company. 2,200 yards of gravel were sluiced giving a yield of $525 in gold equal to nearly 24 cents per cubic yard. Some of the nuggets being of good size, the largest being worth $5.85. When it is remembered that 8 cents per yard is regarded as profitable working, and that many of the great placers have been worked remuneratively at 3 or 4 cents per yard, this result must be regarded as most encouraging.

Notwithstanding the very high expenditure already incurred by this company in collecting the waters of six or seven mountain torrents by means of a ten mile ditch, it cannot but be recognised that this source of supply is entirely inadequate for the purpose, as it is merely the rush of the spring freshets, and attention is necessarily turned to the magnificent body of water in the Pend d'Oreille river, to ascertain whether it can be made available to supply the water to the monitors with a pressure equivalent to a head of 200 or 300 feet.

Messrs. S. B. Robbins and E. F. Schoemaker who have been mining in Alaska during the past seven years, gave some interesting information respecting gold mining in the far north.

"Last year was a very hard one," said Mr. Robbins, "particularly on those who went up there with barely enough to live on. Over 400 men crossed over into the Yukon basin, some equipped only with a single blanket and enough food to last them a few days. The wages are a half ounce—about $8—a day, but there were two men for every job in sight.

"Every man who goes into the Yukon country should have at least $350 or $400. That is enough to carry him through for a year. He can then winter in the basin and be at once prepared to commence work when the spring opens. Four of my friends during the past season cleaned up $90,000, but their luck was exceptional.

"The great Treadwell mine," said Mr. Robbins, "runs every day in the year except two, Fourth of July and Christmas. There was some talk last year of putting in one hundred additional stamps in order to keep up with the ore output. There are many mines along the coast that are equally as rich as the Treadwell, but the coast line is so rough and the vegetation so rank that prospecting is very slow work.

"There are hundreds of men up there who have claims staked out, on which they are barely able to keep up their assessment work. They have made the same mistake which others have—gone up there as they would to a mine where the base of supplies is distant the journey of a day or two. The past season was very severe. The snow was frequently six feet deep where it usually averages about a foot.

There is room for 100,000 men in Alaska, but they must go there prepared to spend at least four months of the year in idleness. If they strike the country at the right time they can earn good wages at steady employment. I would caution all intending to go there to think well of what they may be called upon to endure."

A valuable discovery of a large deposit of chomic iron is reported from the property at Black Lake, Que., operated by Dr. James Reed, Reedsdale. A force of men are at work opening it up, and about 200 tons have been mined to date. Shipments to the United States have realized $25 to the ton.

A syndicate of American capitalists has leased four thousand acres of land from the Canada Company, three miles north of Thedford, Ont., and test wells for petroleum are being put down. A Petrolea firm has taken the contract to sink holes in different parts of the territory, and a drilling rig of the latest design has arrived on the ground and commenced operations.

Just as we go to press we learn that the Hon. George Irvine, Q.C., is dangerously ill, and that his trusty henchman, Mr. Lawrence J. Lynch, has been severely injured by an accident.

FREE MINING AND SMELTING MACHINERY.

The Subject Discussed in the Tariff Debate in the House of Commons.

Mining and smelting machinery imported prior to the sixteenth day of May, 1896, which is at the time of its importation of a class or kind not manufactured in Canada. Free.

Mr. J. A. MARA (Victoria, B.C.)—When the Government in 1890 decided that mining machinery not made in Canada should be placed on the free list, the Minister of Finance stated that the object was to encourage the mining industry by offering the freest market for procuring the most modern machinery, and he also stated that the most liberal construction would be placed upon the wording of the Act. So far as British Columbia is concerned, I am sorry to say that the benefits that were expected have not been realized. We feel that a liberal construction has not been placed on that Act in many cases; instead of a free and liberal construction, we feel that a harsh and restricted interpretation has been placed upon the Act, that it has not stimulated the development of our mines and only to a limited extent have we been afforded a free market for the purchase of modern mining machinery. From a return laid before the House a few days ago, I find that during the three years, 1891, 1892, 1893, the total value of mining machinery admitted into Canada free of duty was $227,488, of which $79,847 was received by Ontario, $55.999 by Quebec, $53,081 by Nova Scotia, $46,043 by New Brunswick, $20,425 by Manitoba, and only $16,199 by British Columbia. I believe a considerable portion of the machinery credited to Manitoba was entered for British Columbia, but even taking the whole it only amounts to $36,000, or an average of $12,000 a year. I am not in a position to state how many applications were made during those years, but from the many communications I have received I am satisfied that the machinery admitted free of duty was small compared with the applications made. I believe at the time it was the intention of the Government to place a liberal construction on that Act, but difficulties arose in interpreting it, and unfortunately I think the Government applied to the manufacturers to provide them with a list of mining machinery made in Canada. In that list they enumerated almost every article of mining machinery under the sun. For instance, take concentrating machinery for iron and other metals. I am informed that in the Dominion there is no foundry or manufactory that can or has made complete concentrating machinery for the treatment of gold, silver and copper ore. It is true they have manufactured such machinery that will treat iron ore, but none that will treat the precious metals; but this list, which was placed in the hands of the collectors, and is an instruction to them and is for their guidance, covers concentrating machinery for the precious as well as the base metals. That the view I now present is not an exaggerated one will be apparent to the committee from the proceedings of the Quebec Mining Association. I find that in the eastern provinces mining men have had the same difficulties to contend with that we have experienced, but they are fortunate in the fact that they are nearer to the capital. They can get the ear of the Controller of Customs, their grievances can be more easily made known to him than ours at a distance of 2,500 or 3,000 miles, and their difficulties are more easily adjusted. At this late hour I feel it almost necessary to apologise for reading extracts or quotations, but I will make them as brief as possible, and I only do it to make the point I wish to emphasize, that this grievance is felt all over the country, and in British Columbia there is at the present time no more important question than that of having mining machinery admitted free. At the adjourned meeting of the annual general meeting of the Mining Association of the Province of Quebec, Mr. B. T. A. Bell, the Secretary, stated:—

One of the resolutions left over from the annual meeting yesterday was that relating to the Customs tariff on mining machinery. As you know, the Dominion Government, with the object of encouraging the mining industry, amended the tariff in 1890 so as to admit the machinery for mining purposes of such class or kind as is not manufactured in the Dominion free of duty. The period was three years, and it expires next month. The Government has renewed the provision until May, 1896. The Act is in the main liberal, but difficulty seems to have been experienced in its interpretation by the collectors at some of the ports of entry. While in several districts no difficulty has been experienced in passing mining machinery free of duty, at others the duty has been imposed on machinery which distinctly was not made in Canada. The collectors seemingly were not instructed what class and kind of machinery should come in duty free. It has been thought that some representations might be made to the Government on the subject.

Capt. R. C. ADAMS—This is one of the questions I desired to speak about. As it is the law is a perfect farce. I inquired when in British Columbia how it worked there and found that it created a great deal of bother. An importer brought in some piece of machinery which the collector often held for duty pending investigation, and then as likely as not some country blacksmith was found to claim that he could manufacture the machinery.

Mr. J. BURLEY SMITH—The mining industry is quite as important, if not more so, than any of our other industries, and it seems to me an unwise policy to hamper its development by any tariff restrictions. At present we are only partially relieved of the duty. I refer to the stipulation in this Act whereby only machinery that is not manufactured in Canada shall be admitted duty free. It opens a question as to what machinery is free. For instance, while rock drills as a class are manufactured in Canada, only two particular kinds are made—the Rand and Ingersoll. Yet in Europe, at the present moment, there are actually 34 distinct types of rock drilling machines, some of which contain improvements which were not even dreamt of at the time the Rand and Ingersoll-Sergeant were patented. Now does the law permit me to import any of those other kinds of drills duty free?

Mr. B. T. A. BELL—Certainly; I do not think there can be any doubt about it. The Government provides you with a form of declaration in which you simply swear that the machine you are importing is of a class or kind not manufactured in this country, and the collector is bound to pass it. The law is good enough of itself; it is its operation at some of the ports of entry that is defective.

Mr. W. H. IRWIN—Mr. Bell's conclusion is that the Act is liberal. The experience of my company has been different. The meaning of the Act is vague and ambiguous—it is so loosely worded that almost anything we use in asbestos mining can be construed by the collectors to be either directly or indirectly manufactured in Canada. Can Mr. Bell tell me just what machinery can be brought in free under this Act.

Mr. B. T. A. BELL—That would be a big contract. The whole essence of the Act lies in the words "class or kind." For instance, rock breakers as a class are made in Canada, but the types known as the "Forster," "Wiswell," "Cyclone," and numerous other kinds of crushers are not manufactured. We are entitled beyond a peradventure to bring in these free. The same applies to pumps, and all the various kinds of specialties not manufactured here. The Department evidently is not posted on the details of the subject.

Mr. JOHN E. HARDMAN (Halifax), said he had had considerable experience in the operations of the Act, particularly with reference to the importation of machinery for gold mining. At first they had found some difficulty in getting the collectors to arrive at a proper interpretation of the meaning of the Act. As an example, copper plates were admitted free of duty, but when silvered for amalgamating purposes, the Government in order to protect the few silver plating works—which had has a matter of fact no bath large enough to take in these plates—charged the duty. Representations were made by the Gold Miners' Association, with the result that a clear understanding now existed in Halifax, and there was comparatively little difficulty now in getting free entry for machinery. In every case, where the form of declaration had been filled in, the importer never failed to get his machinery in free of duty.

Mr. W. H. IRWIN—Unfortunately our experience at the port of Sherbrooke has been very different.

Mr. HARDMAN—In Nova Scotia we have no faul to find wih the Act.

Then a committee was appointed to wait on the Controller of Customs, and at that interview, Mr. Franchot, who introduced the deputation, addressing the Controller, made the following statement:—

We have come to see you, sir, as representatives of the General Mining Association of the Province of Quebec, regarding the present law relating to the importation of mining machinery. As you are aware the Act admits free of duty all mining machinery of a class or kind not manufactured in the Dominion. The law in itself, as at present is perfectly satisfactory, but its interpretation by some of the collectors has not been satisfactory.

There are several other extracts that I had intended to read, all of which are in the same direction, but at this late hour I am rather afraid that I might tire the patience of the House. It occurred to me that there are three plans by which we might get over the difficulty. One is: To ask that all mining machinery be admitted free, but in interviews which the British Columbia members had with the Minister of Finance, we were clearly told that the Government could not permit that, and I am free to admit that there are many objections to it. One is: That it would be almost impossible to define what is mining machinery. A hammer or a saw would be entitled to free entry just as much as a boiler, or a pick or shovel as a steam engine. I can also see where it would be difficult to arrange this, because the local merchant or trader would have to pay the duties on everything he kept in stock, while the mining man, by making a declaration, would be able to get the same articles in free of duty, and that would not work. Another course that suggested itself to my mind was that mining machinery that is not manufactured within the province where it is to be used should be admitted free; but that is objected to also, on account of sectionalism. Then a third plan suggested itself, and that is, to append a list of articles of mining machinery that will be useful in the development of gold or silver and copper mines. I have made out a list of this machinery which I intend to submit to the committee and to ask them whether it would not be advisable to amend the item as it stands at present by adding these articles. I have placed on this list, "The Bridgeman Ore Sampling Machine," a machine that is not made in Canada, but is suitable for prospecting and developing mines not already open. Also, "All concentrating, refining, and amalgamating machinery and appliances for the treatment of gold, silver and copper ores." I may state that none of these are manufactured in Canada, and I suggest that they should be made free.

Hon. N. CLARKE WALLACE—Are there none of the ore sampling machines made in Canada?

Mr. MARA—From the best information I can obtain, I believe that no machines for sampling galena or gold quartz ore are made in Canada? Then there is the "Tremaine Stamp Mill," a small and cheap machine which is very useful; also "Forster's Ore Breakers," which are peculiarly adapted to gold mining, and which have introduced many economies in the treatment of ores. That is not made here. Then there are "water jacket furnaces for galena and silver ores," none of which are made here. I believe there is a furnace for copper ore manufactured in Sherbrooke, but none for galena or gold ores. Then, again, "Root's Patent Spiral Rivetted Water Pipe, and all special lines of piping, manufactured for hydraulicing, and steel plates and rivets used in the manufacture of hydraulic pipes." My object in putting steel plates and rivets used in the manufacture of hydraulic pipes on the list is: That it would be unfair to admit all piping free of duty and not admit the raw material. In British Columbia considerable hydraulic piping has been manufactured, and the manufacturers, I am informed, are not afraid of competition if they can get the raw material, the plates and rivets admitted free of duty. I have also put on this list, "hydraulic motors, Bleichert, Hallidies, and Lidgerwood wire rope, tramways and cableways, and diamond prospecting drills." Now, it is unnecessary for me at present to go over the arguments that have been advanced from time to time in this House in favor of admitting mining machinery free. The justice of that was conceded three or four years ago when the Government placed mining machinery of a class or kind not manufactured in the Dominion of Canada, on the free list. But I will state this: that at no time in the history of British Columbia will the enlargement of the free mining list be of as great service to our province as to-day. In the Kootenay country, in the Toad Mountain, Slocan and Ainsworth districts, the mines are past the prospecting stage; many of them are developed, and I am happy to say are shipping ores. During the last winter over 3,000 tons of ore were hauled on the snow and shipped to American smelters at a cost of from $25 to $40 a ton. This year, when railways will tap that section of country, I believe that shipments will increase tenfold. To illustrate the value of some of these mines, I will give the returns from a few of the companies. The Mountain Chief Company shipped over 300 tons, averaging 130 ozs. in silver, and 70 per cent. lead; the Blue Bird Company shipped 300 tons, averaging 134 ozs. in silver and 71 per cent. lead; the Noble Five Company shipped 350 tons, averaging 150 ozs. in silver and 69 per cent. lead; the Dardanelles Company shipped 150 tons, ranging from 284 to 322 ozs. in silver and from 26 to 30 per cent. lead. Of course, these mines shipped only what is called shipping ore, in many cases handpicked; but for one ton of shipping ore now in sight in these claims, there are 100 tons of concentrating ore. In one claim, the Slocan Star Mine, there have already been proved to be over 12,000 tons of concentrating ore. When we have such valuable deposits of concentrating ore in the Slocan district, I think it is the duty of the Government to assist in every possible way the development of these mines by admitting mining machinery free. When we find that $227,488 worth of mining machinery was admitted free of duty in the last three years, we can see that the manufacturers on the one hand have not been injured, nor on the other hand has the revenue suffered to any great extent. We may reasonably assume that of this amount a large proportion would not have been imported if mining machinery had not been on the free list. I submit to the committee this proposition, for which I ask a favourable consideration, namely, to add the following articles, without restriction or limitation, to the free list:—

The Bridgeman ore sampling machine.

All concentrating, refining and amalgamating machinery and appliances for the treatment of gold, silver and copper ores.

Huntingdon's centrifugal roller quartz mill for gold and silver ores.

The Tremaine stamp mill.

Foster's ore breakers.

Water Jacket furnaces for galena and silver ores.

Root's patent spiral rivetted water pipe, and all special lines of piping manufactured for hydraulicing. And steel plates and rivets used in the manufacture of hydraulic pipes.

Hydraulic monitors.

Bleichert, Hallidies and Lidgerwood wire rope, tramways and cableways.

Diamond prospecting drills.

Hon. Mr. IVES—Do you claim that wire rope is not made in Canada?

Mr. MARA—Wire rope is made in Canada, but there are aerial tramways suited for mountain districts that are not made in Canada, and no mountain company would purchase an aerial tramway made in Canada when they can get one that is peculiarly suited for their work.

Hon. Mr. IVES—Are not diamond prospecting drills made in Canada?

Mr. MARA—Some are, but there are modern inventions for prospecting that are not made in Canada. Only a short time ago one was imported, and the party who imported it would not have gone to Chicago if be could have got what he wanted in Canada.

Hon. Mr. WALLACE—The Government's policy has been to put the most liberal construction on the item in the tariff, admitting free mining machinery of a kind or class not manufactured in Canada, while, of course, safe-guarding the revenue as much as possible. There are a great many implements used in mining operations which, of course, are made in Canada, and upon which a duty has to be levied if they are imported. For instance, steam engines are required for operations at the mines, and those steam engines of almost every class and character are made in Canada, and are dutiable if imported, and I believe they can be made as cheaply in Canada as in almost any other country. Then, all such implements as picks, shovels and spades are of course made here. Of the articles which the hon. gentleman has mentioned, a large proportion will, I think, come in free of duty; for instance, ore sampling machines, concentrating and amalgamating machinery, stamp mills, ore breakers and water jacket furnaces; these are not made in Canada, I think. But when it comes to piping and articles of that kind that are made in Canada, and which can be made probably of a superior kind, that would be in contravention of the Act as it now stands.

Mr. MARA—Is there any hydraulic piping made in Eastern Canada?

Hon. Mr. WALLACE—It would be more likely to be made in British Columbia, because that is the place it would be in demand. The department has decided, on the advice of the Department of Justice, that the machinery for extracting ore from the rock will be correctly classified as mining machinery. Also the machinery that conveys the ore to the surface, and also the machinery for treating it when it arrives. Those three classes of machinery having been declared free, under this clause as mining machinery, I think a very liberal construction has been placed on the Act; and the fact that, during those three years, a quarter of a million dollars worth of machinery has been imported, and last year about $88,000 worth, shows that mining operations are being more vigorously prosecuted and that advantage has been taken of this free importation.

Hon. Mr. FOSTER—I would suggest to the hon. gentleman whether the amendment he proposes would not tend to narrow the scope of the resolution. I would suggest to my hon. friend that he could have the very same certainty, without narrowing at all the application of the free clause, if the Controller of Customs would make a list of those items of machinery, as to which there is no doubt, and some of which the hon. gentleman has mentioned in his amendment, and forward such list to the different collectors. This list would include all those articles which it is certain are not made in the country and be forwarded to the different collectors, so that the instructions to the collectors would be positive and not negative, and whenever a piece of machinery of the kind mentioned was imported, the collector could be in no doubt as to its right to free entry. The hon. gentleman would gain everything he desires to gain, and would not narrow the scope of the resolution by attempting to define, in the law itself, the particular articles which it covers. I think the Controller of Customs would have no objections at all to make out a list, and if the hon. gentleman will submit any others that are used in his portion of the country, the Controller could go into the matter with him, and arrive at a positive list of those which could be admitted free.

MR. MARA—My object was not in any way to limit the scope of the free admission of mining machinery, but rather to let the miner and the capitalist see at a glance that the articles I have enumerated would be admitted free of duty. The trouble heretofore has been that a list was furnished to the collector which was issued by the manufacturer, and that list was so cunningly worded that it covered nearly every article of mining machinery made. When an application was made for free entry, the collector would refer to this list, and ten to one he would find in it an article of the class, but not of the kind which the importer wished to pass free of duty. I therefore thought that by making out a list, the miner could see at once what machinery he could bring in free of duty and so would the capitalist, and both would be saved the uncertainty and expense they have been subjected to in the past. However, if the Government will allow a list to be sent to the different collectors, embracing all classes of mining machinery, not made in Canada, and substitute that list for the present one, I think the proposition is better than mine and would most gladly withdraw my amendment.

HON. MR. WALLACE—Why not send both?

MR. MARA—The present list is misleading. For instance, it says in one case machinery for iron and other minerals. If that means anything at all, it means all other minerals.

HON. MR. FOSTER—A positive list would be far more satisfactory.

HON. MR. IVES—Would you not meet with this further difficulty, if you mentioned the machines made by these particular makers. This tariff is made, I hope, for a good many years to come, and you will simply have the power to bring in these certain machines, whereas something a great deal better might be made by some other maker and this would be excluded.

MR. MARA—I simply asked that these articles be added, without restricting or limiting, or in any way affecting the preceding paragraph, admitting mining machinery of all kinds, not manufactured in Canada.

Amendment withdrawn.

Coal Shipments from Old Sydney Mines.—The shipments of coal from the Old Sydney mines of the General Mining Association, Ltd., were 25,000 tons last month.

Nickel—Its History, Uses and Distribution. *

By MR. A. G. CHARLETON.

The subject of this paper is one which the author begs leave to present, thinking that it may be profitably considered. His own interest was awakened in nickel some years ago when making an inspection of an important group of nickel mines, and the works connected with them, in Germany, but the superior attractions of gold and silver mining have prevented him till now from reviving it. The discovery that nickel was a new element was made by Cronstadt in 1754, and he named it after the mineral kupfer-nickel, in which it was discovered by him, but it was reserved to Bergman, in 1779, to show that nickel was really a new metal. Kupfer-nickel was described by Hierne in 1694, and its name indicates the low value set upon such ore by the German miners in those days. Kupfer-nickel, in fact, might be freely translated into English as Old Nick's copper, the term nickel being probably derived from the Low German "nikker," which stands for the devil or hangman.

Deceived by the copper colour of the mineral, the miners no doubt mistook it for copper ore, and probably gave it the name to warn future generations against what they, not unnaturally, regarded as a fiendish imposition on them. The miners, however, would no doubt tell you that it was due to the metallurgist's command of bad language, as they discovered that when cobalt ores became over-roasted in the manufacture of smalt the nickel they contained followed the former metal, and, combining with the silica, spoilt the blue colour of the glass the makers wanted to produce. To quote a most instructive paper on nickel by Mr. W. T. Austin, one may say that "nickel has not received from scientific men the attention to which it is entitled, and the subtle influence exerted on the physical properties of its alloys by the admixtures of exceedingly small quantities of other elements have mystified the practical man (so called by courtesy), and kept him in the background. For more than a century nickel puzzled and perplexed all who had anything to do with it, and its history is a long story of contradictory statements and mistakes." It seems to me it is a capital metallurgical illustration of the proverb, "Give a dog a bad name." But, granted so, a bad dog may sometimes be broken in, and become of service to its owner.

The literature dealing with the subject is exceedingly scanty, on the one hand because the properties of the metal have been insufficiently studied by those who would naturally be expected to investigate them from an economic point of view, and on the other because the interest of pure scientists in this field has for some reason lain dormant. Another cause is the secrecy maintained for so long a time by those manufacturing nickel products with regard to their processes and methods. This policy, which, it is to be presumed, has generally for its object the idea of deterring competitors from entering a special field, is surely a short-sighted one, as it may well be doubted whether manufacturers are ever benefited in such cases by jealously excluding the scientific discussion of their methods of treatment, experience in the rapid development of the iron and steel trades, in one instance at any rate, going to prove the benefit of adopting an opposite policy.

Nickel has certainly maintained a high price in the past, but at the cost of an exceedingly limited consumption of the metal, and the original discoveries of ore in Scandinavia, Germany, and the United States furnished the trade for many years. It was only with the increased demand for the metal, induced by its more extended applications, that prospectors began to busy themselves and look around for larger supplies of ore, and the result has been the discovery of most important new fields, like those of New Caledonia, and Sudbury in Canada.

Austin traces four marked stages of development in the modern history of nickel. First, the century or more when the presence of some unusual metallic combination was recognised to exist in certain minerals, during which time the metal was introduced into the arts as an alloy known as "white copper," consisting chiefly of copper and nickel with a small proportion of zinc, closely resembling silver, tough, easily worked, and not tarnishable when exposed to gases containing sulphuretted hydrogen. Secondly, the period which commenced with the manufacture of German silver on a large scale at Berlin (about the year 1824), when nickel obtained a recognised position, Brandes having shown, the year previous, the exact composition of the new alloy. Up to 1838, nickel was wholly derived from its arsenide ores, and it was not till then, when Berzelius is thought to have discovered nickel in the Klefva ores (Sweden), that Aschen made his first smelting experiments upon the nickeliferous pyrrhotites and pyrites of that country. The metallurgical losses were at first heavy, but between 1849 and 1851 Berdberg laid down certain principles, which have held good in nickel metallurgy up to the present time. Thirdly, the period which dates about this time (1850, when Switzerland adopted nickel for subsidiary coins) marks another era in the history of the metal. In 1888, it was first successfully alloyed with steel on a scale of commercial importance, and this has given nickel a fourth periodic impulse, which has only just practically commenced, and promises to far exceed all the preceding ones in its results.

The world's production of metallic nickel has increased within the past ten years from 1,000 tons per annum to over 5,000 tons, whilst previous to 1876 not more than 600 tons were produced in any one year. As far as our knowledge at present extends, the principal value of nickel seems to lie in the properties of its alloys. For example—(1) German silver is of such general utility that articles made of it are everywhere to be found in household use. (2) Alloys of nickel and copper have largely supplanted the smaller silver coinage of several European countries and America. (3) A small percentage of nickel, incorporated into steel, has provided the engineer with a structural material superior, for many purposes, to the best carbon steel made. (4) Pure nickel, in the metallic form, is used for plating other metals; and though its cost is at present too high to admit of wide use, it is employed for making numerous small articles.

To give one instance only. A short time back the interest aroused in me by nickel, combined with the conviction that silver, under existing international currency conditions, at even 29⅜d. an ounce, was an extravagant luxury, induced me to extend the application of nickel, by having a cap of it set on the handle of my old but valuable umbrella. Austin predicts that nickel will be put into the form of ferro-nickel, suitable for making commercial steel, at no distant time, in not more than three operations, without innumerable bye-products being left over to work afterwards. At present, the simplest and most direct method of treatment includes at least seven distinct stages—roasting, matting, Bessemerising—after which it has to be "topped and bottomed," refined, reduced to oxide, and finally incorporated, not to mention all the side operations of working up the bye-products. It is a subject indeed to which English metallurgists might, in all probability, profitably turn special thought.

Before the Christian era, nickel was employed for coinage purposes by the Bactarian king Euthydemos, 235 years B.C., and analysis of these coins shows that they were evidently intended to contain 22 to 23 per cent. of nickel to 77 or 78 per cent. of copper, closely approximating, curiously enough, the proportion of 25 to 75 per cent. which experience has taught us is the most desirable admixture of these metals for use in coinage. It is remarkable that Euthydemos hit upon this particular ratio of copper to nickel, and the fact that analysis shows no arsenic debars rich arsenical ores from being a source from whence the nickel employed was derived, and points to the use of sulphides, as the silicates could scarcely have been treated at that time. If this be so it indicates considerable metallurgical skill on the part of the early smelters, and, considering the nature of the metals employed, it is hardly probable the alloy was a haphazard mixture. Professor Roberts Austen mentions also that, long before Europe awoke to the value of nickel, that enterprising person, the heathen Chinee, was making an alloy of nickel, and shipping it to Europe for a century or more, under the name of Pack Fong, * or white copper. Just before the commencement of the second period, before alluded to, nickel appears to have been discovered in the United States, when Seth Hunt opened up the cobalt mines near Chatham, Connecticut, and shipped some of the ore to England, where it was reported upon and stated to contain nickel. These mines, in 1854, were said by Whitney to be the principal sources of American nickel, but, from the fact that they were repeatedly taken up and abandoned, they no doubt proved commercially unremunerative.

The principal deposit of nickel opened up to date in the United States, the celebrated Gap Mine, appears to have been discovered somewhat later, viz., in 1718, and was being worked for copper in 1744. It was not, however, till 1852, when the property came under new management, having proved unsuccessful as a copper proposition, that investigations began to be made as to the nature of the yellow sulphide ore, looked upon as worthless mundic by the former owners, and thrown by them over the dump. The first tests were not conclusive, but, in 1853, Dr. Genth, of Philadelphia, pronounced it to be millerite. During the third period in the history of the metal, in 1862, Joseph Wharton acquired the Gap property, and put it into operation as a nickel producer in May, 1863, starting a refinery at Camden. At the Centennial Exhibition in Philadelphia, in 1876, Wharton made an exhibit of nickel products, such as had not been seen elsewhere up to that date; and in 1878 he showed articles made of pure nickel, both forged and cast, which were so remarkable that they excited at first considerable incredulity.

In 1804, Richter had succeeded in producing malleable nickel, but subsequent investigations met with very variable results, through neglect in recognising the important part played by small quantities of impurities alloyed with the metal. A new future for nickel as a metal, apart from its alloys, dawned when, in 1879, Fleitmann found that by the introduction of small amounts of magnesium just before pouring the quality of the nickel was improved; Garnier subsequently accomplishing the same end by the use of phosphor-nickel. This third period is likewise marked by the important event of the discovery, in 1876, of immense quantities of hydrated silicates of nickel and magnesium (garnierite) in New Caledonia, which placed an exceedingly valuable material at the disposal of manufacturers, opening up the possibility of producing a purer nickel from ores free from the usually accompanying deleterious substances, reducing the price of the metal, and extending its uses. Nickel ores had been discovered in the island some years previously, but it was not until 1876 that they began to influence the market. These new ores contained the

* Abstract of a paper read before the London Society of Arts, May, 2, 1894.

* According to an analysis of a specimen in Dr. Percy's collection at South Kensington, composed as follows: Copper, 4·4 per cent.; zinc, 25·4 per cent.; nickel, 31·6 per cent.; iron, 2·67 per cent.

nickel in the form of protoxide, free from cobalt, copper, sulphur, and arsenic, and consequently required an entirely different system of treatment from that by which the sulphide and sulpho-arsenide ores have been handled. Some years previous to the appearance of the New Caledonia silicates at the metallurgical works of Europe, somewhat similar ores had been worked at Ickatarinenburg, in Russia; others were known to exist in Spain; and since then further deposits have been found in Oregon and North Carolina. In 1876, the production of the Scandinavian mines reached its maximum height, the yield of Norway being 360 metric tons of metal, and that of Sweden considerably less than 100 tons. Since that date the production of this district has very considerably declined.

Nickel silicates were discovered in Douglas county, Oregon, in 1881, and have lately been exploited by an Anglo-American company, whilst in 1884 deposits of nickel ores were proved to exist in Churchill county, Nevada. The Pacific Coast mines are said to be the most promising deposits at present known to exist within the boundaries of the United States, but distance from market, and the discovery of nickel in Canada, have militated against their development. In 1856, Mr. Alex. Murray pointed out the occurrence of a dingy green magnetic trap at a point 10 miles south-west of what is known as Sudbury in Canada, and this rock, upon analysis, showed small quantities of nickel and copper. The first discoveries of any commercial importance were not made until the building of the Canadian Pacific Railway in 1883 and early in 1884, when a cutting on the line pierced a small hill about 3½ miles south-west of Sudbury, exposing the deposit since known as the Murray Mine. In the spring of 1886 the Canadian Copper Company was formed to operate the Copper Cliff (Stobie & Evans' mines), but it was not till 1888 that the company erected their first furnace. Shortly afterwards a number of companies entered the field, amongst others Vivian & Co., of Swansea. These Canadian mines, which are in the districts of Algoma and Nipissing. in the province of Ontario, have of late years attracted world-wide attention; first, on account of their apparently inexhaustible character; lately, because of the new applications of nickel in the manufacture of nickel steel. One is apt to overlook nickel in its mineralised forms, and the Sudbury ore bodies were originally opened as copper mines.

The unusual properties displayed by meteoric iron, in regard to its extraordinary toughness, and in some instances its non-corrodibility, coupled with the fact that it is invariably associated with nickel and other elements, has of late years drawn attention to the influence which nickel exerts when alloyed. Farraday, Berthier, Longmaid, Liebig, Fairbairn and Boussingault Künzel, and even Ledebur, all investigated the subject, but all efforts to manufacture a valuable alloy of iron and nickel were in vain until a few years ago, when the fourth era of nickel commenced. The trouble was that the immense influence of minute quantities of other accompanying metals and metalloids was unsuspected. Probably, the first appearance of nickel-iron alloys in the United States was when Philip Thurber, of Detroit, exhibited some products of the iron furnace at Marquette, Michigan, at the New York Exposition in 1853 This iron was made from a nickeliferous limonite, and possessed some remarkable qualities, but it was not till 1888, after experiments had been made by Marbeau, in France, with crucible nickel-steel alloys, that James Riley took the subject up and began experimenting in Scotland with similar manufactures produced in the open hearth, and convinced himself and the metallurgical profession of the genuineness of the claims advanced for this new material. The results are given fully in a paper read by him at the Glasgow meeting of the Iron and Steel Institute, May, 1889.

Notable among these was an alloy containing 4·7 per cent. nickel, which showed an elastic limit of 28 tons per square inch and a breaking strain of 40 tons, whereas similar steel without nickel showed only 16 tons and 30 tons respectively. The elongation and contraction of area of this steel were not, moreover, materially impaired. In a series of competitive armour trials made at Annapolis, Maryland, in September, 1890, the palm was awarded to a French nickel-steel plate, and Mr. Tracey, at that time Secretary of the U. S. Navy, gave orders to have further trials of similar material made, which had been manufactured of American material by American mills, with a view to decide the best material for protective armour for the new men-of-war being built. These tests, as reported by Mr. W. S. Abbott, of Messrs. Carnegie, Phipps & Co., gave an ultimate tensile strength of 100,000 to 102,000 lb. per square inch, with an elastic limit of 59,000 to 60,000 lb. The elongation was 15½ per cent., with a reduction of area of 29½ and 26½ per cent. respectively at fracture.

The toughness of nickel steel is shown by the fact that blocks cut from the armourplates at Bethlehem, many of them weighing several tons, cannot by any method yet devised be profitably broken up into sizes suitable for returning them to the furnaces. It is stated also that experiments lately made by the German Government show that shells exploded in ordnance made of ordinary steel badly injured it, whilst with nickel steel it was only enlarged. One by one the objections raised against nickel steel have been removed, the effect of cold weather on the plates, for instance, having been experimentally demonstrated to be of no consequence, if one may judge from a series of experiments carried out at the United States navy yards since 1891.

The tough tenacious material flows under the impact of the shot, and in the case of Harveyised, *i.e.*, surface-hardened plates, the extreme hardness of the exterior, reinforced by the tough untreated steel behind, shatters the forged-steel Holzer projectiles, which have hitherto proved irresistible. These shells are made, I believe, of highly-carbonised steel, containing 0·8 to 0·94 of carbon, and, in addition, 0·94 to 2 per cent. chromium. Nickel steel is practically incorrodible, and can be advantageously made on the basic open-hearth furnace. Professor Roberts-Austen states that nickel has an atomic weight of 58·60, atomic volume of 6·7, specific gravity of 8·80, specific heat 0·110, melting point 1,600, coefficient of linear expansion, 0·0000727; electric conductivity, 7·374. Quoting the investigation of Riley, he gives a diagram which shows that nickel up to 7 per cent. materially increases the tensile strength of steel and elastic limit, while its extensibility is as rapidly diminished.

Though there has been no material increase in the established channels of consumption. except it be for plating, whilst 1,000 tons of nickel flooded the market in the early days of the century, 10,307,275 lb., or, roughly, five times as much, was produced in 1891, consequently the large excess of metal produced must have gone into nickel steel, yet this alloy has scarcely begun to be used in the arts of peace. As its price tends steadily downward, we many confidently expect that it will eventually enter into competition with other materials for other purposes than armourplates and guns. Though there is always naturally some hesitation in adopting a comparatively untried material, where it is subjected to extremes of temperature, such as for boiler plates, bridgebuilding, and marine engineering, experiments are going on all around us, and last year it was decided to place sections of nickel-steel propeller shafting in the U.S. protected cruiser *Brooklyn* and the battleship *Iowa*. The ordinary carbon steel used for such purposes has a tensile strength varying from 60,000 to 65,000 lb. per square inch, whereas the nickel steel will show a tensile strength of 90,000 lb. per square inch, the elongation in both cases being about the same, 20 per cent. Using this stronger steel will warrant boring out the shaft, materially lessening the weight whilst preserving its efficiency, and such cored shafting can be hollow forged when the hole is large enough to admit a mandril.

If it is found possible to apply it to the construction of boilers, the tensile strength of nickel steel being 1½ time that of ordinary steel, it will enable their thickness to be reduced one-third, effecting a saving in weight, which is often a great consideration. Jules Garnier gives in *Le Genie Civil* the results of a series of tests made in 1892, at the Cleveland Rolling Mill Company's works, on nickel steel. The nickel was produced at the Brooklyn Nickel Works, from Sudbury ore, by the Canadian Company. The deductions drawn from a comparison of the results of these trials with others obtained from ordinary steel made and tested under identical conditions are:—1. Nickel steel has a higher elastic limit of some 11,400 lbs. per square inch, or nearly 31 per cent. more than ordinary steel. 2. The tensile strength of nickel steel is greater by some 10,400 lbs. per square inch, or an increase of about 20 per cent. 3. The ductility of steel is not reduced by the presence of nickel.

During last summer the Bethlehem Ironworks completed a spare shankshaft for the American liner *Paris*, using nickel steel of about 90,000 lb. tensile strength, which is said to be 25,000 lb. in excess of any German or English manufactured steel, with the exception of the material turned out by one firm in this country, which has adopted steel of a similar character. Another important channel of consumption is the manufacture of a nickel-copper alloy (Ni 20 per cent., Cu 80 per cent.) for casing bullets to be used with smallbore rifles, now adopted by all the armies of Europe. This alloy has a higher degree of tenacity than the best brass, combined with a higher co-efficient of clongation. The possibilities opened up by the uses to which nickel alloys may be applied by engineers in different branches of business may well attract the attention of miners and capitalists to deposits from which supplies of the metal can be got. The ores of nickel include the following minerals:

Sulphides.

	Nickel Per Cent.
Millerite, NiS	64·6
Polydymite, Ni_4S_5	59·4
Beyrichite, Ni_3S_4	54·2
Pentlandite, (FcNi)S	34·0

Arsenides and Sulpho-arsenides

Niccolite, NiAs	43·9
Rammelsbergite and Cloanthite, $NiAs_2$	28·1
Gersdorffite, NiAsS	35·4

Sulpho-antimonides.

Breithauptite, NiSb	32·8
Ullmanite, NiSbS	27·8
Wolfachite, Ni(AsSb)S	29·8
Coryite, Ni(AsSb)S	28·8

Silicates.

Genthite, 2NiO. 2MgO. $3SiO_2$. $6H_2O$	22·6
Garnierite, $H_2(NiMg)SiO_4 + Ag$	25·0
Connarite, $H_4Ni_2Si_3O_{10}$	31·4
Rewdanskite, $(NiFeMg)_3Si_2O_7 + 2H_2O$	28·1

Sulpho-bismuthide

Kallilite, NiBiS	19·0

Telluride.

Melonite $NiFe_3$	23·8

Oxides and Salts.

Bunsenite, NiO	78.5
Nickel oxide, Ni_3O_4	73·1
Morenosite, $NiSo_4 + 7H_2O$	20·9
Annabergite, $Ni_3As_2O_8 + 8H_2O$	29·4
Cabrerite, $(NiMg)_3As_2O_8 + 8H_2O$	25·1
Forbesite, $H_2(NiCo)_2As_2O_8 + 8H_2O$	14·4
Lindackerite, 3NiO. 6CuO. So_3. $2As_2O_5 7H_2O$	12·9

Carbonate.

Zaratite, $NiCO_3 . 2Ni(OH)_2 + 4H_2O$	46·8

It may be mentioned that millerite has been found in Iowa forming tufts of beautifully arranged needles, in large, perfectly transparent crystals of calcite, in the compact lower carboniferous limestone of the Keokuk quarries, some 20 feet below the "geode-bed;" in cavities running up to 20 inches in length, thickly set with rhombohedrons of this peculiar character.

Geologically, nickel ores are equally divided into three main groups, which broadly correspond with the following classification. Vogt has employed this subdivision as a foundation for a genetic classification. His groups are: (1.) Arsenides, which include sulpho-arsenides and sulpho-antimonides, as well as combinations of the metal with sulphur and bismuth. (2.) Sulphides, such as nickeliferous-pyrrhotite and pyrites, millerite, &c. (3.) Silicates, garnierite, genthite, &c. A brief description of a few typical examples of each group is interesting, as throwing light on the general occurrence of the ores of this metal.

The first of these groups is found in veins in Hungary, of the Dobchau type, and in the so-called Kobaltrücken, typified by the Richelsdorf Bieber veins. They occur also (as subordinate minerals) in the silver-bismuth-cobalt veins of Schneeberg, in the ordinary silver-lead veins of Freiberg, and in the Gem mine of Fremont, Colorado. In addition to nickel cobalt ores of various kinds, Von Groddeck shows that the typical Dobschau veins carry copper, and all these three metals are found in the serpentines and older eruptive lime-olivine rocks, which form the country of the veins, and appear to have been produced from the decomposition of the adjacent rock masses, composed of olivine and gabbro. A vein of this class is found at Dillenberg in Nassau, in pickrite, altered to serpentine, and contains millerite, bismuth-glance, pyrite, and other sulphide minerals. This vein was only productive in the serpentine, becoming barren when it passed into the adjoining schaalstein country. The gabbro in the neighbourhood of Dobschau, which has been partly altered, as before mentioned, to serpentine, is fringed by a peculiar green silicious schist, resting on gneiss and granite. The veins occur between the gabbro and the schist, do not possess well-defined walls, and often reach a width of 25 feet. The Schneeberg deposits, which likewise belong to this group, have a special interest for me, as I visited the district in 1880, and had an opportunity of examining its geological features, although my attention was more particularly directed to a study of the methods of dressing these ores, which present particular features of interest in their details. The veins chiefly occur in mica-schist, which passes into clay-slate, more rarely entering the deep-seated underlying granite, which, along with basalt, is found in intrusive masses, penetrating the overlying formation in the neighbourhood of Schneeberg.

The chief group of nickel cobalt veins lies around Neustadtel, and, in general, strikes from N.W. to S.E., the dip being in some cases N.E., in others S.W., but in all cases highly inclined. The gangue is called by Von Cotta hornstone, and they carry, in addition to nickel and cobalt, bismuth, copper pyrites and silver. He considers them to be veins of infiltration, formed by percolating mineral waters. Closely connected with this system of veins is an independent group of copper lodes, which strike N.E. and S.W., with an almost vertical dip to the N.W. These show a great variety of copper and other minerals, amongst which may be named copper pyrites, bornite copper-glance, tetrahedrite, cuprite, tenorite, chrysocolla, malachite, azurite, galena, cupreous sulphur of lead, cerusite, pyromorphite, iron and arsenical pyrites, blende, native silver, jasper alophane, diaptase, barytes and brown-spar, a veritable mineralogical museum. The nickel-cobalt ores as they are delivered to the dressing works average, I am told, 4 to 6 per cent. of cobalt, 3 per cent. of nickel, and 8 to 10 per cent. of bismuth.

The second or sulphide group of nickel deposits embraces those of Sudbury, Ertali, Piedmont, Varallo, and other places, and possesses very wide distribution, and marked geological characteristics. Vogt assumes this class of deposits is usually formed by a process of differentiation, or segregation from a basic eruptive rockmagma, and they are distinguished by the peculiarity that the ore chiefly consists of pyrrhotite, which carries, disseminated through its substance, various nickeliferous sulphide minerals, such as millerite, polydymite and pentlandite, while chalcopyrite and titaniferous iron usually accompany the iron pyrites as accessory minerals. The largest and best known deposits of this class are at Sudbury, in Canada, where the ore is found in irregular, lenticular masses in the Huronian rocks, apparently conformable to the planes of bedding, and invariably in proximity to dykes or uptilted sheets of greestones (diorite) and diabase. From the fact that the greenstones themselves are found at times with ore disseminated through them, Merritt thinks the nickel has been brought to the surface by the agency of these dykes. The region has been much faulted, and in places the pyrrhotite and chalcopyrite form a breccia, in a dark, dioritic matrix. The main range is about 50 miles long, and one to five miles wide, running N.E. and S.W. from Lake Wahnapitae to the Spanish river. The nickel deposit outcrops are described as forming hills or ridges.

According to Mr. D. W. Browne, the ore frequently loses the character of a copper ore, which it possesses at surface, becoming more and more nickeliferous, and less cupriferous in depth. To illustrate this, he cites the Copper Cliff Mine, stating that on the fourth and fifth levels the ore carries 4 per cent. of copper, and 4·5 per cent. of nickel, while on the seventh level many "stopes" show an average of 0·5 per cent. Cu, and 8 to 10 per cent. Ni; the evidence, however, so far, would hardly appear to be sufficiently extended to warrant any general conclusions of similar enrichment, in other cases, taking place, founded upon what may turn out to be an exceptional occurrence.

As far as the Sudbury deposits have been exploited, down to a depth of 600 feet, there is no sign of falling off in the grade or quality of the ore. It contains in bulk 1 per cent. to about 5 per cent. Ni, and 1 per cent. to 4 per cent. Cu, and cobalt, traces of gold and silver, and platinum in the rare form of sperrylite (arsenide of platinum) is found in it. Mr. Argall, of Denver gives the following analyses of an average month's out of the Copper Cliff, Evans, and Stobie mines, to illustrate the ratios between the nickel and copper contents of the ore:—

	Copper Cliff.	Evans.	Stobie
Cu	4·31	1·43	1·92
Ni	5·57	3·74	2·36

A division of value is effected in the ore simply by screening. Thus at the Evans mine it is found:—

	Per Cent. Cu.	Per. Cent. Ni.
The coarse ore carries	1·62	3·45
The raggings	2·99	3·90
The fines	3·78	5·04

The ore is sorted by hand into four grades—1st, the average mixed ore (nickel copper); 2nd, copper pyrites: 3rd, pyrrhotite or nickel ore; and 4th, gangue. The closeness with which this separation can be made is shown by the following results:—

	Cu per cent.	Ni per cent.
Mixed Ore.		
Copper Cliff	5·67	4·75
Stobie	2·21	2·28
Evans	2·60	4·00
Picked Copper Ore.		
Copper Cliff	14·13	2·74
Stobie	15 71	1·28
Evans	13·86	1·34
Picked Nickel Ore.		
Evans	0·80	8·12
Copper Cliff	0·49	5·36
Average diorite rock	0·80	0·70

This table shows that the pyrrhotite carries the principal nickel value, in comparison with which the chalcopyrite is quite lean, and that these ores are not intimately admixed.

The report of the Ontario Bureau of Mines shows that eight mines operated by four companies produced 85,790 tons of ore, which probably cost about \$5 a ton to produce in 1891. The whole lot averaged 2·62 per cent. nickel; therefore the nickel in the state of ore cost about 10 cents per pound. The cost of succeeding operations to produce one ton of nickel oxide, containing 76 per cent. of metallic nickel, may be estimated to be \$140.74, dealing with these pyrrhotite ores. Its mining and transport can be reckoned at 10 cents per lb.; conversion into oxide, 9 cents; reduction into metal, 8 cents; and allowance for loss in working, 4 cents; total, 31 cents per lb. Vogt endeavours to trace a constant ratio between nickel, pyrrhotite and chalcopyrite occurring in ore deposits in certain rocks, stating that, while in each mine the ratio may vary from day to day, the ore ratio over a long period will give constant results. He gives a table showing the ratio for eight of the principal mines in Norway and Sweden. In them the copper contents corresponding to 100 parts of nickel vary from 20 to 80 and average 43; while the nickel and cobalt contents in 100 parts pure pyrrhotite vary from 2·5 to 7·5, and average 3·8. Thus he claims for ores produced by a segregative process, from one and the same eruptive, such as norite, there is a ratio between the proportion of nickel to copper on one side, and the absolute nickel contents of the pure pyrrhotite on the other. The higher the nickel contents of the pyrrhotite, just so much lower is the ratio of copper to nickel. This phenomenon cannot have occurred by chance, but results probably from the relation existing between the small contents of Cu and Fe held in the silicates of the original eruptive magma.

Mr. Brown has determined that the nickel exists, in the pyrrhotite of the Copper Cliff and Evans ore, chiefly as pentlandite (NiFe)S, two-thirds of it being in this mineral form, and he ascribes the enrichment of the ore in depth to the increased amount of pentlandite found in the pyrrhotite of the deeper levels. He claims that the finer grained the ore is the more the nickel exists as an element, replacing the iron in the pyrrhotite, while experience has shown that the coarser grained the ore, and the deeper it lies below the surface, the more it occurs as pentlandite with the pyrrhotite.

Mr. S. H. Emmons recently described three new nickel minerals, which he discovered in the Sudbury ore, viz., folgarite, found at the Worthington Mine, having a composition represented by the formula NiSFeS; blueite, discovered in the workings of the Emmons Company's mines, composition $NiS_2 \cdot 12FeS_2$; and whartonite, found at a mine seven miles south-west of Sudbury, supposed to have the composition $NiS_2 7FeS_2$. In the Gap Mine of Lancaster, Pennsylvania, we have another example of a nickel-sulphide ore, consisting of millerite associated with pyrrhotite, impregnating a lenticular mass of hornblende rock, embedded in mica schist at or near their planes of contact. It has been suggested that this hornblende mass may prove to be an altered eruptive, while it is not unlikely that an adjoining trap dyke had some influence in the formation of the ore body. According to Blake, the ore runs 1·5 to 2 per cent. Ni, whilst Wharton averages it from a series of his analyses at 3·6 per cent. Ni and Co., and 0·75 per cent. Cu.

For a third example, we may turn to the Norwegian pyrrhotite deposits, in which the ore occurs chiefly at the contact of the eruptive norites (massive hypersthene gabbros), with the archean country schists. It has been pointed out by Stephen Emmens and others that the plane of contact between eruptive and sedimentary or metamorphic rocks offers a favourable passage for the circulation of mineral solutions. The Minkjar Mine represents a familiar ore deposit of this type, such as is usually assumed to have been so deposited. The norite body is 243 feet long by 135 feet wide, and is almost entirely surrounded by an irregular deposit of pyrrhotite, from 3 to 6 feet thick.

The third or silicate group of nickel deposits are best represented by those of New Caledonia, which have been described recently in a paper read by Mr. J. Garland before the Institute of Mining and Metallurgy, and by other writers. M. Heurteau, I believe, made a detailed geological survey of the island in 1873, which led to mining operations being commenced. The base of New Caledonia seems to consist of a light coloured non-fossiliferous schistose rock, on which secondary and tertiary rocks rest, and about one-third of its area appears to be covered by massive serpentines, which are most prominent in the east and south-east parts of the island. According to M. David Levat, the nickel occurs solely in the form of magnesian hydrated silicates of a beautiful apple-green colour when pure, as coatings or concretions, in the fissures of the serpentine, and he concludes, from the absence of arsenides or sulphides of nickel, that their mode of occurrence points to the deposition of the ore from solution in the state in which it is now found. The pure mineral, he reckons, often averages 26 per cent. Ni, but the average ore, after sorting, does not carry over 10 per cent. mixed with some serpentine gangue. Garland puts the average quality of the ore shipped to Europe at only 7 to 8 per cent. of metallic nickel, stating that ore of less than 6 per cent is considered unmarketable, and cannot be sold. The darker green the colour of the silicates, the richer the ore seems to be, some specimens appearing to shade off into almost pure silicate of magnesia, which is almost white, containing only traces of nickel M. Peletan has found cleopters enclosed in crystals of the green silicate.

This green silicate is not, however, the only form in which nickel ore occurs in the district, as most valuable deposits are found of a brown mineral, of nearly the same composition, which Mr. Garland states is generally the richer of the two. It seems to consist of green silicate, in which part of the magnesia is replaced by hydrated oxide of iron (limonite), which gives it this brown colour. Treated with dilute hydrochloric acid, the iron is dissolved out, leaving the green mineral garnerite, which shows that the iron is not chemically combined, but merely mechanically associated with it. The deeper brown it is, the richer the ore is reported to be This is remarkable, and points again to the fact before remarked, that association with iron appears to affect the nickel contents of the ore in a favourable way. This brown ore has a very light specific gravity, only 3·00, and Claudet gives an analysis of it as follows:—

	Per Cent.
Oxide of nickel (nickel = 9·64 per cent.)	12·25
Oxide of iron	32·2
Magnesia	3·07
Alumina	3·62
Silica	34·8
Water at 212° Fahr	6·43
Water above 212° Fahr	7·07
	99·44

The percentage composition of both the green and brown minerals varies greatly, and the above analysis may be presumed to be below the average, as Garland states that, omitting minor constituents, the average of twelve analyses of the green garnerite made by Professor Liversidge show $SiO_2$44·75, NiO.19·73, MgO15·25, and the Government year book for 1891 states that the richer mineral has sometimes the following composition:—Silica 45, nickel 26, magnesium 13, iron 3, water 13. I am also informed by Mr. Gregory that he found millerite in a sample of the ore from New Caledonia.

According to Levat the massive serpentine itself contains nickel in proportions varying from 1 to 3 per cent., and in some cases even 5 per cent. He further inclined to the helief that the protoxide of iron of the serpentines diminishes as soon as the nickel appears in them, and the total of the two metals remains constant, but when his paper was written he had not had the benefit of a microscopical examination to determine this. He lays great stress on the fact that the nickel ores, though found exclusively within the serpentine area, are not distributed there in an arbitrary manner, but always occur at or in the neighbourhood of certain beds of red clay (vasques), which Mr. Garland describes as looking in the distance like huge scars on the face of the hills. Levat says they appear black in the centre and red at the edge, when seen in the distance from the sea, and they are often ranged one above another like stairs on the flanks of the hills, giving a most characteristic profile. The former observer, however, denies their argillaceous character, stating that they contain practically no alumina, but consist almost entirely of iron and silica, with 1 to 3 per cent. of nickel, and he gives two analyses in proof of this contention. The existence of these basins of red clay, or earth, as they might perhaps (from what has been said) be more properly called, is certainly a most curious feature in the geology if New Caledonia, scarcely less extraordinary than that of the red pigs for which the island is said to be famed, and possibly the colour of the latter may have some connection with the presence of these red deposits on the island. So much of the island appears to be coloured red by nature that it seems quite a pity in fact it is not red on the map.

The clays or earths are believed by Levat to be the products of the hydrothermal decomposition of the serpentines, as they contain all the elements of these rocks, in addition to iron, manganese, chromium, and cobalt. He supposes that numerous iron and manganiferous springs found vent through fissures in the serpentine and have eaten it away, leaving half-dissolved masses of so-called sugar-rock in the clay that fills the basins, which in many places are capped by a deposit of oolitic iron ore, the product of the overflow of the ferruginous waters. Mr. Garland's observations that the ore is found in massive pieces in botryoidal, mammilated, and occasionally in stalactitic forms, and in brecciated masses, supports this view. It has been pointed out also as a remarkable fact that these deposits are mostly found at high altitudes (the mountains of the interior rising to a height of 5,576 feet, and averaging 1,640 feet), and in the lower lying serpentine areas they are non-existent; but I think it is capable of explanation, if we suppose that the serpentines are the altered products of volcanic action which overflowed in the interior of the island, as it is just there that the conditions would be found most favourable for the deposition of the minerals we have under review, under such circumstances. Veins of chrome iron ore also occur in the hard unaltered serpentines of New Caledonia,* whilst cobalt ore is likewise found in the red earths, the origin of which latter deposits is considered by Levat to be essentially hydrothermal. The chromium, on the contrary, he thinks pre-existed in the serpentine, and was derived from it, whilst the nickel solutions only appeared after the deposition of the clay.

These solutions, circulating not only on the contact, but in the cracks and joints of the adjacent serpentine, would explain the deposition of the hydrated silicon of magnesium and nickel, in "Stockwerk form," which is the most usual mode of occurrence. The nickel ore is, however, also largely found, according to Levat, in a brecciated form on the roof or walls of the basins of red earth, being sometimes symmetrically deposited, when the axis of the basin is vertical (in which case the ore is of equal thickness on the walls); at other times the axis of the basin is inclined, and the serpentine which forms the roof is fissured, the cracks so found being often several metres wide, filled with rich ore, the nickeliferous solutions being unable to penetrate the clay and finding a natural passage along the walls of the cavities. Where the circulating waters moved for a long time between the walls and the clay, fine striæ are found upon the latter. Levat further states that the nickel deposits lie in a series of zones, running north-east and south-west, starting from the east coast, penetrating into the interior, and continuing, as Mr. Garland points out, to the west coast; outside of them there are only local encroachments, which lack uniformity.

Though in 1887, at the time Levat examined them, the deepest workings were only down 275 feet below the outcrop, he concluded that in depth they would lose their thickness, basing his opinion on the probability that the red earths with which they appear connected would not hold down to any great depth. Levat summarises the general characteristics as follows:—1st, the ore is essentially dependent on the serpentine of the east and south-east parts of the island. 2nd, ores of cobalt, associated with manganese, are found in beds on the rim of the basins of the earth found traversing the serpentine in a number of places. These cobalt ores do not contain over 2 or 3 per cent. of Co, but they are very extensive, being mined simply by scraping up the material. 3rd, the deposits of chromium are of two kinds, either in veins in the serpentine or in stratified beds in the basins of earth. 4th, the nickel deposits are of later formation than either of the two preceding ones, and are situated exclusively at or in the neighbourhood of the contact of these clays or earths with the serpentine, and never in the body of the former. They are united in a certain number of north-east and south-west lines, the width of which does not exceed, as before said, 600 metres. The crystalline diallage, being less attacked than the other constituents of the serpentine by the mineral solutions which have eaten it away, forms a skeleton, which is sought for by

* At the Gasconne Mine the serpentines are particularly rich in chromite, occurring in veins in the undecomposed rock, but breaking off suddenly at the contact of the serpentine and clay.

the miners as an indication of ore. True lodes appear to be absent, but some of the fissures filled with ore can be traced for considerable distances along their strike, possess regular walls and dip, have a width of 18 inches to 5 feet, and have been followed down in one instance to a depth of 360 feet below the surface outcrop.

As the formation of the deposits in the basins of red earth is due, Levat thinks, to the shrinkage of those clays, their continuity in depth may probably depend, as he supposes, on the depth of the clays in the basins. It must not be supposed, however, that the deposits are likely to be speedily exhausted, as they have a very wide distribution indeed. They are mined in open quarries, in benches, when found as stock works; at other times, by tunnels and winzes. The work is commenced by removing the red clay, which, if mixed with the ore, entails difficulties, as the grains of iron are with great difficulty separated by washing, and consequently appear in the matte produced. Moreover, the clay, being very aluminous (according to Levat), renders the silicious ore still more refractory. The gravity system of transport on a single rope at these mines is certainly extremely primitive, but is no doubt due to the necessity of frequently shifting the position of the terminals. It might, however, be improved upon by hauling up the empty bags and carriers on a carriage attached to the main cable by means of a small hoisting rope, operated by a windlass, instead of carrying them up, as is now done, on men's shoulders. The principle of using gravity-inclines with double ropes has been satisfactorily employed underground at the Pierrefitte mines in the Pyreneés, in large open gunnices—the only instance I know of where such a system has operated underground. It was introduced because the flatness of the lode would have involved shovelling, and it possesses obvious advantages over an inclined plane for a short temporary roadway in lofty workings.

According to Mr. P. Argall (quoting, I believe, from official sources), the output of nickel and cobalt ore from New Caledonia in 1890 was 22,690 tons of (say) 10 per cent. nickel ore, and 2,200 tons of 3 to 5 per cent. cobalt ore, whilst in 1891 the output of nickel ore had only reached 35,000 tons. Mr. Garland states, on the other hand, that these mines are now producing over 60,000 tons of nickel ore per annum; and, to reconcile the two statements, I take it that he alludes to the crude ore. He puts the cost of mining at 6s. to 40s. per ton. The first mechanical treatment of the ore consists of sorting and washing at the quarries, where a division is made into rich ore, carrying 8 per cent. and over of nickel, and poor ore under that amount. The ore is then carried to the plain below to be washed, so as to remove the red clay. The nickel has the same specific gravity as the serpentine, but less than the iron. The ore rejected at the quarry, although it contains 3 or 4 per cent. of nickel, is of no value. Garnier's first idea was to treat the ore in a blast-furnace, to obtain crude nickel and refine it; but this latter process presented such difficulties that it was abandoned. Fusion for matte was then tried, but was also given up, owing to the high price of fuel and the inefficiency of the convict labour. The cost of producing metallic nickel, dealing with such ores, appears to be—mining and transport, 10 cents; conversion into oxide, 3 cents; reduction into metal, 8 cents; allowance for loss of working, 1 cent; total, 22 cents.

Deposits closely approaching in type those just described were discovered in 1881, at Riddles, Douglas, Oregon, and others of a similar kind have been found at Webster, North Carolina. The Riddles deposits all lie at or near the surface, in beds 4 to 30 feet thick, occurring as a boulder formation, scattered through a ferruginous earth or in beds underlaid by serpentine, and associated with chrome lime. Mr. F. W. Clarke has made a series of analyses, which shows that the relative composition of silicate minerals obtained from New Caledonia, Oregon, and North Carolina agree very closely in composition and appearance. A fresh specimen of "country" was analysed from Oregon, and some olivine was found in it. The rock contained 0·10 per cent. NiO, the olivine 0·26 per cent. NiO. This suggested to Clarke a profitable source of derivation of the nickel in the altered beds of ore, and the microscopical investigations of Diller confirm his view. He considers the Riddles rock as belonging to the peridotes. It is a holocrystalline, granular rock, composed essentially of olivine, whilst one-third of the rock mass consists of enstatite, with a small percentage of chromium and magnetite. Quartz is present from metasomatic change, and whenever genthite appears it is always associated with quartz or serpentine. The genthite occurs in the serpentine, directly connected with the grains of olivine, from which the serpentine has been derived, and Diller states there is every reason to think the genthite is primarily derived from the same source. Though the Webster rock (which is also a peridote, of the variety known as dunite) contains less enstatite, and the nickel silicates are not so closely intermixed with quartz, the relation of the genthide to the serpentine and olivine is the same as at Riddles. Of the New Caledonia genthite Diller says, like that of Oregon, it is disposed in layers and cavities thoroughly intermingled with quartz, and sections show the serpentine with traces of olivine and enstatite so disposed as clearly to indicate that the serpentine naumeite, and other secondary products, have resulted from the alteration of the peridote rock.

According to Mr. S. H. Emmens, the nickel deposits of North Carolina are found in veins of three classes—1st, those occupying fissures the strike of which is more or less normal to the planes of division, that give a bedded aspect to the chrysolite rock mass; 2nd, there are numerous caunter veins, with a strike oblique to the first series; 3rd, there are bedded veins, located in planes of division. He is of the opinion that the caunter and bedded veins will not be found very productive, and the first series will alone yield any considerable supply of ore. A nickel-iron josephinite has been lately discovered, in the form of pebbles and smooth boulders, in considerable abundance in the placer gravels of a stream in Josephine County, Oregon. They are supposed to have been driven from some dyke of ultra-basic rock.

Melville has described this alloy,* which is highly magnetic. The pebbles are a greenish black, with bright areas of a greyish metal. The greenish-black portion consist of silicates, some of which are indissoluble in HCl. Nickel is found in the Urals at Rewdinsk, in veins six feet wide, between chloritic schist and serpentine, as well as in a great many places in other parts of the world. At the Kelsey Mine, Los Angeles, Co. California, Ni and Co ores are found in the comparatively rare form of arsenates, together with silver-glance and native silver, in a fissure vein in close relation with a diorite dyke. The assorted ore contains 7 per cent. to 15 per cent cobalt, 2 to 3 per cent. nickel, and 1,000 to 1,400 ozs. of silver per ton. Rich nickel ore has been found in the Gem Mine, Fremont, Colorado, in a hornblende schist, occurring as an arsenide and sulpho-arsenide, some of the specimens being so permeated with fine wire silver as to be difficult to break. At surface the ores were mostly copper, but at a depth of 15 to 20 feet nickel was struck, and continued down to 75 feet, when the vein, which had averaged 3½ to 4 feet, cut out and appeared to be lost, but, on resuming sinking, a streak of ore about 18 inches wide was struck, containing the same minerals and supposed to be a continuation of it, though this has not been definitely proved. Small shipments of this ore ran from 12 to 24 per cent. nickel, and 2 to 4 per cent. cobalt; the last lot shipped to England contained most of the nickel as niccolite. The ore streak is unfortunately narrow, the walls hard, and the ore difficult and expensive to mine. Nickel is known to exist in the hornblendic rock near Salida, Colorado. The serpentines of the west of Ireland and Cornwall, and indeed almost all serpentines, contain a little nickel, and it is met with in Australia, New Zealand, and South Africa. Sufficient has therefore been said to show that nickel ores are widely distributed over the world, though in the present condition of our metallurgical knowledge of the subject, payable deposits are less numerous than those of most of the common metals.

(To be continued.)

The Limitations of the Gold Stamp-Mill. †

Mr. Rickard (communication to the Secretary): I wish to supplement the interesting remarks of Mr. Olcott by adding a few figures illustrative of some of those features of the stamp-mill to which he has made particular reference.

The consumption of iron by the wear of shoes and dies is dependent mainly upon the hardness of the ore crushed and upon the brittleness of the metal used. Table I. ‡ gives the results obtained at eight localities working under very dissimilar conditions:

The minimum wear of shoes and dies amounts to 7.1 oz. of iron per ton of ore crushed, while the maximum is 25.4 oz., the average of the eight districts being about 1¼ lb. Two facts are apparent from the examination of the tabulated figures. As would be expected, the life of the dies does not vary in an equal degree with that of the shoes for the obvious reason that the ore upon the die serves as a cushion, protecting it from excessive wear. When that cushion of ore is not properly maintained, we get "low feeding" and an excessive abrasion, due to the working of iron upon iron. The importance of a regular feeding of the ore into the battery becomes very apparent when we look at the figures of those mills which do not employ rock breakers, grizzlies and automatic feeding machines. With the absence of these appliances, designed to produce a regular supply of pieces of ore of uniform size we find an excessive wear of shoes and dies, and more particularly of the former, for the reason already mentioned. In five districts scattered over different countries and in which the rock breaker and feeder are not employed the wear of the shoe is never less than 10 oz. of iron per ton of ore crushed, while in the other three localities, where the mills are properly equipped, the wear never exceeds 7½ oz.

The successful use of wrought iron dies at some of the Australian mills is worthy of note. Experience indicates that the minimum of wear and tear is to be obtained not so much by the use of a metal of excessive hardness as by making the die of a material more tough and less brittle than that of the shoe. Thus, steel working on iron, chilled upon unchilled, cast upon wrought iron, etc., all give better results than when the metal of the shoe is the same as that of the die.

In the matter of screens there is often a practice of false economy. The relative cost of one kind of screen as compared with another can usually be disregarded by the mill man. In California the cost of the screens amounts to one cent per ton of ore crushed, and the mill man will do well to leave the expense out of the question and procure that variety of screen which best favors the particular conditions of discharge which he requires.

Table II. gives the wear of screens at different localities.

In Australia the old-fashioned round-punched Russia iron still holds its own, though it must manifestly do very imperfect sizing as compared to wire cloth. Thus, for example, the "grating" most commonly used at Bendigo has 143 round holes per square inch; these holes are 0.024 inch in diameter, so that the discharge area per square inch is only 0.064 square inch. A typical 30-mesh wire cloth screen, made in San Francisco, has openings of 0.025 inch square. Assuming for the purpose of comparison that the openings in the latter instance are the same as in the former, as is very nearly the case, we find that the discharge area of the wire cloth per square inch is 0.51, or eight times that of the punched iron sheet.

The screen, as used in many mills, can hardly be looked upon as a device for sizing the ore. The peculiar kind employed in Gilpin county has straight alternate burr slots which are 0.015 inch wide and ⅜ inch long. There are five slots in a length of two inches, so that there is afforded a discharge area equal to only 0.028 of each square inch. The chance of the exit of a particle of pulp is as 1 in 34. Some appreciation of this fact is shown by the local mill men, since it is their intention to use a screen which will retain the ore inside the mortar long after it has been crushed to a fineness permitting its passage through the openings.

In looking over the figures given in table it will have been noted that the life of the screens is subject to wide differences. This is due to a variety of causes. In Gilpin county, Colorado, for instance, the minimum is 16 and the maximum 80 days of service. When examining the mills of this locality I obtained the figures of five mills, and was much puzzled over the seemingly contradictory results exhibited. The explanation was found in the relative locations of the mills. They are all situated by the side of the creek which flows through Black Hawk, and beginning with the mill farthest up the creek, there is a steady diminution in the service of the screens, commencing with 80 days and decreasing to 16. The uppermost mill receives comparatively clean water, and after having used it returns it to the creek, together with the addition of a certain percentage of sulphuric acid, as sulphate of iron, derived from the contact of the water with the partially oxidized pyrites in the ore, under conditions favorable to a certain amount of solution. The water then passes on to the next mill, where its slightly increased acidity reduces the life of the screens from 80 to 73 days. This second mill in turn contributes its share of sulphates, which help to injure the screens of the third mill. At this point the very acid waters of one of the mines flow into the stream, and, moreover, before it reaches the fourth mill, the creek has washed the sides of banks of sand more or less charged with partially oxidized pyrites, so that when it at length reaches the two lower mills, the wear of the screens is measured by days instead of weeks. *

In a case of this kind the addition of quicklime is to be recommended. At Ballarat (Victoria) five pounds are added every twenty-four hours to each battery of five heads.

The effort to maintain a uniform depth of discharge is much to be commended, and the importance of such a uniformity is very generally overlooked. In addition to the devices mentioned by Mr. Olcott, I may instance the employment of blank strips of iron placed outside, and against the lower edge of the screen. These strips can be of various widths. When the discharge is thus heightened there will be a tendency to accumulate sand inside against the screen, and this will protect the screen from abrasion along its lower edge, where it is covered by the iron strips. I have seen this method used in New Zealand. Again, in Amador county, California, where the "chuck-block" is used, the uniformity of the depth of discharge is aimed at by the employment of chuck-blocks of various thickness. †

On the use of double discharge mortars, much has been said, but, in spite of frequent recommendation, they have gone out of favor. The main point to be considered in this connection is, that the use of a back discharge weakens the force of the issue through the front screen, and so gives results less than would be, at a first glance, expected. There is another objection, especially in dry regions, to the double discharge, namely, the consumption of water is considerably greater. This in itself proves the smaller force of the splash. At Clunes (Victoria), in the use of double discharge mortars, ‡ the consumption of water is from 8 to 10 gallons per stamp per minute, while at Ballarat, an adjoining mining district, with ordinary single discharge mortars, it is usually at the rate of 5 gallons. The crushing capacity is 2¾ tons per stamp in the former, and 2 tons in the latter case.

The minimum loss of quicksilver, which has come under my notice, was at the South Clunes United Mill at Clunes, where it was 5½ grains per ton of ore. The maximum was that of the Caledonia Mill at the Thames, New Zealand, where 1 ton of quicksilver was consumed in 2 weeks by 20 stamps.

Table III. indicates the loss at a number of localities.

In addition to the figures of cost of milling given by Mr. Olcott, I may contribute the data contained in Table IV.

* *American Journal of Science*, vol. xliii., p. 509.

† Continued discussion of the paper of Mr. T. A. Rickard, read at the Chicago meeting of the American Institute of Mining Engineers, August, 1893.

‡ This Table accompanied an article on this subject by the writer in the *Engineering and Mining Journal* of Sept. 23rd, 1893.

* See also "Variations in the Milling of Gold Ores," by the writer, in *Eng. and Min. Jour.*, N.Y., Sept. 3rd, 1892.

§ See a more lengthy desctiption in the *Eng. and Min. Jour.*, N.Y., Dec. 23rd and 30th, 1893.

‖ See *Eng. and Min. Jour.*, N.Y., Jan. 28th and Feb. 4th, 1893.

Table I—WEAR OF SHOES AND DIES IN STAMP MILLS.

Name of District.		Metal.	Weight. New.	Weight. Worn out.	Ore crushed during time of service.	Metal worn per ton of ore crushed.	Cost of metal per pound.	Value of the scrap.	Cost per ton of ore crushed.	Total cost per ton of ore crushed.	Remarks.
NITED STATES:			Lbs.	Lbs.	Tons.	Oz.	Cents.	Cents.	Cents.	Cents.	
Gilpin County, Colo..	Shoes	Cast iron	83	27	80	11.2	4	1	3.82	5.95	No rock breaker; no automatic feeders; ore moderately soft; long drop; wear of dies is very variable.
	Dies	Same	48	26	78	4.5	4	1	2.13		
	Shoes	Chrome Steel	111	31	202	6.3	8	..	4.39	7.15	Rock breakers and feeders; ore very hard; dies contain 1/5 steel scrap.
	Dies	Same	55	25	159	3.0	8	..	2.76		
Grass Valley, Cal.....	Shoes	Chrome Steel	152	48	251	6.6	9	1½	5.17	9.43	Rock breakers and feeders; ore soft; short drop.
	Dies	Cast iron	93	45	96½	7.9	4½	1½	4.26		
Angels' Camp, Cal.. .	Shoes	Chrome Steel	175	40	585	3.6	9	..	2.70	4.06	Ore medium; rock breakers and feeders; no grizzlies.
	Dies	Cast iron	95	35	275	3.5	4½	1½	1.36		
Mammoth, Ariz......	Shoes	Chrome Steel	132	40	190	7.7	11	..	7.64	13.14	No rock breakers and no feeders; ore variable but medium hardness.
USTRALASIA:	Dies	Same	120	37	240	5.6	11		5.50		
Bendigo, Victoria.....	Shoes	Cast iron	180	38	115	19.7	2½	¾	3.66	4.37	No rock breakers; feeders used; ore almost entirely quartzose.
	Dies	Wrought iron	98	26	335	3.4	2½	⅓	.71		
Clunes, Victoria......	Shoes	Cast iron	196	56	105	21.3	2¾	¾	4.67	5.55	No rock breakers; feeders used; dies wear very irregularly.
	Dies	Wrought iron	138	30	420	4.1	2¾	⅓	.88		
Harrietville, Victoria..	Shoes	Fagot iron	172	38	185	11.5	3½	..	3.25	4.72	No rock breakers or feeders; ore of very variable hardness.
	Dies	Same	84	37	200	3.7	3½	..	1.47		
The Thames, N Zealand	Shoes	Cast iron	170	51	135½	14.1	3	1	3.40	5.65	
	Dies	Same	108	42	141	7.5	3	1	2.25		

Table II—WEAR OF SCREENS.

Locality.	Description.	Fineness.	Wear in Days.	Tons crush'd
Gilpin County, Colorado	Burr-slot Iron..	50 to 60 mesh............	16 to 80	80 to 450
The Thames, New Zealand..	R'd-punched Russia Iron	148 to 180 holes per sq. in.	5 to 6	45 to 54
Clunes, Victoria...........	Perforated Copper Plate...	80 to 100 " "	25 to 30	312 to 375
Otago, New Zealand........	R'd-punched Russia Iron..	140 to 180 " "	6 to 8	39 to 52
Ballarat, Victoria.	Same	120 to 200 " "	10 to 14	100 to 140
The Ovens, Victoria.......	Same	200 to 290 " "	17 to 20	145 to 175
Amador, California.........	Angle-slot iron........ / Steel and Brass Wire....	No. 7 & 8 or 35 & 40 mesh / 20 to 30 mesh	25 to 45	275 to 475
Grass Valley, California.....	Tin Plate Round-punched..	30 mesh...............	16 to 24	140 to 220
Bendigo, Victoria.....	R'd-punched Russia Iron..	115 to 170 holes per sq. in.	9 to 17	95 to 180
Charters Towers, Queensland	Burr do Charcoal Iron..	200 to 225 " "	3 to 4	35 to 60
Treadwell, Alaska.	Angle-slot Iron...........	No. 7 & 8 or 35 & 40 mesh.	20	300

Table III—CONSUMPTION OF QUICKSILVER.

District.	Loss per ton of Ore. Minimum.	Maximum.	Usual.	Remarks.
Gilpin County, Colorado	3.7 dwts.	9.8 dwts.	5 dwts.	Inside and outside plates.
The Thames, New Zealand..	12 dwts.	25 dwts.	14½ dwts.	Outside plates. Grinding in pans.
Clunes Victoria........	5½ grains	5¾ grains	5½ grains	No plate amalgamation. Wells and barrel.
Otago, New Zealand........	5 dwts.	8½ dwts.	7 dwts.	Outside plate amalgamation.
Ballarat, Victoria...........	2½ "	5¾ "	5½ "	Outside plates and wells.
The Ovens, Victoria	4 "	19 "	9 "	Outside plates. Grinding in pans.
Bendigo, Victoria......	6½ "	9½ "	7 "	Outside plates and wells.
Charters Towers, Queensland	60 "	100 "	80 "	Outside plates. Grinding in series of pans.
Amador, California..........	2½ "	6½ "	4½ "	Inside and outside plates.
Grass Valley, California......	11 "	15 "	12 "	Inside and outside plates.

Table IV—COST OF MILLING.

Mill.	Power.	Stamps	Cost.	Year.
Hidden Treasure, Gilpin, Colorado..	S. & Wf.	75	$0.78	1891
Gover, Amador, California	W.	20	0.53	1893
North Star, Grass Valley, California.	W.	40	0.81	'88-90
Wildman, Amador, California... ..	W.	30	0.47	1891
Britannia, Ballarat, Victoria..	S.	40	0.56	1891
S. Clunes United, Clunes, Victoria..	S.	60	0.54	1890
New Chum, Con., Bendigo, Victoria	S.	30	0.58	1891
Excelsior, Charters Towers, Queensland	S.	50	1.95	1890
Saxon, Thames, New Zealand......	W.	33	0.98	1892
Mountain, Thames, New Zealand...	W.	40	0.90	1892
Phœnix, Otago, New Zealand......	Wf.	30	0.70	1890
*Morgan, South Wales, Gt. Britain.	Wf.	40	0.20	1891
†Phœnix, Wynaad, India...	Wf.	20	0.64	1884
†Mysore, Kolar, India	S.	90	3.05	1892
†May, Con., Johannesburg, S. Africa	S.	20	3.15	1890
†Jumpers, Johannesburg, S. Africa..	S.	100	2.40	1890
‡El Callao, Caratal, Venezuela.....	S.	60	1.08	1891
§Treadwell, Douglass I., Alaska....	Wf.	240	0.35	1893

NOTE: S—Steam. W—Water which is bought. Wf—Water which is free of cost.

* With steam power it was 52 cents, according to Dr. C. Le Neve Foster.

† These figures, which I owe to Mr. A. G. Charleton, are taken from his paper "The Choice of Coarse and Fine Crushing Machinery, etc."—*Transactions of Fed. Institute of Mining Engineers*, 1893.

‡ Mr. Hamilton Smith, Jr.

§ Company's report for half year ending November 30, 1893.

In each of the cases given in this table the cost of transportation is omitted. The cost of water power in California is usually about 20 cents per miner's inch (or 1.57 cubic feet per minute). At the Gŏver Mill this expense amounts to from 18 to 20 cents per ton of ore, while at the North Star it is 31 cents, so that, including the cost of power, the milling was done at these two thoroughly representative plants, at the rate of 33 and 50 cents per ton respectively. The ore crushed at the North Star is particularly hard. The use of grinding and amalgamating pans increases the cost at the mills of Charters Towers (Queensland) and the Thames (New Zealand). At the Phœnix (N.Z.) no plates, but blankets only, are employed.

The question of the turning of the stamp is referred to by Mr. Argall and Mr. Olcott. The amount of the revolution is dependent upon the height and speed of the drop, and upon the amount of grease upon the cam. Occasionally, when the cam surface has too much lubricant upon it, the tappet slips past without causing any observable turn. At four different mills, working under dissimilar conditions, I have noted the turn to be as follows:

	Stamp lbs.	Drop in.	Speed per min.	Amount of Turn.
Hidden Treasure, Gilpin Co., Col. .	550	17	31	1 to 1½ revols. per drop.
Garden Gully United, Bendigo, Vict.	780	9	80	1 revol. in 4 to 9 drops.
Harrietville, Ovens, Victoria	700	8	70	1 revol. in 4 to 7 drops.
North Star, Grass Valley, Cal	850	7	84	1 revol. in 5 to 6 drops.

As to the practical effect of the turn there is evidently much question. If the stamp turns as it is being lifted, it must continue to turn slightly after the cam has passed from under it. That the result, as far as it affects the ore upon the die, is insignificant in most cases, may be admitted; but it is supplemented by another factor, namely the inequalities of the surface of the shoe. The effect of the latter is various, sometimes causing the stamp to move bodily out of the vertical (a movement soon checked by the guides), and at other times causing a revolving motion. The die, of course, also wears unevenly, but as it is covered with ore, this fact has not the importance in this connection which must be allowed to that "cupping" of the shoe which promotes an irregular grinding action against the ore.

The use of a modern form of the arrastra at the Pestarena Mill, is quoted. The extraction, according to the report of the company, was 81 per cent. in 1888-89, and 78 per cent. in 1889-90. The loss of mercury in the respective years was 230 and 234 grammes per metric ton, equivalent to about 7½ pounds per short ton. The capacity of each mill was two-thirds of a ton per day. No doubt machines of the arrastra type will, in many cases, give the best conditions for promoting amalgamation; but, as compared with the stamp mill, most machines of the grinding class have a very small crushing capacity, and consume a great deal of mercury.

In commenting upon my description of the Gilpin county milling practice, Mr. Argall has made a series of verbal criticisms which seem to me unnecessarily hypercritical and occasionally unfair. I reply to them only so far as to make my meaning plain, using the numbers employed by Mr. Argall.

(1) He points out "that if the pyrites remained longer in the mortar than the other portions of the ore," certain results would follow. I ask him to refer to the paper which he is criticising, when he will find that he has no warrant for saddling me with any supposition such as that which he is needlessly controverting. I was emphasizing the fact that the main idea of the Gilpin county method is to retain the ore inside the battery longer than is necessary for pulverization, in order to give more opportunity for amalgamation. The ore is mainly pyritic, and it is the pyrite that is immediately associated with the gold, therefore I spoke of the pyrites remaining in the mortar longer than was necessary for crushing purposes, but not "longer than the other portions of the ore."

(2) My statement that "the long drop gives the interval of time required to allow the settling of the fine gald" is true. All the gold of the ordinary Gilpin county ore is fine, and because it is fine, the present system of reduction is employed. The character of the amalgam, and the low retort yield, are indicative of the minute sub-division of the gold particles. There was no comparison made or intended by me between the "coarse" and the "fine" gold in the ore, and Mr. Argall controverts his own imagination.

(3) It is quite possible to comprehend my statement without supposing the gold to be endowed with "the potentiality of locomotion." The deep discharge and the roomy mortar, both "jointly" and "severally afford a chance for the gold to get out of the way," because the depth of the one and the roominess of the other prevent the making of a violent splash, such as is produced in a narrow mortar with a shallow discharge; and the smaller force of the splash prevents a rapid exit of the pulp through the screen, and enables it to remain inside, so that the gold which it contains may be collected by the mercury lying at the bottom of the mortar, and by the amalgamated surface of the inside copper plates. If the discharge were shallow, and the mortar narrow, the gold could hardly get out of the way of the falling stamp without making its exit through the screen, and therefore, in the case of ore carrying gold in the finely divided condition which characterizes the Gilpin county mill stuff, it would not be possible to save more than a very small percentage inside the battery. It is indeed true that in California and Australia a good proportion of the gold is often arrested inside the mortar, but such gold is considerably coarser than that caught upon the amalgamated tables outside; and, moreover, the ore itself is of a different nature, and the gold is essentially less fine than that treated by the mills of Gilpin county.

Referring to the interval which occurs between the successive drops of the stamp and the pause which is thus occasioned, enabling the particles of gold to settle and become amalgamated, I remarked that "in a Colorado mill the interval is two seconds; in California it varies from three-fifths to two-thirds of a second." This was said in comparing the relative frequency of the agitation to which the water in the mortar is subjected by the action of the falling stamp. It is quite unnecessary to point out that there are five stamps in each battery, and that therefore the duration of the interval should be divided by five. If we carry out this line of reasoning we shall conclude that there is no time of absolute quiet, for when none of the five stamps of any particular battery are falling, the water is still being agitated by the concussion produced by the stamps falling in the mortar boxes on either side.

As regards the warming of the water in the mortar by the conversion of wasted energy into heat, I did not consider it very considerable; but, it may be, nevertheless, sufficient to add to the solubility of certain portions of the ore—as, for instance, partially oxidized pyrite. A careful test made at the Gover mill, Amador, California, gave the following results:—

TEST OF THE TEMPERATURE OF THE WATER BEFORE AND AFTER LEAVING THE BATTERIES, JANUARY 10, 1894.

	Before. Deg.	After. Deg.	Temp. of air.
8.30 a. m.	37.0	40.0	40° F.
8.30 a. m.	38.0	40.5	do
8.30 a. m.	38.0	40.5	do
3.30 p.m.	43.0	44.0	50° F.
3.30 p.m.	43.0	45.0	do
3.30 p.m.	43.5	44.5	do
3.30 p.m.	43.0	45.0	do
4.30 p.m.	42.0	44.0	48° F.
4.30 p.m.	42.0	45.0	do
4.30 p.m.	42 0	45.5	do

In his criticism of my statement that the retention of the pulp within the mortar, long after it is pulverized to a fineness permitting exit through the screen, has been used by the Gilpin county mill man to assist him in obtaining the conditions which he desires, Mr. Argall has missed the main principle, repeatedly emphasized by me, of the milling practice which he is discussing. The methods in vogue in Gilpin county originated in no idea of concentrating; if they had, then the excessive sliming of the pyrite, due to the deep discharge, would be a stupid blunder. On the contrary, however, the practice of the district is founded upon the principle of using the mortar, not only to crush the ore, but also, as far as possible, to make the mortar an amalgamating machine. The introduction of percussion tables for concentrating the pyrites in the tailings is comparatively recent. The mill man's intention is, to save as much gold as possible inside the battery, and, to do this by retaining the pyrite (with which the gold is mainly associated) inside, until a separation has been brought about; and these ideas are carried out by having a roomy mortar, a long, slow drop, and a deep discharge—more especially the last, which assists in procuring the condition he considers the most favorable to his purpose.

A statement was made, more than once, at the Chicago meeting, which does not, however, appear in the printed discussion, namely, that while the Californian type of stamp mill has been introduced in mining regions all over the world, that of Gilpin county has not passed outside its own *habitat*. This statement is not quite accurate, since mills of the Colorado type have been successfully used in Dakota, Montana, Arizona and Idaho; but, broadly speaking, it is no doubt correct to say that the Californian type is, by far, the more widely employed. Upon this fact is founded the suggestion that the methods of "the little kingdom" of Gilpin are not thought worthy of imitation. In commenting upon this matter, I trust I may be absolved from any charge of prejudice, since I have used both types of mills successfully, and have endeavored to discuss the advantages and disadvantages of both fairly. The explanation of the fact just referred to is somewhat as follows:—

The methods in vogue at Central City and Black Hawk were evolved under unusual conditions, and have been retained under peculiar circumstances. The first mills introduced, in the early "sixties," were modelled on the Californian type, and had a quick, short drop and a shallow discharge. While the mines were still in the gossan, or surface quartz, everything went well; but as soon as the unoxidized pyritic ores were reached the extraction began to diminish fast, and finally, this diminution nearly put a quietus to stamp milling. Then the smelter* came to the rescue, and prevented the cessation of mining during the years which elapsed until the mill men, by a long series of experiments, arrived at the conclusion that a long, slow drop, and a deep discharge, gave the conditions most favorable to the successful treatment of their ores. When the present methods were adopted, nearly twenty-five years ago, there was no market for low grade iron pyrites, and the ores, although containing from 10 to 25 per cent. of sulphides, would give up a large percentage of its gold contents when crushed in the deep mortars which had come into use as the result of a hard-bought experience. The old methods have been retained, but with the addition of percussion tables, because now the smelters charge very low rates of treatment for pyritic concentrates. Smelting charges are $4.50 for concentrates,* and $12 for crude ore. Railroad freight to-day (from Black Hawk to Denver) is $1.50 per ton on material worth less than $30 per ton, and $2 per ton for higher grade stuff. Small coal ("mine run") is delivered at the mills for $1.60 per ton. These are some of the conditions which have tended to perpetuate a milling practice which is, in many respects, out of date.

*The Boston and Colorado Smelting Co. commenced operations at Black Hawk in 1867. In later years the works were removed to Argo, near Denver.

On the other hand, the methods of Gilpin county have not been adopted extensively elsewhere, because it is rarely that ores rich in pyrites are found to be comparatively so free milling. The Californian mill, moreover, in its typical form, is a crushing machine, adapted to preparing the ore cheaply and rapidly for a great variety of after treatment, by plate amalgamation, blanket saving, pan amalgamation, concentration, lixiviation, etc. It is, as a crushing machine, having its parts so arranged as to give a maximum of automatic handling of the ore, that the California mill is first of its kind. Compared with it, in this respect, the Gilpin county batteries are clumsy and incomplete; but, as an amalgamating contrivance for the treatment of a particular class of ore, they were well conceived at a time when amalgamation methods had no competitor in cheap smelting. Thus, after all, we do but return to the truism, which is often forgotten in these generalizations, that the milling practice to be introduced at any mine or in any district must be suited to local conditions, the most important of which is, of course, the character of the ore.

W. L. AUSTIN, (Denver, Colo.)—A word as to the current fable of which Dr. Raymond speaks. Stamp-stems being among the "working parts" of a mill are, therefore, included by Dr. Raymond in the category of the iron that does not crystallize. It will have been observed by any one who has operated a new stamp mill of the California type, with stamps dropping from 90 to 100 times per minute, that after his battery has been running 12 to 18 months, the stamp stems begin to break. Moreover, they break off, as a rule, right above the stamp head, though occasionally they snap off just under the tappet, and often it becomes a serious undertaking to remove the ends of the stems from these heads or "bosses." On account of these breakages, the stems are made tapering at both ends, so that when one end has broken off it can be reversed. In due course of time a similar mishap usually overtakes the other end. In many cases the mutilated stem is then laid aside as a problem for some future manager to solve, and new ones are ordered from the manufacturers. Now, the breakages may, as Dr. Raymond says, not be due to crystallization of the iron—for properly speaking, the iron, (which should be the best quality of wrought iron) originally used in their manufacture is crystallized, to begin with—but during the pounding which the stamp has been doing, some molecular change has taken place, changing the fibre into a structure coarsely granular in appearance. That such a change should take place is quite conceivable, for these stems are submitted to an unusual amount of jarring. The 3½ inch stem weighs 363 pounds, and the 3¼ inch stem 390 pounds, while the aggregate weight of stamp, including stem, head, shoe and tappet, is over 850 pounds. Such a weight, falling 6 inches 100 times a minute, for 300 days in the year, finds no parallel case in pump rods or the connecting rods of engines. As would be expected, when the shoe is allowed to fall on the die, the life of the stem is shortened. The fact remains that the stamp stems do break, and the iron has the appearance of being what, in the absence of a better term, is technically known as "crystallized." There is a class of men engaged in milling throughout the West who have been brought up in mills and have made a business of running them. It is a common practice among these operators to take the stamp stems out of the batteries and anneal them by heating, and hammering them when the limit of safe working has been reached. These men are not chemists, and had once their little foibles, among which was the harmless use of sage tea and similar concoctions in their amalgamation departments; but they are first class, practical mechanics, and their experience and opinions in these branches of milling are entitled to respectful consideratiod. Among such men as these the fable spoken of by Dr. Raymond is still current. At one mill, which was under the writer's charge for a while, there was a man employed who was classified as mill blacksmith. He was the highest priced man carried on the pay-roll, and it was his special duty to repair the iron work about the mill, anneal stamp stems, etc. Considering the appliances at his command, he managed to perform what might be termed feats of blacksmithing, and among such was the piecing out and welding of 3⅛ inch stamp stems in an ordinary horse shoeing forge, so that they afterwards withstood the wear and tear of the battery. He always paid great attention to the careful annealing of such work; for it is the experience of mill men that stems thus treated last much longer than when such precaution is neglected. To have rendered this annealing necessary, the fibre of the iron must have undergone some change by the long continued jarring which the stems had received. One can easily satisfy one's self of the extent of this jar by taking hold of a stamp stem while in operation. It will be found to quiver violently. If the molecular change which takes place among the particles of iron in a stamp stem after long and continuous use, by which the fibrous texture is altered into a granular one, may not be termed a crystal-

* Or, "tailings," as they are termed locally.

lization, what is the proper expression to employ for such a phenomenon?

Dr. Raymond.—Mr. Austin's remarks indicate a misconception on his part of the meaning of my statements concerning the alleged "chrystallization" of iron by vibration. It was not in the least my intention to quibble over a word. If I were so disposed, I should take exception to his present assertion that the wrought iron of which stamp stems are made is "crystallized," to begin with. The question in my mind, as I think a careful reading of my remarks will convince Mr. Austin, was, whether there is really a molecular change produced by vibration in wrought iron or steel. When Mr. Austin triumphantly inquires what is the proper expression, if "crystallization" is not, to describe such a molecular change, he simply begs the question. It will be time enough to discuss the name when the existence of the phenomenon has been demonstrated.

Before considering the evidence as to *that* question adduced by Mr. Austin, I would recall that my own criticism was made upon the sweeping statement of Mr. Argall, that "vibration under all conditions will crystallize iron." This I pronounced to be, "beyond question incorrect," and to this, my only unqualified assertion on the subject, Mr. Austin's argument does not apply. If his evidence proves anything, it proves only that iron is *sometimes* thus affected by vibration

As to this more limited proposition, I must frankly say that I see no conclusive force in Mr. Austin's argument. The one fact upon which it rests is the breakage of stamp stems after twelve to eighteen months' running and the granular appearance of the fracture. But the fracture of a fresh bar of iron can be made to appear granular without any prolonged previous vibration, by the condition of the fracrure itself. *A granular frac u e does not prove an altered struc.ure.* If the vibration theory were correct, the rest of the stamp stem ought to be more or less altered in structure; and, indeed, other parts of the stem ought to be more affected than the parts where the breakages usually take place; for the two places mentioned by Mr. Austin, namely, "right above the stamp head" and "just under the tappet," are precisely the points of *minimum* vibration. They are the points of maximum *stress*, due to the checking of vibration by the stamp head or the tappet.

Now, it probably never occurred to Mr. Austin, or any of the practical mill men on whom he relies, to find out whether the parts of the stem which vibrate most freely are molecularly changed by such vibration; but some experiments of this kind which have been made have revealed no such alteration.

The fracture of iron under repeated stresses, no single one of which would produce visible rupture, is a very different proposition, and does not necessarily involve molecular change. It is more probably due to minute ruptures between the particles of the metal, which finally aggregate to constitute visible fracture.

I cannot admit that the vibrations in a stamp mill are more severe or more likely to produce molecular changes than those to which railway axles, marine shafts, and locomotive connecting rods are subjected. In these departments, quite as much as in stamp mills, the notion of "crystallization" by vibration is an old one, and the evidence in its favor is essentially that which Mr. Austin adduces, namely, the granular appearance of fractures, which, taken by itself, is quite inadequate.

If vibration produces molecular change, why should previous annealing prevent that change? As it would be manifestly impossible for Mr. Austin's mill blacksmith to anneal the whole of a stem in a horseshoeing forge, it must be that he annealed only the part which he had welded, which would be the very part out of which he had taken all effects of previous vibration. Such an annealing was very proper to remedy the unequal strains caused by the welding process itself, and to prevent the piece from breaking under stress or shock. But as it left untouched the rest of the "crystallized" stem, it can scarcely be considered as regenerating a fibrous structure. Moreover, a fibrous structure cannot possibly be produced by annealing.

In short, while I have never denied the possibility of molecular change in iron due to vibration, I must continue to regard the proposition as unproved, and the burden of proof as resting upon those who assert it, in the face of numerous experiments and careful tests which indicate the contrary. Mr. Howe's conclusion, after a patient analysis of much evidence, is:

> To sum up, while vibration and shock often cause rupture under light stress, and while it is proverbially difficult to prove a negative, we have, I think, every reason to believe that the granulation and crystallization of iron under vibration and shock is a myth.*

Unquestionably, the notion of a mysterious change produced by vibration in the quality of iron has worked double harm in stamp mill practice. On the one hand, it has been the convenient excuse of manufacturers, who declare the evidences of bad workmanship shown in fractures to be the result of subtle changes thus produced in originally sound pieces of good metal. On the other hand, mill engineers, believing that the inevitable vibration would break anyhow, in the course of a few months, the jarring parts of their mills, have given too little attention to the distribution of stresses and shocks by which such breakages might be greatly delayed or wholly prevented. If they would lay aside their preconceived notions, and disregarding even the opinion of the mill-blacksmith, study the mechanical reasons for the liability of a stamp stem to break just over the head or just under the tappet, I think they would find more significance in the way tappet and head are attached to the stem (so as to subject it to heavy side shocks at points where it is not made stronger than elsewhere) than in any amount of molecular speculation.

* *The Metallurgy of Steel*, p. 199.

Commercial Mining.*

By Mr. F. Danvers Power, F.G.S., M.A.I.M.E.

(From the Mining Journal, page 95.)

The width of a vein is another important point. The cost of nearly all mining requisites is greater in proportion for narrow than wide veins, with the exception of timber. A man is cramped when working in a narrow place, and cannot put the same force into his actions as if he had more room. There are more re-entering angles in proportion to the are of the face when working in narrow than in wider levels, and therefore the miner is hampered in the judicious placement of his drill holes, and the effect of his blasting material is not so great as it woutd otherwise be. A miner naturally does not desire to extract more country than necessary, simply for the sake of enlarging his working place, or he may find a quantity of mullock left on his hands over and above that which he can utilise for packing purposes, which he has to go to the expense of sending to the surface. Even when given the length, direction, underlie, and with of a vein we have not all the knowledge we desire about it. Veins, as a rule, are not of the same value throughout, the greater portion is barren or nearly so; the rest is classfied according to its nature into firsts, seconds, etc. The ore-bearing portions are termed "shoots," and the importance of a vein greatly depends on the dimensions and quality of these "shoots." We want to know the ratio of the ore to the gangue, and how much dead work must be debited to each ton of ore extracted; also whether the ore is rich enough to bear the expense. The way in which the ore is distributed in its matrix, the nature and quantity of the associated minerals, and whether they are deleterious to the metal sought, must also be considered, for if disseminated through the vein stuff it may have to undergo the expense of being "dressed" before it is ready for the market.

Many expensive mistakes have been made by men who, only thinking of the metal to be extracted, have quietly ignored the presence of undesirable substances till it was forced upon them, as in the case of a certain iron ore in Tasmania. Mere traces of some impurities so impare the value of a metal as to decide whether a mine is to be placed on the list of paying or non-paying ventures. Such technical details can only be learnt by study and experience, for there is no royal road to this end. The rule-of-thumb man may manage to scrape along in simple cases, but as soon as a real difficulty arises he is utterly helpless, so has to fall back on his better informed neighbour for assistance. Shoots sometimes occur in the form of pipes, when they are called "pipe veins," and they extend for some distance more or less vertically. A shaft sunk on such a shoot would show ore all around. People before now have too hastily jumped to the conclusion that the vein between two shafts sunk on such cylindrical shoots was as rich as the ore they saw exposed to view, but later on have had reason to regret the loss of the money with which they backed up their opinions, supported in all probability by the crude judgment of some illiterate miner, instead of seeking the mature advice of a professional man.

The presence of much water in a mine in districts where surface water is scarce, or easily lost by evaporation, may be the salvation of a company. On the contrary, an excess of water that cannot be utilised, may prove its ruin. Working expenses are often greatly increased by the presence of objectionable gases in a mine, by the occurrence of swelling floors that must be cut down constantly, or by the nature of the rock, which, when hard, adds to the labour of mining, or if bulky, danger to life is added to the expense of careful timbering; while if a stratum of quicksand is encountered, all previous work may have to be abandoned while necessary arrangements are being made to dam it back. Occasionally, owing to the bad selection of a site, or due to mining operations themselves, the works are subject to "creeps" or landslips. I once remember seeing men working at a brown coal deposit in Australia in a most dangerous position, there being a huge slice of the hill above, ready on the slightest provocation to overwhelm them; in order to temporise, the manager had connected the slipping portion and the main hill with a rope attached to trees growing on the respective parts.

Certain minerals that depend on their size, colour, transparency and such like qualities for ther market value must be prospected on a large scale to determine what output may be expected. Mica, for instance, is used for varioue purposes, depending on such qualities; the large sheets of white, transparent, flawless mica fetching the highest price, it is naturally the object of miners to avoid breaking up suitable pieces more than possible; yet in dressing it for the market there it much waste. A hundred pounds weight of block mica will scarcely yield more than about 15 pounds of cut mica, and sometimes even less. The scrap, it is true, can be sold for minor purposes, but its value greatly diminishes with its size. When working a mine in the proximity of old excavations plans of such old workings should be secured when possible, for tradition is not to be relied upon, and is apt to become distorted by time. The possession of such plans may save a mint of money in advance work, in avoiding the unwatering of old workings, or the payment of compensation for death or injury to the workmen in case of accident. Shareholders have a voice in choosing the directors who actually carry on the business of a company, for very little work would he transacted if all the shareholders met to deliberate over every small detail. Directors are frequently elected before an individual, who is late in joining a company, becomes interested in the mine, but it rests entirely with that individual whether he throws in his lot with the others or not, and if he cannot assist in selecting the shareholders' representatives for that term of office, he at least has the opportunity of approving of their *personnel*. On looking over the names of directors certain persons are dazzled by the handles attached to some, and feel flattered at the opportunity of being associated with them. Others, again, acknowledging their ignorance in mining matters, trust to the wisdom they assume the directors to be possessed of, instead of using their own common sense, which would stand them in better stead. They conclude that the mine must be good, otherwise so-and-so would not have gone into it, and in case of difficulties, no doubt his influence would bring them out safely.

If a business man has purchased a large interest in a mining property, it is only natural to conclude that he has carefully enquired into the matter, and if satisfied with its prospects; also that his large interest is sufficient to warrant him in accepting a seat on the board so as to assist in supervising the business of the company for his own profit; and in attending to his own affairs he, if honest, also promotes the interests of his associates. Unfortunately, however, directors are not always such as is sketched above; there are some who sell their names with the usual accompaniments without the slightest intention of performing the duties that are expected from them; they are simply figure-heads, and their names are used as decoys for those who do not think for themselves, but take statements for granted on the strength of another's name. One can hardly expect a man who is given shares in a company for the sake of his name, to have the same lively interest in its welfare as a man who has invested his hard earned savings in it. We cannot pretend to know the true reasons that influence a director to take certain steps, and unless one is behind the scenes, it is difficult to judge of the motives of the guiding hand. He may take advantage of early news received officially from the mine to instruct his agents to buy or sell as the case may be before the rest of the shareholders are given an opportunity, forgetting that he is representing others as well as himself; or he may be a professional guinea-pig, who attends as many meetings as possible in the day so as to qualify for his fee, caring little or nothing how he scamps through his work, so long as the formality is got through. We cannot condemn too much those men who accept fees with no intention of fulfilling the duties their position requires of them, and which their friends and the public, who joined on the strength of their personality naturally expect. It is not desired by any means to run down professional directors as long as they do not belong to so many companies that they are unable to pay proper attention to their business. On the contrary, there are many advantages in obtaining the services of the right sort of professional director, for they can give new companies the benefit of their experiences gained elsewhere, and their knowledge is handed on to others who are graduating for professional directors themselves. A laborer is worthy of his hire, whether he works with his head or hands, so it is only fair that a director should be paid for his trouble, besides which, it acts as an incentive to close application to the interests of his company.

The ideas that emanate from the brains of some directors are as annoying to the harassed mine manager as they are absurd; for example, the English directors of a South African mine, in reply to their manager, who wrote to say that a new shaft was necessary, which he estimated would cost £500, said they thought the price was exorbitant, and enquired if he could not buy a second-hand one at a less figure! Or, again, a Victorian mine manager, after well testing a reef, wrote to his directors informing them that the mine was a duffer, the reef being only three inches wide, containing hardly any gold, so he recommended them to close the mine, and divide what balance was left among the shareholders. Well, one director, who had also been a vendor, was very vexed, and plainly said he suspected the manager of wishing to depreciate the property, so that he could secure it cheaply for himself, and offered to visit the mine to see how matters stood. On his return the director reported that things were just as he expected, that the reef was looking well, and was 6 feet 6 inches wide, the whole length of the tunnel. The manager was naturally asked for an explanation, which was to the effect that what he had previously stated was quite true; that the director had arrived with the intention of teaching him his business, which he commenced to do by measuring the depth of the reef exposed to view in the face of the drive, which he had mistaken for its width, which still remained three inches of "buck quartz." Similar absured mistakes were made in the early days of Victorian reefing, when men, hearing that gold was found in quartz, thought it it referred to a measure, and so started for the goldfields with buckets and pans, being under the impression that they could pick up the precious metal like periwinkles on the seashore.

Some directors are as bad as old women at auction rooms, as far as buying up all sorts of unnecessary and useless machinery is concerned, which they send on to the mines. I remember once having the misfortune of being employed by a company whose directorate was given that way, and I do not desire a similar experience; they, moreover, were under the impression that they understood more about the technicalities of the work than their manager and it was only by accident if the original orders were attended to. If double tape fuse was ordered they would send up single because it was cheaper, and they considered the former extravagant; the time lost over misfires did not count for money with these directors. Did you desire powder or dynamite, you would receive some new fangled explosive for an experiment, the range of which you would have to find out, accompanied with the usual difficulties one has in getting an ordinary miner to adopt something he is unaccustomed to. There is a certain mineral property I have in my mind's eye where the managing director, formerly a wholesale butcher, and the mine manager, who was by trade a fitter, put their heads together over a second hand volume of "Phillip's Elements of Metallurgy," from the study of which they decided to erect a furnace for treating copper ore that was originally designed for smelting iron. In due course the plant was finished and the furnace put in blast, but unfortunately the mine manager, a very worthy and hard working man, had never seen any smelting done, so it was hardly surprising when before twenty-four hours had passed the furnace was choked up, the crucible was chilled, and all the heat was at the mouth of the furnace. Of the little matte and slag that was tapped, the former was thrown over the tip—now carefully covered up—while the slag was bagged for shipment home. So long as people have such a confusion of ideas that they cannot distinguish between an engine driver or fitter and an engineer, or between an apothecary or druggist and a chemist, we will continue to have the wrong people in the wrong places.

One man I know in Melbourne makes a point of owning the largest share in any mining venture he goes into, so that he can have the controlling voice in its future. By this means he has an interest which is worth his while to look after, and he can command the money of his fellow shareholders to carry out his plans. Most of the mines are managed in his office, and should one fail and go into liquidation, he sells the machinery to one of the more successful mines, whether it wants it or not as long as it suits his plans, which it generally does, for he mostly has a mortgage over the defunct property.

As to the constitution of a company, that also frequently determines its success or otherwise. If a limited liability the property is at least sure of a fair trial, provided the capital subscribed is sufficient and is used for the working of the mine; but if a company is registered under the No Liability Act, like most of the Australian mines, it is convenient for a shareholder who wishes to back out by forfeiting his shares, should he not be satisfied with his prospects; but the difficulty of securing calls greatly retards the development of a non-dividend paying concern, and tempts the legal manager so to manipulate the mine manager's weekly reports as to give them a false color. Many an unhappy mine manager, surprised at seeing a report supposed to proceed from him, writes to town to demand an explanation, in reply to which he is informed that his report was too long to print *in extenso* so it had to be curtailed; that it was written in such bad English the legal manager was obliged to put it into readable form; that the use of technical expressions made it necessary to simplify the report for the public use; or, in some cases, instead of trying to cover their actions by excuses, the mine manager is told straight out that it would be impossible to get calls in with such a report as he wrote, and that many more like that would close the mine and throw him out of employment.

A mine is like a child—it must have money spent on its development before it can be expected to pay its way, unless it is a monstrosity. There are many mines, which, if opened up properly to commence with, would pay well, but as they are worked on a small scale, and exist on a hand-to-mouth principle, they cannot make ends meet. It is generally cheaper to work on a large than a small scale; the expenses of management is distributed over a larger number of men; miners, instead of being suspended when work is slack at one part of the property, which breeds discontent, can be employed on another portion, and so, instead of creating dissatisfaction among the employees, you gradually collect and retain the best skilled labor in the country, which always comes where constant employment is certain; in short, on a large property, the different departments can play into each other's hands, and it will pay them to do things for themselves that a small mine would not be warranted in doing, owing to the expense of the first outlay in a plant that could not be fully utilized.

There are, of course, many properties that Nature never intended should be converted into mines, but in spite of which man insists on working, in the hopes of extracting valuable metals, if not from the rock, at least from the shareholder's pockets. Again, there are other properties, which, although they cannot pay at present, owing to adverse local conditions or the want of improved processes, will yet pay at a later date when these difficulties are overcome. But there are other mines that ought to pay now, if properly worked, which on account of the bad way in which they have been financed bring no profit except to the first robbers. Under this category are those mineral properties that have proved failures when under capitalized, but which, when reconstructed on a more liberal scale, have been successful; in the meanwhile much money has been thrown away, and the original shareholders require a large profit to make up their losses. The number of shares in a company, their value, whether they are fully or partly paid up, whether ordinary or preferential, and whether they have all been subscribed for, are all important features in the success of mining from a monetary point of view. It may be easier at times to float a mine in £1 shares than if valued at, say, £100; they both have their *pro et con*. A low-priced share enables it to circulate among a class of people whose presence is not always desirable; they may take a fancy to operate on the shares, and to bull or bear them in such a manner as to finally ruin the reputation of the mine; this is not so readily done in more expensive parcels. The mine manager can at times checkmate such persons, or at least can make it more difficult for them to practice their nefarious plans. If his mine is properly opened up, he can equalize the values of his output by treating rich ores, when circumstances prevent him from working large quantities, such as want of water or fuel; he thus diminishes the excuse for sending shares up or down in the market with every fluctuation of the weather.

If vendors are partly recouped in paid-up shares, they should not be allowed to flood the market with them to the hurt of those shareholders who have paid hard cash for their interests. Sometimes, in order to entice the public to take up shares, the vendors guarantee a certain interest for so many years; this interest, when not forthcoming from the property, is sometimes paid out of the cash received for the mine, or from the sale of shares received in part payment; in other cases they "bear" the shares down to such a pitch that they are enabled to purchase the majority of the shares at a less price than they guaranteed for interest, and then close the mine. The fact of a mine having paid dividends is no proof that it is a desirable one to invest in; the dividends may have been procured by the sale of "paps," or even direct from the capital in the hopes of drawing fresh blood into the concern; or dividends may be paid out of money fairly earned, which would have been better to place in a reserve fund, so as to avoid the necessity of a call for, say, increasing the plant; in such a case the dividend is virtually paid out of the call. Other causes which result in disappointment to mining investors might be mentioned, such as the excessive prices often given for properties, mere prospects, on which interest can only be expected in years to come, if ever. Miscalculations as to expenses of working are rife, the cost of stoping frequently being taken as the total cost of mining, no allowance being made for deadwork, depreciation of plant, contingencies, and the hundred and one other expenses, all of which give their quota to the cost of winning a ton of ore.

The public seem rather to like the process of being taken in; at least they lend themselves to it very kindly; it is so nice to be the favored man, to be allowed to go into a good thing through the unselfishness of a vendor, who offers you a chance in preference to anyone else, notwithstanding that you are an utter stranger to him; it is also pleasant to be considered an authority on mining matters with no trouble to oneself. In the meanwhile, perhaps, the bubble bursts. In the hope of getting out at the top market prices, the disposal of shares was put off till too late, and an adequate interest on the inflated value of shares, or even a return of the money spent, is a thing devoutly to be wished, but hardly likely to be realized. One point to be remembered is that a fair interest on the original nominal value of shares may dwindle down considerably when applied to the quoted market rate, if high.

That there is a good deal in a name is recognized by certain vendors who give their mines the modified names of some well known property, either in the hopes that the public will confuse the names and buy the wrong stock, or intending that the public shall assume that the new mine is as good as the more noted one; but any mining man knows that a district is not to be measured by the richness of one mine, and that when one property is proved successful, dozens of others spring up around it, both on and off the line of lode; thus we find a mine, which is afraid to stand on its own bottom, is called the so-and-so north, south, extended, etc.

Since a great deal depends on appearances, it is sometimes considered advisable to spend more than the fair share of money on surface works that are readily seen, at the expense of productive underground work; in fact, in such a hurry are some companies to make a show that they erect works before there is any stone to treat, or before they are acquainted with the necessary process suitable for the extraction of the metal. Much money is thus thrown away on worthless or unnecessary machinery, and when this is added to that lost in absurd prospecting, excessive payments to vendors, law suits, and numerous other leakages, it is little wonder that we hear the oft-repeated statement that it costs more than £1 sterling to get a sovereign's worth of gold. If mining is to be saddled with all the mistakes and fads of those who put their money into such ventures, the remark must be accepted as true. The price of shares are at times so low, due to blunders, that the value of the plant is more than the market value of the mine and its accessories.

"The ore is refractory" is an expression often made use of to shield ignorance. The term refractory is an arbitrary one. What is refractory to one man is not to another. Give a metallurgist money and he will extract the metal from any ore; it is true that the extraction may not be an economical success, though it may be a technical one; local conditions too frequently step in, and make it advisable to employ a less thorough process, which leaves a fairly high percentage of ore in the waste, because the extraction of the last portion will cost more than its market value. It might be as well here to utter a warning against those inventors of processes or machines that claim to win a certain percentage of the metal in the ore. In making a fair comparison of percentages, the ores treated should contain the same amount of metal; it is obviously a bad or unsuitable process that only wins 80 or 90 per cent. from 100 oz. auriferous quartz, but the same percentage from a 5 dwt. parcel would be considered very good. In many new countries ores are sent to Europe for treatment. Were it simply the knowledge of treatment that is required, it would be cheaper to import men with the necessary training; but, may be, want of fuel is a drawback, skilled labor may be expensive and uncertain, barren fluxes may have to be used instead of making one ore flux another, for in a new country prevailing conditions are seldom such that ores from different parts of the world can be brought together and suitably blended. Then it may be most economical to concentrate by a raw smelting and to send the product to be refined at home, because the colonial market may not be large enough to utilise the bye products and pure metals, and when precious metals have to be sent away for consumption it is cheaper and less risky to ship silver locked up in "pigs" of lead than it is to send the silver bars separate.

The few hints given in this article touch but a little of the points that should be considered by persons about to invest in mines, and will help to show that there is much more in mining transactions and operations than the ordinary dabbler appears to be aware of. If a man will not take the trouble to make due inquiry into his business, he must not be surprised if he is unsuccessful. There is no effect without a cause, and it is only right that one should master the causes that are likely to influence his investments. The natural value of a mineral deposit cannot be affected by the artificial market transactions of man, but the amount of money put into or taken out of our pockets, which chiefly concerns us, can be greatly influenced by his manipulations. The opinions of over-sanguine men, however well intentioned they may be, must be accepted with caution; we must not base our calculations on abnormal conditions, but take a fair average and make due allowance for bad times; in fact we must conduct our transactions in connection with mines on the same lines as we would our ordinary avocations, for to enter upon indiscriminate speculation is to court ruin and disaster, which is bound to come sooner or later to those who tempt Providence.

The Commercial Aspect of Coal Mining.

(Excerpted from Mr. G. A. Mitchell's Presidential Address to the Mining Institute of Scotland.)

As a coal master I am inclined to look first of all at the commercial aspect of coal mining. The great question is: How are we to make our mines successful? Sometimes we hear of an interesting modification of some piece of machinery, ingenious and involving a new principle. We may admire it, but we ask ourselves—not, will it work—but is it a real improvement, is it an economy? In the same way the ultimate question to be asked in connection with all changes in mining is: Are they profitable, the question of safety to life, of course, always coming first? I intend to speak, therefore, as a coal master on some subjects which affect the successful working of collieries.

To make the most of a colliery we must (1) sell the produce to the best advantage; and (2) work at the lowest possible cost.

In speaking of the first of these points, I will refer to the practical side of the question, viz.,

THE SUITABLE PREPARATION OF THE COAL FOR MARKET,

and what has been done, in a general way, with regard to this during recent years. What I can say on the subject must be more or less familiar to you all.

Not many years ago it was thought that no preparation of coal was required, and little attention was paid to the handling and cleaning. It was screened over ordinary bar screens, possibly too short and too steep to be very efficient, and any foreign matter present was allowed to find its way, with a good deal of dross, into the waggon. If the coal was sold for household purposes a little extra care was taken, but, if it was for shipment or locomotive use, the quicker it could be passed over the screen the better. That coal sold as well as it did was due to the fact that the seams which were being worked were mostly clean and of good quality. Coal was abundant in the country, and any seams of inferior quality or with ribs of stone were generally neglected altogether. As coal became more scarce, however, attention had to be paid to seams formerly left untouched, and, to obtain a satisfactory market for the coal from such seams, it was found necessary to devise some means of removing the foreign material and of sorting the different qualities. Various forms of picking tables and screening arrangements were introduced, and there are few collieries now where such tables are not to be found in operation. As picking became common it was found that, even for good seams, increased care in screening, handling, and sorting improved the value in the market, and, even for such seams, picking tables and jigging screens are now largely used. Few seams are of uniform quality throughout. In most there is a mixture of hard and soft coal, each suitable for a different purpose. For instance, we may have a hard coal which is good for furnace purposes, and which burns with a light, white ash and along with it a soft coal which is suitable for house use, and which burns with a dark colored, heavy ash. If the two are filled together the coal is neither first class as a furnace coal nor satisfactory as a household coal, but, by proper separation, good prices may be got for both kinds. Or, again, part of a seam may be inferior, and the mixture of even a small proportion of the inferior part may reduce the value of the whole.

But it is not only in the case of round coal that attention must be paid to the handling of our products. It is almost of more importance to prepare the dross for the market so that it may be sold to the best advantage, and it is hardly necessary for me to remind you that dross is an import part of the output of every colliery. Although miners' leaders seem to ignore it altogether when they speak of prices realized, the coal master can never forget it, for in many collieries it forms more than fifty per cent. of the total output, and the proportion tends to increase as the depths of the pits become greater. When we look back over the last twelve or fifteen years we must be struck by the extraordinary change that has taken place in the value of dross. We all remember the time when it was of very little value. I have sold dross at 6d. per ton at the pit, and was glad to get rid of it at that price. Now, a good dross sells for nearly as much as an inferior coal, and the difference between the price of coal and dross at certain times is comparatively small. This is due to various causes, but I think I put it fairly when I say, that it is very largely due to the increased consumption and sale of dross, made possible by the improvement in the quality due to washing and careful sizing.

The desire for economy in fuel consumption has for many years caused steam users and manufacturers to turn their attention more and more to dross, but it has only been in recent years, since abundant supplies of clean dross could be got, that the great impetus has been given to the substitution of its use for that of round coal and triping.

But it is not only in the home markets that dross is now an important item, but in the export trade also. It has been found that clean dross is of value although very small in size, and that, by sub-division into different sizes, various markets may be suited. What was formerly sold as dross merely is now, when washing is carried on, divided into from three to five different sizes, and a very large trade has been developed, specially for the larger size of nuts, for export purposes.

It is not many years since there were only three or four washing machines in Scotland. Now there are dozens. Fifteen years ago I do not suppose the shipments of nuts would amount to 30,000 tons per annum. Now the exports are hundreds of thousands of tons. It has been abundantly shown that a good article will make new markets for itself.

There is another direction in which something has been done to increase the value of small coal. I refer to briquette making. This is comparatively a new industry for Scotland, but there are now several extensive plants in operation I believe that there is room for greater development in this direction. Where washing machinery is in operation, and where there is sufficient quantity of the smallest size of washed material of good quality, the making of briquettes should be exceedingly profitable. The difficulty hitherto has been to keep the plants going during the summer, but if briquettes can be made cheap enough, it should be quite possible to form for them a satisfactory shipping connection.

Washing has had special attention, and I don't know if any other Institute in the country has gone so thoroughly both into the theory and the general arrangement of machinery for the purpose. There is still room for more papers on these subjects, as there have been many improvements during recent years in the different arrangements. There are better washers and better plants generally now than there were when the Coal Cleaning Committee's report was presented in 1889.

The surface erections at a modern colliery are of a very elaborate description, and more and more care is being taken to make the arrangements such that the output can be satisfactorily handled with the minimum amount of labor. At some collieries, where modern machinery has been erected, it is safe to say that the coal is being cleaned and satisfactorily prepared for the market, at quite as low a cost as it formerly took to put it into waggons without any cleaning whatever.

We cannot say that we have come to an end of the improvements that are possible, and there is still room for inventive ingenuity in designing tippers, screens, picking tables, methods of lowering coal into waggons, etc. I believe that twenty years hence we shall consider antiquated what are now the most improved modern arrangements.

I cannot but refer here to the lamentable absence of one link in the chain of improvements. The railway companies are still making use of the barbarous methods of shipping coal common many years ago. It is little short of a disgrace that coals, carefully loaded in good condition at the collieries, into railway waggons, should be treated with such scant consideration at the shipping ports. It is evident to any one who has watched the shipment, for instance in Glasgow, that much of the care spent in handling the coal at the collieries is rendered of no effect by the smashing which it gets in falling from the trucks into the holds of the vessels.

When the railway companies and harbor proprietors shall have given us the best possible arrangements for shipping our coal, we shall feel that we are neglecting nothing that can assist us in placing our coal and dross in the market, in the condition most favorable for commanding the best price that can be got.

WORKING COST—THE LABOUR QUESTION.

The preparation of coal for the market is of immense importance, but, after all, the main question we have to deal with is the working cost. In speaking of the necessity of working at the lowest possible cost, I feel that I must refer, first of all, to that question which has been so specially exercising the minds of colliery owners during the past year. I mean the labour question. In ordinary circumstances I should avoid the subject altogether, as something largely beyond the control of colliery owners and managers. Until recent years wages fluctuated with the demand for coal, and high wages ruled when trade was good, and good prices were being realized, and the wages were low when trade in general was bad. During the past year or two, however, we have been brought face to face with a different state of matters. The prices of coal have varied so much from artificial causes depending on labour troubles, that it has become increasingly difficult to conduct business on the accustomed lines. The labour question has become so serious that I feel that, instead of avoiding the subject, I should require rather to make an apology if I did not refer to it at this time, when I speak of the cost of working.

Of late years trades' unions have become very powerful in all branches of trade, and have shown themselves strong enough in many cases to cause the most serious stoppages of business. It is not for me, here, to discuss the advantages or disadvantages of trades' unions; no doubt working men have as much right to look after their own interests as the employers have to guard their own. But it is certain that unless these unions are conducted with prudence and wisdom, their powers may be exercised in such a way as to seriously injure the business of the country. Unreasonable demands made by a strong union may be successfully enforced for a time, but the concession cannot bring any lasting advantage to those employed.

You will remember that during the whole of the year 1893, trade all over the world was in a seriously depressed condition. In sympathy with the general depression the coal trade suffered. The demand gradually abated, and prices fell rapidly. Following on this, in most districts, wages were reduced, but in the Midland districts of England the Federation of Miners' unions was so strong, and it was made so plain by the Unions that any reduction of wages would be resisted that, to avoid a strike, the intimation of a change in wages was postponed as long as possible. An attempt was made to keep up the prices, but it might as well have been attempted to stem the tide, and contracts, when they fell out in the summer, had to be renewed at large reductions in price. It was found necessary to intimate a reduction of wages at the end of July. The miners resisted, and the disastrous strike which continued full sixteen weeks was begun, and lasted until Lord Rosebery intervened.

But what was the demand on the part of the men? Why was a reduction resisted in these districts when already enforced elsewhere? It was acknowledged that prices had been lowered. It was well known that the miners were earning a daily wage far in excess of that ruling in other districts, and, nevertheless, any reduction of wages was strenuously resisted. A new cry was raised, —the demand was for a minimum daily wage of about 7s. per day. It was contended that the miner is entitled to a good living wage, and that this should be made a first charge on the cost of production. This is a logical demand. It is, at first sight, even apparently a reasonable demand, but, if it is properly considered, it will be found to be economically unsound, and I am satisfied that it can be shown to be a claim which, if established, would have a most serious effect on the coal trade and other industries of the country, and, which, moreover, would not be for the benefit of the miners themselves.

With reduced exports of coal, reduced consumption owing to reduced exports of manufactured goods, and increased imports from other countries, it is to be feared that it would be found that a minimum daily wage would be a very different thing from a living wage. Miners would be better with full work at 4s. or 5s. per day in times of depression than with 7s. per day with work for only two or three days per week.

The other alternative, of course, would be that a large number of miners would lose employment, but such a state of matters the Miners' Federation refuses to contemplate. It is certain that, even without increased costs, we shall gradually lose many of our foreign markets, but the process may be a gradual one and may go along with the exhaustion of the coal fields in a natural way. If costs are suddenly raised the decline in shipments will be more rapid, and the hardship to miners through many being thrown out of employment will be very great.

It is not sufficiently realized that we are able to pay higher wages and give our working men in this country a better standard of living very largely on account of cheap fuel, and that, if fuel rises much in price, wages must come down to enable us to compete in foreign markets. It would be a curious anomaly if a high minimum wage were fixed in the coal trade, and that the direct result was a lowering of the earnings of all other classes of labour.

No coal master grudges good wages where they can be paid, and history shows plainly enough that there are times when very high wages are earned, if there are other times when the figure is below what all would desire to see. The average is above that earned by men of the same standing in other industries, and it is surely not much to ask those employed in the coal trade to take the good with the bad, to make the most of good times, and to help the country during periods of depression by taking lower wages to cheapen the cost of fuel, and so stimulate demand and prepare for better times. It is to be hoped that this claim for a minimum wage will be very seriously considered before being further pressed by all the men interested and that the leaders will not force on demands which will, in all probability, only end in disaster for the miners themselves, and in ruin for many colliery owners and manufacturers.

The leaders sometimes speak as if the easiest way to pay extra wages would be simply to reduce profits, but such statements are thoughtlessly made. It has been estimated that the coal trade of this country has returned on an average little more than 3 per cent. on the outlay, and it is not easy to see where advanced wages could be paid out of profits were the return even twice this amount.

I have spoken at too great length on this question, but the problem is a serious one, and I feel that every one interested in mining ought to have a clear apprehension of the commercial importance of the claims that are now being made.

It may be that some ultimate good will come out of the disputes. Trade differences may, after all, have their useful purposes to serve. As Shakespeare says—

> There's a divinity that shapes our ends,
> Rough-hew them how we will.

All these contentions may be the crude way that men have of putting wrong right. No doubt reasonable counsels will prevail, and ultimate harm to trade may not be done. It is to be hoped that our country will continue to prosper in the future as it has done in the past.

The prosperity during the past century has been beyond all anticipations. We are told that James Watt, the inventor of the steam engine, said, when he left Scotland, that he was glad to go, because the climate was bad and the trade of the country was done. He may have been right in the former statement, but I wonder what he would say about the latter if he could pay a visit now to our collieries, our steelworks, our engineering shops, and our ship-building yards.

But, though we may have confidence in the future, it is nevertheless our duty to consider, with the utmost care, what can be done to avoid disputes and enable work to be smoothly carried on, when we have to face such demands as those we have been considering, and when we have too much reason to fear trade disputes, even if the demand for a minimum wage is dropped entirely.

Various expedients have been suggested for settling disputes. Conciliation boards have been advocated are in existence in some districts, as notably for the Midland district, where such a board is on trial for a year. I believe that a conciliation board can never be very satisfactory except possibly if confined to dealing with the large question of general advances and reductions of wages. Such boards should never have the power of interfering between any individual manager or master and his men. It is impossible for any outsider, by a casual visit, to gauge accurately the working rate for any particular place or set of places in a colliery where circumstances vary so much. The adjustment of such rates must, in fairness, be left to arrangement between manager and men and to the natural competition between man and man.

There is, to my mind, more hope for sliding scales. No doubt, many of you will have read, with interest, a series of articles on this important subject, by Dr. Smart, which have been published in pamphlet form. Dr. Smart has taken a great deal of trouble in getting up all the statistics on the subject and he has put very fairly and clearly what is meant by a sliding scale. There are, of course, difficulties in connexion with the working of sliding scales, owing to the varying conditions under which coal is worked, but I believe that even if the sliding scale be not economically sound, yet as an expedient for adjusting general advances and reductions of wages, it is well worth trial. The difficulties can be overcome if the subject is approached in a fair-minded manner by masters and men.

It seems to me that the principal points to be observed for a fair sliding scale are: (1) it should be such as to give as nearly as possible the same wages as those that would rule without a scale, viz., there should be large percentages of advances and reductions of wages with the rise and fall of prices; (2) it should act quickly and frequently; and (3) it should be open for revisal at stated periods. The subject is too large a one for me to take up here at length, but I mention it now, as I look upon the sliding scale as one of the best expedients for preventing dislocations of trade such as have recently occurred.

I think we may take it for granted that, even if wise councils prevail and the miners' leaders learn to take a reasonable view of the wages question, we have come to a time when wages will be generally at a higher level than formerly, with rises and reductions taking place periodically, but with rises to higher levels, and with reductions not to such a low level as formerly. In view of this, and of increased competition, it is very necessary for mining engineers to relax no effort to introduce all possible improvements in working, that coal may be raised at the lowest possible cost. This is all the more necessary from the gradual increasing difficulties in mining.

There are many seams now being worked which would not have been touched twelve or fifteen years ago, either on account of their great depth from the surface, thinness or inferior quality, or the heavy quantity of water to be pumped. The increase in the depth of working seams over a series of years has been very noticeable. In a recent paper, Prof. Hull gives the average increase in depth for England, since the introduction of steam engines, as being at the rate of 13½ feet per annum.

I could give many examples of thin and inferior seams now being worked which were formerly neglected, but it is hardly necessary to do so as you are all aware of the fact. There are many collieries which were supposed to be exhausted twelve or fifteen years ago, which are producing a fair output still, mainly from seams such as I speak of, and there are districts which seemed to be approaching exhaustion many years ago, which have lately shown signs of new life.

IMPROVEMENTS IN MECHANICAL APPLIANCES.

Fortunately mining engineering has kept pace with the increasing difficulties to be met, and there are many improvements in the various departments which have assisted in keeping down costs. If wages are to be higher in the future, there will be more occasion even than in the past for the introduction of labour-saving machinery, and managers should be on the outlook for every possible plan of introducing it.

In my opinion there is a considerable cheapening of cost to be looked out for by the adoption of coal-cutting machines. There are, no doubt, many seams which are unsuitable for their use, but they might be adopted with success in very many cases. One of the things that has prevented their more general adoption in the past is the heavy first cost with the fear of failure, indeed with the history of failure in many cases. Another difficulty has been that compressed air, the power generally employed, while convenient in many ways, has the disadvantage that the efficiency is very low, and the trouble in laying pipes and in connexion with their upkeep is very great. I believe that, at no distant date, electricity will solve these difficulties. Wires are very much more easily laid than pipes, and an efficiency of fully 50 per cent. can be got, against 20 or 25 per cent. for compressed air.

There are many other advantages and comparatively few drawbacks. The advantage to be gained from coal-cutting by machinery is not only reduced cost at the face, but concentration of output, and therefore reduced on-cost charges. With machines, very much more coal can be put out from the same faces than with men, and, therefore, haulages can be conveniently arranged to work closer to the faces, and these haulages will be worked more economically because they will have a larger quantity of material to convey. This aspect of the haulage question is important. In many cases the cost of bringing coal from the face to the rope is a large proportion of the total cost of drawing. The system used at the Bent colliery, and described in the *Transactions*, appea s to be one of the best designed haulages in this respect. The rope can be brought very near a range of working-faces, and the hutches can be hung on more easily than with most haulages, at a number of different places. I think a similar arrangement might be adopted with advantage in longwall as well as in stoop-and-room workings, provided the coal field has a moderate and fairly uniform dip and rise. One great advantage of the system is that single roads only are needed, and this is a very important point for longwall workings where the roof is bad.

It is well adapted where it is desired to have a self-acting haulage from rise workings. There are some haulages on this principle at the Hallside colliery which appear to be very successful. It is a pity to see the forces of nature going to waste, and there are many cases where the force of gravity and power to be got from falling water might be employed for useful purposes.

One of the subjects i connexion with haulage which deserves very special attention is the conveyance of power from the surface to the workings by ropes, steam or electricity. We require papers for the Institute on this subject, giving actual results from experience—not mere general statements, which are of little value.

The arrangements for loading and unloading cages at pit bottoms and on the surface are of great importance, and perhaps often too little considered.

These are a very few examples of some of the points requiring careful attention, but every detail in connexion with the working of a colliery is of importance. To have pulleys, haulage-rollers, hutches, etc., all of the best construction, and kept in the best condition, is of great moment, and we would be surprised, I am sure, if we were to know the actual loss in money occasioned by the want of attention to what are often considered trifles. Take for example the question of balance ropes for cages in deep pits. Mr. C. M. Percy has shown the result, by calculation, of working with and without a balance rope. He takes a pit 1,200 feet in depth with an output of 1,000 tons in 8 hours. He makes out that in such a case the use of balance ropes would save three Lancashire boilers 25 feet long and 7 feet in diameter. These are striking figures, as an example of the importance of what appears to be a detail.

COLLIERY FUEL CONSUMPTION.

Perhaps one thing that is as much deserving of attention as anything about a colliery is one which has been least considered in the past, and that is the fuel consumption. As small coal becomes more valuable, this question is pressing itself more and more upon the attention of those interested in the working of collieries. The importance of it to the nation as well as to colliery owners is evident, when we consider that at least 9,000,000 tons of coal are used annually at collieries, and the quantity becomes greater in proportion as the shafts become deeper, as the water in many cases becomes heavier, and as there is a more extensive use of machinery for haulage and other purposes. New collieries show considerable advance in attention to fuel economy. Improved boilers are superseding those of the egg-ended type. Boiler pressures up to 100 lbs. per square inch are becoming common. Compound condensing engines are being extensively used for heavy pumping purposes. Expansion-valves are more often made use of. Feed-water heaters are almost universal. Stokers and improved fire-bars are frequently introduced, and steam-dryers and traps are common. It is a pity that we have not more statistics to guide us in the actual saving effected by the adoption of such improvements. It would be an exceedingly interesting thing, for instance, to take a colliery where little attention is paid to fuel consumption, to take indicator diagrams from all the engines, find their defects, and put them into good order, to adopt various improvements, such as heaters and steam traps, and then find the saving of fuel resulting.

When we consider all the various points that are of importance in connexion with the working of a colliery we must be struck by the amount of varied knowledge that colliery managers require to be possessed of. There has been in the past, perhaps, some tendency to elevate practice at the expense of theory. The latter ought—to a considerable extent—to regulate the former, and one great objection to rule-of-thumb management is that every colliery manager very largely learns for himself, and, to some extent at least, must acquire his knowledge at the expense of the colliery which he has under his care. As the poet Coleridge said, "Human experience, like the stern lights of a ship at sea, illumines only the path which we have passed over." But it ought to be our aim to let our experience benefit others as well as ourselves, and to prevent the loss of knowledge gained thereby. This can be done by endeavouring to reduce practice to theory, and by forming general principles which may guide others. Do not think, however, that I am speaking against the value of practical knowledge in any way. Theory may help practice, but it can never take its place.

As a writer has put it—"When we use another's light we must not take his candlestick, nor even his candle, except to kindle our own at it." The education which a man gives to himself is always more valuable than that which is given to him, and the best part of our knowledge is that which we work out for ourselves, but it is, nevertheless, true that the stored-up knowledge of others will often save us much unnecessary labour.

I have a strong feeling that mining engineering has not been developed like other sciences in such a way as to give a record of the results of investigations made. The books on the subject are, for the most part, far too general in their nature. In each new one published it is sought to cover the whole ground, and it therefore often is no real addition to the literature of the subject. The time has surely come when the science should be more specialized, when we should have separate books dealing with various forms of working, haulages, coal-cutting machinery, washing machines, and cleaning plant, etc., all giving careful descriptions, going into details, and taking up theoretical as well as practical questions.

In connexion with the importance of working from general principles I may call attention to the great need of accuracy, and the great advantage of taking careful notes for every colliery. All managers who work on this principle must feel what an immense advantage it is to have carefully recorded all the information about the workings of a colliery. Take for example the careful levelling of a coal-field. If it is troubled, and if there are, in consequence, mines to cut, much expense will often be saved by the knowledge of levels in different parts of the coal field, and where these are known in one seam, the workings in other seams can be laid out to greater advantage.

Where a seam is exhausted, and another has to be worked in the same coal field, it is often felt what an immense advantage it would be to have such details available, and most mining men are familiar with puzzling over old plans to make the most of the meagre information which they give.

So far as I have referred to colliery managers, colliery owners, and engineers, but it is not to these only that we should look for improvements in mining. Valuable inventions, especially in details, might be made by intelligent workmen if they were encouraged to devise improvements in co nexion with their work. It is the man who is constantly engaged with particular details who is most ready to see defects and most ready to suggest improvements, and not the coal master, engineer or manager, who have all to attend more particularly to the larger and more important matters in connexion with the management.

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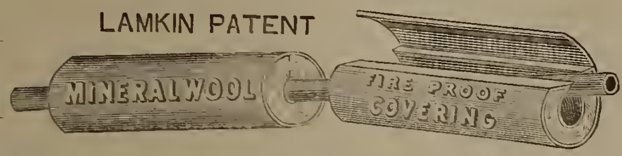

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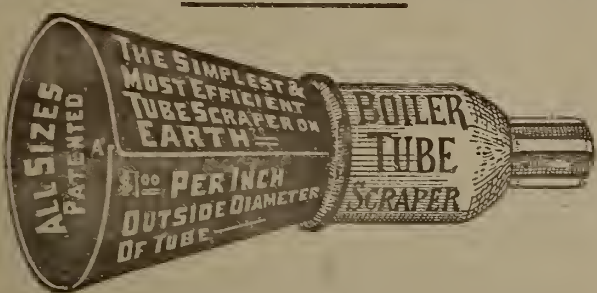

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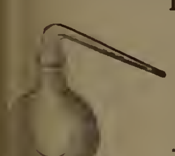

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Original discoverer of ore or mineral on claim entitled to stake out a second claim.

Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines.

TORONTO, May 25th, 1894.

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1 Ingersoll Steam Hoist.
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1 Hardwicke Steam Pump.
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1 Compressed Air Receiver, 12ft. x 1ft. 6in.
1 Pile Driver and Fittings complete, (monkey 1,600 lbs weight.
3 3in. Seargeant Drills and Tripods.
1 2½ inch Eclipse Drill and Tripod.
1 Tunnel Column for ditto.
1 No. 4 Sturtevant Blower.
1 No. 00 do do
1 Machine Lathe and Tools, complete.
1 12 h.p. Horizonal Engine, by Low, of Ottawa.
1 Steam Rotary Hoisting Engine, Drum, Brake and Wire Rope.
1 No. 5 Cameron Sinking Pump.
40 Side-dumping Mine Cars and Carriages, 12in. guage, constructed of hardwood and iron.

As well as sundry other machinery and plant.
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2600ft. Iron Track Rails, 25 lbs to the yard.
10¾ Karats of Carbons for diamond drill, unused.
2900ft. ⅝in. Wire Rope, new.
3700 lbs. Iron, (new) round, square, and flat, assorted sizes.
3 Electric Blasting Batteries.

Also a large quantity of wrought iron piping, 4in., 3in., 2in., 1½in., 1¼in., 1in., pipe fittings, steam hose—miners' tools, fire bricks, building bricks, blacksmith's coal, several end-dumping cars, car wheels and axles, rope sheaves, derrick masts, booms, etc., explosives, screens, machine steel, wire ropes, stoves, etc., etc.

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

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

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

MINES OTHER THAN GOLD AND SILVER.

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

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

Canadian Mining Review

Established 1882

Vol. XIII. –No 7 | 1894—OTTAWA, JULY—1894 | Vol. XIII.—No. 7.

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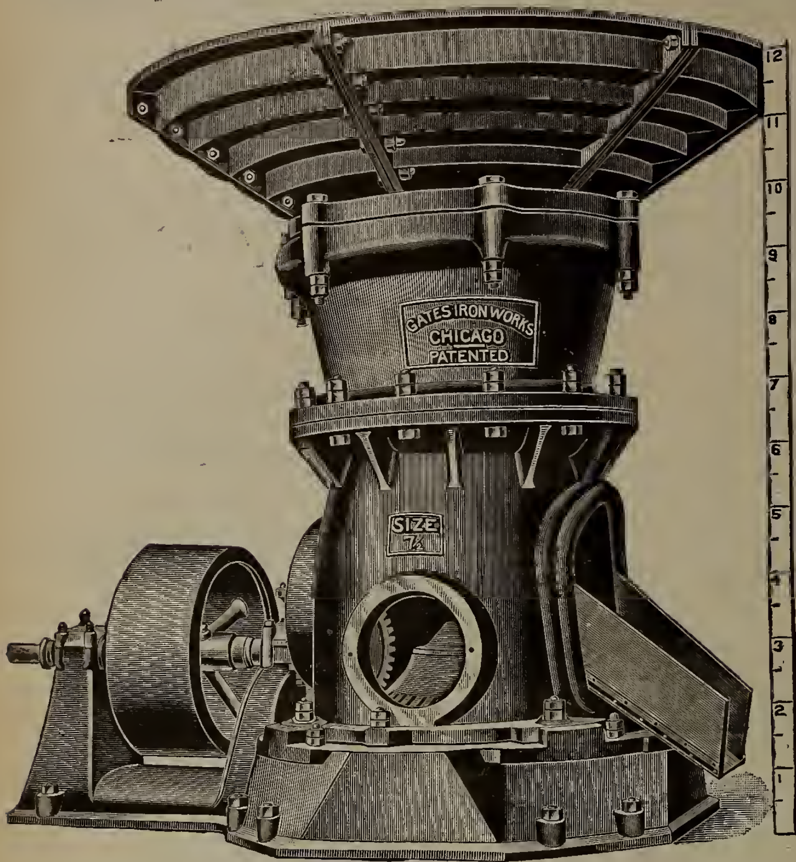

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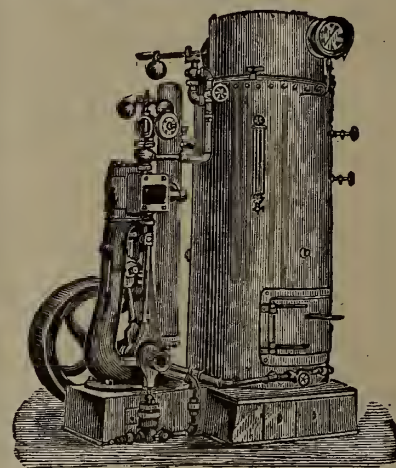

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CANADIAN MINING & MECHANICAL REVIEW

CONDUCTED BY - - - - - - B. T. A. BELL.

THE OFFICIAL ORGAN

—OF—

HE GOLD MINER'S ASSOCIATION OF NOVA SCOTIA,

THE UNITED MINING SOCIETY OF NOVA SCOTIA,

THE ASBESTOS CLUB, QUEBEC,

THE GENERL MINING SSOCIATION OF QUEBEC.

OFFICES:

Victoria Chambers, 140 Wellington Street,

OTTAWA.

Vol. XIII. JULY, 1894. No. 7

The School of Mining at Kingston.

This School begins its second session next October, with increased staff and equipment It has already done good service in giving to men interested in our mineral wealth opportunities for acquiring precise and practical knowledge of this subject. This it has done not only by its regular classes conducted throughout the session, but by special short courses at the School and at Marmora. This latter feature of the work of the Mining School commends itself to us as of great importance and value. The men who attended the class at Marmora speak in the highest terms of the character of the work conducted by Mr. Hamilton Merritt. We note that in the calendar for 1894-95, just published, provision is made for extension of these classes to other mining centres. No doubt practical men will be ready to take advantage of this opportunity. We note also that "the School is provided with chemical laboratories, an assay, a blowpipe, and a petrographical laboratory. There will be built during the summer a mining laboratory and experimental reduction works, which will be furnished with a stamp mill, concentrators, separators, amalgamators and other machines with which ores are treated at the mines. The machines will be of sufficient size to operate upon large quantities of ore; and those opening up mines are invited to send in large samples of ore (a ton is a good sample), to be put through a milling process in order to test the suitability of the process for their ores. In this way, costly mistakes may be avoided. The School is prepared to undertake a limited number of such tests and will charge only for running expenses."

These laboratories must give every opportunity for practical study in assaying and milling. Certificates are given by the School for a special course in Analytical Chemistry and Assaying. The course as laid down in the calendar is very complete and practical.

In our opinion the proper functions of a Mining School in Canada are (1) to provide education more particularly in those subjects which bear upon the discovery, winning and dressing of ores, rather than upon smelting and metal working; (2) to give opportunity for working out problems in Canadian mining, ore dressing, &c.; and (3) to lead the way in improving methods at present in vogue, and in suggesting new methods; to keep a step in advance of the requirements of the country; to be the pioneer in mining ideas.

The School at Kingston bids fair to discharge most, if not all, of these functions.

Mr. Hugh Fletcher, B.A.

On the eve of the visit of Canadian mining men to the Sydney coal field, the subject of our portrait this month is, appropriately, Mr. Hugh Fletcher, B.A., whose geological investigations in this field are so widely known and have been of so much value to the development of the coal mining industry of Cape Breton.

The official reports of the Geological Survey since 1874, speak for themselves of the zeal and industry of Mr. Fletcher in the work of unravelling the structure of Cape Breton, and recording its resources, and mapping the surface configuration as well as its geological features. Of Mr. Fletcher it may be said no other living man is possessed of his familiarity with crag and fell, with wave washed cliff and wood encumbered dell throughout the Island of Cape Breton. From Cape North to Cape Porcupine, from Cape Mabou to Scaterie, he knows it all.

Mr. Fletcher was born in London, England, of Scotch descent, in 1848, and emigrated to Canada in 1857, when his father leased the Bruce copper mines. He is a graduate of Toronto, with honors in languages and science. His vacations were spent with his father at the various operations with which he was engaged, and he thereby acquired a valuable insight into copper, silver and gold mining and the associate rock formations. A term spent in an engineer's office fitted him for the preparation of the neat and careful mapping for which his geological work has since been distinguished. In 1872 he joined the Geological Survey of Canada, under Mr. Robb, in Cape Breton. On Mr. Robb's resignation he succeeded him in the charge of that important work, and ever since has devoted himself to the survey of Eastern Nova Scotia. It was in 1875 that he made the important discovery of copper ores in the Coxheath felsites that has led to the operation of the Eastern Development Company. In the same year he found fossils of Lower Cambrian age at Long Island on the Bras d'Or and at Mira, the first to be noted in Nova Scotia. His systematic surveys naturally took him over the portions of country that had been given previous attention by Dr. Dawson and Dr. Honeyman, and with a wider range for generalization, his conclusions were not always quite in accord with what they had written. That the close observations of the Survey would lead to conclusions in some cases different from theirs was to be expected, the only surprise is that Sir W. Dawson with his comparatively limited opportunities should have been so generally correct over so wide a field.* Differences seemed to turn on names rather than facts in the correlation of some horizons, as in the age of the rocks below the primordial, and as to whether the slates and quartzites of Loch Lomond are Horton or Devonian.† That the latter are unconformable below the Carboniferous Limestone is certain.

On crossing the Strait of Canseau the differences of opinion became more marked, Fletcher declining to recognize Medina at Arisaig or to regard the rocks at Riversdale otherwise than as Devonian. This remark is merely by the way, our present purpose being to confine ourselves to Cape Breton only.

Having separated the Laurentian rocks of Cape Breton into an upper crystalline and gneissic series, and into a lower syenitic and feldspathic series, he traced, in 1876, the Cambrian rocks to East Bay, and found in them Lingula nodules.

Among the coal measures the Survey was anticipated by Brown, Lesley and Lyman. The former especially, did a great deal of valuable work and recognized the conformability of the millstone grit with the coal measures in Nova Scotia, a point of much importance. Mr. Fletcher, in going over the work that had been done in the carboniferous, was able to correlate the several portions of the coal field and show the relation of the coal beds throughout it. The voluminous reports and the maps which accompany them, speak for themselves; they are mines of facts for subsequent writers to work in and although they have not been the finger posts to wealth that some have hoped for, they should be as "danger boards" to those otherwise tempted to seek their fortunes in unkindly ground.

Of Mr. Fletcher's subsequent work on the main land we make no reference on this occasion, nor of his services as the representative of the Geological corps before the special committee of the House of Commons, their value is so well known.

*Acadia Geology, 1878, pp. 86-90.

†Acadian Geology, 1891, p. 20, line 3.

EN PASSANT.

In view of the Cape Breton meeting of Canadian mining societies, at which the REVIEW will be represented, the present number is issued earlier than usual. Our next impression will contain a very full report of the proceedings of this meeting and many portraits of the principal operators, engravings of the collieries and works to be visited, a new map of the Sydney coal field, drawn specially for the REVIEW, and other features which will insure our readers an unusually interesting and attractive number. Look out for it!

Mr. A. L. Russell, Dominion and Provincial Land Surveyor, Port Arthur, has, with characteristic enterprise, just published a very useful and handy map of the Rainy Lake and Seine River Gold District, Ont., which is attracting so much attention as a new gold field among capitalists. The map is printed on the scale of 2 miles to the inch, and is published at $1.

Mining prospects in East Kootenay, B.C., are, as a matter of course, dull on account of the low price in silver, but discoveries are being made that indicate the district will rival West Kootenay in mineral wealth. Besides the great North Star mine, near the St. Mary's river, very promising leads of argentiferous galena have been discovered on the Moyea, near Cranbrook, and from the assays and the immense bodies of ore in sight there is no question that these mines will be exceedingly valuable when silver is reinstated in currency. The reports of the gold quartz leads at Wild Horse, near Fort Steele, are very encouraging and are attracting considerable attention.

The immensity of the operations carried on at the Witwatersand mines can be gauged from the fact that 4,046 whites and 29,500 natives are regularly employed on the mines. The average wage paid to the natives amounts to 58s. 10½d. per month on the Rand, but at Barberton and Lydenbury the average pay is much lower, only amounting to 33s. 3d. and 32s. 6d. per month respectively. A return of the stores consumed on the Witwatersrand mines during the past year places the total value at £1,428,477. By far the largest item was coal $314,127, machinery coming next with $298,255, and timber (including deals) being responsible for £109,400, chemicals $70,027, mealies (for feeding natives), £73,010.

A huge 8,000 ton forging press is now in use at the River Don works of Messrs. Vickers, Sons & Company, Sheffield, England. The shareholders, at the close of a recent meeting, were invited to inspect the working of this machine, and, it is stated, an ingot weighing 66 tons was taken from the furnace and conveyed to the press, under which it was swiftly and silently squeezed to the required proportions. When finished it will be 18in. thick and is ultimately, we understand, to form one of the plates of the Russian warship Three Saints.

The Schlesische Nickelwerke is now preparing to erect works for the extraction of nickel from the ores. It is expected that the construction and arrangement of the plant will take about 18 months. This company owns several mines near Frankenstein, and in 1891 began working the Benno and Martha shafts, from which 1,160 metric tons of nickel ore had been taken up to the end of 1893, carrying from 1·5 per cent. to 4 per cent. of nickel. The Benno shaft is now 170·5 feet deep, and so far the nickel contents of the ore have increased gradually with depth. The work of exploration is to be continued on an extended scale.

Diamonds are still down despite all the efforts of that powerful combination, the De Beers Consolidated Company, to manipulate the market to their own advantage, and the explanation of the depression is said to be a decreased demand for the precious stones in America. The Americans are credited with absorbing, in normal times, one-third of the total output of diamonds, but the effect of commercial depression has been felt in the States as elsewhere, and has restricted the demand for such luxuries. It was expected that the unfavorable state of the market for diamonds would seriously affect the De Beers returns, but Mr. Cecil Rhodes, at the last annual meeting of the company, at Capetown, on July 17, was able to tell shareholders that the usual dividend would be paid. The company had, he said, reduced their obligations by £700,000, and had increased the value of the reserves of blue earth on the floors to £4,000,000, besides maintaining a reserve of £700,000 in Consols. The company spend £100,000 per month in South Africa, and are now using local coal.

A new form of prospector's stamp battery specially designed for use in rough country is described in the last issue of the Australian *Mining Standard.* The patentees are Melbourne mining engineers. The improved stamp mill weighs complete 230 lbs., the heaviest piece being 40 lbs.; the whole when in working order being only 3 feet 10 inches high by 16 inches wide and 12 inches deep. It can be readily taken to pieces and carried by men or pack-horse. The machine is of the best mechanical design, very simple, and specially constructed to stand rough usage, the principal parts being of wrought iron, such as the bedplate, standard, mortar box, etc., the cams and tappets of steel. The stamp crushes with ease the very hardest quartz gangue obtainable in Victoria, and reduces it to go through a screen of 144 to 196 holes to the square inch, the matter being discharged continuously as it is crushed through the screen, and is discharged or delivered all round the circumference of the stamper box. The small, or No 1 mill, as now made, is a *one man machine*, but the principle can be applied to the largest type of stamp battery, and it is claimed by the inventors to solve the difficulty of crushing ore dry by stampers, whilst getting a rapid and continuous delivery of the material as it is crushed. It is acknowledged by all practical men that no machine has yet been introduced to transplant the stamp battery, which has been in existence since the 12th century in Germany, and the machine under notice aims at providing prospectors with a long felt want, viz., a crusher capable of reducing large samples of reef outcrops to a fine powder, either crushed dry, with water, as may be desired. A trial took place recently, and some of the hardest quartz obtainable in Ballarat was put through the machine, which needs only one man to work it, and which delivered the stuff in the form of a fine powder continuously. The powder can then be treated either by washing in a dish in the ordinary way or by Clark's patent dry process gold concentrating machine. The stamper should prove handy for prospectors desiring to test large samples of reef outcrops.

In the course of an address delivered at Nottingham College, Feb. 24th, Mr. C. M. Percy made the following observations on fan construction: Simplicity should never be lost sight of, and strength should always constitute a first consideration. These two virtues ensure what is so desirable in colliery appliances—continuity of work, and non-liability to get out of order. I have always had an objection, which has increased as time went on, to "mammoth" slow-running fans. They are cumbersome in themselves. They absorb power by the movement of themselves. They are costly to make. They occupy much space, and necessitate extensive and expensive foundations and houses. I believe that the entry of the air to the fan should be easy, which means large inlets having a clear course, not baffled by projecting arms or cones, or even blades "veed" towards the centre. The inlet should be on each side of the fan, with a central diaphragm to prevent the two currents conflicting. The passage of the air through the fan should be easy, which means that there should be sufficient and not excessive fan capacity. In open running fans the blades should be so formed that the air may pass through as nearly in a straight line as possible, and leave the circumference with as little circumferential velocity as may be, because all velocity of discharge in open running fans represents a loss of energy. This means that in open running fans the blades should have considerable backward curvature, and the number of blades should not be too great, producing by their surface excessive friction and drag upon the air. I have come to the conclusion that the inlets and the outlets, and the circumference of the inlets, multiplied by the width, and the total blade surface, should represent equal quantities, and that the circumference of the fan at any point, measured by its width at that point, should be an equal quantity. In a closed running fan the circumstances are somewhat different, because the energy of discharging air can be utilized after leaving the fan, in diminishing the pressure outside the fan, and thus expediting the delivery from the fan. The curvature backward of the blades need not, in consequence, be so great as for an open running fan. The air should be free to leave the fan at any point of the circumference, and the spiral casing all around should be continued into the chimney. But the quantity in proportion of the inlets to the fan, the passage into the body of the fan, the passage through the fan, and the discharge from the fan, should be equal, as in the open running. I believe that the sides of the revolving parts should be enclosed, preventing leakage, and only allowing discharge at the circumference. The journals and bearings of the fan should be so perfectly constructed that

Mr. Hugh Fletcher, B.A.

Geological Survey of Canada.

they fit exactly, and can revolve without heating, at practically any speed. The engine which drives the fan should be designed on lines by which the highest economy in the use of steam can be obtained. The engine should work with a high pressure of steam, because it is only with high pressure steam that we can get the maximum economy. The engine should be compound, to admit of the highest range of expansion, and discharge the exhaust into the condenser at the lowest possible pressure. Excessive speed in the engine is undesirable, and to enable a moderate speed of the engine and a high speed of the fan, the power should be transmitted by rope gearing. An approximately perfect ventilating arrangement would be two fans, each with its own engine, but, in any case, there should be duplicate engines. On such lines as I have sketched, I believe we have at our command the highest type of ventilating fan. For further improvements in the production of great volumes of air, with a comparatively small expenditure of coal and power, we shall have to look, not so much to improvements upon our present fans, as improvements in the arrangements of the mine itself.

The value of the mining machinery imported free of duty into Canada since the special provisions were enacted in the Custom's Tariff has been :

1890 (to 30th June)	$ 9,950
1891	78,432
1892	61,848
1893	87,208

The American liner "Paris" has had constructed for her a spare length of shafting of nickel steel. This is believed to be about the first application of this alloy in a merchant steamer, notwithstanding that it is five years since Mr. Riley, of the Steel Company of Scotland, first demonstrated in this country its greater elasticity and tensile strength. The "Paris's" new shaft has tensile strength of about 90,000 lbs., probably 25,000 lbs. more than any British or German steel shaft. It has been established by tests that nickel steel has a higher elasticity than ordinary steel to the extent of 31 per cent., and that the tensile strength is 20 per cent. greater. Moreover, ductility is not adversely affected. Although, therefore, the size and weight of the "Paris's" shaft might have been reduced with maintenance of strength, it has been kept the same as those first fitted at Clydebank.

In a recent discussion of a paper on the result of an experimental research into choke-damp poisoning, before the Mining Institute of Scotland, the writer, Dr. Thomson, as the result of special investigation arrived at the following conclusions : 1. That in some explosions men could have been rescued had an apparatus been at hand to enable some of the rescue party to penetrate the after-damp, and that in some cases the distance to be traversed was short. 2. That the Fleuss apparatus was too much after the fashion of a diving dress, closing up the ears and covering the whole face, to commend itself to the practical miner. It was also somewhat costly. 3. That there was a want of a simple apparatus for use by those of the rescue party to enable them to penetrate the after-damp, and perhaps of a means of supplying air to the victims whilst removing them. 4. That it would be a great advantage for the mason putting in a stopping in the face of a fire, to have a simple apparatus which would enable him to work and breathe in a bad atmosphere without considerable restraint of his movements and without interfering with his speech and hearing. He had accordingly designed an apparatus on the principle that carbonic acid gas in fairly large amount may surround the head and face provided a stream of respirable gas be kept upon the mouth and nose. His apparatus, which was exhibited, is intended to serve two purposes. 1. Where pure air was obtainable at no great distance, such as was the case in building off a fire. 2. Where pure air was not obtainable, as when penetrating after-damp. Speaking generally, the apparatus consisted of an arrangement by which, in whatever position the workman places his head, there is constantly coming to his mouth and nose from a face-piece (the distance of which can be regulated), a supply of fresh air in a diverging stream, the intention being not necessarily to supply the whole 30 cubic inches of air which is taken in at each inspiration, but to dilute to a greater or less extent the heavy atmosphere existing about the head, and to add also to the percentage of oxygen present. The conclusions he had come to were as follows: 1. His apparatus would, he believed, be useful and effectual for breathing in a poisonous atmosphere in those cases of building off where good air is accessible at no great distance. In such cases the air would be supplied by a hand pump or bellows. 2. When the distance to be traversed was not very great through a region of after-damp, or when, carbonic oxide being absent, the percentage of carbonic acid gas was not great, the apparatus might be used in connection with a cylinder of air strapped to the back, which would last the longer, the smaller the amount of carbonic acid gas present. Oxygen should be compared with air too see if it has any advantages, for the reason above adduced, namely, that a smaller bulk of it than of air will bring the percentage of oxygen up to the normal. A working model of the apparatus, with bellows, could be made for about £2 10s., or perhaps even less. A 20 cubic feet cylinder with regulator costs about £3 5s. 0d., but for experimental purposes these might be hired. It was only by trial that the question could be settled, and the best way to try it would be to use it when putting in a stopping. He thought the question of resuscitation of victims must wait till it had been determined whether they could get to them.

Mr. John S. Kennedy, of Chambersburg, Pa., has invented and patented an apparatus for breaking pig iron, which may be briefly described as follows: The method consists in lifting the beds of iron, when cold, by means of an overhead crane and traversing same to a breaking table, which may be located at the end of the cast house for a single blast furnace or centrally located for a plant of two or more. The beds of pig iron are lowered on a breaking table, where, by a series of vertical hammers, striking a cushioned blow, the sow is broken from the pigs, broken to length and the pigs are broken at their centres. In case of strong iron, the sows are first broken and then the pigs, but when the iron is weak the sow and pig hammers strike the bed simultaneously breaking it at one operation. No movement of the bed is necessary after it is placed on the breaking table. The sow is cast thin and wide, giving an easily broken section as well as a minimum of sow-iron, and the necks of the pigs at the junction with the sow are cut down to a small section, which allows their being readily detached. It is claimed that this method of carrying out and breaking iron, will be found much cheaper and quicker than the present practice. It will reduce the labor cost per ton of iron, lighten the work of the furnacemen, effect a saving in scrap and "sandage," as well as giving a cleaner fracture to the iron.

According to the report of Mr. A. H. Stokes, inspector of mines for the Midland district, Great Britain, there appears to be a growing demand for a safe, effective, and economical explosive, but at the present we are far from having reached the maximum of either safety, efficiency, or economy, or restricted their use to the minimum required for the working of the mine. Great strides have been made within the last few years in the attempts to produce a safe explosive, but at the present moment he is not aware that we have an absolutely flameless explosive, or one by which infallible security may be attained during blasting in a mine. The chief element of danger in connection with blasting operations is the production of a flame of high temperature, which may ignite inflammable gases in the vicinity of a shot, or by the concussion of the shot in dusty places raise sufficient dust to convert an atmosphere only slightly charged with gas into an inflammable mixture. Recent experience leads him to think that gunpowder should be prohibited from use in all fiery and dusty mines, and although we have high explosives which, with care and under stringent regulations might be used, yet all such shots should be fired by an official of the mine who has been taught the nature and power of such explosives, for miners are liable to use a high explosive for a given amount of work in the same proportion as they would use gunpowder, and with the frequent result that explosives are wasted and the element of danger from a blown-out shot, or exposure of flame of intense heat, which would result from an overcharge shot is intensified. Miners accustomed to gunpowder all their lives scarcely understand the power of a high explosive, and do not consider the importance of using the minimum quantity of such explosive substance to perform the work required, neither do many men appreciate the importance that stemming or ramming should consist of a damp non-inflammable material, and that the first part of the tamping should be introduced in small proportions, to prevent the compression of air at the bottom of the shot-hole. In mines worked with safety lamps, Mr. Stokes considers that all shots should be fired by electricity and low tension fuses, for the employment of ordinary gunpowder fuse is liable to emit sparks at the moment of ignition, which will ignite gas, and the incongruity of prohibiting a man from using a naked flame to light the end of a fuse, which, when lighted by a red hot wire, is equal to a naked flame, cannot be justified, especially when we have at command electric exploding appliances which are both safe and efficient, and present many advantages as regards safety over any kind of fuse which emits sparks that will ignite gas, or which cannot be ignited except by the application of flame to its extremity The simplicity and certainty of firing by the low tension system of electrical blasting commends itself to all who have adopted its use. The electric fuse can be safely tested by a galvanometer before being taken into the mine, and little fear need be entertained that the operatives will be troubled with mis-shots, and the weight of the firing apparatus need not prevent its general use.

The Canada Coal and Railway Co., Joggins Mines, N.S., are putting in a 300 horse power Lancashire boiler fitted with Galloway conical tubes. It was built by the Robb Engineering Co. who have another of the same size under construction for them.

THE ASBESTOS CLUB.

Proceedings of the Annual General Meeting—Election of Officers, Etc.

The Annual General Meeting of "The Asbestos Club,"—adjourned from 27th April—was held in the Club Rooms, at Black Lake, Quebec, on the evening of 25th day of May.

A larger number than usual of the officers and members of the Club were present, thus manifesting an increasing interest in its welfare and success.

The usual routine business having been accomplished, the election of officers for the ensuing year was proceeded with. The ballot papers, which had been received by the Secretary during the previous month from members at a distance, were opened and read.

The following officers were then elected by acclamation :—

President :

Mr. John J. Penhale, Black Lake.

Vice-Presidents :

H. J. Williams, Thetford, and R. T. Hopper, Montreal.

Secretary-Treasurer.

R. Stather, Black Lake; B. J. Bennett, Assistant.

Council :

Capt. Mathew Penhale, Black Lake,
Wm. King, Quebec, D. A. Brown, Boston,
Capt. Prideau, Black Lake, T. H. Crabtree, Black Lake,
Dr. J. A. Marcotte, Black Lake.

FINANCIAL STATEMENT.

May 1st, 1893—	
Bal. E. T. Bank	$ 59 80
Subscriptions, 1893-4, 28 Members	140 00
Note at Interest	92 17
May 25th, 1894	$291 97

Sept., 1893—		
Insurance		$ 9 15
Rent Club Room to 1st May, 1894		40 00
Postage Account		9 25
Express "		2 62
		$ 61 02
Bal. in Bank	$174 80	
" due on Note	52 17	
Cash on hand	3 98	
		$230 95
		$291 97

The Report was adopted. On resolution of Mr. Klein it was decided : "That in view of the flourishing financial condition of the Club—having a surplus fund of $230—the annual dues for 1894-5 be remitted, or abandoned, but that all members who are in arrears to the Club to 1st May, 1894, shall pay up the said arrears previous to 1st August, 1894, or be no longer considered members, thereby forfeiting all claims to any and all privileges of said Club."

The meeting then adjourned. The regular monthly meeting of the Club will be held in the Club Room on the evening of Thursday 28th, when business of importance is up for consideration.

The Profits of Coal Mining.

In a recent issue of the *Nineteenth Century*, Mr. G. P. Bidder, Q.C., has the following article on the Profits of Coal Pits :

Nothing became more apparent in the course of the late coal strike and of the conferences between coalowners and men, and discussions in the Press and elsewhere arising out of it, than the extreme ignorance on the part of the public, and even of the representatives of the miners themselves, of the elementary conditions of the coal trade and of the principles upon which the question at issue depended. The public may well be excused for not having mastered the details of a subject of no little complexity; but it might have been expected that those who undertook to be the guides of some 200,000 men in a matter of such importance to their well-being would have shown a better acquaintance with the subject. Yet it was abundantly evident that they had for the most part regarded the question only from the point of view of the men, and their very natural desire to maintain, if possible, the rate of wages at the level of recent years, and that their ideas of the financial condition of the coal industry and the factors on which the capacity to pay wages depends, were of the most limited and erroneous description.

In view of the possible recurrence of disputes such as that of last year, it does seem very desirable that the governing elements of the problem should be better understood. It may therefore not be amiss, now that the struggle is over and there is a truce between employers and employed, to illustrate the financial economy of the coal trade in such a way as to show what are the conditions on which the profitable working and wage paying power of a colliery depend. Before proceeding, however, it is to be observed that there is, of course, considerable variation in different colliery districts and in different collieries in the same district, both as regards the cost of production, the selling price, the demand, and the markets available. Thinness of seams, greater depth, heavier pumping charges, bad roof, or other causes may raise the cost of working. The distance from the best markets will vary, so also will the nature and extent of the fluctuations in the demand for the coal, which depend on its character and the purposes for which it is in request. Clearly, therefore, no figures can be presented that will exactly represent the position in every or any district; but the general conditions are practically the same, and a statement based on any fairly normal collieries will reliably illustrate the principles applicable to all. In the following remarks I have drawn mainly on experience derived from collieries in the district with which I am best acquainted.

The capital employed in a colliery, including the original and subsequent development, sidings, plant of all kinds and working capital, though, of course, subject to variation, may be taken at about 10s. for every ton of annual output, so that a colliery which produces for sale 500,000 tons in a year presents a total capital of some £250,000. What, taking one year with another, is a fair and reasonable return to look for from this capital? The business is one of a very fluctuating character. There are occasionally periods of inflation, when the profits are excessive; they are invariably followed by periods of depression, usually of much longer duration, in which little or no profit is realisable. Moreover, in any individual colliery profits are liable to disappear entirely, apart from rise and fall of markets, in consequence of accidents, failure of the seams, faulty ground, or other contingencies impossible to be foreseen. I know a case of a colliery which, after having returned substantial profits, made a loss every year for fifteen years in succession. It is also to be noticed that some time must always necessarily elapse before a colliery can be developed sufficiently to earn profits, and during this period the capital is necessarily unproductive. Now, there are many opportunities for investing money far less risky and fluctuating than the coal trade, by which a return of 5 per cent. per annum or upwards can be obtained. It seems, therefore, not unreasonable to expect a return somewhat higher than 5 per cent. on colliery capital. Further it must be remembered that the life of a colliery is limited by the extent of workable coal that can profitably be won from it, and therefore, in addition to interest an annual sum must be provided for the redemption of the capital sunk. Taking all these circumstances into consideration, an annual return of 10 per cent. on the capital, to include both interest and depreciation or redemption of capital, is surely a very reasonable remuneration. To put the same things in other words, no man would embark his money in colliery property unless he had a fair prospect of obtaining at least this return for it. Taking, then, such a colliery as we have supposed, with a capital of £250,000 and an output of 500,000 tons in the year, there must be an annual profit of at least £25,000, or 1s. per ton of output.

Next, as regards working cost. This, of course, varies considerably; but, assuming the colliery to be working full time—that is, six days a week—and wages to be at their present rate, it will probably be between 5s. 6d. and 6s. 6d., let us say 6s. per ton. It is important to note how the cost is made up, especially as wild statements have been made on the subject, one assertion being that only 1s. 6d. per ton is paid in wages to the men. The following is very closely the distribution of the cost throughout the year, based on actual experience :—

Wages	69·26
Materials	15·26
Royalties on coal raised	7·70
Surface rents	1·52
Rates and taxes	3·15
Salaries, general expenses, etc	3·11
	100·00

It will be seen that nearly 70 per cent. of the whole cost is paid in wages. It is interesting also to notice, with reference to the cry for the abolition of royalties in the interest of labour, that the sum paid for royalties is only one-ninth part of the amount of the wages bill. Further, in order to properly understand the economy of a colliery, there is another matter of the utmost importance to be considered, and that is the proportion of the working cost that consists of fixed charges. This is one of the most powerful factors affecting the profitable working of a colliery. Without a due appreciation of it, it is impossible to understand the relations of price and tonnage, on which the profit and wage-paying capacity of a colliery depends. Fixed charges—that is, expenses which are constant and independent of the amount of business done, and which must be incurred week by week whether the concern is working full time or standing altogether idle—are incidental to every business. Rent, rates and taxes, salaries, repairs, etc., must be paid whether business is brisk or slack. There is, however, this difference between a colliery and a manufactory : If a mill or workshop be idle for a considerable time, a good many establishment charges can be temporarily put down. The owner can stop his machinery, discharge many hands, put the key in his pocket, and wait for better times. But in a colliery there can be no stopping. The pit must be kept clear of water, the roads and roof require constant attention and expenditure, the horses must be fed and attended to, and, consequently, the pumping and winding engines must be kept constantly in steam. All these items, together with the other general expenses I have mentioned, involve a heavy expenditure, and it follows that the fixed charges of a colliery represent a considerable item in the working cost.

In such a colliery as I have taken for illustration they will probably amount to about £700 a week, and this sum must be spent, although not a ton of coal is raised. Suppose now our colliery to be in full work, it will produce about 13,000 tons of saleable coal in the week. The £700 divided over this tonnage is equal to 1s. 1d. per ton nearly. Therefore, as we have taken the whole cost per ton at 6s., the portion of the cost, exclusive of fixed charges, is 4s. 11d. per ton. In other words, the total weekly cost of the colliery is £700 plus 4s. 11d. for each ton raised. If, now, trade falls so that the colliery is only able to work three days in the week, the tonnage produced being only one-half of what it was, the fixed charges rise to 2s. 2d. per ton, and the entire cost of production per ton becomes 2s. 2d. plus 4s. 11d., or 7s. 1d. per ton. When the colliery was working full time at a cost of 6s. per ton, a selling price of 7s. was sufficient to yield the 1s. profit required. It will be seen that the result of working half time is not only to have the tonnage, but, assuming the price to remain the same, to sweep away the entire profit and convert it into a loss.

The consideration of these facts will throw much light on several fallacies which have been put forward by representatives of the miners and others. One is, that owners might profitably restrict their output in order to maintain the selling price. The figures given show that if the coalowner reduces his working days from six to three, his profit is reduced to 1s. 1d. per ton; and as he sells only half as much coal, he requires 2s. per ton profit instead of 1s. to yield the same weekly profit. So, unless he is able to raise the price 1s. 1d. plus 1s. (or 2s. 1d. per ton), he is a loser by the transaction. But this is utterly hopeless to expect—in fact, unless the conditions of general trade are materially altered, any artificial rise in price operates adversely to the coalowner, both by restricting demand and inviting competition of coal from other districts, or even from abroad. The men have also asserted that coalowners act against their own and the men's interests by reducing the price of coal, in order to get orders and so make a reduction of wages necessary.

This is the same fallacy in another form. The cost per ton when working six days a week being 6s., and when working three days being 7s. 1d., it is obvious that it pays the owner better to work six days at a selling price of 6s. 6d. than to work three days at a selling price of 7s. In the one case he gets a profit of 6d. on 13,000 tons, or £325 in the week, in the other a loss of 1d. on 6,500 tons, or £27 in the week. In fact, in order to get the same weekly profit in the latter case he requires a profit per ton of 1s. on the lesser tonnage, and in order to realize this, must have a reduction of 1s. 1d. per ton in wages, which is equal to 26 per cent. of the present rate of wages. It must not, moreover, be forgotten that the reduced price, by stimulating consumption in iron making and other coal consuming industries, tends to improve the demand, whilst prices unduly raised have, of course, an opposite tendency. The all important principle to be recognised, and which cannot be too strongly emphasised, is that so long as a colliery is not working at or near full time, tonnage and not price is and must be the primary factor in determining the profit, and therefore the amount of wages the coal owners can afford to pay.

It is impossible to leave the subject without a few words on the present cry for "a living wage." Every one, and employers especially, must wish that working men should be able to earn wages that will enable them to live in comfort as well as make provision for old age or illness in the future. But to put up the cost of production for this purpose to a point which the state of trade will not bear, and which either kills the demand by enhanced prices or renders it impossible to work except at a loss, must be a suicidal policy. In order, however, to rightly appreciate the unreasonableness of the demands made, it is necessary to examine them in detail. The daily wage of a collier may be taken as varying from 6s. to 10s., according to his skill and the conditions of the stall in which he works. No one suggests, not even the miners themselves, so far as I am aware, that this wage is inadequate, but their contention is that, owing to slackness of trade, a miner often only gets three days' work or even as little as two and a-half days a week, and they argue that 15s. or 18s. is not a sufficient weekly wage, and therefore the standard daily wage should be increased, so as to make the wage adequate. Can anything be more unreasonable or impracticable? If the miners, and therefore the pit, is only working three days in the week —and this is the very time when trade is slack, prices low, and, as I have shown, owing to small output, the colliery owner's burdens are heaviest, and when he most probably is losing money—that, according to the reasoning of the men, is the time when wages should be raised so as to enable them to earn in three days the wages they formerly earned in five or six. In other words, the weekly earnings of the miner are to be practically guaranteed whether there is or is not sufficient trade to keep him employed, and consequently in case of extreme depression the wages may rise to a point at which it is impossible to work the pit at all. In what other trade is such a demand made? Has not the bricklayer, the carpenter, or the dock labourer, and every other artisan to take his chance of employment, and when his employer suffers through slackness of trade, to suffer with him? So long as the claim of the workmen is directed to attaining a fair wage for a fair day's work it is legitimate, but when it takes the form of requiring a fair week's wage when only a fraction of a week is worked it becomes impossible and absurd. Are there, then, no ways in which it is possible to adjust the relations of coal owners and miners in the varying condition of trade without resort either to the barbarity of strikes or the tedious and invariably unwieldy process of arbitration.

One plan, that of the sliding-scale, in which the day's wage rises and falls with the price of coal, has been tried with, at times, considerable success; but, although undoubtedly a step in the right direction, it is open to the objection that, as has been shown above, price alone does not always correctly represent the wage-paying capacity of the coal owner. There is another plan which has been more than once suggested, and which, if the miners could be persuaded to have confidence in it, would, I believe, work far more justly and satisfactorily. I allude to profit-sharing. On this plan the coal owners would be entitled to a minimum interest on their capital and the miners to a minimum daily wage, *i.e.*, such a daily wage as could be paid under the most depressed condition of trade; the whole of the profits remaining after these payments being divided equally each year between owners and men, and the men's share being divided among themselves in proportion to their individual earnings during the year. The men would of course be entitled to appoint auditors or accountants of their own to examine the accounts, but it is essential to the successful management of the colliery that it should be left entirely and exclusively in the hands of the masters. Such a system, if cordially accepted by men and masters, would, I believe, soon be recognised as enormously to the advantage of both. There would be established and felt a unity of interest that would practically abolish the trade disputes and strikes that at present interfere so much with the prosperity of trade. But who shall persuade the men to lay aside their attitude of suspicion and their inveterate distrust of results obtained from the books of their employers? Could this be accomplished, and could they be induced to see that with proper safe-guards and checks they would be safe in so throwing in their lot with the owners, and in trusting to their self-interest for an intelligent management of the business in which both are interested, the results that would be realised in general prosperity, contentment, and absence of friction are not easily to be estimated.

Nickel—Its History, Uses and Distribution.*

By Mr. A. G. Charleton.

(Concluded from page 110.)

To explain the genesis of this class of ore deposits one must glance for a moment at the sources from whence nickel is derived. Native nickel is found alloyed with iron in meteorites, and also in some ultra basic lavas, while the spectroscope reveals its presence in the solar atmosphere. It is showered on the surface of our planet in the form of meteorites, those fiery messengers telling of the wreck of other worlds, and testifying to the common origin of the material universe, in the form of (1) holosiderites composed entirely of nickel iron; (2) syssiderites the nickel iron of which contains silicates of magnesia and iron protoxide, identical with olivine, and at other times a mineral resembling augite; (3) sporadosiderites, the most common kind, usually crystalline in structure, and containing nickel iron, trollite, chrome iron, olivine, titanic and phosphoric acids; (4) asiderites, distinguished by the presence of hydrocarbons in which nickel is present as an oxide. Some of them have been shown to contain pyroxine and felspar (chiefly anorthite) and the absence of quartz and highly silicated felspars is to be noted. These four classes of meteorites show a gradation from almost pure metal containing over 98 per cent. of nickel iron to a stony mass closely resembling some basic lavas. Now, according to the latest determinations of M. Alphonse Berget,† the density of the earth is 5·41, whilst, so far as our limited observation extends, that of the crust is about 2·5. Various theories have been advanced to account for this, and some very first-rate authorities have suggested that the heavier metallic elements might possibly be found to predominate in the nucleus, basing their views on widely extended observation of past and present volcanic phenomena.

It has been found that once the acid stage is past lavas become more basic, and while each succeeding flow from any one vent might not be more basic than the preceding one, yet the tendency is in that direction, till, finally, ultra-basic lavas are excluded from the centres of intense and long-continued activity. This average order invariably, I believe, holds good everywhere over the earth's surface, provided the volcanic force is long enough active. The ultra-basic rocks have in composition many points of resemblance to some of the above-mentioned meteorites. Thus dunite is a crystalline granular aggregate of olivine and chrome iron, which passes by alteration into serpentine; we have also picrite, half of which is olivine, associated with hornblende, diallage, and magnetite. Lherzolite is another of these peridote rocks, consisting of olivine and enstatite, with other accessory minerals. Olivine is the dominant constituent of such rocks, and as a class they possess the highest specific gravity and least oxygen of any known.

Some of the basalts, notably those of Antrim in Ireland, contain metallic iron in microscopical particles, and Professor Nordenskiold discovered, in 1870, on the shores of Disco, on the coast of Greenland at Ovifak, fifteen blocks of nickel iron within an area of half an acre, the two largest being 20 and 8 tons weight respectively; while further observations in the same locality showed that a basalt dyke, at no great distance from the supposed meteorites, contained lenticular disc-shaped blocks of precisely similar iron, and crystals of labradorite and arigite associated with viridite, round which minute particles of iron were moulded. These facts led Professors Judd, Daubrée, and others to decide that the blocks of iron Nordenskiold discovered and took to be meteorites were of terrestrial origin, as the basalt was certainly not derived from the clouds. The Ovifak iron contains 0·5 to 6·5 of nickel, and a nickel-iron awaruite, lately discovered in New Zealand, presumed also to be of terrestrial origin, is said to contain 68 per cent. Ni, 31 per cent. Fe, and 0·7 per cent. cobalt.

In the Urals platinum is found alloyed with nickel iron in association with olivine. Taking the mean density of awaruite as approximately 7·1, and that of rhyolite as 2·6, the terrestrial basic and ultra-basic rocks, which include basalt, gabbro, Lherzolite, trachite, and dolerite, are found to closely correspond in density with the extra-terrestrial meteorites. Those of solid nickel iron have a specific gravity of 7·1, and graduate down to stony asiderites, which possess a density of 2·7.

Meteorites.

	Sp. Gr.
Nickel iron solid	7·1
" considerable	6·8
" medium proportion	3·5
" small quantity	3·1
Stony	2·7

Terrestrial Metals and Rocks.

	Sp. Gr.
Awaruite, (approx)	7·1
Nickel iron in Ovifak basalt, (approx)	6·8
Basalt, gabbro, Lherzolite	3·0 to 3·5
Trachyte and dolerite	2·7 to 2·9
Rhyolite petro-silex	2·6

The conclusion to be drawn appears to be that the genesis of nickel deposits may, in most instances, be traced to the ultra-basic rocks and their derivatives, serpentines and magnesian silicates. The great nickel deposits of the world are found in rocks in which olivine is the predominant mineral, while we have seen that olivine and the magnesian silicates are found not only in the ultra-basic rocks of the earth, but also in meteorites. While these facts alone do not prove that the nickel was derived from the olivine, it is well to note the conditions under which the olivine was formed, and to see how far it is nickeliferous. Assuming a semi-metallic nucleus for the earth, and that in this nucleus iron and nickel are the predominant metals, as they are in meteorites, and allowing that the ultra-basic rocks came from the greatest depths in the earth's interior, under such circumstances, it would not be remarkable for silicates, crystallising out of the magma, to contain such metals.

From the microscopic study of the igneous rocks, much light has been thrown on the order of crystallisation of their component minerals, which has pretty definitely been proved to be fairly uniform. Thus the first minerals to form appear to be magnetite and illmenite, sometimes chromite and picotite. Next come silicates, which occur in minute quantities, such as zircon and titanite; pyrite and pyrrhotine usually follow; and next the metallic oxides and sulphides, and the heavy dark-coloured basic silicates, olivine, augite and hornblende. Olivine is the first of the rock-forming silicates to crystalize out of the basic magna. According to Rutley, olivine sometimes contains traces of titanic, phosphoric and chromic acids, and the protoxides of nickel and cobalt. Sandberger's experiments with rock silicates almost invariably show traces of Ni, Co, and Cu, from olivine and augite. Whether the nickel occurs, as he supposes, in chemical combination, or, as Mr. A. W. Stelzner thinks, mechanically admixed, is practically immaterial to the question under discussion; it is sufficient to know that olivine contains the metal in quantity enough to form, when dissolved and re-precipitated, rich and extensive deposits. We have seen, indeed, that the olivine in the Oregon rock gave 0.25 per cent. Ni, while the serpentine from Dillenberg showed 0·66 per cent.; and much of the serpentine in New Caledonia runs over 1 per cent. A review of the foregoing facts certainly points to the conclusion that the nickel, at least of the serpentinous deposits, has been derived from the basic magnesian silicates of the original rock masses. As regards the nickeliferous pyrrhotite deposits, they may possibly have a different origin as suggested by Vogt.

It has been proved that workable deposits of titaniferous iron have been probably formed in certain basic eruptives in Norway and Sweden by a process of differentiation or segregation of the iron ore to the centre of the eruptive mass; and Vogt has suggested, and endeavored to apply, the same theory to account for the formation of the nickel sulphide deposits in the norites of Norway and Sweden and the Huronian deposits of Canada. As against this theory, it is remarked that the pyrrhotite deposits referred to occur along the contact planes of the gneiss and schists; and therefore, if they were formed by segregation from a molten magma, this process has taken place from the centre towards the outside, or in reverse order to that which characterizes the iron ore and the supposed structure of the interior of our globe.

Though there may be grounds for further investigation in this direction, these ore bodies would seem more probably to have been deposited from circulating mineral waters. Some geologists explain the presence of deposits of mineral by supposing them to have been formed by the agency of circulating solutions bringing them to the surface from unknown depths, disregarding the fact that fissures have never yet been proved to have indefinite extension, nor can water circulate below certain limits. Before, therefore, adopting an ascension theory for the formation of nickel deposits in basic eruptives, it is well to recollect that these rocks came from greater depths within the earth than circulating water is likely to have penetrated; much deeper in all probability than any vein fissure could have extended to. It is more rational, it seems to me, to suppose that the metals were brought within reach of surface agencies, and it is probably owing to the subsequent leaching of these basic eruptives that our principal deposits of nickel were placed at the disposal of the miner's pick. The practical lesson to be gathered from this is, I think, that the prospector looking for new deposits of this class will best turn his attention to a field where rocks of this character are met with.

The progress of science day by day makes the art of mining less speculative and more business-like, and it should be I think, the function of the engineer to apply science to this legitimate commercial end; to raise it, in fact, into the position of an industry, which has materially assisted in building up the prosperity of all new countries; which has done so for America already, and which will do so for our British colonies in the future, with marked advantage to us. Mining supports tens of thousands of our population, opens outlets for remunerative enterprise and emigration, and exercises a civilising influence which is world-wide, and, I think, the surest means to foster it is to point out its risks as well as its advantages; to encourage the employment of necessary capital in profitable fields; and, equally, to discourage wasting valuable money on enterprises which do not possess the elementary conditions for achieving success. There are, in fact, three classes of people, I believe, who engage in mining—those who get most metal out of the pockets of the public, those who are content to mine in pockets of ore, and those whose endeavour is to successfully develop valuable mineral deposits on what I would term a profitable commercial basis, with the aid of scientific knowledge applied practically.

The contracts for the metal in America closed early in 1892 were made at prices ranging from 55 to 60 cents

*Abstract of a paper read before the Society of Arts, May 2, 1894.

†*Comptes Rendus*, July 1893.

per lb., these quotations being for metal of 98 to 99 per cent. fine. Later on very good nickel of the same fineness has been offered at 52 to 54 cents, and at the close of 1892 could be bought for 50 cents. The dry process has greatly tended to cheapen the cost of producing nickel, but this, it must be recollected, is off-set when there is a demand for metal of extreme purity, which can only, as yet, be obtained by wet treatment. This feature of the nickel confers a great advantage on the New Caledonian ores: to illustrate it, it may be stated that the leading nickel refiners in the United States asked 70 cents per lb. for metal of first-class quality, while the price asked for the regular 98 per cent. grade was 56 cents prepared from the same ore.

The Walker Patent "Indestructible" Ventilating Fan and Engines, as Erected at the Park Collieries, Garswood; Their Construction, Arrangement and Efficiency.

By Mr. Charles H. Higson. *

The Walker "Indestructible" ventilating fan and engines were introduced some seven years ago by Messrs. Walker Bros., of the Pagefield Ironworks, Wigan, and a ventilating plant of this description having been erected at Messrs. J. and R. Stone's collieries at Garswood, of which I have charge, it has been suggested to me that a description of its construction, arrangement and efficiency would be acceptable to the members of this Society.

In designing this machinery endeavour has been made to produce an arrangement which, while obtaining a high degree of economy and efficiency, should possess freedom from liability to break down, and also sufficient simplicity in its working parts to bring it within the comprehension of the every-day colliery engineman. With this view the engines have been made large enough to perform their duty at a moderate piston speed, and all complicated valve gearing has been avoided. Experience in the construction and working of engines driving ventilating machinery, and, indeed, in colliery engines generally, has shown the advantage of moderate speeds. These engines were designed for a speed of 50 revolutions per minute. This gives a piston speed of 400 feet per minute, which is very moderate when compared with the performances of many engines driving mills; but it is found that the destructive effect lies not so much in the speed at which the piston travels as in the frequency of its change of direction, and that a speed of 50 revolutions per minute is the most advantageous when dealing with engines of the class and size herein referred to.

In the case of mill engines it is usual to run them at much higher speeds; but the difference between these engines and those driving ventilating machinery is that the former work with the advantage of the intervals of meal-times and stoppages during the night and at week-ends. but with fan engines the stoppage is limited, as a rule, to a very brief interval on Sunday mornings, and in some cases even this is not permissible.

Taking the hours worked during a week, mill engines run only one-third the time of fan engines; or. in other words, each year the work done by ventilating engines represents three years' work as compared with mill engines.

The engines are of the twin or side-by-side compound, condensing type—that is to say, there is a crank at each end of the crank shaft, one crank being actuated by the high-pressure piston and the other by the low-pressure piston, the driving pulley being placed midway between the two cranks.

The stroke of each cylinder is 4 feet. The diameter of the high-pressure cylinder is 22 inches, and of the low-pressure cylinder 38 inches.

The valves are ordinary slide valves, an adjustable cut-off valve being fitted to the high pressure cylinder. The cut-off valve can be regulated while the engines are running and it is intended that the stop-valve should remain at all times wide open, the speed being controlled by the cut-off valve.

A warming valve admits live steam to the low pressure cylinder to warm it before starting and to start the engines when the high pressure crank is on the dead centre.

In Messrs. Walker's more recent engines, adjustable cut-off valves are fitted to both cylinders. This enables the load to be equally divided between the high and low pressure cylinders at all speeds, to meet the varying duty required from ventilating machinery, as in the case of new mines opening out.

By means of a system of valves in the exhaust pipes, either engine may be disconnected and the remaining engine may be worked alone, either condensing or otherwise, and is sufficiently large to develop almost the full duty of the fan when so doing.

A separate steam stop valve is provided to admit live steam direct to the low pressure cylinder when working alone, and a combined reducing and safety valve, reduces the steam pressure in proportion to the increased diameter of the piston and prevents the accumulation of dangerous pressure in the pipes leading to the low pressure cylinder.

A three way valve on the main exhaust pipe and controlled from the engineroom enables the man in charge to turn the exhaust steam into the condenser or into the atmosphere as may be required whilst the engines are running.

The air pump is worked by a drag-crank from the low-pressure crank pin.

Motion is transmitted to the fan by fifteen cotton ropes, each 1⅜ in. diameter. The grooved driving pulley is 16 feet diameter, and the driven pulley on the fan shaft is 7 feet 6 inches in diameter, giving a ratio of one to a little over two.

It is found that these cotton ropes run most satisfactorily at speeds of 3,000 feet per minute and over, and it is therefore now the practice to increase the diameter of the driving pulley to 20 feet for engines of this size.

The power which may be safely transmitted by a cotton rope 1⅜ in. diameter may be taken at about 10 horse power per 1,000 feet per minute up to 3,000.

In mill practice it is found that the average life of cotton driving ropes when properly treated is about twelve years. The comparatively recent application of these ropes to ventilating machinery renders it impossible to say what their durability is likly to be, but experts say that it will probably exceed that of mill ropes, in consequence of the steady load and freedom from sudden strains.

The method adopted for lubricating the crank pins is a noteworthy feature of the engines.

A cylindrical vessel filled with oil is suspended above the crank pin. A rectangular brass tube passes through the bottom of the vessel and projects above the surface of the oil inside. A number of woollen threads are led from the inside of the vessel through the tube, and are allowed to hang dowwnards from its end.

The wool becomes saturated with oil by capillary attraction, the flow of oil being regulated by a brass plate inside the tube, which may be caused to compress the wool.

To the end of the connecting rod is attached a brass tongue in such a manner as to come into contact with the saturated wool at each revolution, wiping off a certain quantity of the oil, and conducting it to the crank pin. The tongue is faced with flannel to prevent the oil being thrown off by centrifugal force.

The consumption of oil is 1½ pints per week for each crank pin.

When local circumstances will permit of its adoption the "twin" arrangement—that is, placing the high and low pressure cylinders side by side—is much superior to the tandem arrangement, in which the cylinders are placed one behind the other.

By the twin system the inconvenience of dead centres is avoided, as live steam can be admitted to the low-pressure cylinder to start the engines when the high-pressure crank is centered. The driving pulley receives a comparatively light impulse at each of four points in the revolution, instead of receiving a heavy impulse at each of two points in the revolution, and greater regularity and evenness in the running of the ropes is thereby secured. The working parts may be lighter and are more evenly balanced, and an accident, for instance, to a crank pin which could be met by disconnecting the disabled engine and by running the other alone, would, in the case of the tandem engines, lay the fan idle and stop the pits until the damage was repaired.

The Fan.

The chief points aimed at in designing the "Indestructible" Fan were (I learn from the makers) to produce a ventilating machine which should obtain a high percentage of useful effect without the great weight, unwieldy dimensions or expensive foundations of the large direct driven fans, and which should at the same time possess the strength, rigidity and durability of the smaller fans, whilst avoiding their high speed and consequent frequently heated bearings.

The construction of the fan, which is 24 ft. diameter and 8 ft. wide, and is built up exclusively of iron and steel, is as follows:—

There are two strong cast iron bosses. These bosses are carefully bored out and made a good fit upon the fan shaft, and are further secured to the shaft by means of steel keys. The bosses extend lengthwise on each side towards the journals, thereby distributing the weight of the fan over a considerable portion of the fan shaft.

Between the bosses are placed two discs of steel, of uniform thickness, bored in the centre to fit the fan shaft.

The bosses, where they come in contact with the discs are turned on the face.

Each disc is in halves, the joints being placed at right angles to each other. By this arrangement the two discs form one disc of considerable strength, much lighter but stronger, than if the disc were in one solid plate.

Between the two discs the iron arms of the fan are fixed "sandwich-like," and are gripped tightly by them. These arms extend from near the axis of the fan to its periphery, being supported half-way by the discs.

The two bosses are secured together by means of turned bolts passing into carefully rymered holes; the bolts being lock-nutted, and as these bolts pass through both the discs, the bosses and the fan-arms, the whole structure becomes specially strong.

In the small spaces between the discs which are not filled up by the fan arms, there are inserted annular plates. The whole portion outside the boss is then securely rivetted together.

Angle irons are rivetted to the fan arms where they extend beyond the discs, to these angle irons the vanes, eight in number, are firmly secured. the cross section of the arm and vane together being like the letter T, thus forming a beam of great strength and rigidity. The top of the T representing the vane and the surface pressing against the air. The vanes which spring tangentially from a small circle concentric with the fan shaft are curved longitudinally to the arc of a circle of a certain radius and are cut away from the edge of the inlet to the fan shaft to minimise central resistance.

The main bearings of the fan are placed in the two inlets of the fan chamber, the distance inside the bearings being only 8 ft. The outer bearing being placed just outside the rope pulley upon the fan shaft. The latter bearing is made with adjustable brasses so that the wear produced by the tension of the ropes may be taken up.

The pedestals are cased all ronnd to prevent access of dust to the bearings.

It is very necessary to minimise the slipping of the air between the sides of the vanes and the walls of the fan chamber as far as practicable. The vanes being strong and of iron cannot be brought close to the walls, as in the event of any side movement of the fan on its bearings the vanes might "catch" and be injured. This clearance is, therefore, made up by attaching strips of pliable hoop iron to the sides of the vanes.

The method adopted for obtaining constant lubrication of the fan bearings is worthy of notice. An eccentric upon the crank shaft of the engines actuates a small pump which delivers oil from a tank beneath the floor of the engine-room into one fixed high up against the wall. From this latter tank the oil flows by gravity through pipes communicating with each of the fan bearings, and, after lubricating the journals, is collected by cups fixed to the sides of the pedestals and conducted to the lower tank. Here it is filtered by passing through a sheet of copper gause, and is again pumped into the upper tank. Constant lubrication is thereby secured, the bearings practically running in a bath of oil. The consumption of oil is 4 pints per week for the three bearings.

The fan is fitted with the Walker anti-vibration shutter.

The history of the invention and introduction of this shutter (for which I am indebted to the makers), is very interesting.

About 1886 Messrs. Walker constructed and erected three Guibal fans for ventilating a portion of the Metropolitan and District Underground Railway.

Those who have had experience with Guibal fans will be aware that as each blade or vane passes the lower edge of the shutter a pulsatory action takes place. When the fans above mentioned were set to work the pulsation or vibration of the large volume of air discharged was so great that it caused a corresponding vibration of the window sashes, doors, &c., of the surrounding buildings, and this was so unpleasant that the professional men and others near obtained an injunction against the railway company compelling it to stop one of the fans. The work by this time was out of the makers' hands, and they only casually heard what had taken place, learning, also, that in addition to this injunction another was threatened in the case of the second fan, and that the railway company had thus far escaped the enforcement of this threat by agreeing to run the second fan at a few short stated intervals only during the day.

In considering the case it occurred to the makers to incline the lower edge of the shutter instead of making it parallel with the axis of the fan, by which means it was thought that the waves of air might be broken up or at least reduced. It was, however, ultimately decided to make the shutter like an inverted V, and this was found to be completely successful.

Having thus explained the history of this invention and its utility in removing vibration and consequent noise, we now come to a still more important advantage to be gained by its application. Experience in the working of Guibal fans proves that fan shafts, even though made unusually strong in proportion to the horse power transmitted through them, frequently break. In Belgium, the birthplace of the Guibal fan, the average life of the shafts is found to be from twelve to fifteen years. The breakage of fan shafts, and the loosening of bolts and rivets in fans generally, are to be attributed to the excessive vibration hitherto inseparable from their working. This vibration is caused by the too abrupt cessation of the delivery of the air from the fan vanes or blades as they pass the opening to the chimney, and for this the shape of the regulating shutter or slide is responsible. The upper part of this opening, formed by the shutter, as hitherto constructed, has a line parallel to the tips of the fan vanes, and as the fan revolves these lines become identical; the delivery of the air is as a consequence abruptly terminated.

Whilst discharging the air, the pressure is against the front of the vane, but immediately the vane enters the fan casing the load upon it is suddenly removed, and the pressure, owing to the vacuum within the casing, is instantaneously reversed, and a rebound upwards of the previously depressed blade takes place. The effect is communicated throughout the whole of the fan and to the shaft also, and as each blade represents a powerful lever, the momentum of the blow or jerk becomes serious on reaching the shaft and a dangerous tremor or vibration is set up.

As an illustration of the effect of this action let us take the case of a fan constructed strictly on Guibal principles and upon which experiments were made some time ago. In these experiments readings were taken from a water gauge which was attached to the fan casing at intervals from the centre to the periphery, above the shaft. At the centre the water gauge indicated 3 inches, but near the outer edge or periphery it was half an inch. The fan was 24 feet diameter and ran at 80 revolutions per minute. Taking the average water gauge over the surface of the blades at 1½ inches it would represent a pressure of 7·8 lb. per square foot or a total pressure on each blade of nearly 500 pounds. Assuming the centre of the blade to be the centre of the load, the distance from the centre of the load to the centre of the fan shaft would be approximately, 9 feet. Taking the work of one day of 24 hours,

* Manchester Geological Society Trans.

the fan running at 80 revolutions per minute:—eight blades, by 80 revolutions, by 60 minutes by 24 hours = 921,600. This product represents the number of times in a single day that a weight of, at least, 500 pounds is, as it were, instantaneously removed from the blades and the shock resulting from the removal is transmitted to the fan shaft. The shaft is thus in a constant state of tremor, and sooner or later reaches its elastic limit. The consequent injury to the general structure of the fan is obvious. The Walker anti-vibration shutter as attached to the fan at the Park collieries removes this evil by effecting a perfectly gradual change in the pressure referred to, and so governs the discharge of the air as to cause it to pass, without objectionable eddying in a continuous stream from the fan vanes into the chimney, instead of intermittently, and without the pulsatory action described.

The shutter is constructed in sections, any of which can be removed for the purpose of adapting the area of the opening to varying duties of the fan.

The fan is suspended eccentrically in a volute or spiral chamber.

In the experiments, the results of which are given in the annexed tables, elaborate precautions were taken to avoid error. Each airway was divided by wires into a number of similar and equal parallelogrames, and the calculations are based upon the average of several measurements in each parallelogram. The anemometer used had been sent to the makers for adjustment for the purposes of these experiments. A competent person remained in charge of the engines to ensure a constant speed being maintained. The end of the water-gauge tube was fixed at right angles to the current, about half-way between the fan inlet and the pit, and was enclosed in a box filled with cotton waste to avoid false readings through fluctuation of water in the tube. The water-gauge readings were also checked at several points in the fan drift, and found constant.

In the experiments made to ascertain the coal and steam consumption, indicator diagrams were taken from the engines once in each hour, other observations being taken every half-hour. The results given are the average results yielded by an experiment extending over six hours.

The feed water passed through a Green's economiser before reaching the boilers.

The steam was generated by two Lancashire boilers, each 30 feet long by 8 feet diameter.

The fuel used was slack from the Wigan Nine-Feet and Wigan Four-Feet mines.

In comparing the relative merits of the fan with the furnace as a ventilating appliance, the advantage is, without doubt, largely in favor of the fan. It is not uncommon for a furnace to consume 50 pounds of coal or even more per horse power per hour, in the air at the bottom of the upcast pit, whilst the tables annexed shew that by the employment of a fan the fuel consumption need not exceed 4·75 pounds per horse power per hour, in the air at the upcast pit bottom. In addition to this the fuel burnt at a ventilating furnace is usually of superior quality, and therefore of greater value than that burnt under steam boilers.

The ventilating power of a furnace is limited, and when that method of ventilation is employed, in addition to the danger of introducing fire into a mine which may give off large quantities of inflammable gas, and the risk of setting fire to adjacent coal or other strata, trouble constantly arises from the corrosive action of the products of combustion upon shaft fittings and tubbing, also from collapse of brick-work and leakage of tubbing owing to contraction and expansion due to the wide range of temperature in the shaft. This leakage has in some cases been so great as to reverse the air current by the cooling of the shaft, and the momentum of the falling water.

The smoke and fumes are a source of great inconvenience where the shaft is used for winding coal, and this is especially the case where the shaft has to be utilised for the descent and ascent of workmen.

Mr. J. Unsworth proposed a hearty vote of thanks to Mr. Higson for his very valuable paper, in which he was very much interested. Perhaps it was only reasonable he should be, inasmuch as he had no practical knowledge of the working of fans and consequently he had listened to him with very great attention. He was quite sure he had made his points very clear, and had done his work well and was entitled to their thanks.

Mr. J. Dean, in seconding the vote of thanks said he had had to deal with a similar fan at the Broomfield pit and he could endorse everything Mr. Higson had said about the satisfactory working of it. It was a strong fan, economical, and certainly non-vibrating. He did not think they could hear it 30 yards from the place. He should like to ask Mr. Higson if he had had much experience with regard to the tightness of the rope gearing; they found that when the ropes were put on taut, according to the makers' wishes, they were very much troubled with them coming out of the grooves and getting broken. They had had two ropes broken. They had lengthened the ropes and given them from three to four feet of bag and they ran as steadily as possible.

The Chairman, congratulated Mr. Higson on his paper, and said: He had been a member of the Society a good many years and he did not remember hearing a paper from a mining point of view which he considered to be a better one. He thought it was more especially useful now that so many people had it on their minds to change their system of ventilation from furnace to fan, and those members who were thinking of doing so must be very grateful to Mr. Higson for his paper.

The motion was passed with applause.

Mr. Higson said he was very much oblighed to them and as to Mr. Dean's question about the ropes, they had found exactly the same difficulty, when the ropes were very tight they did not work satisfactorily. It was only when they had been running some time and had become slack that the jumping out of the grooves ceased.

Mr. Dean asked what was the size of the shaft the ventilation came up.

Mr. Higson: 14 feet 6 inches diameter.

Mr. Thos. Grundy asked Mr. Higson as to his experience in the thickness and construction of the walls of the fan chamber. They were putting down a large fan; and had noticed that the footing of walls, as given by the makers, had not proved sufficient, owing to the damp weather, he fancied, the water had acted upon it and the wall had given a little bit. When he mentioned it to the makers they suggested chipping the bricks off; but that did not suit his idea, because they had put the very best bricks in they could, to form the casing of the fan. If he was informed rightly, he believed considerable chipping had had to be done in connection with other fans. He would like to known what kind of bricks were used inside the chamber, and what were the means of carrying the rain or storm water from above the top casing of the fan.

Mr. C. M. Percy said he had no doubt in his own mind that furnace ventilation was a thing of the past and ought to be, and that fan ventilation was much more efficient; but the difficulty was in getting to know which was the best fan. They heard of such startling results—sometimes the efficiency claimed was more than 100 per cent.—that really practical men were bothered what to do; and whilst he was exceedingly glad that that paper, which was a very valuable one, had been read, he thought the discussion would more likely be of a searching character, and effect more good if it took place at a meeting after the paper had been printed and distributed. He joined in the congratulations to Mr. Higson. He might say that, at times, papers were not prepared with sufficient care. Papers ought to be prepared, first, to maintain the reputation of the person reading them, and, second, the reputation of the Society before which they were read. Looked at from these two points, Mr. Higson had set an excellent example, and had increased his own reputation and not lessened the reputation of the Manchester Geological Society.

The Chairman asked Mr. Higson to tell them what was the amount of coal in bulk used by the fan, and the amount of coal in bulk used by the furnace, when he made the comparison, assuming the two to be getting the same quantity of air. The Chairman went on to say that the question of fan and furnace was a very important one, both from a safety and also from an economical point of view. Where they had a fan they were able from the fact that they could manipulate it so easily to deal with dangers they could not overcome where they had a furnace. If they had a fire underground they could deal with the ventilation at once with a fan, but with a furnace they were perfectly helpless. With regard to the shaft, if they had a furnace it was difficult to examine it, and he imagined the ropes suffered very much, which must be a great drawback. If they had a fan they could examine the shaft and the ropes did not suffer in the same way. If Mr. Higson was correct in his statement as to the consumption of coal, there could be no question which system of ventilation was the most economical. During the last 10 or 15 years fans appeared to have made great headway more especially in the northern districts, and in Lancashire they had made some steps in the right direction. They had a great many good fans, and he thought most of their large collieries were now thinking of changing from furnace to fan, but there were always a great many people whom it was difficult to get to make any improvement. There were two or three classes of colliery managers, and also of colliery owners. He found there was a class of colliery owner who seemed to love to see a huge black cloud of smoke coming up the pit. He did not know why it was, but he (Mr. Hall) thought he fancied it showed there was somebody below who was very busy. He often went to the extent of loving to see about his pits broken boxes, iron, and machinery, and he seemed to think it was a sign of energy on the part of his manager. It was a sign of energy in a certain direction. He loved to see the men and women employed on the pit bank exposed to a hurricane of rain and wind, and seemed to think it hardened them, and that it was a proper thing for colliery people to submit themselves to. As to the managers he personally tried to make the meeting at Wigan a good one. Whenever he met a colliery manager he asked him to come to the meeting. Some of them came, others looked at him with a kind of supercilious smile and passed on. He thought they were the losers and not those wno attended. He was sure if any colliery manager in Lancashire had been there that afternoon he would have been interested in the paper which had been read. He did not know what steps one ought to take to get rid of that feeling of opposition to improvements. There was that feeling of opposition to improvements on the part of colliery managers and also of owners, but he did not quite see how they were to get over it. If one could hope to get them to join this Society, possibly it would be the right course, and before he sat down he should like to say a word about the support accorded to it. In the North of England nearly all the colliery owners subscribed to or became members of the Mining Institute, not possibly with the intention of attending the meetings, but simply to give it their support from a monetary point of view; whereas in Lancashire they had very few of the owners subscribing. He thought it would do great good if the owners would help the Society in that way, and although some of them might look down upon it—some of them he was sorry to say looked down upon that mining school and anything that was technical—but as far as he could judge their managers by attending these meetings would gain some knowledge which would eventually save the owners' pockets.

The motion was then put to the meeting and was heartily adopted.

Mr. Higson, in reply, said that with regard to the comparison of the results from the furnace and the fan, he might say they had not got a furnace at Messrs. Stone's collieries, but he had made enquiries and obtained the results he had quoted. Some were so startling that he was afraid to produce them. They had had no difficulty in the foundation of the fan race, and they used ordinary machine-cut brick.

Mr. Tonge said it was well known that the work of furnaces in mines varied proportionately with their depths; those at great depths giving far better results than those near the surface. In comparing the work of the fan with that of certain furnaces, Mr. Higson had not stated any depths, and so they could not form an accurate or definite judgment. However, he was not speaking at all in favour of the furnace; and he trusted when the time arrived for the paper to be discussed there would be a full meeting, as no more important subject could be discussed in connection with mining.

The discussion was then adjourned.

A vote of thanks to the Chairman closed the meeting.

Coal Tar Pitch—Its Uses and Future Market.*

By Mr. R. Watt.

Coal tar pitch twenty-five years ago was comparatively a new factor in the commercial world. It was almost unknown. Whenever pitch was mentioned, the mind of the merchant or manufacturer reverted to the pine tar product of North and South Carolina. Even the gas companies of the United States were ignorant of the commercial value of tar. Instead of turning it into a source of revenue their main object was to dispose of it in a way that should not pollute the rivers or streams near the works and cause a public nuisance. Consequently they wasted millions of gallons of tar which, if turned into pitch and the avenues of uses had been opened to it, would have largely augmented their revenues. As a result of this lack of foresight, consumers not being educated in its uses, they were limited to the use of pine tar pitch and resin for roofing and other purposes. When pitch was placed on the free list foreign pitch was reduced in price, and came into general use in this country, largely owing to its cheapness, but it was often of such poor quality that it was unavailable for many of the functions of pitch. The cause of this poorness was obvious. Foreign producers, who were also little instructed in the advantages of pitch in its various lines, did not regard their product of much importance, and thought that anything would suit so long as it was called pitch. They distilled the tar mainly for the resultant oils and chemicals, and pitch with them was only a by-product of many impurities. It was usually hard and brittle, and contained many foreign substances which were detrimental to its utility. Its importation, however, brought pitch into more general use by reducing the price of what pitch was manufactured in this country.

Now, while this result curtailed the revenues of the gas companies engaged in the production of coal tar, it also stimulated them into better appreciation of the commercial worth of the product. The tar distillers revised their methods of manufacture, and sought to meet the necessities of the growing market. Instead of treating pitch as a by-product as many of their European competitors still do, they now distilled the tar solely for the pitch, and looked upon the resultant oils and chemicals as the by-products of secondary interest from a commercial point of view. Owing to this change of front on the part of the distillers, the coal tar pitch of the United States takes first rank in the market. It is free from the impurities of the imported article, and therefore better adapted for the various purposes for which coal tar pitch is now used.

In this brief paper I need only call attention to a few of the leading uses of coal tar pitch. For roofing purposes it is unsurpassed, and in general vogue in all our large cities. Its superiority over tin and iron roofs is everywhere admitted. During the past fifteen years it has become the principal factor in nearly all the prepared roofing on the market. A combination of pitch and felt resists the action of water much lo ger, and is more durable than any other class of roofing material; and, what is of equal importance, the cost of such roofing is one-third less than roof of tin or iron. It moreover makes a much safer roof in the case of fire. While the metal aoofs disjoint and fall to pieces from the action of heat, rnd thereby add to the intensity of the fire, pitch roofs fall down bodily and tend to smother out the flames, and in this respect effect a much quicker result than thousands of gallons of water.

In street paving the advantages of pitch have frequently been demonstrated. In many cities specifications call for from 10 to 20 per cent. of refined Trinidad asphalt added

*Abstract of a paper read before the Ohio Gaslight Association, Columbus, Ohio, March 21, 1894, with discussion thereon.

to pitch or cement employed in paving; but this clause is rarely complied with. Practical men know that the addition of this asphalt is more of a detriment than a benefit to the pavement, and they condemn and reject it, even when set forth in the specifications. City authorities, as well as contractors, know that block stone pavements are not satisfactory or durable unless pitch has been used for filling the crevices or cementing the blocks together. Years of costly experiments were needed in many instances to substantiate this fact; but to-day pitch filling is regarded as of the utmost importance, since pavements so treated are more lasting and less subject to ravages of water than those which have been laid without pitch as cement and filler. Indeed, pitch pavements are practically impervious to water, and accordingly escape its corrosive or undermining effects.

But there are other and equally important avenues for the employment of coal tar pitch. It enters extensively into the manufacture of carbons for electric lighting. Various substitutes for pitch have been tried, but none have thus far proved successful. In Germany it is used in the manufacture of pipes for the conveyance of cold acids in chemical works, and also for lining acid holders. Underground pipes for gas or water are coated with pitch to prevent rust and corrosion. Boat bottoms are pitched to preserve the timber and give a smooth surface. The wooden pipes, manufactured in Michigan and New York, are made more useful and durable by their pitch coating.

Another important use for coal tar pitch has been found in the manufacture of patent fuel. This fuel is made of hard and soft coal dust mixed with 10 per cent. of pitch, and pressed into egg shaped pieces. Its popularity for family and manufacturing purposes is already so pronounced that factories for its production are contemplated in various sections. This industry will undoubtedly give great impetus to the pitch market. Even the dust and screenings of the mines can be converted into as valuable a fuel as hard coal; while many grades of western coal can be rendered bituminous by the use of pitch as a binder. All the indications are that the demand for the new fuel will go on increasing. In England its manufacture and sale has already reached large proportions.

Owing to the manufacture of gas from petroleum products, of late years the supply of coal tar has diminished. A quantity of pitch obtained from gas tar derived from petroleum products has been used for paving and roofing purposes; but the large percentage of water in the tar has rendered it very difficult to handle. While the pitch made from this tar is not so good as genuine coal tar pitch, yet the cheapness of the tar has forced it into the market as a substitute for many purposes, with fair success.

The expanding market, as well as the revenue from the production of pitch, ought to stimulate the production of coal tar, and tend to the diminution of gas making from petroleum. When the gas companies fully realize the conditions of the market, they will no doubt govern themselves to meet those conditions in the most profitable manner. Besides those already referred to, there are hundreds of avenues, some of them individually small, but large in the aggregate, for the consumption of pitch. Indeed, taken altogether, the outlook for this valuable product of coal tar is very promising. With the increasing demand for felt roofing, the growing popularity of brick for paving, where pitch will in time be universally used for filling, the employment of granite block for paving with pitch filling, the extension of electric light, causing a larger demand for carbons, and the expanding consumption of the new fuel, to say nothing of the many minor avenues of use, the producers of coal tar pitch certainly have every reason to expect a bright and profitable market.

Discussion.

Mr. Somerville, in the discussion which followed the reading of the paper, referred to the excellent result obtained at Peebles, in Scotland, where there is a plant getting 14,000 feet of 22-candle gas out of a ton of tar, and 13 cwt. of coke, averaging 0·96 carbon, which is eagerly bought up by brassfounders and others. He thought that was the proper thing to do with the tar. Were he constructing a new retort house, he would have some means for the tar, as it comes from the hydraulic main, to get into a still and have the oily matter distilled and go into the hydraulic, and the residue drawn off as pitch; and just put the oil and hydrocarbons into the gas, where they belong, and where they are worth more than anything else, and sell the pitch, as pitch, right from the works.

Mr. Miller, referring to the paragraph which says "a quantity of pitch obtained from gas tar, derived from petroleum products, has been used for paving and roofing purposes; but the larger percentage of water in the tar rendered it very difficult to handle," stated that, as the result of a number of experiments, he had found that if the separator was kept hot—at about 140 to 150°—no difficulty would be experienced in separating the water from the foam.

Mr. Somerville, rising again, said there was at present a large demand for water gas tar, which was used for making a perfectly pure asphaltum. No difficulty was experienced in eliminating the water from this tar. The asphaltum was used in the production of a deodorised paper. A sheet of paper dipped in it, he stated, became odorless, and therefore more valuable for some purposes.

Mr. Holmes—I would like to enquire whether there is very much by-product, in addition to the pitch, that is secured from the distilling of the tar? I infer from what has been said, that it will take about five barrels of tar to make a ton of pitch. That is, there is something like 35 per cent. deterioration in it, and it strikes me that this is overestimated, unless there is some by-product to realise upon it.

Mr. Watt—The by-products are the light and dead oils. The dead oil is not worth quite so much as the tar. The price of dead oil has been demoralised somewhat owing to the amount that has been imported of a poorer quality than could be produced from the tar in this country.

The President—The dead oil is worth less per gallon than tar?

Mr. Watt—Yes sir. The lamp black manufacturers use it largely for producing different kinds of blacking.

The President—Is it valuable for fuel?

Mr. Watt—Yes, it can be used for that. It produces a stronger heat if used as a fuel; it is better and stronger than Lima oil. One barrel of dead oil for fuel purposes will go as far as, at least, 15 per cent. more Lima oil.

Gold-Milling at the North Star Mine, Grass Valley, Nevada County, Cal.

By Emile Rector Abadie, Grass Valley, Cal. *

The picturesque little mining town of Grass Valley, nestled in the foothills of the Sierra Nevada mountains, at an altitude of 2,500 feet, has been for 43 years the scene of uninterrupted activity and prosperity, as the center of a mining district which was intimately associated with the pioneer days of California, and the discovery of gold by James W. Marshall, in El Dorado county, in January, 1848.

Although placer-mining was inaugurated in Nevada county as early as 1848, the first quartz ledge was not located until the summer of 1850. Discoveries made on Gold Hill and Massachusetts Hill increased the excitement in quartz mining, and hastened the erection (during the same year) of the first mill operated in the State.

At the close of 1864, the district had produced $23,000,000 in gold, and all the well-known properties of to-day had been discovered and worked. The Eureka-Idaho, the North Star, and the Empire mines were in active operation; and to-day we still find them equipped with large crushing plants, operating 80 per cent. of all the stamps in the immediate Grass Valley district. Of the mines just named, the North Star possesses the most recently constructed mill, a description of which, the writer believes, may prove of interest to members of the Institute engaged in the milling of gold ores.

During the year 1886, operations at the North Star mine (the property of the North Star Mining Company) had reached such a stage of development that the necessity of a crushing plant at the mine became imperative, and early in October the erection of a 30-stamp mill was in progress. The building designed to contain 40 stamps was speedily erected; and within sixty days the large structure was under cover.

Late in February, 1887, the mill was in readiness, and, upon the completion of the water power system, then being introduced at both mine and mill, the crushing of ore was commenced March 15, 1887.

The local topography presented most favorable conditions for a mill site. At a distance of only 142 feet from the landing floor of the main incline of the mine, it was found possible to discharge the ore at a vertical height of 67 feet above the projected concentrator floor. During the construction of the mill all mining operations continued uninterruptedly, the ore extracted being crushed in leased plants one mile distant.

From the numerous stopes, the ore is trammed to the main shaft, which has now reached a depth of 2,400 feet, with an average incline of 20°. The shaft is well equipped with a double track-way, over which 140 cars can be delivered to the surface in 9 hours, actual running time. One man on each shaft delivers the quartz to the mill and waste to the dump.

The ore, as raised from the mine, is delivered in mine cars, containing a little over 13 cubic feet each; three cars making 40 cubic feet, or two tons of ore. Sorting on the surface is not resorted to; underground, however, the custom of "stripping" the ledge *in situ* insures for the mill a clean product, generally free from diabase (the enclosing rock).

On passing into the mill the ore is discharged over grizzlies, placed at the top of long ore bins. There are 8 fine ore bins, one for each battery, of 5 stamps, each provided with a grizzly 4 by 12 feet in size, set at an angle of 40°. The 3 by ¾ inch bars are placed on edge, 2 inches apart. These grizzlies simply classify the mine ore into fine and coarse. The former drops through the grizzly directly into the fine ore bin, from which it passes through a gate, supplying the automatic feeder, which in turn supplies its own particular battery. Meanwhile, the coarse ore is delivered over the grizzly into the coarse ore bin, from which it passes through a gate into one of the three rock breakers. From the breakers it drops as "fine" into the fine ore bin, mixing with the mine fine, and passing on into the ore feeders as above described.

The ore thus passes, by gravity alone, from the dumping floor to the automatic feeders. One man on the day shift operates the rock breakers to crush the accumulated coarse ore delivered from the mine. The breakers (improved Blake, 9 by 15 inches), run intermittently, aggregating not over 7 hours' work during the 24.

From the automatic feeders the quartz is delivered into the batteries for stamping and amalgamation. The free milling character of the material demands only the simplest methods of amalgamation and concentration for the recovery of its gold contents. The pulp discharged through the battery screens flows over silver plated copper amalgamating plates to concentrating machines beyond, passing thence for further treatment in pans, or escaping from the mill direct as tailings.

The mill contains 40 stamps, weighing, when newly shod, 875 pounds each. The stamps drop 7 inches eighty-six times per minute. The shoes (steel exclusively used), weigh 159 pounds, and the remaining 716 pounds of the stamp are distributed as follows: stem, 358 pounds; stamp head, 228 pounds; tappets, 130 pounds.

The life of a steel shoe averages 130 days, and it crushes during that period 260 tons of ore. The weight of the shoe, when removed, will average about 38 pounds. The very smooth and uniform wear observed on these shoes is due in great measure to the use of cast iron dies.

The weight of the die when new is 100 pounds, and it loses during a life of 70 days one-half its original weight. The recent introduction of cast iron plates 2 inches thick has increased the life of the die to 80 days, the die, when removed, weighing from 40 to 45 pounds. These plates, two in number to each battery, fit snugly in the mortar, forming a false bottom, upon which the dies are bedded as usual. They serve a double purpose, prolonging the life of the dies and decreasing the height of the discharge, which ranges from an initial of 4 inches to a maximum of 6 inches.

Brass wire No. 30 screens and perforated No. 0 tin screens are used exclusively. The latter screen is an experiment, and thus far has given good results. The life of a tin screen is about 30 days; the cost, one-fourth that of wire screens. At the North Star mill, in crushing 113,955⅓ tons of ore, the cost for screens has been $0.008 per ton. Dies have cost $0.026 and shoes $0.056 per ton, exclusive of a rebate of 1½ cents per pound on removed shoes and dies.

The recovery of gold is first made in the mortar, where the amalgamation begins. Mercury is fed to the batteries at regular intervals, the amount varying with the grade of the ore crushed. At times, this amount has exceeded one pound per battery, or a flask of 76½ pounds in nine days. Of this amount, however, 35 per cent. is recovered at the fortnightly retorting of amalgam. There is, however, a considerable loss of quicksilver, which, in treating 113,955⅓ tons of ore, has amounted to $3,680.05 or $0.032 per ton.

In the interior of the mortar, immediately under the screen frame, are silver plated copper plates 4½ inches wide by 52 inches long. These plates, one for each mortar, are bolted to chuck blocks fitting tightly against the lip of the mortar. As the pulp is discharged from the mortar through screens, it falls upon an outside battery or splash plate 18 inches in width, covering the iron mortar apron, which is bolted to the mortar and forms part of it. The length of this plate is equal to that of the inside plate.

The apron plate, 48 by 58 inches, lies below the splash plate, tapering to 24 inches and connecting with the three sluice plates which cover the sluice 12 feet long and 24 inches wide. From the sluice, the pulp passes over shaking tables, which have a plated surface of 10 feet by 48 inches, made up of two plates 48 by 36 inches and two smaller ones, each 48 by 24 inches.

The grades of the above plates are as follows: battery and apron plates, 1½ inches to the foot; sluice plates, 1¼ inches to the foot; shaking tables, $1\frac{1}{8}$ inches to the foot. The natural tendency of the narrow sluice plates to "scour" has always been objectionable, and in fitting the more recently erected batteries with a line of plates, the width of the sluice has been doubled. These plates, eight in number, are placed side by side, and overlap slightly, aggregating 15¾ feet by 4 feet wide, the total actual plate surface being equal to that of the narrow sluice plates and shaking table plates combined. The grade of these new plates is approximately uniform at 1½ inches to the foot.

Two-thirds of all the gold recovered by amalgamation is found in the batteries. The yield is, however, variable, frequently reaching 75 per cent. Of the amount recovered from the outside plates, the battery and apron plates will produce 70 per cent., the sluice plates 23 per cent., and the shaking tables 7 per cent. The average value of amalgam from all sources is about $7.25 per ounce, the fineness of the gold bars is 856.

The batteries are cleaned up fortnightly; the outside plates, every other day, frequently daily, and, on rare occasions, morning and evening.

In addition to the usual method of recovering the amalgam from the plates, the writer introduced, several years ago, the method of hot water "sweating," which can be recommended for its simplicity, safety and excellent results. The effect of simply pouring boiling water upon the plates or immersing them (on the apron), is a source of as much pleasure as surprise when the amount secured from a poor looking plate is weighed. Notwithstanding previous sweatings during the year, the December or annual sweating at the North Star mill produced 1703 ounces amalgam from which 600 ounces gold was obtained, valued at $10,524.82.

Leaving the battery floor, the pulp is conveyed through 3-inch pipes to the concentrators on the floor below. Each battery of 5 stamps being provided with two machines, the full complement consists of 12 Triumph and 4 Frue vanners. The latter machines are preferred, and were introduced when the 10 additional stamps were in-

* Transactions American Institute of Mining Engineers.

stalled. The machines are conveniently arranged on one floor and readily overlooked by one man on each shift.

The ore crushed at the North Star mill contains about 4 per cent. of "sulphurets." Their average value is $53.58 per ton; and they have yielded in seven years a total product of $236,756.63. The concentrates are sold to the local chlorination works.

From the concentrating machines the pulp escapes as tailings, containing more or less gold, notwithstanding a high percentage saved of the ore value (reaching 94 per cent. under favorable conditions). At the present writing there is in operation a simplex rotary amalgamator, treating 10 tons of tailings per 24 hours. Results obtained thus far have reduced the loss in the tailings 22 cents per ton.

The mill is operated entirely by water power, and notwithstanding a high rate per available horse power, the cost of power per ton of ore crushed has not exceeded $0.32. The water used has previously been utilized by the Original Empire Mill and Mining Company under a head of 450 feet. At the North Star, the effective head is 275 feet at the mill.

Electricity as a Motive Power in the Iron and Steel Industries.*

By D. Selby Bigge.

In accepting the invitation of the Council of this Institute to write a paper on Electric Power applications, the author can only hope that, however unworthy his paper may be in itself, it may yet be the means of bringing forward a comparatively new subject in which considerable interest is being evinced by engineers at the present time, and that, in this manner, the opinions of more experienced men will be brought forth, and additional light thrown on the subject.

During the past three years the author has been almost exclusively engaged in applying electricity in the form of power to different mining and industrial operations, and in the course of his work, has been struck with the vast field which lies open to the application of electric power, and the numerous branches of engineering to which the new, and, perhaps, it may be said, coming power, is applicable.

In taking for the subject of his paper Electricity as a Motive Power in the Iron and Steel Industries, the author will endeavour to trace out those branches of the iron and steel industries in which electricity in the near future may take a predominant part. It will be his endeavour in the following pages to treat the subject as far as possible from the standpoint of those engineers who are connected with the daily management of iron and steel works, etc., and not from that of a purely electrical engineer.

Electric power has been applied in this country hitherto chiefly for the purposes of traction, or for carrying out various operations in mining work, such as hauling, pumping, winding, ventilation, drilling, etc., and its chief advantages and characteristics in these branches are now very generally known. All these applications, up to the present, have come under the head of long distance transmission, and there has been a general tendency on the part of engineers to consider applying electric power only in those cases where the power has had to be transmitted a considerable distance. The author is particularly anxious to draw the attention of engineers to what he may term short distance transmission, or concentration of power. Seeing that it may be considered as coming within the scope of the iron and steel industries, ironstone mines, blast furnaces, iron and steel works, engineering shops, shipbuilding yards, the author will endeavour to point out the cases in which electric power is applicable to each of the above.

1—LONG DISTANCE TRANSMISSION.

Ironstone Mines—When transmitting electric power over long distances it is necessary, in order to keep down the cost of the conducting cables, to employ high tension currents, that is to say, the generating dynamos are wound to give off their power at a high voltage and small current. It has hitherto been the practice in mining work to convey the power at voltages of 300, 500 or 800 volts. Electric power in this way may be transmitted with a comparatively trifling loss to distances of several miles in length. It was not long therefore before electricity found an opening in its application to various mining operations, and especially to hauling and pumping. It was the author's privilege some two years ago to apply electricity in the Cleveland mines for drilling purposes, and since then these electric drills have proved themselves in every way a thorough success, and their use is being further extended into other mines in the district. The voltage in the case of the electric rock drills does not exceed 300, as the power involved is comparatively small, and the distances do not exceed one to two miles in length.

In the case of ironstone mines situated at any great distance from the main line, or in cases where a special line has to be built to the mines, an electric plant could be laid down, not only to operate the drilling in the mine, pumping the water, hauling out the ironstone, but could also be employed to generate current, at the same time for performing all the traction on the branch line. The whole of this work could be performed by current generated from a single engine and dynamo at the mine itself.

In the case where several ironstone mines are situated in close proximity one to the other, a central power station could be laid down, by means of which there would be no separate steam plants situated at the different mines, these all being replaced by electric motors, driven off one main generating dynamo situated at the central station. There is no difficulty whatsoever in carrying out the winding, hauling, pumping, drilling and ventilating arrangements at these mines electrically.

Blast Furnaces—There may be some at this meeting who may think that the author now proposes to work blast furnaces by electricity. He regrets, however, it is not yet in his power to revolutionise the world by doing this. He would, however, seek the aid of blast furnaces in generating his electricity, and considers that, after a water fall, a Cleveland furnace is the next best friend to those desirous of generating electric power economically. In many cases there are large amounts of waste gases available from the furnaces. These are generally used for firing the boilers necessary for driving the blowing engines, etc., but there is frequently a considerable amount of waste gas left over. It is with this waste gas he would propose firing the boilers in connection with the electric generating plant. The power thus generated could be transmitted at a high tension to engineering works situated at a considerable distance, and, if necessary, transformed again to a lower tension for use in the works.

At blast furnaces themselves there are not a great number of applications to which electricity could be adapted for driving purposes, excepting perhaps in pumping water from a neighboring river for condensing. The mineral hoists could be worked electrically.

From the few remarks above, engineers will easily be able to see for themselves the cases in which electric power is applicable at the mines and in connection with blast furnaces.

2—SHORT DISTANCE TRANSMISSION AND CONCENTRATION OF POWER.

Iron and Steel Works—By short distance transmission the author means the distribution of electrical energy for the purposes of driving engineering works. As already mentioned, there has hitherto been a tendency on the part of engineers to consider electricity as applicable only in those cases where the power has had to be transmitted over a long distance. It is now necessary to consider quite a different case, in which the power has only to be transmitted over distances not exceeding 300 or 400 yards in length, but in which area a multiplicity of uses may be found for the application of electric power to driving various classes of machinery.

First of all, let the case of iron and steel works be taken, and the classes of machines most frequently employed in these works be considered. These will be found in a great measure to consist of the following: Punching and shearing machines, straightening machines, cold and hot saws, drilling machines, planing machines, blowers, overhead travellers, locomotive cranes, rolls, winches, scrap breakers, etc.

In connection with iron and steel works there are frequently found girder shops, fitting shops, etc., in which the machinery is driven through shafting and belting off one or more engines situated in the shop. In laying down machinery of the above class it has almost invariably been the practice, not only when the machine tools are driven by separate engines, but also when they are driven by belting and shafting, to make allowances in these engines for very large losses, due to condensation or leakage in steam pipes, or to friction caused in the belting and shafting. It is a well known fact that the power actually expended in performing the work on these various machines is a mere fractional part of that transmitted from the generating source. In those cases where the machine tools have been driven by separate engines, it has been a regular practice to provide engines with cylinders sufficiently large to compensate for any possible losses which may occur through leakage, condensation, etc. It seems generally to have been the practice in engineering works to indicate the main driving engines, but during the author's visits to some thirty or forty of the principal engineering works in this country, he has never been able to obtain indicator diagrams showing the power absorbed by each steam driven machine tool in the works. Although attention has been paid to the economy of the main engines, the question of that in the small engines driving these machine tools, and the conveyance of steam has often been entirely overlooked, and an enormous waste has been going on in this manner for years past.

With the advent of the electric motor this condition of things was at once changed. Every electric motor may be said to be a self-indicating machine in itself, in that the power which it absorbs can be immediately detected through the readings on the ammeter and voltmeter provided in connection with the motor.

The following are results of experiments that have been recently carried out by the author, in conjunction with Mr. H. Panton, on the actual power absorbed by various machine tools in doing their work. The figures are extremely interesting, as showing the very small amount of power absorbed by the different tools when doing their work:—

Table of Electric Motor Tests taken at the Works of Messrs. Dorman, Long & Co., Middlesborough.

Description of Machine.	Driven by Engine capable of Indicating.	Replaced by Motor capable of Indicating.	Voltage at Generator.	Voltage at Motor.	Current taken by Motor.	E. H. P. absorbed in doing Work.
	H. P.	H. P.			Amperes.	%
Group of machines as under:— Three cold saws; Two ending machines; One saw sharpening machine	27	10½	120	115	70	10·7
Troughing straightening machine	14	3½	120	118	12	1·9
Double-ended punch, punching four holes one side one other	14	5	120	115	25	3·7
Straightening machine, all sections	14	3½	120	115	15	2·3
Straightening machine, biggest sections	16	3½	120	115	35	5·4
Cold saw, 26 inches diameter	9	3½	120	110	15-27	2·2 3·9

The saving in coal effected on above machine tools amounted to 30 tons per week, after the adoption of the electric system.

The author now wishes particularly to draw the attention of engineers to the concentration and distribution of power in works by means of electricity, and in order to fully demonstrate his ideas on this subject he has had two diagrams prepared, one showing the various cases of power transmission one meets with at an old works, and the other showing the way in which these works could be remodelled, and what savings could be effected by a judicious application of electric power. Of course the works represented above are purely imaginary, but it will be found that almost any works will contain some or other of the examples of power transmission depicted on this plan. The plan contains examples of power transmission met with in iron and steel works, engineering shops, shipbuilding yards, etc. In the case of the old works there are examples: 1. Of a large number of scattered steam engines; 2. long lines of shafting and belting in the various shops; 3. considerable lengths of steam pipes; 4. separate and scattered groups of boilers; 5. low pressure steam; 6. old or uneconomical engines, especially in the smaller sizes; 7. intermittent character of the work.

Turning back to these cases, it is very evident to all engineers the great economy which would be realised if all these scattered engines could be concentrated in one large and highly efficient engine. The amount of coal taken per unit of work done would necessarily be very much less, and in replacing these engines by electric motors the services of a large number of men could be dispensed with.

Taking the second case of shafting and belting, the author thinks that few engineers really realise what is actually lost in the transmission of power through long lines of main shafting, counter shafting, pulleys, belts, etc. The power lost has often been ascertained to vary between 30 and 69 per cent. of the total power transmitted.

In the case of long steam pipes, it is a difficult matter to entirely prevent condensation, and one is always liable to leaky valves and joints. With separate boilers, this of course entails extra men to attend to the firing. With low pressure steam, it is impossible to use the economical class of engine one could do with high pressures. In many large works the auxiliary engines are often found to be of an uneconomical nature. The work carried out is frequently of an intermittent nature, and machines which should be stopped when not in use are left running.

The author will now proceed to demonstrate a manner in which these old works could be entirely remodelled so as to effect an enormous saving both in coal consumption, wages, and upkeep.

The first thing to be done is to make a general survey of the whole works, and to have as many engines indicated as possible. Where this cannot be done it would be advisable to lay down a small temporary installation of an engine and dynamo, with a motor which could be transferred from one machine to the other, in order to ascertain accurately the exact power absorbed by the

*Iron and Steel Institute of Great Britain.

machine in question. In this way an accurate opinion could be formed of the amount of power actually required for operating the different machines throughout the works.

Having arrived at the total horse power absorbed by all the scattered and outlying machinery, it is advisable to divide this into, say, two units of power. If the total power involved is 1000 horse power, this would mean that it would be advisable to have two units of 500 horse power each.

The reason why so large a power is selected as unit is that in electric power installations the load diagram will be found to be of quite a different nature to that of an electric lighting station, which exhibits a more or less constant rise and fall according to the time of day, whilst the load line in an electric power station is of a very different and fluctuating nature, varying at times between a quarter and full load, half load and full load, and so on. It is necessary, therefore, both for simplicity in working and for economical reasons, to have a steam dynamo capable of giving out current for at least half the installation. It would be necessary in the case of the five small machines to keep them all running, even if the load was only 25 per cent. of the total, in case at any moment the load should suddenly rise. This practice has been adopted in nearly all large power installations on the Continent, and the author cannot help feeling that it is the right one.

In the case of works where waste furnace gases are available, the evident site for the generating plant would be in close proximity to these furnaces, in order that the boilers of the generating plant might be fired by the waste gases, the cost of the production of the electric current being thereby reduced to a minimum. Should there be no waste furnace gas available, the generating plant should then be placed close to the main battery of boilers in the works, and if these boilers are of a pressure below 80 pounds, it will be found economical to lay down entirely new boilers of say 150 to 180 pounds pressure.

Having settled on our site, the next question to be decided is the form which the generating plant should take. In the case of a unit as large as 500 horse power, one out of three alternatives may be resorted to; a compound condensing Corliss engine running at 80 revolutions per minute, with a multipolar dynamo, built up after the Continental fashion with the armature forming the fly-wheel of the engine, may be employed. Great confidence may be placed in a plant of this description, but the initial cost is comparatively a large one, owing to the large dimensions of the dynamo, and the slow speed at which it runs. If this speed were doubled, and an engine running at say 160 revolutions a minute taken, it would be possible to employ a triple expansion marine engine provided with condensing arrangements. A great reduction will be effected in the cost of the dynamo, and an engine of this type should work with great economy. It will be found necessary, however, to provide this marine engine with proper automatic expansion and regulating gear, owing to the variations in load and the necessity of absolute steadiness in running. The third alternative is still further to increase the speed of the dynamo, and to employ an engine of the high speed type, similar to those adopted in our electric lighting stations. These engines would run at about 300 revolutions per minute, thereby doubling the previous speed of the dynamo, and again reducing its cost. These high speed engines would be of the triple expansion type, and provided with condensing arrangements. Their consumption should not exceed 15 pounds of steam per indicated horse power per hour. In any case, the plant to be laid down should be of the steam dynamo type, that is to say, steam engine and dynamo combined on one and the same bedplate, and direct coupled.

Having taken a decision as regards the generating plant, it is necessary next to consider the actual application of the electric motors themselves to the various machines, and the distribution of the power generally. According to the character of the works, the main conductors would be carried either overhead or in a culvert underground, and, in order to keep down the cost, should be, if possible, bare copper, uninsulated. As works which have not a greater extension than 300 or 400 yards in length are now under consideration, the voltage which will be employed will be of a low tension.

In this manner can not only the whole of the power be run off the one single generating plant, but the entire lighting, both arc and incandescent, of the works themselves. The author considers that the voltage in such a case should be 120 volts. If the distances are too great to allow of this, owing to the expenditure in copper, the voltage could be increased to 500 volts. In iron and steel works, however, the low voltage is for many reasons preferable, as it is far easier to maintain a high insulation on a low voltage system than it is when a high voltage is employed. In all cases where new machinery is ordered for extensions or otherwise in the works, it would be preferable to embody the electric motor in the actual construction of the machine tool itself. In the case of old works, this is hardly feasible, and the next best thing to do is to drive direct by belt on to the fly-wheel of the machine in question. The motor itself, in the case of machines having to start up against any sudden or heavy load, should be of the shunt-wound type, with the shunt coils permanently excited off the line. Every motor should be provided with a starting and stopping resistance switch, by means of which the current could only be thrown gradually on to the machine, thus ensuring slowness and steadiness in starting up, and avoiding any sudden rises of voltage in the magnet coils, owing to instantaneous breaking of the circuit. Every motor should be enclosed with a suitable covering to protect it from damp or dust, and should, if possible, be kept under lock and key, only an authorised attendant having access to the motors. The author has found the use of carbon block brushes almost indispensable with motors, and especially with those that have to run in both directions. The oiling arrangements of every motor should be perfect.

Supposing that the whole of the outlying machinery is actuated by electric motors, and that motors have been substituted for the engines and boilers on the overhead and locomotive cranes, that the driving power in the fitting shops and other places where shafting is employed has been split up, and that separate motors have been applied to the various counter shafts, the following are the practical results which will have been obtained by remodelling the old works on the lines described and shown in diagram No. 2.

Coal Consumption.—The total efficiency of the new installation, provided that the distances involved do not exceed 500 yards, should attain 75 per cent. The loss of 25 per cent. would be made up as follows:—

Loss in main generating dynamo..	7 per cent.
Loss in the mains..............	3 "
Loss in the motors........	15 "

In many works where the engines are very much scattered, it will be found that the coal consumption per horse power of work turned out will amount from 8 to 15 pounds of coal and even more. Although a great reduction in the coal consumption will be effected through the use of the improved class of machinery employed and means for transmitting the power generated, there is another way in which the coal consumption can be further decreased, and that is by the instantaneous switching off of the motors when not in use. Many of the outlying engines in the old works will no doubt have been left running when not actually employed; and even when not running a considerable quantity of steam may have been escaping from them or from the steam pipes leading to them. Unlike steam, the moment a motor is switched off, electric current ceases to be generated, and the small loss in conveying the power through cables instead of steam pipes is a matter evident to every engineer. In the case of the remodelled works, the coal consumption at the end of a year's work will probably be found to be one-half, or even less, of what is was previously, before the adaptation of electricity.

It is advisable that in every case the electric lighting of the works should be combined with the power, current for the lighting being obtained from the same generating dynamo. In looking at a total coal consumption, it must be remembered that the considerable proportion of this goes towards the electric lighting. Previously the works may have been lit either by gas, oil, or lucigen lights. In the case of the remodelled works, the lighting would be carried out in the yards by means of arc lights, in the fitting and engineering shops by means of inverted arcs, and in offices and such places where arc lighting is not suitable, by means of incandescent lighting. The cost of coal consumed in producing electric light for the whole of the works, should compare very favorably with that of gas and oil lighting previously employed.

Wages.—The next point to be considered is that of wages. It is evident that by the entire suppression of the scattered boilers, the services of a considerable number of stokers can be entirely dispensed with. This is also the case with those steam engines which require an engineer to run them. It is also probable that more men will have been employed in looking after the gas and oil lighting, than will be required for the electric light. The motors can be kept practically under lock and key. Should anything go wrong with them, this will be at once indicated on the instruments in the engine room, and an attendant can go from there to see what is the matter. The motors, therefore, in no way involve the necessity of special attendants, and one man to see that they are properly oiled and the brushes set, is all that is required. For powers up to 500 horse power, one stoker, one engineer, and one electrical attendant, is all that should be required at the generating station per shift. It will therefore at once be seen, in comparing diagram No. 1 with diagram No. 2, that the wages of a large number of men could be entirely dispensed with, owing to the application of the electric system.

Upkeep.—We have now a further point to consider, and that is the question of upkeep of such an electrical installation. The upkeep on electric power installations which have already been running over three years, involving the use of a large number of motors, arc lamps, etc., has proved that this can be safely estimated at something under 5 per cent. on the total capital expenditure of the electric installation. No hard and fast rule, however, can be laid down for the exact cost of upkeep, as this must necessarily vary with the different classes of works to which electricity is applied. It is clear, however, that the maintenance of bare copper conductors must be very much less than that of a large system of steam pipes, lines of main shafting, ropes or belts, which have hitherto been employed as a means for transmitting the power, from the generating source to the spot at which the power is actually applied. The depreciation on the copper cables should therefore be very small. As to the upkeep of the electrical machinery itself, nearly everything depends on the cleanliness with which this is kept. If properly attended to, the only wearing parts requiring renewal will consist of bearings, brushes, and commutator, all of which can be replaced for a very small outlay. These renewals compare very favourably with renewals in steam engines, shafting, gearing, etc. The cost of upkeep of a well considered electric power installation shoul therefore be very low; and, indeed, many proofs are forthcoming that this is actually the case.

Control.—The author thinks that one of the most important features in connection with electric power installations is the absolute check or control one has over the coal consumption and running expenses at the works. It is advisable, where possible, that circuits from all motors or groups of motors should be taken direct to the generating station, that on each of these circuits a separate ammeter should be placed, which will indicate the exact power taken by any of the machines at any time of the day. With a little practice, the man in charge at the engine room can tell from the various indications on the measuring instruments almost exactly what the various machines in the works are doing—whether standing idle, or whether working up to their full power or not. By means of an automatic registering ammeter placed in the main dynamo circuit, the total amount of power going off into the works will be recorded on a card; and the coal consumption for the day having been kept, the cost of production per unit of electrical energy can be ascertained. Owing to the self-indicating nature of electrical motors, in this and other ways, can a most perfect check be kept on the running expenses of the electric power plant, and the slightest loss due to leakage or undue resistence in any part of the electrical apparatus can be at once detected and remedied.

Rolling Mills.—It is quite within the bounds of possibility that electricity may find a new opening in its application to driving the lighter class of rolling mills. The result, as far as economy in steam consumption is concerned, would show a great saving on methods formerly employed. The saving would be arrived at in the following manner: Instead of the present form of engine used for actuating the rollers, which is necessarily of a somewhat uneconomical nature owing to the work it has to perform, and in which the cut-off is of a very imperfect character, an engine could be laid down on the most highly economical principles, working at a high pressure, with three expansions of steam, and taking not more than 1½ pounds of coal per 1 horse power per hour. This engine would be coupled direct to a dynamo of suitable power, and the steam dynamo generator would be kept running continuously. On each set of rollers would be directly coupled an electric motor. The switching apparatus would be worked by means of hand and foot levers, almost in identically the same manner in which the steam is shut on and off existing rolling mill engines.

An electric motor may be considered as an elastic coupling in itself, and provided that the power furnished to it is sufficient, it will revolve when the necessary torque has been obtained. The jar, however, would be furthermore reduced by mechanical methods of coupling, and the wr ter does not anticipate any difficulty in being able to obtain a motor which would resist such strains as would be put upon it. The switching apparatus, however, would require carefully planning out and constructing, in order to withstand the rushes of current which would take place through the apparatus, but here again there is nothing that cannot be overcome.

The main advantages, however, to be derived from the electric system, would be the following:—

1. The question of dead centres would be practically eliminated. An electric motor in itself, unlike a steam engine, having no dead centre. The main engine driving the generating dynamo being kept continuously running, the difficulty of dead centres would be overcome there also, the result being that the total size of the engines employed would be considerably reduced, as in the present case it is necessary that either cylinder of a rolling mill engine should be capable of starting the rolls from nothing to full load, in case one of the engines should be on its centre.

2. Owing to this new arrangement of driving, a totally different class of engine could be employed to what is now used, and instead of using 7 to 8 pounds of coal per indicated horse power owing to its imperfect cut-off, the coal consumption should be reduced to 1½ pounds per indicated horse power.

3. A considerable number of small mills could be actuated in totally different parts of the works by means of the one generating engine and dynamo, and would thus save wages and upkeep over several smaller engines scattered about.

4. The whole of the auxiliary engines required for working the live rollers, elevating, or transverse gear, overhead cranes, etc., could be replaced by electric motors all worked off the one generator.

5 Great economy in steam consumption owing to concentrating the production of the power in one spot, under highly efficient conditions.

In speaking of the above applications the author does not, of course, refer to the heavier class of rolling mills, which absorb several thousands of horse power, but firmly believes that as regards the lighter class of mills there is a future for the application of electric power, the great advantages to be derived being the large economy which could be effected in coal consumption and wages.

There is another point that should be taken into consideration when laying down an electric power installation, and that is, the small size of the motors themselves, which, owing to the rotary and not reciprocating motion, only require light and inexpensive foundations. The same thing applies also to the foundations required for the central generating plant.

Engineering Works and Shipbuilding Yards.—The same arguments apply to the application of electricity to engineering shops and shipbuilding yards as have already been cited. In shops where the work is of a very intermittent nature, it would be an economy to drive the larger machine tools by separate motors, and there is do doubt that in the near future manufacturers of machine tools will turn their attention to embodying the electric motor in the actual construction of their tools. Where the tools are of a lighter character, economy will result from doing away with the main shafting, and applying motors, at the intersection of this with the secondary lines of shafting, and in other ways subdividing the power and running the various machines, as far as possible, independently one of the other.

The following table, calculated by Mr. Félix Mélotte, shows a very interesting comparison between the efficiencies, obtained on a varying load, of electrical and mechanical transmission of power :—

Electrical Transmission.						
Load on the engine	1000	750	500	333	250	200
Constant frictional loss	50	50	50	50	50	50
Variable electrical loss	50	27	11	4·5	2·2	1·2
Total loss in dynamo	100	77	61	54·5	52·2	51·2
Available power of dynamo	900	673	439	278·5	197·8	148·8
Efficiency, per cent	90	89·7	87·8	83·5	79·1	74·4
Loss in conductors	18	10	4	1·7	0·8	0·5
Energy available at motor terminals	882	663	435	276·8	197	148·3
Of which, 6 per cent. frictional loss	53	53	53	53	53	53
4 per cent. variable loss	35	20	8·5	3·4	1·7	1
Total loss in motor	88	73	61·5	56·4	54·7	54
Power available	794	590	373·5	220·4	142·3	94·5
Final efficiency, per cent	79·4	78·7	74·7	66·2	57	47·2
Mechanical Transmission.						
Load on engine	1000	750	500	333	250	200
Loss in shafting, etc	206	206	206	206	206	206
Useful effect	794	544	294	127	44	0
Final efficiency, per cent	79·4	72·5	58·8	38·1	17·6	0

From this table it will be seen that the two systems of transmission, which at first appear to be equivalent, become very different as the load diminishes. Thus, when only one-fifth of the power is developed, electrical transmission still yields 47·2 per cent., whilst mechanical transmission has had all its power absorbed in the constant frictional loss of 206 horse power.

In shipbuilding yards there are few machines that cannot be run electrically. The whole of the machinery usually found in the machine sheds, such as punching, shearing, bending machines, etc., saws, wood-working machinery, can all very easily be run by electric motors. Owing to their light and portable nature, there is a considerable opening for electric machines on board ships during construction. Electric power can be utilised with advantage for the drilling of ships' plates, temporary winch and derrick crane work. The author understands that it has also been successfully applied for planing wooden decks.

Results Obtained—There are few works in this country, if any, that are solely actuated by electricity. The principal applications of electric power for driving works, up to the present, may be found in the workshops of electric manufacturers themselves, who have naturally had more opportunities for investigating the advantages to be derived from electric driving.

In order to give some idea of results actually obtained in the running of works for a considerable period, the author will take some figures from electric power installations carried out in Belgium, which have now been running some three years, cases in which the entire works have been actuated solely by electric power. This information may possibly be of interest to the members of the Iron and Steel Institute, who before long will be paying a visit to Belgium. One of the first, and perhaps most important, electric power installations that has been laid down in that country, is that of the National Arm Factory at Herstal, near Liége. It would be impossible in this paper to deal with a full account of this installation. The plant in the first instance consisted of a 500 horse power compound Corliss engine and multipolar dynamo combined, the armature acting as fly-wheel of the engine. The Arms Factory is solely and entirely driven by electricity derived from this one dynamo, which provides at the same time the whole means of illuminating the works. Until about nine months ago there was no other engine or dynamo on the place. Some 2000 hands are employed, and have been dependent for over two years on the running of this one dynamo. There has been no stoppage from the day of starting the installation up till the present time. About nine months ago another 300 horse power was put in. This, however, was not to act as reserve power, but to supply power for extensions which had been made to the factory. The steam consumption of the engine is 13 lbs. of steam per indicated horse power. The total efficiency, reckoning from the indicated horse power of the engine, has proved itself to be 71·3 per cent.

Following the example of the National Arm Factory, the Belgian Government decided to remove all the steam engines and boilers from the Royal Arm Factory at Liége, and to replace them by electric distribution. It was ascertained that for a certain portion of the work which, previous to the introduction of electric driving, had taken 3 tons of coal per day, this was found to have immediately come down to 900 kilogrammes, or less than 1 ton, for the same amount of work done.

About a year and a half ago a 100 horse power dynamo and six or seven motors were laid down at the glass works of the Val St. Lambert, Belgium, the total efficiency attained coming out to 75·5 per cent.

At the zinc works of the Veille Montagne Co. a large electric power installation has lately been laid down, by means of which these old works will be entirely remodelled, every engine and boiler on the place being done away with. The power at present installed consists of a 600 horse power dynamo and compound Corliss engine combined, running at a speed of 80 revolutions per minute, and wound for a voltage of 500 volts. The following are the number and sizes of the motors employed in this installation :—

5	motors of	1	horse power.
7	"	2	"
6	"	3½	"
6	"	5	"
4	"	7	"
2	"	10½	"
4	"	14	"
2	"	45	"
1	"	64	"

The following additions are now being made :—

1	motor of	80	horse power.
1	"	14	"
5	"	1	"
1	"	10	"

Another section of 600 horse power is provided for. The engines have been specially built by the Société Cockerill, and the dynamos by the Compagnie Internationale d'Electricité, under the direction of their chief engineer, Mr. Henri Pieper. Babcock & Wilcox boilers are used, and the steam engine takes from 13 to 14 lbs. of steam per indicated horse power. The efficiency of the engine is 90 per cent., that of the main generating dynamo 90 per cent. at full load, and the efficiency of the distributing cables, also at full load, is 98 per cent.; the average efficiency of the motors is 86 per cent., and the commercial efficiency of the whole installation is there ore 68·5 per cent., that is to say, the proportion of work done to the indicated horse power of the steam engine. A continuous current transformer is used to reduce the voltage from 500 to 100 volts for lighting purposes.

Several works in Germany and Switzerland are also operated solely and entirely by the electric system.

CONCLUSION.

Taking into consideration all that has been stated in the preceding pages, it will be seen that electric power is destined in the near future to become an important factor in the iron, steel, and engineering trades. Whether applied for the purpose of long distance transmission at the mines, or for short distance transmission and concentration of power at works, great economy will be realised in wages, fuel, and upkeep, over methods hitherto employed. Old works can be remodelled with advantage, as shown in the cases of the Royal Arm Factory and the Veille Montagne Zinc Works in Belgium, and the case of Messrs. Dorman, Long & Co's Steel Works at Middlesbrough, and what possibilities lie open to those contemplating laying down entirely new works! The author was fortunate a few months ago to come across a company who were about to lay down entirely new works, and finally succeeded in getting them to promse to look into the electric power question thoroughly before taking any definite decision as to what power they would adopt for their works. Some four months were spent in visiting power installations in this country and abroad, and the electric system was minutely compared with steam and gas, actual experiments were carred out, with the result that the Bedson Wire Company finally decided on adopting electricity as their sole power for manufacturing purposes.

These works in many respects are so entirely novel, the question of economy has been so minutely gone into, that the author belives that Mr. Bedson, in the course of a few months, will be able to publish a record in working efficiency and steam consumption which has seldom, if ever, been equalled. Messrs. Bell Brothers, of Middlesbrough, who have also been taking great interest in electric power question for some time past, are installing electric power at their Clarence Works.

There are, no doubt, many of the author's colleagues in electrical work who could add many interesting examples of electric power applications in this country.

The author trusts that in the foregoing paper he has shown that electric power has passed out of its experimental stage, and should he have been so fortunate as to have provided a subject worthy of interest, and subsequent discussion by the Iron and Steel Institute, his task will have been amply accomplished.

Pneumatic Electric Coal Cutting Machine.

At a recent meeting of the Manchester Geological Society, Mr. Joseph Crankshaw read a paper describing Hurd's pneumatic electric coal cutting machine. He said that the president of that society, in his address at the opening of the session, mentioned the fact that coal cutting machinery had not been adopted on a large scale in this country, and it was strange that, while mechanical was superseding manual labour in so many branches of industry, and while they were doing everthing they possibly could to improve their appliances for pickin., screening, winding and hauling the coal, and ventilating and lighting the mine, the actual tool for extracting the coal—viz., the collier's pick—was practically what is was a hundred years ago. He thought that not only for the sake of economy, but in the cause of humanity, it was a reflection upon the enterprise of Lancashire that there was not a single coal cutting machine at work in the Manchester district to-day, and he ventured to bring the subject before the society, not from any special knowledge he had upon it, but in the hope that his action might, if only to a feeble extent, stimulate thought upon the subject.

In considering the subject of motive power for coal cutting machines, he stated there are three methods of driving to choose from, viz., steam, compressed air, and electricity, but the heat from steam and the difficulty of dealing with the exhaust in the workings practically reduce the choice to compressed air and electricity. There is much to be said in favour of compressed air; it is safe and helps to cool and ventilate the workings, but the loss in transmission is very great. The machine, briefly stated, consists of a cutter bar drill and an electric motor, connected by suitable gearing. The combined forged or cast-steel cutters bar drill, with separate chilled steel or chilled iron cutter fixed on its end along its fluted or twisted periphery is actuated by the motor, and is caused to revolve and reciprocate in a twisted or rifled sleeve having a key cast in it, which fits the fluted or twisted cutter bar drill; the sleeve forms the wheel boss, by which it is driven through suitable gearing from the motor shaft. The driving wheel may be cast or keyed on the sleeve or wheel boss. A number of dovetailed recesses are formed at intervals along one edge of the twisted groove, and holes are drilled from such recesses transversely through the bar. The cutters are formed to fit the recesses, and are retained in position by a split locking shank, which may be separated from or attached to the cutter, and the head of which, when made in one piece with the cutter, springs into a countersink formed at the outer end of the transverse hole; the end cutter is of slightly modified auger form.

When the machine is brought up to the face of the coal or mineral to be operated upon the cutter bar drill is set in motion, and while revolving is fed into the face by an automatic or hand-feed motion, in which latter case a circular or screw rack is cast or cut on the cutter bar or otherwise combined therewith, a pinion being arranged to gear into the rack. When the cutter has entered to the depth required, it is locked by the reciprocating motion here and all strain taken off the feed gear. The reciprocating motion is obtained preferably by forming on the sleeve a worm thread, into which gears a worm wheel, carrying on its gudgeon two crank pins, which actuate two rocking levers. Fitting around the sleeve between two or more shoulders is a thrust block in halves, each half being coupled by a right and left hand screw. These divided thrust blocks are fitted to connecting rods operated by the rocking levers, which imparts the reciprocating motion of the latter to the cutter bar drill when the thrust block and drill are connected. The machine is traversed forward along the face of the mineral by means of a snatch block and a hauling drum, chain wheel or connecting cranks, and rods mounted on the axis of a switch, the casing of the latter being fixed to the front trunk of an electro-motor, and the hauling drum, or chain wheel and connecting cranks and rods, is or are driven from the motor shaft by means of worm gearing and friction cones. The cutter bar drill at the same time revolves, thus cutting away the coal in front of it, while its reciprocating motion assists in breaking up the coal and dislodging any lumps of pyrites that may be met with. In order that the coal or mineral may be nicked on end to expedite the breaking down of the mineral when undercut, the cutter bar drill, with its sleeve and feed gear, are carried by a separate casting carrying the bearing for the motor shaft, and which is arranged so as to make a whole or partial revolution around the motor shaft. By this arrangement the machine is also enabled to cut either right or left hand thus dispensing with the costly left-hand cutting arrangement required in other machines.

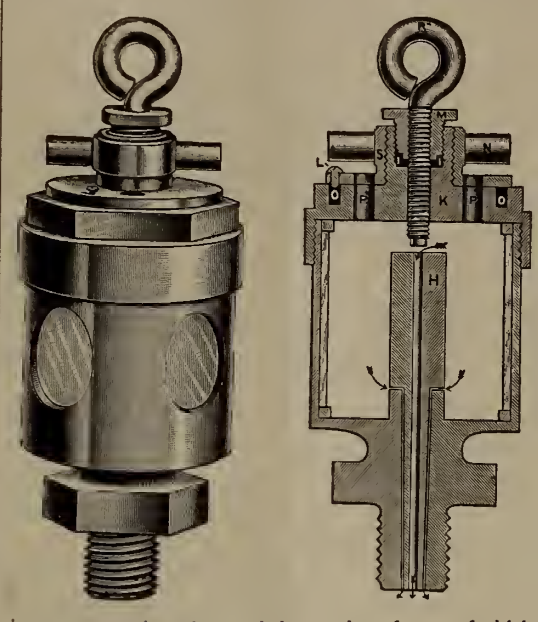
In ordinary machines the vibration when at work is very great, but this is greatly reduced by fixing or constructing the journal to carry the cutter bar drill at an angle of about 80 degs., with the rails in the direction in which the machine is moving, thus causing the machine to hold itself well up to its work. To take out the cuttings made by the cutter bar drill a clearing bar is used, preferably U shaped in section, set at an acute angle to and behind the cutter bar drill, and fixed to the machine by suitable means when at work. The cuttings are caused by the forward motion of the machine to slide along the face of the cleaning bar, and are deposited between or at the side of the rails as the machine proceeds. Irregularities are removed from the face of the mineral and from the floor by means of a fixed cutter attached to the journal casting of the cutter bar drill, and forming at the same time a cover for the thrust lock gear. This fixed cutter has a cutting edge to clear the bottom, and an inclined cutting edge to remove projections on the face of the mineral, sufficiently high to clear the cutter bar bearing. The fixed cutter is also formed with an inclined groove, so arranged as to carry the cuttings back over the cutter bar front journal to the rear of the machine. The machine is thus enabled to proceed with its work without stoppages. In using the machine for tunnelling or sinking a slight modification is necessary.

The danger of working an electric motor in an explosive atmosphere has been overcome in the novel manner which has given the machine the name of pneumatic electric. The motor and all the moving parts of the machine, except the drill, are enclosed in a neat insulated casing, both air and water tight. The wires conveying the electric current are enclosed in a flexible tube, which also carries a supply of compressed air, which enters the machine along with them. The motor is thus immersed in a bath of cool, dry, compressed air, which is kept constantly passing through every part, and is discharged into the atmosphere of the mine at the pressure of 15 pounds to the inch, which effectually prevents anything from the mine getting into the machine, and also helps to cool and purify the air. The coal cutting mechanism can be detached, and the motor used as a locomotive for hauling the coal along the main roads. At collieries where electric and air compressing plant are already at work the motor power can be taken from them; but Mr. Hurd has also patented a direct-activity engine for driving the dynamo, and an air pump for the compressed air is worked from the same shaft, so that the whole of the power for the machine can be derived from the same self-contained engine. Mr. Hurd has also designed special rails for the machine, made of malleable cast steel in one yard lengths, and with steel sleepers. The machine as a whole has a strong, neat, workmanlike appearance, and gives one the impression that it will stand the rough and tumble of the mine, from ironstone modules in the coal, to falls of roof on the face, without much damage. Among its advantages are the following: It not only undercuts the coal, but nicks on end, and will cut either right or left hand, while the drill can be instantaneously withdrawn to sharpen the cutters and another as quickly inserted; the self-acting scoop fills the holings into bags straight from the face; the exhaust air helps to ventilate the mine; electric lamps can be attached to it for lighting the working place; and it can be used as a locomotive.

Mr. C. Cookson said he should not like the impression which seemed to be conveyed by the opening portion of the paper read by Mr. Crankshaw, to the effect that colliery owners had not done all in their power to provide the best appliances for the safe working of their mines, to go forth without some remark. The reason why coal cutting machinery had not been more largely adopted in the collieries throughout Lancashire was not because of any prejudice against them, or unwillingness on the part of the coalowners to adopt them, but simply because inventive engineers had not produced machines that would work successfully with the bad roofs they had in most of the mines. He had worked with several of the machines, and had not found them suitable for working the mines in the district. The machine described, however, seemed to him to be an effective one, and, subject to the question of satisfactory arrangements, he should be disposed to try a machine of that description in one of their mines. It was not so much a question of diffidence on the part of the coalowners to the introduction of these machines as of obtaining a machine which would satisfactorily and efficiently do its work.

A New Crank Pin Oil Cup.

There has always been a demand among engineers and engine builders for a Crank Pin Oil Cup, which will give a steady flow of oil in just the right quantity to keep the crank pin from heating, while not allowing sufficient oil to pass to it so as to cause a waste. Many schemes have been devised for effecting this result, but up to the time the Penberthy Injector Co. placed their Safety Crank Pin Oiler on the market, about two years ago, there has been nothing devised that was entirely satisfactory. Cups have been made which would insure a steady flow of oil, but many of them were so constructed that when in use the oil would be thrown out of the top of the cup, and others were very easily clogged by dirt. The Safety Cup met with a very rapid sale, owing to its simplicity of construction, and its very satisfactory operation. The Penberthy Co., however, is noted for never being satisfied until the articles which it manufactures are as perfect as skill and ingenuity can make them. Recognizing the fact that their cup, as originally made, had one or two weak points about it, they set to work to remedy these defects, and have recently produced their improved Double-Feed Crank Pin Oiler, which we illustrate herewith. The



improvements have lessened the number of parts of which the cover is composed and have also simplified the construction of the cup, while at the same time allowing of a much finer regulation than any other cup made. A careful reading of the following description will show the points wherein the cup is superior to others.

H is the plunger, which rises and falls with the motion of the engine, forcing part of the desired amount of oil to the crank pin, while at the same time the oil is flashed on top of the plunger and passes down through its hollow center, thus giving two distinct and separate feeds, so that in using this cup there are two chances against its feed becoming clogged. K is the cover of the cup, containing two passageways P, P. One of these is to allow the oil to enter the cup, and the other is the vent hole by which the air in the cup passes out. On top of the cover is an escutcheon S, operated by means of a handle N passing through it. When the cup is in operation, this handle is turned hard to the right, bringing the holes in the escutcheon out of line with the holes in the cover of the cup, and the escutcheon being threaded and turning on a corresponding thread on the cup cover, allows of an absolutely tight seat being made between the escutcheon and the cover, so that it is impossible for the oil to spill out while the cup is working. To fill the cup, the handle N is turned to the left until the holes in the escutcheon and the cover are in line, when the oil can be quickly poured in from a spring bottom can, and as the air is allowed free vent through the vent hole, there is no spilling of oil possible with ordinary care. In this manner the cup is filled without changing the regulation in the least. The screw L, passing through the escutcheon allows it to turn to the left just a sufficient distance to bring the holes in line. The feed is regulated by the regulating screw R, which admits of a regulation as fine as $\frac{1}{1000}$ of an inch or less. This regulating screw passes through the stuffing nut M and through the packing I, in the same manner that the stem of a globe valve passes through its stuffing nut, and the tension on the regulating screw is altered by turning this stuffing nut M same as the packing is tightened or loosened on a globe valve.

As will be seen, the cup is simplicity itself, and it is impossible to get it out of order. The plunger H having a square shoulder against the bottom of the cup, the oil stops feeding as soon as the engine stops running, and there is therefore no waste. Owing to its fine regulation, it can be set to feed just the desired amount of oil, and with the proper size cup it can be so regulated as to run for a half day or a full day as desired, so that the engine need never be stopped to refill the cup, and the only attention required from the engineer is to fill it at the proper time, as it does its work automatically. This cup has been adopted by several of the largest manufacturers of threshing engines in the United States, and also by several large engine builders, and wherever introduced is meeting with a rapid sale.

The manufacturers, the Penberthy Injector Co., of Detroit, Mich., will be pleased to send descriptive circulars and quote prices on application.

Disputed Mica Ownership Settled: The Court of Review, Montreal, on 30th ulto, gave judgment in the cases of A. W. Stevenson vs. Wallingford, and Gilman and Hatch, et al, defendents en garantie, confirming, with costs, the decision of Judge Gill at Alymer by which Mr. Stevenson was declared the owner of the mining rights in dispute and was awarded the sum of $3,300 for the value in the ground of mineral extracted by the defendents without his permissson. The cases were of especial interest, both to mining men and to the legal fraternity, as they involved several intricate questions in regard to the mining law of the Province of Quebec, as well as on account of the value of the property. The property was purchased, prior to the suit, from Mr. A. W. Stevenson, Montreal, by the Lake Girard Mica System, Ottawa. It is situated in the Templeton district and contains valuable deposits of large sheet mica.

The Copper Trade.

In their fortnightly "Statistics of Copper," Messrs. Henry R. Merton and Co., of London, Manchester, and Birmingham, gave the visible supply for England and France, including copper afloat from Chili and Australia, as 49,153 tons on June 15th. These figures show an increase of 1,573 tons in the available stock during the fortnight, and the quoted price of Chili bars and G.M.B's, £38 per ton, shows a furthrr fall of 17s. 6d. per ton within the same period. The continual decline of the price of copper, regardless of the statistical position will, however, be best seen from the following table, showing the visible stocks and the prices at various dates:

	Visible Supply Tons.	Price. £ s. d.
May 31, 1891	58,258	55 5 0
May 31, 1892	53,965	46 7 6
May 31, 1893	49,951	43 2 6
May 15, 1894	46,259	39 10 0
May 31, 1894	47,580	38 17 6
June 15, 1894	49,153	38 0 0

It is true that the decline during the past four weeks has been coincident with some increase of stocks, but a glance at the figures for previous years shows that with falling stocks prices have also fallen. Thus with the stock now nearly 16 per cent. less than at the end of May, 1891, the price is about 31 per cent. less. The latest mail advices from the United States intimate that orders had meanwhile, that is since the beginning of this month, been placed for quite a large quantity of Lake Superior ingot copper for delivery several months ahead, the amount thus contracted for being estimated at about 10,000,000 pounds, and the price 9 cents per pound, or, say, about £41 5s. per ton. These transactions, it is stated, have served to unsettle the market. There have been exceptionally large exports of ingot copper from the United States to this country and the Continent during the past year, as will be seen from the following table showing the figures for the first 10 months, July to April inclusive, of the fiscal years 1893-4 and 1892-3 respectively:

	1893-4. lb.	1892-3. lb.
To United Kingdom	61,069,038	2,308,259
" Germany	21,164,702	2,863,142
" France	26,619,864	9,769,766
" Other Europe	59,427,139	9,261,520
" Other countries	617,311	209,252
Total	168,838,054	24,411,939

The American Nickel Market in 1893.

The nickel trade in 1893 differed considerably from preceding years, as consumers found no difficulty in getting what they needed, while before they had often been hard put to secure supplies, the question of price not considered. Then it was the custom to make contracts calling for deliveries a long time ahead, the terms of such contracts not being allowed to become generally known. This year it has not been so, as what was left over from the supplies contracted for 1892, together with what was readily obtainable, was amply sufficient to enable the manufacturers to fill all demands for German silver, while the nickel plating business, like many another, has been almost at a stand still.

In previous years almost all the nickel came from abroad, although there was one producer at home, in the interior, who now produces chiefly from Canadian ores, selling under the old time brand. The new factor in the market has been the Canadian Copper Company, whose product being placed upon the market, to compete with any and all others, caused the foreign makers to reduce their prices, which, at the opening of the year, were about 60 to 62 cents, while at the close they are but 52 to 53 cents, American refined nickel being quoted at 45 to 47 cents.

Most of the nickel produced in this country from Canadian ores has been exported to Europe in the form of oxide of nickel, for which a ready market, notably among the iron and steel industries, has been found. *The Mineral Industry*, 1893, vol. II.

Repairing a Broken Pipe in a Mine.

An interesting expedient was adopted in replacing a broken length of pipe at the Claycross Colliery, described as follows in a mining journal: The pipe in question was the discharge pipe from a set of pumps, and was carried vertically up the shaft, its length being about 420 feet and its diameter 6½". The break took place in the lower portion of the pipe; and to make the repair it was necessary to raise the column slightly. To this end a couple of balks were put across the shaft at a height of 70 feet above the pumps. These timbers formed a support for a sleeve which could be clamped to the pipe. By turning steam in the pipe the latter was warmed and expanded, and it was then clamped by the sleeve. The bolts being loosed at the broken length; the pipe as it cooled contracted upward, leaving a 1" space at the broken joint, thus giving room for the insertion of a new section.

Compressed Air at High Pressure for Tramways.

It is not much more than thirty years since street tramways were brought into use in this country. During this period their development has gone on rapidly until there is now a large capital invested in these properties. Compressed air is used as the motive power in driving locomotive cars on a few tramways, and the same power is applied for locomotive traction in coal mines. The experience gained in working tramways may possibly be applied to the more advantageous working of locomotives underground, where long distances and other circumstances give some scope for this system of haulage. Both above and below ground the competing systems are horse traction and ropes worked by stationary engines. Besides these there are locomotives on tramways driven by electric power and steam.

For tramway service, the engineer will be guided in his choice of a system by questions of economy, safety, and convenience. Horse traction may be convenient, hut it is not generally economical, while steam locomotives are generally inconvenient and not adapted to circumstances inseparable from the traffic of towns, large and small, though it is principally in the latter where they have gained a footing. The getting rid of the exhaust and products of combustion is the chief difficulty in this form of traction.

For tramway locomotives driven by compressed air, several designs have been brought out in the past, of which the following are most noteworthy.

In Colonel Beaumont's locomotive the air was compressed to sixty-eight atmospheres, equal to about 1,000 pounds per square inch. It was compressed in four stages, passing successfully from one air cylinder to another without difficulty, the heat being absorbed to a certain extent at each stage. The first compressing cylinder was 12 in., the fourth $2\frac{1}{2}$ in. diameter. The engine itself worked on the compound principle, the storage at the above pressure consisting of seventy steel cylinders, 6 feet long, 4 inches diameter, two of the cylinders being $1\frac{1}{2}$ in., two of 3 in. and two of 7 in. diameter. The engine worked over the ordinary 4 ft. $8\frac{1}{2}$ in. gauge. Trials were made with it on the Metropolitan Railway, but the necessary plant to work the line on this system would have heen great, and made it prohibitory.

Another engine of the same type was constructed hy Colonel Beaumont to work on tramways, the gauge being 4 feet $8\frac{1}{2}$ inches. The air was compressed in four stages, up to near 1,000 pounds per square inch. The locomotive had two cylinders, to work on the compound principle, the first or high pressure cylinder being $2\frac{3}{4}$ in., the low pressure cylinder 10 in. diameter. The consumption of air at 1,000 pounds pressure was 10 cubic feet per mile.

Mr. Scott-Moncrieff's compressed air locomotive consisted of a car for passengers, the compressed air reservoirs and engine being placed underneath. There were three reservoirs at each end of the car, placed horizontally, each 7 feet 9 inches long, 2 feet diameter. In the space of 8 feet between each set of three reservoirs the engine is placed. Each reservoir was made of wrought iron, welded at the seam, the hemispherical ends were also welded to the cylindrical part; they were tested to 750 pounds pressure. The working pressure of compressed air was twenty-six atmospheres, equal to 382 pounds above the atmosphere; at this pressure there was storage for 140 cubic feet of air. As this force, at which the reservoirs were primarily charged, was continually decreasing so long as the engine continued to work, and the variation in gradients had to be dealt with, it became necessary to reduce the pressure by a throttle valve to about 100 pounds to an inch, but this meant loss of power. The plan adopted was by means of adjustable expansion valves, to be able to cut off at any part of the stroke, and thus assimilate the decrease of energy in the reservoirs to the work to be done. Expansion could be carried out to its full extent—that is, to ordinary atmospheric pressure under these circumstances; there would then be no trouble with the formation of ice, as does occur when the air escapes considerably above this pressure. In a locomotive car it is desirable to start with a maximum diameter of cylinder, affording energy to overcome the maximum resistance, as on uphill gradients, and yet to cut off early so as to have the exhaust terminate almost at atmospheric pressure. This car is stated to have performed a journey of three miles with one charge of compressed air.

M. Mekarski's pneumatic locomotive has worked well on tramways in Paris. The gauge is the ordinary one on railways in France, 4 feet $8\frac{1}{2}$ inches. The air reservoirs are thirteen in number and cylindrical. At the beginning of each journey they are charged at 25 atmospheres, equal to 367 pounds per square inch. The pressure is reduced by throttling to 5 atmospheres, equal $73\frac{1}{2}$ pounds. This is the constant initial pressure in the first cylinder of the motor, but reduced by variable expansion gear to atmospheric pressure at the exhaust of the second cylinder. Before passing the throttle valve the air is heated by steam, which increases its elasticity. This tramcar is stated to have carried forty-five persons over a distance of $4\frac{5}{8}$ miles with one charge of compressed air.

The Ryhope compressors are two 33 in. cylinders, 5 ft. stroke; the steam cylinders are 32 in. diameter. The receiver at surface is 30 ft. by 6 ft. The air is conveyed down the shaft, 518 yards in depth, through 9 in. wrought iron pipes, $\frac{3}{8}$ in. thick, to the second receiver; from thence underground to a third and fourth receiver and to the first hauling engine, which is placed 1,505 yards from the receiver at bank. This engine has two 14 in. cylinders by 22 in., geared 1 to 3. The drum is 4 ft. diameter, and a train of thirty-six tubs is brought up a steep gradient in ten minutes; each tub carries one ton of coal.

MINING NOTES.

The last clean up of the Kootenay Hydraulic Placer Mining Company, on Pend d'Oreille River, B. C., netted 22 cents. per cubic yard.

Burleigh Rock Drills are being put in at the LeRoi mine, Trail Creek, B.C.

Fifteen new claims were recorded at New Denver during the first half of the month of June.

Mr. H. E. P. Haultain, M.E., has been appointed assayer to the Alpha group of mines at New Denver, B.C. This section of the district is, and in all probability will continue to be, the busiest portion of the Slocan. The number of men employed at the Alpha group, i increased, work being carried on at the "Silverton," "Fisher Maiden," "Kazabazua" and "Wakefield," while work will shortly be resumed on the "Vancouver," "Mountain Boomer," "Read" and "Robertson," in addition to numerous assessment work.

Alex. McKenzie, manager of the Grady group, reports nearly 4,000 tons of ore in sight on the Grady and is well satisfied with the property. As soon as the railway reaches Rosebery 1,000 tons of supplies will be shipped in and an equal amount of ore sent out. Mr. McKenzie will try the experiment of shipping ore in bulk and expects to effect a saving of $6 per ton in this way.

MINING REGULATIONS

TO GOVERN THE DISPOSAL OF

Dominion Lands Containing Minerals other than Coal.

THESE REGULATIONS shall be applicable to all Dominion Lands containing gold, silver cinnabar, lead, tin, copper, petroleum, iron or other mineral deposits of economic value, with the exception of coal.

Any person may explore vacant Dominion Lands, not appropriated or reserved by Government for other purposes, and may search therein either by surface or subterranean prospecting for mineral deposits, with a view to obtaining under the Regulations a mining location for the same, but no mining location or mining claim shall be granted until the discovery of the vein, lode or deposit of mineral or metal within the limits of the location or claim.

QUARTZ MINING.

A location for mining, except for iron or petroleum, on veins, lodes or ledges of quartz or other rock in place, shall not exceed 1,500 feet in length and 500 feet in breadth. Its surface boundary shall be four straight lines, the opposite sides of which shall be parallel, except where prior locations would prevent, in which case it may be of such a shape as may be approved of by the Superintendent of Mining.

Any person having discovered a mineral deposit may obtain a mining location therefor, in the manner set forth in the Regulations which provides for the character of the survey and the marks necessary to designate the location on the ground.

When the location has been marked conformably to the requirements of the Regulations, the claimant shall within sixty days thereafter, file with the local agent in the Dominion Land Office for the district in which the location is situated, a declaration or oath setting forth the circumstances of his discovery, and describing, as nearly as may be, the locality and dimensions of the claim marked out by him as aforesaid; and shall, along with such declaration, pay to the said agent an entry fee of FIVE DOLLARS. The agent's receipt for such fee will be the claimant's authority to enter into possession of the location applied for.

At any time before the expiration of FIVE years from the date of his obtaining the agent's receipt it shall be open to the claimant to purchase the location on filing with the local agent proof that he has expended not less than FIVE HUNDRED DOLLARS in actual mining operations on the same; but the claimant is required, before the expiration of each of the five years, to prove that he has performed not less than ONE HUNDRED DOLLARS' worth of labour during the year in the actual development of his claim, and at the same time obtain a renewal of his location receipt, for which he is required to pay a fee of FIVE DOLLARS.

The price to be paid for a mining location shall be at the rate of FIVE DOLLARS PER ACRE, cash, and the sum of FIFTY DOLLARS extra for the survey of the same.

No more than one mining location shall be granted to any individual claimant upon the same lode or vein.

IRON AND PETROLEUM.

The Minister of the Interior may grant a location for the mining of iron or petroleum, not exceeding 160 acres in area which shall be bounded by north and south and east and west lines astronomically, and its breadth shall equal it in length. Provided that should any person making an application purporting to be for the purpose of mining iron or petroleum thus obtain, whether in good faith or fradulently, possession of a valuable mineral deposit other than iron or petroleum, his right in such deposit shall be restricted to the area prescribed by the Regulations for other minerals, and the rest of the location shall revert to the Crown for such disposition as the Minister may direct.

The Regulations also provide for the manner in which stone quarries may be acquired.

PLACER MINING.

The Regulations laid down in respect to quartz mining shall be applicable to placer mining as far as they relate to entries, entry fees, assignments, marking of localities, agents' receipts, and generally where they can be applied.

The nature and size of placer mining claims are provided for in the Regulations, including bar, dry, bench creek or hill diggings, and the RIGHTS AND DUTIES OF MINERS are fully set forth.

The Regulations apply also to

BED-ROCK FLUMES, DRAINAGE OF MINES AND DITCHES.

The GENERAL PROVISIONS of the Regulations include the interpretation of expressions used therein; how disputes shall be heard and adjudicated upon; under what circumstances miners shall be entitled to absent themselves from their locations or diggings, etc., etc.

THE SCHEDULE OF MINING REGULATIONS

Contains the *forms* to be observed in the drawing up of all documents such as: "Application and affidavit of discoverer of quartz mine." "Receipt for fee paid by applicant for mining location." "Receipt for fee on extension of time for purchase of a mining location." "Patent of a mining location." "Certificate of the assignment of a mining location.' "Application for grant for placer mining and affidavit of applicant." "Grant for placer mining." "Certificate of the assignment of a placer mining claim." "Grant to a bed rock flume company." "Grant for drainage." "Grant of right to divert water and construct ditches."

Since the publication, in 1884, of the Mining Regulations to govern the disposal of Dominion Mineral Lands the same have been carefully and thoroughly revised with a view to ensure ample protection to the public interests, and at the same time to encourage the prospector and miner in order that the mineral resources may be made valuable by development.

COPIES OF THE REGULATIONS MAY BE OBTAINED UPON APPLICATION TO THE DEPARTMENT OF INTERIOR.

A. M. BURGESS,

Deputy Minister of the Interor.

MINING LAWS OF ONTARIO.

ANY person may explore Crown Lands for minerals.

Mining lands may be taken up as surveyed locations or staked claims.

Locations range from 40 to 320 acres.

Claims range from 10 to 20 acres on vein or lode.

Locations may be acquired in fee or under leasehold.

Price of locations north of French River, $2 to $3 per acre, and south of it, $2 to $1.50, according to distance from railway.

Rent of locations first year 60c. to $1 per acre, and subsequent years 15c. to 25c. per acre.

Rent of claims, $1 per acre each year.

Claims must be worked continuously.

Royalty on ores specified in the Act, 2 per cent. of value at pit's mouth less cost of labor and explosives.

Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.

Original discoverer of ore or mineral on claim entitled to stake out a second claim.

Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines.

TORONTO, May 25th, 1894.

Canadian Mining Review
Established 1882
Vol. XIII.—No 8 1894—OTTAWA, AUGUST—1894. Vol. XIII.—No. 8.

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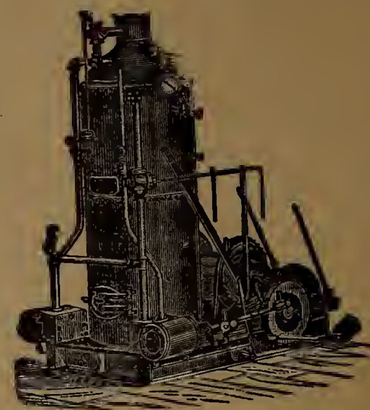

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Established 1882

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VOL. XIII., No. 8. AUGUST, 1894. VOL. XIII., No. 8.

The Dominion Coal Company Ltd.

Our issue this month, following upon the very interesting and en-ole meeting of the Mining Societies of Nova Scotia and Quebec at ney, Cape Breton, in July, is naturally redolent of the Dominion Coal npany, at whose hospitable invitation the gathering was held there. strongest light of criticism has for many months past been thrown n this company, and it is indebted to the press of Canada and the ted States for a great deal of gratuitous advertising. The latest and no means the least remarkable discussion of its aims and objects was ked the other day in the Senate at Washington, by Senator Chandler's ion to appoint a commission of enquiry into the true inwardness of Company's connection with the movement favoring free coal for the ited States. Surely no body corporate starting out to conduct an rtant enterprise within the limits of the Dominion, has ever been cked and belaboured to the extent this company has been in Nova tia. This hostility can no doubt be attributed to two causes: 1st. fact that there is a preponderance of foreign, *i.e.*, American, capital influence about it; and 2nd. That it came into existence under the ful manipulation of Premier Fielding, to whom accrued therefrom ch political kudos, while, at the same time, a proportionate amount of grin and envy filled the breasts of his political opponents. At the of relating a story already familiar to many of our readers, and as an oduction to our description of the meeting of the Mining Societies in e Breton, we propose to give a brief history of the company from its eption until the present day.

The idea of combining the various Cape Breton collieries under management is quite an ancient one and it would be difficult to e it back to the original source. Prior to the imposition of the erican duty on coal, the Cape Breton mines did a profitable business, efly with the United States, albeit on what seems now-a-days a very ll scale, but with the loss of the American market, the coal trade guished, and much suffering ensued locally among the laboring sses in and around the mines. Then in 1878, as all are aware, came John A. Macdonald's National Policy, under which, fostered by a y on imported coal, the business gradually revived, not with leaps bounds, as the most sanguine had predicted, but with sufficient adiness to restore comfort and a moderate degree of prosperity for ployees and employed. The producing capacity of the mines, how-r, was a good deal in excess of the demand, competition was very n, and prices, in consequence, very low. The Montreal market then icated but a faint shadow of the substantial growth it has since ained, and with the American markets closed to everything but slack l, the outlet for Cape Breton coal was very limited. It was in 1881, believe, that the Cape Breton Colliery Association was instituted by resident agents and managers of the different mines. Its formation prompted by the aggressive attitude assumed about that time by the rkmen, and as a sort of counter-move to the Provincial Workmen's sociation, which had just been started. But beyond being a combi-ion for mutual defence against the machinations of Mr. "Bobby" Drummond—we beg his pardon—the Honorable Robert Drummond—this Association essayed to regulate the course of business, and by entering into obligations more or less solemn, sought to keep the selling price of coal at a level which would ensure a decent profit. But, as is almost invariably the result in such cases, holes were sought for and generally discovered by the wiley manager, by which escape from the solemn obligations could be compassed, without sense of dishonor to an elastic conscience; so notwithstanding that from 1887 onwards, times sensibly improved, and although, with a steadily increasing demand from the St. Lawrence markets, the mines had now pretty well as much work during the season of navigation as they could handle at the capacity to which they were developed, only one or two of the mines could show a decent margin of profit upon their workings, while the rest of them were not doing much more than make both ends meet. As each succeeding Spring saw the blind struggle for contracts at bed-rock prices, the more sagacious sighed over such short-sighted and suicidal policy and figured enviously upon the prices they could legitimately have commanded, had common sense and mutual confidence prevailed among the coal owners. Such being the state of affairs, the ground was in a favorable condition for the operations of the gentlemen who sowed the seed of the great project which culminated in the Dominion Coal Company as it is to-day. The initial step of any significance was the purchase in the winter of 1891-2, of the Ontario Colliery at Glace Bay, (which had been practically idle for some years) by Messrs. B. F. Pearson, of Halifax and J. A. Grant, of Boston, acting for Boston people. Among whom were Mr. F. S. Pearson and the gentleman whose name is better known than any other in connection with the whole transaction, Mr. Henry M. Whitney, then President of the Boston West End Street Railway Co., of which Mr. F. S. Pearson was Engineer-in-Chief. We have understood that it was through the Messrs. Pearson that Mr. Whitney's attention was first drawn to the Cape Breton coal fields and to the vast possibilities that underlay a proper development of their resources. It was no difficult matter to estimate that, with increased and cheapened production, with Louisburg equipped as a shipping port and with modern means of water transit, it would be possibly to supply, in a measure at least, the markets of the New England States. Mr. Whitney was sufficiently impressed to post a large sum of money wherewith to secure options on all the working and workable properties lying within the limits of Cape Breton County. As he came to look more closely into the matter, an obstacle to the successful working of the scheme appeared in the shape of the uncertain tenure under which coal areas were leased from the Province of Nova Scotia, which could, through its Government, increase the royalty at will. Mr. Whitney at once recognised that it would be useless to attempt to enlist the assistance and capital of his countrymen in an undertaking which could be taken out of existence at any time, if the people of the country through its Local Legislature so willed it. The royalty we may mention had just been raised from 7½ to 10 cents per ton in the teeth of strenuous and united efforts in opposition from the coal owners of the Province. At this juncture Mr. Fielding, the Premier of Nova Scotia, appeared as the "*dens ex machina.*" He was anxious to see the Whitney project carried through to a successful issue, foreseeing as he did, that, apart from any advantage his Treasury might derive from the amalgamation, introduction of millions of foreign money to work the mines to an extent impossible under the existing state of affairs, was just what was wanted by the Province in general and Cape Breton in particular. The result of negotiations between Mr. Fielding and the Whitney syndicate, as it had come to be styled, was that, in return for a 99 year lease of the areas they might acquire, the syndicate agreed to pay the Government a fixed and unalterable royalty of 12½ cents per ton, and furthermore, as an evidence of *bona fides*, and to stifle the voices of the prophets of evil who were loudly vociferating that the Philistines were upon them, and that the mines, as soon as purchased, would be closed down in the interests of Pennsylvania coal barons; they undertook to pay this rate of royalty upon the largest quantity of coal produced in any one year up to that time by all the mines they proposed to operate, as a minimum annual contribution to the Provincial coffers, no matter if they failed to ship that quantity. This legislation once agreed upon, all was comparatively plain sailing. The syndicate had purchased options upon all the principal properties, and the majority of them were taken over and paid for in the early days of 1893, to wit, the International mines, (and with them the Black Diamond line of five steamers), the Caledonia, Glace Bay, Gowrie, Gardiner and Old Bridgeport, (which, a short time before had been acquired by the International Coal Company), while the "Reserve" property was secured by means of purchasing sufficient stock on the London market to give the syndicate a control of it. The options upon the two collieries of the General Mining Association were continued throughout 1893, with the eventual result that the Victoria Colliery was taken over on the 1st January, 1894, while it was decided not to acquire the Old Sydney mines, which, therefore remains the only independent colliery of any size on the Island. Meanwhile, the syndicate legislation of Mr. Fielding had been bitterly opposed by the Conservatives, and the curious spectacle was presented of a commercial undertaking, promising results of a magnitude unparalleled in the history of the Province, being promoted and opposed on the simple lines of party politics. Mr. Fielding's guns, however, were too heavy and the legislation passed both houses. The Whitney syndicate had now broadened out into the Dominion Coal Company Ltd., with a board of directors, including Mr. Whitney, of course, as president, his brother-in-law, Mr. Dimock, the Messrs. Winsor, (representing the interests of Kidder, Peabody & Co., who acted as financial agents in floating the company), and Mr. F. S. Pearson, together with such substantial Canadian representatives as Sir Donald A. Smith, Sir W. C. Van Horne, and Mr. Hugh McLennan, of Montreal, while Mr. W. B. Ross, of Halifax, was added as the legal member of the board. Mr. John S. McLennan, who had been so conspicuously successful as the managing director of the International Coal Company, and than whom no one, if we except Mr. Whitney himself, had played a more important part in the later stages of the new company's development, became treasurer, and Mr. B. F. Pearson, who had acted from the start as Mr. Whitney's agent and political lobbyist, was rewarded with the post of secretary. Mr. F. S. Pearson, in addition to having a seat on the board of directors, was named engineer in chief, while the important appointment of resident manager was offered to and accepted by Mr. David McKeen, M.P., up to that time, and for many years past, manager of the Caledonia mines. Many people fancied and perhaps fancy still, that a younger man of modern ideas and altogether of a more pronounced "*fin de siecle*" type, might more fitly have been chosen to engineer a large concern of this kind, but it has been and still is our opinion that the choice was in many respects a wise one. Mr. McKeen is a man of remarkable originality and determined will, while the history of his past career supplies abundant evidence of shrewd ability and foresight. "*Festina lente,*" might very appropriately be adopted by him as a motto, and his pronounced conservatism and distrust of new-fangled notions have acted as a very effectual and salutory brake upon younger and more ardent spirits, who had framed a programme for his execution, calling for 10,00[illegible] ton steamers, shafts with a daily capacity of 5,000 tons, and loadin[illegible] dock rivalling Cardiff in cost and magnitude—all to be provided withi[illegible] a short space of time and before markets had been found for the bound[illegible]less store of coal to be produced. When Mr. McKeen disapproves an[illegible] disagrees he does so with a blunt outspoken frankness which i[illegible] in the highest degree disconcerting to anyone holding and pro[illegible]pounding views opposed to his own, and he may be trusted to driv[illegible] his arguments home with a force well nigh irresistible. For him as [illegible] well known the sun has risen and set for many years at the Caledoni[illegible] colliery, and it has cost him a considerable effort to enlarge his horizo[illegible] and to extend a sympathetic embrace to the other, and, in some instance[illegible] larger collieries which are now under his management. But if he fal[illegible] short of a thoroughly comprehensive grasp of the reins of managemen[illegible] he can be relied upon to discourage and frown down any rash and in[illegible]mature experiments, avoiding extravagant changes as much as possibl[illegible] and working on and up with characteristic Scotch caution and cannienes[illegible] At the time the new company assumed control of its property, arrang[illegible]ments for the year's business had in many cases been already made, an[illegible] it was confident that little or nothing could be done in 1893 in the wa[illegible] of new developments. As a matter of fact work was carried on through[illegible]out last year pretty much on the old lines, and the only new work of a[illegible] importance that was undertaken, was the extension of the Inte[illegible]national Railway in the direction of Louisburg *via.* Glace Ba[illegible] and Cow Bay. This work was actively pushed on under th[illegible] superintendence of Mr. Hiram Donkin, who had already made his mar[illegible] in Cape Breton as the constructor of the I. C. R. extension from Poi[illegible] Tupper to Sydney, with the result that the line was opened for traffic t[illegible] Glace Bay at the close of last year, when the season of navigation ha[illegible] terminated. Several important developments and changes were take[illegible] in hand, notably the practical re-building of the old International shippi[illegible] pier on Sydney Harbor, which was to be replaced by a new structu[illegible] containing the latest contrivances for shipping coal with the maximu[illegible] of despatch and the minimum of breakage; the sinking of a large sha[illegible] (Dominion No. 1) on the line of the Company's railway near Bridgepor[illegible] to win coal from the popular Phelan seam, and the erection of a ne[illegible] heapstead, with the most up-to-date hoisting and screening arrangement[illegible] at Caledonia, and to a less important degree at Old Bridgeport also. [illegible] cannot be denied that the prosecution of these works has been attende[illegible] by a considerable amount of disappointment and disillusion. Th[illegible] difficulties under which outdoor work is carried on in Cape Breto[illegible] during the winter months, could not have been correctly gauged by th[illegible] powers at Boston, and it was evident when navigation opened in 189[illegible] that the management had attempted to do too much at one time. Th[illegible] new pier was still in an embryotic state, presenting difficulties which ha[illegible] never been experienced even in shipping from its much despised pr[illegible]decessor, and the two collieries, to which so much had been done an[illegible] from which so much was expected, were not only ready to produce co[illegible] but remained unproductive for a considerable time after the season [illegible] active shipping had commenced. Moreover the new and elabora[illegible] hoisting and screening arrangements with which they were eventual[illegible] equipped, developed the habit of running amuck at frequent interval[illegible] and the result, therefore, has been very far from showing any advantag[illegible] gained over the old methods, either in the cost of production or th[illegible] quantity of coal shipped. It is not our business to surmise as to who[illegible] shoulders the blame of these failures and delays should rest upon, bu[illegible] we do no one an injustice in hazarding the conjecture that a great de[illegible] of the new work was somewhat too experimental in character, and tha[illegible] the new management made the mistake of presuming that the chang[illegible] they had planned could be effected with as much ease in Cape Bret[illegible] as in America; and mindful of the facts that materials had to be im[illegible]ported from great distances, that the climate in winter renders work ve[illegible] difficult and uncertain, and finally that the local mechanics, good an[illegible] reliable men as they undoubtedly are, could hardly be expected to ado[illegible] themselves immediately to revolutionary ideas and methods. Bu[illegible] ous and disappointing as these failures and drawbacks have been to management, curtailing their supply of coal available for shipment and preventing them from taking advantage to the full of the demand for provincial coal in the States caused by the recent labor troubles there, the difficulties met with are of a kind that time and experience can remedy. At least we earnestly hope so. We saw nothing in our recent visit to warrant the fear that the mistakes that have undoubtedly been made are more than temporary in their consequences. On the contrary many difficulties had by that time been surmounted, and the general situation seemed to us to be healthy, and full of hope and promise. The new developments are good and sound in principal, and experience will no doubt, soon remedy their defects in detail.

Such then, briefly, has been the history of the rise and progress of the Dominion Coal Co. What it is destined to become, who can say? It is as yet but in its infancy, and its enemies, whose prophecies of a grinding monopoly and other attendant evils, have so far been falsified, let us wait and see what a hydra-headed monster of tyranny it will yet develop into. It may safely be predicted that with its ample means and far-reaching influence, the Company will develop the coal business of Cape Breton within a year or two, to an extent, compared with which the old condition of affairs might be termed stagnation. Whether it will accomplish all that has been promised for it, is of course more problematical. The present crisis at Washington has been fraught with the greatest importance for those interested in the new developments in Cape Breton, and should the duty on coal be removed from the American tariff, there would appear to be no reason why, with Louisburg equipped, as it shortly will be, for shipping coal, a large and profitable trade with the eastern sea board of America should not be built up, side by side with the increasing business the company already enjoys within the limits of the Dominion.

To touch for a moment upon the evils that were foretold as the inevitable result of the Company's occupancy of the Cape Breton coal fields, the management, we hold, deserve to be congratulated upon the moderation and forbearance with which their reign has been inaugurated. That there have been individual cases of disappointment and heart-burning may be true; it was not to be expected that a turnover of so revolutionary a character could be made without them. But outside of these, any changes that have taken place, have, we imagine, been beneficial to those affected. The laborers in and around the mines have as much work as they ever had, in fact, judging by recent complaints of a falling off in the output of coal, more than they want, and the prospect in the near future of steadier employment the year round than they ever enjoyed under the old regime. Viewing the situation from the standpoint of the general public, we are not aware that any attempt has been made to unduly force up the price of coal, nor do we believe that the company's policy contemplates any move in this direction. Perhaps those interested in the coasting trade, which until recently, has been such an important business in Nova Scotia, can present a better *prima facie* case than any other body of men, against the new order of things, for they can no doubt complain with truth that they are being squeezed out of existence, but, in justice, it must be remembered that the decadence of this trade had set in long before the idea of the Dominion Coal Co. had been conceived. We cherish the confident belief that as long as men like Mr. Whitney control the Company's policy, so long will that policy be wise and moderate. It has been claimed for Mr. Whitney that his speculations have invariably been of a kind to bring not only profit to himself, and his associates, but also, benefits to the community at large, and he may be counted upon never to initiate or sanction any line of action in his business to which the epithets "grasping" or "arbitrary" can be applied. The people of Nova Scotia, and especially those whose homes are within the territory dominated by the Dominion Coal Co., can be congratulated upon the fact that the enormous powers possessed by that corporation, are in the hands of a man of his character. So long as they rest there we can feel assured that the progress of the coal trade of Cape Breton will be marked by no harsh or arbitrary treatment of those who directly or indirectly depend upon the company for their livelihood and comfort.

The Memramcook Fiasco.

During the past month many of our subscribers will have read more or less of the collapse of work on the property of the Memramcook Gold Mining Co. Ltd., in New Brunswick, a corporation which, from the local papers, was soon to pay cent per cent dividends. The moral of the whole fiasco is so important, especially as to the manner in which the property was floated and equipped, that THE REVIEW deems it expedient to review the progressive stages of the undertaking. Its history, briefly stated, is as follows: In the fall of 1892, following closely upon the excitement occasioned for a very brief period by the Brookfield conglomerates in Nova Scotia, came rumors of the existence near Memramcook, New Brunswick, of extensive beds of auriferous cement or conglomerate. This conglomerate occurred or was exposed in a cutting made by the Intercolonial Railway for ballast. So-called "mortar tests" were reported as yielding several dollars per ton, by which rumors, attention was drawn to the property, and one J. B. Neilly, a merchant of Halifax, interested himself in getting a commercial test made of the material. In January, 1893, Mr. Neilly shipped a car load of material, supposed to have come from this railway cutting, to one of the best custom mills in Nova Scotia, viz., the Oldham mill. From this car load was obtained a yield of $1.50 per ton by the stamp mill process.

Correspondence ensued between Mr. Neilly and Mr. Hardman, the manager of the Oldham Gold Co., in which it was made clear that the test was accurately and carefully made and that $1.50 of gold existed in each ton of that particular material composing the car load. Further, Mr. Hardman's personal opinion to Mr. Neilly was that although getting $1.50 per ton from the sample sent, yet the deposit was not of economic value at that rate of yield, and could not be made a profitable investment. Mr. Neilly then considered (he has said) Mr. Hardman to be the highest authority in his line in Nova Scotia.

Notwithstanding this expert opinion and advice Mr. Neilly at once issued a prospectus based on this yield of $1.50 per ton, which prospectus contained most ridiculous estimates of the cost of working the deposit, and of the margin of profit sure to be obtained. This prospectus was signed by the provisional directors of the company, (which had been incorporated in New Brunswick), some of whom were men of standing in finance and in politics, particularly so in Nova Scotia.

By the use of these names as directors tone was given to the enterprise, and many people were influenced to buy shares in the company, in the faith that these prominent men would not have endorsed the prospectus unless the scheme had been investigated by them and approved.

It is a question in Canada as to how far such directors are responsible; English law makes such officials personally financially responsible for statements issued over their signatures. It is the conviction of THE REVIEW that the sooner this is made the law in Canada the better for legitimate mining.

Once the prospectus was issued an agreement was promulgated by Mr. Neilly under which stock of the par value of $1 was sold by him for 17½ cents, for the avowed purpose of erecting at first ten stamps for a testing mill, and secondly, to provide for the erection of forty additional stamps should the tests prove favorable. The bait was swallowed and for a time small lots of stock were sold rapidly to people who imagined the endorsement of the prospectus by some leading men of Halifax as directors, was a guarantee of genuine value.

The plant of the Coldstream Mining Co. (which included a 50 stamp mill and appliances) erected on another conglomerate bubble at Gays River, N.S., which had burst, was purchased by Mr. Neilly for about $5,000. Ten of these stamps were at once removed to Memramcook, and in July a 50 ton lot was milled which yielded *no gold*; the amalgamator was replaced by another and a 43 ton lot was milled, again yielding *no gold*. A third and skilful amalgamator was employed, who crushed four (4) lots of 25 tons each, obtaining, as the average of the 100 tons milled, a yield of $1.94 per ton. The gold obtained from this test was, like that of the carload shipped to the Oldham mill, *coarse* enough to be easily saved by stamp mill work.

Meantime assays of lots sent to Mr. A. B. Browne, of Boston, had shown values ranging from $3.72 to $4.18, but the gold obtained in these laboratory tests was, according to Mr. Browne, *very fine.*

Here were discrepancies. Stamp mill tests on 100 tons showed *coarse* gold, stamp mill tests on 93 tons showed *absolutely no recognizable gold,* assay and laboratory tests on one ton showed *very fine gold.*

The explanation offered for finding no gold in the two lots of 50 and 43 tons milled by stamps, of organic matter in the water, and of "chemicals" used, might possibly be taken into account if the gold really was *very fine,* but when gold is coarse enough to be easily saved in the mortar, such an "explanation" fails to explain.

That these variations and discrepancies shonld have made the officials of the company dubious, and have induced caution, goes without saying, but apparently quite the contrary impression was produced, for on the 15th September, after a somewhat discordant meeting, Mr. Neilly and his directors got a vote deeming the erection of the remaining 40 stamps expedient and advisable, and work thereon was at once commenced. This was the beginning of the end. No competent expert, on such conflicting testimony as the company possessed, would have advised such action, yet this company with a paper capital of $400,000 proceeded to equip the property with a large plant, while yet utterly ignorant of the extent or real average value of the deposit they imagined they possessed. No portion of the 370 acres of territory owned was opened or tested beyond the old face of the ballast pit, and the yields from that were discordant, so that absolutely no calculations as to quality, or uniformity, or continuity were possible.

The mill erected was built in a slip-shod and cheap manner; no provisions for heating were made, and the power arrangements were so imperfect that the 50 heads were never able to run continuously for any length of time. Yet for this mill Mr. Neilly is said to have received from his company the sum of $25,000—a larger sum than was paid by the Coldstream Company for the same mill when new, and for which, when they sold to Mr. Neilly, they received only the sum of about $5,000. The profit to this gentleman is variously named at from $10,000 to $15,000.

Late in October, when the 50 stamp mill was under way, a man who describes himself and his business as "a cutter of ladies' coats and jackets," talks "patent electric process," "mercurial hydrate of sodium," and a lot of other senseless jargon to Mr. Neilly to such effect that that gentleman orders several car loads of conglomerate sent to this ladies' coat-cutter to be tested. Who is surprised to find this jacket-maker gets a higher yield per ton than the stamp mill tests gave? His "patented mercurial hydrate of sodium made by electricity," apparently manufactured gold. But who is *not* surprised to find the president of a mining company, with large property and large capital, so credulous and so ignorant as to be induced to make another "proposition" to his company (as a contractor or what you like) to put in one of these wonderful patent mills and to take his pay therefor in "*excess profits,*" whatever they may be, and at a substantial advance upon the cost of the machine!

Truly a wonderfully pliable, credulous and most lamentably unbusiness-like "company." But from letters in the daily press of Halifax, President Neilly was afraid to have the resulting bullion from this wonderful mill tested for fineness; he preferred to treat the gross yield as fine gold because he was going to use the results of this patent process "to sell stock."

Shortly after comes the end. The mill being so imperfect cannot run in winter weather, at which time it is finished, "inspected and accepted," and paid for. Sometime in June of this year, under the guidance of an amalgamator who has no superior in stamp mill work in Nova Scotia, the big mill finally makes a start, dropping on an average between 20 and 30 head. Over 1,000 tons are milled; results: *both in patent electric mercurially-hydrated-personally-ladies'-coat-cutter-conducted-machine,* and in the stamp mill—*nil*—or next to nothing, the magnificent sum of 3 cents per ton being realized.

The bubble has burst, bills remain unpaid for some time, and President Neilly makes an "explanation" which reads very cleverly, but doesn't "explain."

The plain obvious moral is: Don't trust a so-called business man to run a mining scheme unless he has competent expert advice from the beginning. As the Halifax *Critic* so well said in its issue of the 3rd August: "All mine investors cannot be mining experts, but before plunging their money into a venture they should avail themselves of the advice and experience of some professional man who could save them from some financial foolishness of which they might afterwards be ashamed. * * * We can only say 'you have yourselves to blame.'"

We do not hesitate, in our opinion, to say that the gentlemen who acted as provisional directors of this Memramcook Co., are in a great measure responsible, as they took no steps to ascertain the truth or falsehood of the statements incorporated in the prospectus by competent expert mining advice. It is well known that some of the Geological Survey staff, when visiting that district, found nothing to warrant the extravagant claims made; it is also well known that no engineer of reputation ever visited the property or reported on the same. It is *surmised* that Mr. J. B. Neilly is the only individual who has profited by the deal. Who, we ask, are responsible for this state of affairs but the directors? the body of men elected by the shareholders to conserve and forward their interests!

And that such work should be held up as characteristic of Nova Scotian methods in the gold mining business is a slander and libel upon an industry which is legitimate, growing and straightforward in its characteristics.

Copper Mining in Cape Breton.

Hitherto the name of Cape Breton has been synonymous with coal. In fact few people believe that there is anything else in Cape Breton except some lakes, coal mines and enough dry ground for the miners' houses to stand on. A smile often meets the assertion that Cape Breton has a fishing and farming industry either of which is quite as important as coal mining. The number of those who believe that in metal mining there exists in this island the foundation of an industry vastly more important than all the others combined, is confined to those who view the island with experience gained in other countries. The concentration of so much capital upon the coal mines, the facility with which they can be opened, the indifferent and easily procurable skill that can readily mine coal, all have combined to withdraw attention from the more complex productions of the metallurgist's skill. So much has this been the case in Cape Breton that it is hardly known that the island is one of the most promising mineral fields of Canada.

The labors of the staff of the Canadian Geological Survey, have given us a map showing the Laurentian, Silurian, and Carboniferous districts, but as yet the metal prospector and the mineralogist have seen little of Cape Breton. The list of minerals as yet known comprise iron, copper, lead, silver, graphite, manganese, mica, feldspar, asbestos, barytes, fluor spar, strontianite, phosphates, marble, gypsum, building stones, fireclay, etc.

In the development of the gypsum and marble initiatory steps have been taken with fair promise of expansion. The future, however, so far as it relates to the material prosperity and the accumulation of capital in Cape Breton, depends on the utilisation of her coal in the varied and complex methods of the metallurgist, who smelts her ores and produces lead, copper, iron, steel, etc. The mere export of coal, practically a raw material, leaves in the country little beyond the wages paid for its extraction and shipment, in other words the equivalent of the support of the laborer. Take England as a shining example of this. Large as her

H. M. Whitney, Esq., Boston, President,
Dominion Coal Company, Ltd.

export of coal is, it is but a small percentage of the amount consumed in her thousand industrial processes. Where would England be in the scale of nations did she but mine her coal and ship it to foreign countries there to heat the furnace, drive the factory engine, etc.

So important is the connection between the home consumption of coal for industrial pursuits and the accumulation of wealth or capital in provinces like Nova Scotia and British Columbia, that it would seem to be specially the duty of Provincial Governments to take every possible step to foster the home reduction of ores. It would be better that these Governments spent annually a round grant of money in prospecting and testing mineral lands, which could then be leased to responsible parties instead of being held by persons who are without means for development, and expect the prices of mines for prospect holes.

In the list of minerals the development of which would specially benefit Cape Breton, iron and copper ores may easily take the first rank As regards the former, the presence of numerous deposits is well known. Analysis show that some of the ores rank as the best, as "Bessemer." Outcrops are known close to shipping points, yet a few thousand dollars represent all the practical attention they have received. Their value according to the owners is immense, yet where the beds are known in some hill side, enough work has not yet been performed to show a year's output in sight. The same with a single exception may be said of the copper ore deposits of the island. At numerous points outcrops of ore are known, a few trenches have been cut, yet nothing done beyond showing a prospect more or less promising. These prospects upon which capital would readily risk the money required for a proper test are held by the owners as representing great cash values. The only attempt at a legitimate development of a mineral deposit on the Island is that of the Eastern Development Co., Ltd., the owners of the Coxheath Copper Mines. Here a prospect was submitted on reasonable terms to foreign capital. The first steps showed an improvement on the surface indications, which has continued. This company owns, on the felsite rocks of Coxheath Hills, three square miles of territory in which several thousand feet of cupriferous strata outcrop. The explorations show that the comparatively scanty surface indications of copper pyrites which merited attention only from their persistence along a well defined horizon, formed the surface of a highly mineralised belt extending over a large tract of country. This point alone is of interest as showing that expenditure of money and time is needed in examining mineral deposits as the condemnation of a single exposure on the ground of the property of mineral there visible may prove an unfair prejudgment of the value of the same rock a few hundred feet away. The company encouraged by the improvement visible as they worked on the vein prepared for development work. Gradually and cautiously during the falling prices of the metal they have pushed their main shaft until it has reached a depth of 300 feet, and during the sinking have cross-cut the bed rock with the result of showing several veins carrying copper in workable quantity with decided percentages of gold and silver. The principal vein varies from six to ten feet in width carrying in the vein about six per cent. of copper readily dressing to over ten per cent. The remaining veins, of which some six have been cut and tested at the different levels as in the case of the main vein, vary in width up to five feet and promise at several points as well as the large vein. The mine is well equipped with hoisting gear, air drills, pumps, shops, houses, etc. equal to the development being carried on and to a fair daily output. The eastern shaft has been sunk about 1000 feet from the main shaft, and is down about 150 feet on the main vein which at that point presents the same characteristics as at the main shaft.

In the southern lease the company has traced for nearly one thousand feet a large vein which has been opened on at one point to a depth of one hundred feet, showing as well as the main vein at an equal depth. Further explorations may show that this vein joins the others, and experts have expressed opinions that it may prove richer than those already tested. This cross vein has over two hundred feet of backs above water level drainage. So far the work of development has shown large quantities of ore, readily accessible, and presenting no obstacles to treatment. The fact that there are over $50,000 worth of available ore on the dumps which has accumulated from the levels and cross-cuts in the veins certainly proves the extent of the veins and their accessibility.

As for the second part of the enterprise, the treatment of the ore, it requires a modern outfit. So far as the accessory surroundings of copper smelting are concerned in this section, they are unusually favourable. The property can be readily joined to the Government railway system by six miles of road, and at the proposed junction ample ground has been secured for furnaces on deep water in Sydney Harbor. Coal is within a few miles by rail or water, flumes can be had at the furnaces, and the best labor of the continent is a characteristic of the people of Cape Breton. Ores from all parts of the Gulf of St. Lawrence region can be collected at this point, and with smelters here the numerous prospects of copper ore in the Island will undoubtedly furnish some mines ready to supply ores. The locality as a distributing centre for the manufactured article is unrivalled, being on the seaboard instead of, as is the case with so many mines, hundreds of miles from any shipping point.

There is a marked improvement in the mica market, the demand for Canadian being steadily on the increase.

The meetings of the Ontario Institute will be held by courtesy of the Provincial Government in the Private Bills Committee Room, Parliament Buildings, Toronto, on Wednesday and Thursday, 12th and 13th September. Afternoon and evening sessions will be held on both days,

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An apparatus for discovering internal flaws in iron and steel has, it is reported, been invented in Paris by a Captain de Place. Of course it is electrical, and consists of a small pneumatic tapper worked by the hand, with which the sample of steel or iron is tapped all over. With the tapper is connected a telephone with a microphone interposed in the circuit. One operation is required to apply the tapper, and the other to listen through the telephone to the sounds prodcced. Both are in electrical communication, and in separate apartments, so that the direct sounds of the taps may not interrupt the listener, whose duty it is to detect flaws. In applying the system, one operator places the telephone to his ear, and while the sounds produced by the taps are normal he does nothing. Directly a false sound, which is distinguishable from the normal sound, is heard, he signals for the spot to be marked, and by this means is able, not only to detect a flaw, but to fix its locality.

All silver mining companies are keenly alive to the present need for bringing down the cost of production to the "irreducible minimum." The uncertain and varying value of the metal demands this of them; and unless they face the question they will be quickly shouldered out of the ranks of profitable producers. In an article in the New York *Times*, giving the history of American silver-mining, with the growth of the production and the temporary checks from declining prices, the author concludes that as transportation facilities and the mining methods are cheapened there will be a constant decline in the cost of silver production; that if the output is checked at 60c. per ounce because a few mines pay, this is probably only temporary; and that the steady reduction in the cost of mining indicates that there is no minimum price below which silver cannot be profitably produced which can be called fixed or absolute. This minimum, in fact, constantly changes, every reduction in the cost of transport and every cent taken off the cost of food and supplies at the mines, contributing towards reducing the cost of putting silver on the market. Electricity, as yet only partly developed, may further cheapen the cost of mining, enabling America to produce silver profitably, not at 60c. per ounce, but at 50c. or 45c. "The repeated congresses gathered to help silver will always fail," says the writer, "because they try to get a certain result from uncertain facts. The only way to control the price of silver is," he adds, "to curtail the production. There is no other way."

EN PASSANT.

In order to meet a large advance sale of the present number of the REVIEW, an additional issue of two thousand copies has been printed. In order to avoid disappointment, readers desiring extra copies should forward their orders at once.

The Cape Breton meetings of the Mining Society of Nova Scotia and the General Mining Association of the Province of Quebec will be remembered as red letter days in the history of these organizations. The attendance was large and representative of the mineral industries of eastern Canada, though it was a matter for regret that the turn out of Quebec members, on account of the busy season at the asbestos mines, was not so large as the strength of the Association and the importance of the occasion warranted. Needless to say, in the hands of the representatives of these two powerful companies, the Dominion Coal Co. and the General Mining Association of London, whose guests the visitors were, the programme was of an unusually interesting and attractive character, and throughout was conducted by princely hospitality. Too much praise cannot be given to those upon whom fell the burden of so lavish an entertainment. Mr. David McKeen, M.P., the genial director of the affairs of the Dominion Coal Co. in Cape Breton, and his energetic associate, Mr. W. Blakemore, were indefatigable in their exertions to show everything worth seeing in the large territory under the control of their company, and to cater to the comfort and pleasure of everyone. Mr. R. H. Brown will be gratefully remembered for the immense trouble he took to entertain a very large party at the old Sydney mines, and the delightful associations with his charming residence at Beech Hill will remain forever green. Captain Gragg and the only Col. Grainger, Mr. Burchell, Mr. C. H. Rigby, Mr. F. C. Kimber, the officers of the Sydney Club and the Tennis Court, also deserve special mention for courtesies extended. Nor must we forget the unstinted hospitality of the fair sex, Mrs. and the Misses Blakemore, Mrs. R. H. and the Misses Brown, Mrs Rigby and Mrs. Moseley, one and all of whom contributed in no small measure to the success of the meeting by many courtesies and kindnesses extended to the visiting ladies. Indeed, each and every one present on the occasion carry away with them many delightful memories of Cape Breton, and a lively appreciation of its hospitality, its beauty, productiveness and resources.

THE LATE COL. CUSTAVUS LUCKE
Vice-President General Mining Association of Quebec,
Director Beaver Asbestos Co., Ltd.
Sherbrooke, Que.
Died Sunday, 8th July, 1894.

The Ontario Mining Institute, organized in April last, will hold its first business session at Toronto during the second week in September. Papers will be read by Mr. A. Blue, Director of Mines, Toronto, Prof. W. L. Goodwin, Kingston, Mr. J. Bawden, Kingston, Mr. W. Hamilton Merritt, Toronto, and others. Every effort is being made to make the meeting attractive. As the railways offer special inducements in reduced rates to visit Toronto during "Fair" time, the attendance from the mining districts of Ontario should be large. A full report of the proceedings will appear in our next issue.

The General Mining Association of the Province of Quebec will hold its next Quarterly General Meeting at Sherbrooke, Que., during the last week of September. So many pleasant memories are associated with the outing at Sherbrooke last year, that there is sure to be a large attendance of members on the present occasion. We understand that an excursion to the Capelton Copper Mines, where members will be the guests of President Blue, and a run to the gold mines on the Du Loup are on the *tapis*.

British Columbia, the only mining province in Canada, without an association of mineral interests, is now, we are glad to see, moving towards organization, as the following excerpt from a letter from Mr. G. F. Moncton, Vancouver, will show:—

"Some of those here who are connected with mining in various ways are endeavoring to form an association. The matter is at present in a vague form, the idea only having been mooted the other day, as the enclosed letters will show. Will you kindly extend to us the support of your REVIEW which has to so great an extent influenced and assisted the formation of the other mining societies of the Dominion? We hope in two or three weeks to be so far advanced as to be able to call a meeting and form the nucleus of the society."

The Province of British Columbia is making such progress in the development of her minerals that the organization of such an associotion as those already established in the other provinces of Canada is not only desirable but necessary. Apart from the social advantages such an association would confer upon its members, the publication of papers on the resources and mining practice of British Columbia would be of incalculable value in directing the attention of capitalists to the undoubted field for remunerative investment there exists in the western province. Needless to say, the REVIEW will cheerfully exert itself to aid the new organization in every way possible. In the meantime, it heartily wishes success to the promoters of the organization.

While at Charlottetown, P.E.I., *en route* to Cape Breton, the members of the General Mining Association of Quebec were startled by the sad intelligence of the sudden death by heart disease of Col. Gustavus Lucke, an original member and Vice-President of the Association. Col. Lucke, who resided at Sherbrooke, Que., was a partner in the firm of Lucke & Mitchell, the well known hardware merchants of that town, and a director in the Beaver Asbestos Company, Ltd., operating at Thetford Mines. In all matters affecting the welfare of mining in the Province of Quebec, Col. Lucke took a lively interest. He was foremost in the agitation to repeal Mercier's obnoxious Mining Law, and one of the first to sign the roll of the General Mining Association formed at the time. At every meeting and social reunion Col. Lucke's stalwart personality and genial countenance was a familiar figure, and his demise at a comparatively early age will be mourned by the mining men of Quebec and by a large circle of friends. The deceased gentleman was also, we believe, an officer of the Asbestos Club at Black Lake. Almost immediately after the sad announcement, a meeting of the Association was held, at which a resolution was passed expressing sorrow for the untimely death of one so universally esteemed among its members, and tendering to his widow assurances of their most tender sympathy in her bereavement.

"Asbestos," says the *Australian Mining Standard*, "has hitherto been a mineral which has enjoyed the happy, if obscure, fate of prosperity. The fluctuations have not disturbed the market, nor the inrush of huge "parcels" excited speculators. Mine owners have found no difficulty in disposing of their output at a satisfactory return upon capital. Now, however, the position seems likely to be altered, and shareholders in asbestos companies may share the lot of the ordinary mining adventurer in palpitating over the relationship of supply to demand, and both to dividends. A good deal of interest—not to say jealousy—has been awakened amongst the existing companies by the formation of a private company to work newly discovered deposits of asbestos in Griqualand, Cape Colony. The leading men in this concern are connected with the De Beers Diamond Mines, and the competition of South African asbestos with the Italian and Canadian is not, therefore, likely to weaken through want of sufficient capital. Moreover, it is claimed for this new fibre that its specific gravity is quite 25 per cent. less than the other varieties. Thus, at the same figures, Cape asbestos would be a great deal cheaper than its competitors. Moreover, it does not require any heavy expenditure to mine, as the deposits are nearly denuded, and all that is required is to blast it out of the ground with dynamite and load it into trucks. The Italian and Canadian asbestos mine-owners may, however (says the *London Mining Journal*), find several crumbs of comfort against this threatening competitor. In the first place the cost of transport in South Africa is a heavy item, and then, again, the shipping charges to Europe will fall heavily on the raw material. On the other hand, the consumption of the raw material is extending in all directions. It is used nowadays, we believe, for the filiments in incandescent electric lights, and threatens almost entirely to supersede cement as a material for coating steam boilers. Asbestos mill-board, cloth, &c., also may very likely come into enormous vogue for general packing and other purposes, There ought, therefore, to be plenty of room for the addition of South Africa's production to the existing supply. The position may be changed if it is true, as we hear, that extensive and very valuable deposits have lately been discovered in Italy by persons quite independent of the large capitalists, who have hitherto practically controlled the supply of the mineral. If Italy really possesses mines equal to those of Canada for the workable qualities of the fibre, a revolution may quite possibly be impending in the position of asbestos."

But then Italy does'nt. Furthur the inferiority of the Cape asbestos in comparison with the Canadian product is so marked that the Canadian operator may regard its prduction with indifference.

Dr. David T. Day, Chief of the Division of Mining Statistics and Technology has issued his annual volume of the Mineral Statistics of the United States for the year ended 31st December last. As usual a mass of valuable information is given respecting the progress of mining and the industrial conditions affecting the production of minerals in that country. The report is one of the most valuable of the many useful publications issued by the United States Geological Survey and we, in common with a large number of our readers, who constantly refer to it, would be sorry indeed to see it stopped. We have no sympathy with the *Engineering & Mining Journal* which for reasons of its own, personal, professional and pecuinary, would, judging by recent utterances, fain see the work abandoned in favor of its own pretentious but far from reliable annual compilation. Quoting from Dr. Day's work we learn that; "The total value of the mineral products of the United States in 1893 was the smallest since 1889. It represented $609,821, 670, compared with $688, 616, 954, in 1892; a decline of 11.44 per cent. In 1892 there was an increase of 30½ millions or 4.67 per cent. over 1892. The decline in value was most conspicuous in pig iron and structural materials, but most other minerals declined in the amount and the value of the product, the exceptions being gold, anthracite coal, aluminum, phosphate rock and gypsum. Bituminous coal showed a slight increase in quantity but the normal increase was checked and the total value was less than in 1892. Petroleum increased in value but decrased in quantity. Salt, quicksilver, and many smaller products increased in quantity but shared the usual decline in value. This general decline was attributed to the financial depression and the consequent decreased consumptive demands. It was only conspicuous during the last half of the year, as considerable time is necessary for affecting the mining industry, and as it is correspondingly slow in recovering, its effect will be equally pronounced in 1894."

The mica mining industry of the United States has been in an unsatisfactory condition for a number of years. In 1884 the production amounted to 147,410 lbs. valued at $368,525. In the following year it fell off to 92,000 lbs, valued at $161,000 and in 1893 the product was only 40,000 lbs. value $70,000. In 1887 the production increased somewhat, but again declined, and from then until 1891 the value of the product did not exceed 75,000 lbs., valued at $100,000. In 1893 the product is estimated by E. W. Parker (U. S. Geol. Survey) to have been 51,111 lbs of cut mica worth $80,629, and 156 tons short scrap or waste mica worth $8,300 making the total value of the output $88,929. During the year ended 31st December last, mica to the value of $147, 927 was imported.

Asbestos as an industry in the United States practically does not exist, the total product for 1893 only amounting to 50 short tons valued at $2,500 at the mines. This output was confined to the State of California. In the same period Canada produced 6,473 tons of a value of $313,806. The exports from Canada to the United States amounted in 1891 to 7,022 tons, valued at $513,909 and in 1892 to 7,316 tons valued at $514,412. The value of the asbestos imports by the United States during the year ended 31st December last was of crude $175, 602 and manufactured $9.403 or a total import of $185,005.

In a paper on the origin of gold nuggets, read before the Royal Society of New South Wales, Mr. Liversidge gives a summary of the various theories which have been put forth to account for the existence of alluvial gold other than "the old and accepted one," that it had been set free by processes of disintegration. He also gives details of a large number of experiments made with a view to determine whether a mucleus of gold immersed in a gold solution and in the presence of such substances as would be likely to occur in nature will increase in weight, and he concludes that gold is deposited when the nucleus is in contact not only with metalliferous sulphides and arsenides which form strong galvanic couples, but also with such substances as iron oxides, charcoal, graphite, sandstone, granite, quartz, clay and marble, which form but weak galvanic couples with the gold mucleus. He questions whether the common assertion as to the greater fineness of nugget as compared with course vein gold has any foundation in fact. With fine alluvial gold there is such a difference, but this he thinks results from the removal of silver and other impurities by solution owing to the larger relative surfaces exposed. Discussing the question of solutions of gold in natural waters—although absolute chemical proof is still wanting—because it is found in recently formed pyrites, &c., where it must have come from solution. Furthermore, the author urges that large nuggets could be artificially produced by following the methods used in his experiments, and believes that gold is probably being so deposited at the present day. However he did not believe that the large nuggets have thus been formed *in situ*, although gold grains and dust may have been appreciable thus enlarged.

A recent letter from the Rainy Lake gold district, Ont., says: "The whole place is full of prospectors and claim jumpers, and one has to watch every move he makes. Prospecting is being done on a wholesale plan. There are six parties out at present who are playing the hog in every way. To give you an idea of how they work, I will describe one party, a man from U. S. A. He has two surveyors, fifteen prospectors and three or four Indians. This party has already surveyed over 50,000 acres. Although he has not paid for this, yet he holds the ground for one year, and as soon as any other party applies for any location within these 50,000 acres, buys it up and in this way really gets other men to prospect his land for him. There are five more like him—besides there are dozens of other small parties." This looks like a matter for the jurisdiction of the Director of Mines. The wholesale acquisition of lands by speculators is contrary to the letter and spirit of the Mines Act.

A mining exhibition is at present being held at Freiburg, Germany. A few days ago an interesting competitive trial took place between two types of rock drills, *i.e.*, the "Heise" and the "Thomas." The trial consisted in boring a block of sandstone 56 c.m. thick. Including the fixing of the bore frame and the changing of the drill, the "Thomas" machine is said to have occupied five minutes, while the "Heise" machine performed the work in less than four minutes,

SUMMER MEETING

OF THE

General Mining Association of the Province of Quebec.

En route to Cape Breton the members of the General Mining Association of Quebec held their summer meeting in the saloon of the steamer "Bonavista," on Monday evening, 9th July. Mr. John Blue (Eustis Mining Co.), President, in the chair.

THE DEATH OF COL. LUCKE.

THE CHAIRMAN—Before proceeding with the regular business of the meeting, I will ask your permission to make a few remarks regarding the sad event of which we received intelligence this morning. I refer to the death of our esteemed member and Vice-President, Colonel Lucke, of Sherbrooke, who was known to you all as a most active member, having been one of the first of the Association, and a member also of the Council for two or three years. He took a great and energetic interest in all our proceedings; so much so, that he never allowed himself to be absent from a meeting, this present one being the first unattended by him.

He would have come with us upon this excursion had it not been that his personal friend and fellow director in mining enterprises, Mr. Jas. Mitchell, was one of our party; and you understand that both gentlemen could not leave their business at the same time.

We are all aware of, I am heartily glad to say, the many good qualities and qualifications for which Colonel Lucke was esteemed and honored by everyone. His genial disposition, and his heartiness of manner endeared him to all who had the pleasure of coming in contact with him; and these qualities, in addition to his business abilities, make his loss felt keenly in the community in which he lived.

We shall miss him from our meetings more than I can say, and from the position which he filled with such great credit to himself and the Association for so many years. The sad news we have received has dampened the enjoyment of our trip; but we must try and be philosophical and remember that such has to be the end of all. We have to do the best we can to fill the Colonel's place, and that is said in no disparagement of whoever is elected in his stead.

SYDNEY HOTEL,

Headquarters of Mining Societies, Cape Breton Meeting, July, 1894.

Our Secretary has drawn up a resolution of condolence, which I will ask him to read.

THE SECRETARY then read the following motion which was unanimously adopted:—

"The members of the General Mining Association of the Province of Quebec having learned with profound sorrow of the untimely death of Colonel Lucke, of Sherbrooke, an original member and an esteemed vice-president of the Association, be it resolved: That a minute be entered in the proceedings of the Cape Breton meeting recording appreciation of the work and services of Colonel Lucke; and that the Secretary be instructed to convey to Mrs. Lucke an expression of sympathy and condolence in her bereavement."

THE SECRETARY then read the minutes of a meeting of the Association held on board the Steamer Bonavista on the evening of the 7th July, 1894.

ELECTION OF MEMBERS.

The following gentlemen were declared elected as members of the Association:—

Mr. A. Sangster, proposed by Mr. John Blue, and seconded by Mr. Jas. Mitchell; Mr. J. W. Woodside, of Sherbrooke, proposed by Mr. Jas. Mitchell and seconded by Mr. John J. Penhale.

PAPERS READ BY TITLE.

THE SECRETARY moved: "That the papers of Mr. E. D. Ingall, on the Silver Deposits of West Kootenay, B.C.," and Mr. H. J. Williams, on the Canadian Slate Industry," be read by title in the meantime, in the event of there not being sufficient time for them to be read in full at Sydney."

The motion was adopted.

THE SECRETARY then read the following motion, which was unanimously adopted:—

VOTE OF THANKS TO CAPTAIN FRASER.

"That the very hearty thanks of the Association be tendered to Captain Fraser, the officers and men of the Steamer Bonavista, for the uniform courtesy that has characterized their unremitting endeavors to cater to the comfort and pleasure of members during their excursion to Cape Breton."

THE ILLNESS OF THE PAST PRESIDENT.

MR. JOHN J. PENHALE moved: That a telegram be sent to the Hon. George Irvine, Q.C., enquiring as to his condition of health, and expressing regret at his inability to accompany the members of the Association upon the present trip.

The motion carried.

THE NEXT MEETING.

It was then unanimously adopted that the next general meeting of the Association be held in Sherbrooke on Thursday and Friday, the 27th and 28th September next, 1894. Also: That a local committee, consisting of Messrs. John Blue, John J. Penhale, James Mitchell, F. A. Halsey, F. P. Bucke, and E. B. Haycock, be constituted to make arrangements for said September meeting. The motion carried.

INVITATION FROM CARRIERE LAINÉ AND CO.

MR. J. T. DWYER—I may say that I was requested by Messrs. Carriere Lainé & Co. to convey to the members of the Association upon the trip, an invitation to visit and lunch with them at their works at Levis, and see there, under their guidance, the various points of interest.

It was then decided that the Secretary should telegraph or write Messrs. Carriere Lainé & Co. from Sydney, expressing to them the sincere thanks of the members of the Association, their regret at being unable to accept the invitation upon the present occasion, and their hope that they might be able to avail themselves of the goodness of Messrs Carriere Lainé & Co. at a future and more convenient date if the invitation of those gentlemen would then be good.

The meeting was then declared adjourned.

FEDERATION.

Representatives of the Nova Scotia, Quebec and Ontario Mining Associat'ns Resolve to Federate — A Canadian Mining Institute to be Formed.

A united meeting of the members of the Mining Society of Nova Scotia and the General Mining Association of the Province of Quebec, was held in the Sydney Hotel, Sydney, on the evening of Thursday, July the 12th, 1894.

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

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

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

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

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

The meeting was then declared adjourned.

During the Convention of the National Association of Fire Engineers held recently in Montreal, Mr. Ed. Wertheim, of Chicago, one of the principals of the American Asbestos Company, read a valuable paper on the uses of asbestos for fire purposes, which we have pleasure in reproducing in another place. One of the features of the Convention was a practical demonstration of the service asbestos may be made to play in saving life from the flames. A frame building, erected at the back of the Victoria Skating Rink, was set thoroughly on fire, and Mr. Wertheim, clothed in an asbestos suit made at his works in Germany, from Canadian fibre, the eyes of which were faced with mica, entered the burning building and remained among the flames for several minutes, at the same time giving an exhibition of the practical utility of asbestos fireproof roping for ladders, etc. The experiments were highly satisfactory and greatly pleased the large assemblage of fire chiefs.

The outlook for Canadian phosphates appears somewhat encouraging when we learn that one of the largest producers of fertilizers in the world, has given instructions to their representative on this side to be ready to resume mining at any moment.

A meeting of the Council of the Asbestos Club was held at the Club House, Black Lake, on 30th instant, when a number of delinquent subscribers were beheaded.

David McKeen, Esq., M.P., Glace Bay, C. B.,

Resident Manager, Dominion Coal Co.

Quarterly Meeting of the General Mining Association of the Province of Quebec, 6th July—Proposition to Federate Discussed and Adopted.

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A meeting of the Association was held on the Steamer Bonavista *en route* to Cape Breton on Friday evening, 6th July. Mr. John Blue, President, in the Chair.

THE SECRETARY read the minutes of the Annual General Meeting and of the Council Meeting held at Sherbrooke, Quebec, 12th April, which were confirmed.

ELECTION OF MEMBERS.

The election of Mr. Cecil H. Bowen, of Sherbrooke, to membership, was confirmed.

FEDERATION.

THE SECRETARY reported that in accordance with resolution passed at annual meeting, he had attended and submitted the views of the Association respecting a federation of existing Canadian mining organizations at the Annual Meeting of the Mining Society of Nova Scotia, held at Halifax in March, and that after favorable discussion the matter had been referred to a committee of the Society for report on a scheme. He had since received the Committee's report as follows :—

REPORT OF THE MINING SOCIETY OF NOVA SCOTIA.

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

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

2. "That all members of such organizations should become *ex officio* members of the proposed 'Canadian Mining Institute.'

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

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

5. "That it is not desirable to have, or attempt to have, any large body of officials for the Canadian Mining Institute, but rather that such business as may arise should be transacted by a small body or committee, to be composed either : *(a)* Of the several Secretaries to the local organizations; or *(b)* of one specially elected delegate; or *(c)* of a specially elected delegation, based on one member per so many members, for each local organization ;

6. "That the committee, or governing body, so constituted, should appoint or elect one individual to act as secretary-treasurer and editor of the Canadian Mining Institute ;

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

SUGGESTED AMENDMENTS.

It was then resolved that the Association recommend in addition to the report, the following amendments :—

1. That the managing board of any Federated Canadian Mining Institute, consist of the presidents of the associations in the federation, together with one member from each such association, and that these shall be empowered to appoint a chairman and a secretary-treasurer ;

2. That there should be a united meeting of the whole members of the federated associations once a year.

3. That the cost of the publication of the Federated Institute's Transactions and the means of defraying the same be left in the hands of the governing board.

TREASURER'S REPORT.

The Treasurer reported that the note for $600, made in January to defray the cost of the Association's volume of Proceedings for the years 1891-2-3, had been reduced to $100, and that there was sufficient funds outstanding and incoming to clear the Association from debt and leave a good balance.

This being all the business the meeting adjourned.

Shipments from the Silver King—The *Times* (London, Eng.) of July 7 last, has the following : "Two trial shipments of argentiferous copper ore from the Hall mines, British Columbia, have been made. One, of first grade ore, assayed at Swansea, 146oz. silver and 12⅜% copper to the ton of 2,240lb., and the other, of second grade ore, assayed at Denver, Colorado, 93·03oz. silver, 0·13 gold, and 10·98% copper per ton of 2,000lb. The development work at the mine is being vigorously pushed forward.

Sudbury Nickel Mining—Reports from this district indicate a better outlook. The output of the Copper Cliff, Evans, Murray and Worthington mines is over 400 tons a day, and the three smelters are going full blast the whole time, though the railway strike in the United States threatened to necessitate the temporary closing down of some of the smelters for want of coke. The Travers mine in Drury is still in liquidation, but it is reported that arrangements are helng made to recommence work. The development work on the Duluth mine in Trill is progressing well, and a waggon road is being opened from Worthington station to it. This new company proposes to introduce the Emmens process, thus described in *Mineral Industsy :* "To replace the ordinary roast heaps and smelters, by weathering floors, a low roasting furnace and lixiviation tanks." At the Stobie mine, which has heretofore been worked by an adit in the side of the hill, a vertical shaft is being sunk. This is the largest deposit of nickel ore so far opened up in this district.

Meeting of the Mining Society of Nova Scotia, at Sydney, C.B.

—

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

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

The following were elected to membership : Mr. Geo. E. Boak, Halifax, Mr. Dick, M.E., Halifax, and J. T. Burgess, Halifax.

The meeting then proceeded to consider the following papers which are fully reproduced elsewhere in this issue :—

1. "The Organization and Development of the Dominion Coal Co.," by Mr. John S. McLennan, Boston.

2. "Notes on the Geology of the Sydney Coal Field," by Hugh Fletcher, B.A., Ottawa.

3. "The Introduction of Endless Rope Haulage into Cape Breton and Method of Laying Out a New Plant," by W. Blakemore, M.E., Glace Bay.

4. "The Railroad System of the Dominion Coal Co.," by H. Donkin, C.E., Sydney.

5. "The Sinking of Dominion No. 1 Shaft," by John Johnstone, Superintendent International Colliery.

Mr. H. S. Poole, seconded by Mr. C. Fergie, moved a vote of thanks to the contributors of papers, and the meeting adjourned.

THE BANQUET AT SYDNEY.

—

MR. DAVID MCKEEN, M.P., ENTERTAINS THE MINING SOCIETIES AND A DISTINGUISHED COMPANY IN THE SYDNEY HOTEL.

—

On Wednesday evening, 11th July, Mr. David McKeen, M.P., the genial popular General Manager of the Dominon Coal Company, Ltd., entertained the members of the visiting mining societies and a distinguished company to dinner in the new Sydney Hotel.

Shortly after eight o'clock, Mr. McKeen took the chair, having on his right His Lordship, Bishop Cameron, and on his left the Hon. W. S. Fielding, Premier of the Province. At the head of the table were seated : His Honor Judge Dodd, Sydney ; Senator McDonald, Mr. H. S. Poole, General Manager (Acadia Coal Co.) Stellarton ; Mr. John Blue, (Eustis Mining Co.), President General Mining Association of Quebec ; Dr. Smith, Canon O'Donnelly, Rev. Father Quinnan, Dr. McKay, Mr. R. H. Brown, General Manager General Mining Association, Ltd., Old Sydney Mines, and Dr. E. Gilpin, Deputy Commissioner and Inspector of Mines for Nova Scotia.

At the other tables respectively, presided over by Mr. John E. Hardman, S. B., President of the Mining Society of Nova Scotia ; Mr. C. H. Rigby, Sydney ; and Mr. F. C. Kimber, Sydney ; were : W. Blakemore, M.E., Glace Bay ; Dr. Murphy, City Engineer, Halifax ; Hugh Fletcher, B.A., Ottawa : W. Hamilton Merritt, F.G.S., Toronto ; Graham Fraser, New Glasgow ; J. D. McGregor, M.P., New Glasgow ; R. E. Chambers, Ferrona ; C. Starr, Halifax ; Jas. Baird, Joggins Mines ; F. H. Mason, Truro ; John Anderson, Musquodoboit Harbor ; J. Hearne, Sydney ; Mr. Naismith, Ba. Sc., Supt. Railways, Dominion Coal Co. ; J. R. Blackett, Glace Bay ; Dr. McGillivray, Sydney ; J. M. Reid, Musquodoboit ; Jos. Austen, Halifax ; Mr. Nissen, Halifax ; Mr. McEachen, Sydney ; D. Burchell, Glace Bay ; A. Drysdale, Halifax ; Dr. McGregor, Sydney ; Dr. Dodd, Sydney ; Mr. Bertram, North Sydney Herald, North Sydney ; J. T. Dwyer, Montreal ; Mr. Price, Halifax ; A. Sangster, Sherbrooke ; A. M. Evans, Cow Bay ; John J. Penhale, Black Lake ; Mr. Boak, Halifax ; J. D. Sword, Halifax ; H. M. Wylde, Halifax ; G. E. Francklyn, Halifax ; W. Blakemore, Glace Bay ; Rev. Mr. Forbes, Sydney ; Capt. Isaac P. Gragg, Boston ; C. G. Rogers, Ottawa ; B. C. Wilson, Waverley ; J. G. S. Hudson, Glace Bay ; Harry Williams, Thetford Mines, Que ; D. W. Robb, Amherst ; W. R. Thomas, Montagu ; E. D. Ingall, A.R.S.M., Ottawa ; A. W. Stevenson, Montreal ; W. A. Allan, Ottawa ; E. T. Moseley, Sydney ; Dr. Fraser, Sydney ; Rev. W. Chisholm, r. Tyler, J. Johnson, Rev. Mr. McLashen, Jas. Purvis, T. Routledge, Sydney ; Chas. Fergie, Westville ; J. Burchell, Sydney ; Mr. Nicholson, Glace Bay ; M. R. Morrow, Halifax ; Chas. Archibald, Halifax ; John Rutherford, Stellarton ; C. Chisholm, Sydney ; W. Crowe, Sydney ; H. Mitchell, Bridgeport ; J. McVey, Reserve Mines ; Capt. Worgan, A. McDonald, H. Rigby, Dr. Johnson, J. Revere, C. E. Willis, Halifax ; B. McKeen and others.

THE QUEEN, AND PRESIDENT OF THE UNITED STATES.

Her Majesty's health was drunk with a patriotic enthusiasm that would have made the old Greeks envious. The name of Captain Isaac P. Gragg, of Boston, was coupled with the toast of the President of the United States.

CAPTAIN GRAGG—It gives me indescribable pleasure to respond to the toast of President Cleveland ; but to illustrate my unfitness in this regard, I shall tell a short story : In a Western camp of mining desperadoes, a quarter of a century ago, a fight broke out during an evening carousal. Revolvers were rampant, and a young man, a great favorate, was killed ; and that, too, by his best friend, who had intended the deadly shot for another. The circumstance sobered the party, and they carried the body down the canyon to the little log cabin where the dead man had lived. They knocked at the door, and the widow of the victim of the brawl appearing, the leader said, "Madam, we have killed your husband. He was the wrong man. The joke's on us !" And so, gentlemen, the Chairman, in shooting around "promiscuous like" for a proper individual to respond to this toast, shot the wrong man. The joke is on you ! (Laughter.)

I believe that English speaking people, whether represented by Her Majesty the Queen, or by her appointee the Governor General, or by the President of the United

States, have faith that through such representation is presented the basis of good English law, in the application and enforcement of which lie all the enjoyment of education and prosperity and progress. Therefore, in responding to this toast, I do not think that I can refer more fittingly to Mr. Cleveland and the common interests binding English speaking people together, than by referring to the fact—so far as telegrams received to-day assert—that Mr. Cleveland has risen to the occasion as the representative of law and order and their enforcement in connection with the troubles in the United States. (Applause.) Perhaps I may still further and more emphatically refer to this common interest, standing as I do upon Canadian soil and under the flag of England, by presuming to say that this province and more especially this locality is receiving to-day some co-operation and benefit, I trust from American capital, and from American energy and business men. (applause.)

THE GOVERNOR GENERAL AND HOUSES OF PARLIAMENT.

HON. SENATOR McDONALD—In responding to the toast of the Governor General of Canada, said: I thank you very much for the manner in which you have received this toast. As the only member of the Upper House here to-night, I may say the present Governor General is one of the most popular representatives of Her Majesty we have ever had, if indeed not the most popular. His career in the Old Country and in Ireland gave warrant for anticipating his popularity with ourselves; and time has fulfilled our anticipations. With regard to the Senate it serves its purpose in the Dominion. It is composed of eighty gentlemen, many of them old men. Perhaps I am one of the youngest. It is a very healthy place; and those who get there live to a great age. I am sorry to say two of our Senators died lately, one at the age of ninety and the other at eighty-six. I think that is about the average. Regarding the House of Commons, I am sorry to say it is not so healthy a place as the Senate. You will best appreciate that truth when I say that the members of it are at present engaged in their parliamentary duties with the thermometer at about one hundred degrees in the shade. These gentlemen—as if their routine duties were not a sufficient burden—are constantly tormented by their friends from the various constitutencies, who want breakwaters and bridges and things of that sort. So that the House of Commons is an unhealthy place. However, those who have good constitutions can pull through, and of course they are all desirous and hopeful of some day getting into the Senate.

THE GOVERNMENT OF NOVA SCOTIA.

THE CHAIRMAN—In proposing the health of the Local Government and of the Lieutenant Governor of Nova Scotia, said: In this connection I am glad to have the honor of being able to mention the name of the Premier, the Hon. Mr. Fielding. I am sure you are all pleased to see him here to-night. I think the name of Mr. Fielding is deserving of more than passing notice, especially on an occasion of this kind. Mr. Fielding has been obliged to take the responsibility of being instrumental in forming the Dominion Coal Company of which there are a great many representatives around this board. The Dominion Coal Company, I take it, had more or less to do with the erection of this hotel; and without the hotel I think it it would have been almost impossible for us to have this gathering. No other building in Sydney would have been able to accommodate so many representatives from different parts of Canada. Hence it is, I think you will agree with me, that this gathering is due more or less to our honourable friend the Premier of Nova Scotia.

HON. W. S. FIELDING—I thank you very warmly indeed for the more than kind terms in which you have proposed this toast, and for the way it has been received. I am sure that if the Lieutenant Governor were here to-night, it would afford him great pleasure, and he would appreciate the reference made to his name. I am very glad to be able to say that in connection with the welfare of this country he is manifesting a very warm interest. The toast of the local government is of a compound nature. It is of a personal and also of a broader character. As personal, I on behalf of my colleagues and myself appreciate sincerely the very warm references made. In the broader spirit you toast the local government not because you honor the men who hold office, but because the local government represents the law and order which are the foundation of Society and represent the Anglo-Saxon race.

There is a tendency to underestimate the value of the local government and legislature. There was a time when many able men doubted whether it was wise to have other than one government and one legislature for the whole country. I rejoice to say that it was recognized that such a policy would be a mistake; and so we have a distribution of legislative power—a distibution of power that is important. And if our friends of the Dominion Parliament two of whom sit on my right to-night, are disposed to magnify the importance of their office, I am glad to say that whenever we meet the Mining Societies *then* the local legislature comes on top, for what could you do without the local government? (Cheers.) If you want to get down to the business of mining, you have got to come up to the local government at Halifax and take off your hat! (Hear, hear.)

Now, without underestimating the things done at Ottawa, it is a fact that within the functions of the local legislature there is room for great and good work; and I trust there will never be a time when the people will fail to take a warm interest in the affairs of the local legislature and the sending to it of proper men to discuss its questions, none of which are more important than that relating to mines and minerals.

I realize the fact that this enterprise has been like nearly everything that may arise under our system of party government; a matter of honest difference of opinion which appertains to party strife. Our party system of government has its advantages and disadvantages. One disadvantage is that when a measure of importance such as that relating to the organization of the Dominion Coal Company is presented, we are all prone to look at it in a biassed way. But the advantage is that if it proves it is able to stand the test of party strife put upon it, and comes therefrom whole, there must be some good in it. I do not question the motive of any manwho says the scheme was a bad one. I respect his judgment as I would ask that my own be respected. Yet every hour I spend in the County of Cape Breton confirms my judgment. I affirm this scheme was a good thing for Cape Breton. (Loud applause.) I do not imagine it is perfect. You must not expect perfection—even from such a good government as exists at Halifax. I know it is true that in matters of this character personal interests and local interests will suffer. But making an allowance for them all—and they are incidental to every great enterprise—I am persuaded that upon the whole the scheme of organization of the Company was for the benefit of Nova Scotia. It has received the approval of the governmeet and legislature whether it deserved it or not. It has received the approval of the mass of the people of Nova Scotia, and is now arrived at a stage that is beyond any party strife.

If when you come into the County of Cape Breton and wish to see the monument of the financial promoters of this enterprise, you have but to look around you! I have faith in the enterprise, which these gentlemen undertook, for one simple reason; and that is, that from the beginning to the end I viewed it as a *business* enterprise. (Applause.) I never supposed that Mr. McKeen had any idea of entering the company from a spirit of benevolence or that Amercans came for their health. They realize that the progress of the age is such that many things which were conducted in a small way can no longer be conducted in that way; and that if we are to keep pace with the times, we must have capital, regardless of nationality. (Applause.) We must welcome it from whatever source it may come. And so long as it conduces to the development of the resources of Nova Scotia, let us all welcome it. Let us hope that as time rolls on we will be able to understand these things better; and that no occasion will arise in the future for making this matter one of party contention. We shall be able to see the benefits of this scheme, whatever may be said to the contrary, if we have one object in view—the benefit of Nova Scotia! (Hear, hear.) A word respecting my friends of the Mining Society. It is not the first time I have had the pleasure of being among them; but though I have had pleasant times indeed with them, on no occasion have I experenced greater delight than on the present. I have to thank you all again most cordially for the kind words you have spoken on behalf of the Lieutenant Governor the Government and the Parliament of NovaScotia. (Loud applause.)

DR. McKAY—As representative of this county, it affords me much pleasure to address the members of the mining societies on this their first visit to the County of Cape Breton. Cape Breton is the geologist's paradise. I think some one has said that four square miles of the earth is sufficient to employ a scientific man for the whole of his life time; and if that be true, we have in Cape Breton sufficient area of an interesting character to employ the menbers of the societies of the Dominion of Canada for the natural period of their lives. I think we can give you various geological forms which would employ your time during the natural period of your lives. If this is the first occasion we have had of meeting you, I trust it will not be the last. We are heartily glad to have you come to this county; and as a representative of it I am sure I express the feeling of the people when I say it is a red letter day for us. There was a time in the history of this country when our mining affairs were at a very low ebb. And there are those who will tell you that we are a people without ambition—a people incapable of improving what is within their reach. I give that a most emphatic and indignant denial. (Applause.) Our country produced men who have given you what you have seen around you. (Applause.) It has produced a McKeen—it has provided those men who have in turn produced order and prosperity out of chaos. When they saw confusion, these men at the head of mining affairs in Cape Breton took these mining institutes andbuilt them up, and produced what you have seen through the mines. And, sir, I say that when I hear that we have no enterprise, no energy, I say you must go back to the time when mining operations were more difficult—you must look back to the men who were the backbone and sinew of the mining industries of the time and of Cape Breton!

THE QUEBEC MINING ASSOCIATION.

The next toast was that of the General Mining Association of Quebec and the Mining Institute of Ontario, coupled with it the names of Mr. John Blue, Capelton; Mr. B. T. A. Bell, Ottawa; and Mr. W. Hamilton Merritt, Toronto.

MR. JOHN BLUE—I thank you most cordially for the toast given. You have met and welcomed and treated us in a manner that it would be impossible for us to forget. You most assuredly have learned the art of entertaining, which, coupled with your warm native hospitality, is irresistible. When we come again, as you have so cordially invited us to do, we hope to be able to come in greater numbers, and that we shall enjoy ourselves literally as well as in anticipation goes without saying. As to the mining interests of our province, I regret to say they are not at the present moment in a flourishing condition. In the western part of the province the phosphate industry is practically in a state of collapse. And this, too, in the face of the fact that the Buckingham district has the richest minerals of the kind in the world. We are hopeful of better times, and that they may come soon. In the same region mica has been worked more or less on a small scale; but a little mica goes a long way. Coming farther east, the district where we mine pyrites, associated with copper and silver, the market is in very little better condition. We still keep working, but have come to the conclusion that our ore is of more value in the mine than in the market. The bright spot in the gloomy prospect is Asbestos; and in this, I am glad to be able to say, a considerable improvement has been made of late, especially regarding demand. Prices are not improving very much; but as long as the demand continues, we may hope that the prices themselves will improve shortly. In the same district there has been a new find which has created a little excitement, and which we hope may be a very profitable industry. This we have found to be chromic iron; and shipments are being sent to the United States at a good margin of profit to the operators.

As far as our Association is concerned, I am proud to say, that notwithstanding all the conditions I have referred to, we still exist; and not only do we exist, but we are growing steadily and accomplishing good work for our province. We are to-day numerically stronger than ever; and are in a better condition financially, and beginning to be known and recognised; and that means power and influence in our province. We have a good deal to thank our worthy Secretary for. We have to thank him in a great measure for our success. Mr. Bell has been indefatigable in his exertions on our behalf. I might say, too, that he and I as a combination are pretty well known, that is, wherever the English language is spoken. I do not mean to insinuate that our names are likely to go down to posterity for heroic deeds or words or works; but I venture to predict that the *blue-bells* of Scotland will live in song forever. (Applause.)

MR. B. T. A. BELL—I feel that after what has been said by our esteemed President, any further remarks from me at this hour would be presumption and a trespass upon your good nature. But I will say this: That we appreciate to the full the unbounded hospitality that has characterized the proceedings of this most interesting and enjoyable meeting, and that we are deeply sensible of the efforts which have been made so successfully to entertain us in a truly royal manner. I am sure I not only voice the sentiments of each member of our Association present, and none the less so of those who were so unfortunate as to be unable to come, when I say we hope, at no distant date, to be able to reciprocate in some measure at least, the attentions and courtesies that have been showered upon us. We will carry back with us an undying memory of your genial hospitality, your beautiful country, its productiveness and unbounded mineral resources.

MR. HAMILTON MERRITT—I rise with mixed feelings at this hour of the evening. After such a magnificent feast as we have partaken of, it would be difficult to rise otherwise. But the sensation which preponderates is one of gratification at the honor done me in asking me to respond to this toast. The other feeling is one of mild resentment at the annexation which has taken place between Ontario and Quebec. I am an Ontario man, and represent—so far as I can represent an institution which is the guest of another institution—the Ontario Mining Institute. And I may say I thank cordially the Quebec Mining Association for allowing me to be indirectly a guest at this banquet; and on behalf of the Ontario Mining Institute, my thanks can scarcely be put in fitting words. Our Mining Institute in Ontario, which also has been set well going chiefly through its indefatigable Secretary, Mr. B. T. A. Bell, is very young; but we hope that some day it will safely arrive at a growth of importance. We are here in a humble way to learn what we can of the mining operations, which sturdy industry and ability have brought about in this Canada of ours, and of which Canadians in all provinces are proud. Those of us who take an interest in Canada feel very proud indeed of the mining operations of Nova Scotia, which have been brought to such a high state of perfection. (Applause.)

Owing to the unavoidable absence from the room of President Hardman the toast of the Mining Society was not responded to.

Mr. Chas. Archibald. DOMINION COAL COMPANY. W. Blakemore, M.E.

THE LADIES.

MR. F. C. KIMBER, responding to the toast of the ladies said—About a month ago I was invited here to the inaugural dinner of the Sydney Hotel; and I was further and more highly honored by being called on to respond to the ladies toast. The occasion being a festive one and unusual, I broke through my usual habit and invested a very considerable proportion of my previous month's salary in a bottle of champagne; and under its influence the barrier of my natural reserve melted away; and encouraged, moreover, by a benign and almost fatherly smile which I observed illumined the countenance of the gentleman whose a honored guests we are this evening, I boldly stated that if in the exercise of that gentleman's wisdom he could not see fit to increase my salary to enable me to start a small and very modest establishment of my own, it would not be my fault if I remained for an indefinite length of time a bachelor. (Laughter.) Gentlemen, I regret to say, and you will regret to hear, that my pathetic appeal has so far not resulted in the materialization of my wishes. (Laughter.) Not because of lack of opportunity, either; for on the morning following the event I have referred to, I had the pleasure of standing side by side with the resident manager of the Dominion Coal Company. He was good enough, with that grim humor which is characteristic of the gentleman, to compliment me on what he was pleased to term my "essay on woman" of the previous evening; but he was careful, gentlemen, to repress any generous impulse. (Laughter.) I have watched the mail day by day since with increasing anxiety, but with ever lessening hope; and I may add that my expectations have sunk below zero. But although, through man's inhumanity to man, I am compelled, hopelessly, to a life of miserable loneliness, I am always ready to respond to the toast of the ladies, and any other service in their behalf. (Applause). I may say, too, that I think—as the chairman himself said, it is a matter of great rejoicing that so many ladies accompanied the gentlemen who are assembled around here to-night; and while responding for the ladies in general, I should like to thank you for those ladies who are enjoying—and I hope will continue to enjoy—their visit to Cape Breton." (Applause.)

THE CHAIRMAN.

MR. B. T. A. BELL, having fittingly proposed the health of the Chairman, Mr. David McKeen, whose guests they were, and in response to the vocal and vociferous assertion that he was "a jolly good fellow"

MR. DAVID McKEEN, M.P., said—I cannot, though a good deal embarrassed, let your good will pass without thanking you for the way you have received the toast of the two Societies. In bidding you here, I, as one of the Committee, felt some little hesitation as to whether we had the means or facilities at our hands for making your visit an agreeable one, more especially when we undertook to receive you here to-night and entertain you with this dinner, such as it has been. I think we all felt that possibly we might not be able to make this function as successful as we should like. But if you have enjoyed yourselves—and I judge you have from the way you have expressed yourselves—we are more than repaid. It has been a great pleasure for us to see you all, and I trust this is only the commencement of many happy meetings.

This assemblage has not been altogether disinterested on our part. You in Ontario, and more especially in Quebec, are our principal customers. You are the people who take a very great supply of coal we are annually mining, and especially up the St. Lawrence. Hence we felt it our interest to extend an invitation to the Mining Associations of Quebec and Ontario to come and see what we are doing and to offer you an opportunity of viewing our modes of work.

That your visit may be a successful and pleasant one, both to yourselves and ladies, I am sure, is the sincere wish of the committee who have the responsibility of receiving you, and also of every man holding an official position in the Dominion Coal Company."

Songs by Mr. H. J. Williams, of Thetford, Que.; Mr. Geo. Boak, of Halifax; Mr. W. R. Thomas, of Montagu; clarionet solos by Mr. E. D. Ingall, of Ottawa; and recitations by Mr. Gordon Rogers, of Ottawa, were interspersed during the evening, which was regretfully concluded by the lusty and loyal singing of God Save the Queen.

COAL MINING IN CAPE BRETON.

THE HISTORY AND ORGANIZATION OF THE COMPANIES—THE COLLIERIES OPERATED AND THEIR EQUIPMENT—STATISTICS OF OUTPUT AND SHIPMENT.

In addition to the data given elsewhere in this issue, the following notes respecting the companies engaged in mining coal in Cape Breton will be of interest:

The Dominion Coal Company, Ltd.

Incorporated by Act of the Legislature of Nova Scotia 1st February, 1893. Authorized capital, $18,000,000; issued, $16,500,000; common, $15,000,000; preferred, $1,500,000; authorized bonded indebtedness, $3,000,000; first mortgage bonds at 6 per cent. issued, $1,500,000.

Directors—Henry M. Whitney, Boston; Sir Donald A. Smith, Montreal; Henry F. Dimock, New York; Hugh McLennan, Montreal; F. S. Pearson, Boston; Sir W. C. Van Horne, Montreal; Robert Winsor, Boston; W. B. Ross, Q.C., Halifax; Alfred Winsor, Boston.

General Offices: 95 Milk street, Boston. Henry M. Whitney, President; Alfred Winsor, Vice-President; J. S. McLennan, Treasurer; F. S. Pearson, Chief Engineer. *Canadian Office:* Glace Bay, Cape Breton, N.S. David McKeen, M.P., Resident Manager; W. Blakemore, M.E., Assistant Resident Manager; J. R. Blackett, Cashier, B. F. Pearson, Halifax, Secretary. *Canadian Selling Agents:* Kingman, Brown & Co., 14 Place Royale, Montreal, and M. R. Morrnw, 50 Bedford Row, Halifax.

This, the most important coal producing organization in Canada, operates in Cape Breton, under a lease which gives a tenure of its mining property of ninety-nine years, the royalty to the Nova Scotia Government for the whole period being fixed at a maximum of 12½ cents per ton, with a minimum gross amount for each year to be paid on at least as many tons as were in the year 1891 sold by all the collieries it acquired. The property extends over an area exceeding seventy square miles of coal lands in Cape Breton, upon which the following collieries are worked:—

Caledonia Colliery—One mile from Little Glace Bay; Superintendent, J. G. S. Hudson; Underground Manager, George Scott; coal raised, 1893, 169,041 tons; to 30th June, 1894, 15,867 tons.

Phelan seam of 7 ft. worked; dip averages 1 ft. in 10 ft.; vertical depth of shaft, 185 ft.; length of slope, 1,600 ft.; endless haulage driven by 1-12 in. cyl. engine. Patent dumping cages and selfweighing tanks.

System of working: pillar and bord.

Ventilation by Murphy fan 12 x 6 ft., running at 120 revolutions per minute and giving 100,000 cubic ft. of air.

Naked lights.

Boilers: Babcock and Wilcox.

Pumps: one No. 7 Blake.

Hoisting engines: 1 20-in. double cylinder, 3 ft. 6 in. stroke, with 8 ft. drum; 1 double engine for hauling coal from deep, having 12 in. cylinder, 15 in. stroke.

Air compressor: One 20 x 30 piston inlet, Ingersoll make, with a capacity for 12 coal cutters; 8 Sergeant coal mining machines and necessary boilers, air receivers piping, etc.; also one Rand Compound Air and Steam Compressor from World's Fair, Chicago.

Coal heading machines: two Stanley.

Glace Bay Colliery—Situated 14 miles from the town of Sydney, and half a mile from Glace Bay Harbor, from which shipments are made. William Adamson, Underground Manager. Total coal raised 1893, 128,316 tons; to 30th June, 1894, 62,433 tons.

Harbor seam, 6 ft.; dip averages 1 ft. in 10 ft.; vertical depth of shaft, 240 ft.

System of working: pillar and bord; coal from deep hoisted to pit bottom by a double 12 inch cylinder engine; coal from rise workings lowered to pit bottom by self-acting incline; 1 18 in. cylinder engine driving endless haulage.

Ventilation: by Murphy champion fan, 8 ft. dia., driven at a speed of 90 revolutions per minute, giving 35,000 to 40,000 ft. of air and capable of being worked up to 80,000 cubic ft.

Naked lights.

Boilers: one flue, 33 x 3 ft., 16 h.p. steaming fan exgine; six plain cylindrical 33 x 3 ft., 66 h.p., at hoisting shaft for engines, pumps, etc.; two multitubular.

Hoisting engines (on surface): one double drum, 18 in. cylinder, 24 in. stroke; drums 8 ft., built by Matheson, New Glasgow; (below ground) one double 12 inch cylinder, 24 in. stroke, drums 4½ ft., built by Davis, Pictou.

Pumps: two in number—one steam (Cameron's "special"), and one double 10 in., having independent 9 in. col. (double).

Screens: ordinary plain parallel, ¾ stationery.

Air compressor: one, 20 x 20 x 24 in stroke, working two Ingersoll coal cutting machines.

International Colliery at Bridgeport, 12 miles from the town of Sydney; John Johnstone, Superintendent; Thomas Johnstone, Underground Manager. Total coal raised 1893, 126,000 tons; to 30th June, 1894, 60,333 tons.

Harbor seam worked averages 5 ft. 10 in.; dip, 1 in 12; length of slope, 2,800 ft.; vertical depth shaft, 90 ft.

System of working: pillar and room.

Ventilation: Murphy fan, 8 ft. dia.

Naked lights.

Winding engines (on surface): pair 16 x 36 in. and 14 x 30 in.; 8 ft. drum; (below ground), pair Lidgerwood, 9 in. cyl., 12 in. stroke, tandem drums, 30 in. dia.

Pumps: one Knowles, 160 ft. suction, 2,300 ft. discharge.

Boilers: five, aggregating 300 h. p.

Victoria Colliery, situate at Low Point, on the south side of Sydney Harbor; T. J. Brown, Superintendent; John Wilkinson, Underground Manager.

Ross seam: 6 ft. 7 in. worked; dig averages 25°; length of slope, 1,740 ft.

System of working: pillar and board; bords 18 ft. wide; also one section of longwall.

Ventilation: Murphy fan 6 ft. dia.

Naked lights.

Hoisting engines: one horizontal engine, having two cylinders, each 24 in. dia by 4 ft. stroke; drum 7 ft. dia.

Pumps: one forcing pump, cyl. 18 in. dia. by 4 ft. stroke; pump dia., 8 in. one Knowles, cyl. 12 in. dia. by 1 ft. 3 in. stroke.

Boilers: three cylindrical egg-end, 30 ft. long, and four multi-tubular.

Screens: four, each 5 ft. wide by 20 ft. long.

There are also two locomotives and 120 waggons.

A borehole 8 in. dia. and 600 ft. deep is being put down for pumping water to surface.

Gowrie Colliery, situated on the north side of Cow Bay, A. M. Evans, Superintendent; Alex. Macdonald, Underground Manager. Total coal raised in 1893, 117,993 tons; to 30th June, 1894, 65,000 tons.

Seam worked (MacAuley) averages 5 ft.; dip 1 in 8; Odiorne shaft, 200 ft.; New Pit, 260 ft.; two slopes from pit bottom, being West Slope, 1,400 ft.; East Slope, 2,800 ft.

System of working: pillar and room (modified, the rooms being 10 yards wide and the pillars 7 yards), and one section longwall.

Ventilation: by furnace, 7 ft. 8 in. x 6 ft., giving 40,000 cubic ft. air.

Naked lights.

Winding engines: pair, 20 in. x 3 ft. 6 in., direct acting by hoisting engines; 8 ft. drum, and pair 10 x 12 in. Lidgerwood hauling engines, geared 5-1; 4 ft. drums, also pair 9 x 12 in. tail rope hauling engine, geared 6-1; two drums, 3 ft. 6 in.

Pumps: 1 Knowles pump, 20 x 36 x 10 in., 1 Knowles pump, 14 x 24 x 8¾ in., 1 Cameron pump, 12 x 12 x 5½ in., 1 Fly Wheel pump, 10 x 12 x 5½ in., 1 V. Bob Lift pump, 16½ x 48 x 10½ in.

Boilers: 2 30-h.p. tubular, 5 ft. 3 in. x 17 ft. 6 in.; 1 30-h.p. tubular, 5 ft. 6 in. x 17 ft. 9 in.; 6 12-h.p. shell, 3 x 30 ft.; 5 10-h.p. shell, 2 ft. 10 in. x 27 ft.

Screens: common bar (3); angle 31°; size 18 ft. x 5 ft. 9 in.

Air compressors: one 16½ x 20 x 24 in. stroke and one 20 x 20 x 24 in. stroke.

Patent fuel plant: Yeadon's; capacity five tons per hour.

Mitchell longwall machine.

Reserve Colliery, situated at Bridgeport Basin, two and one half miles from Glace Bay; James McVey, Superintendent; Norman McKenzie, Underground Manager. Coal raised to 30th June, 1894, 70,629 tons.

Phalen seam, averages 8 ft. 8 in; dip 1 in 13; worked by two slopes, of which the "Main" is 2,500 ft., and the "French" 3,580 ft. long; vertical depth about 267 ft.

System of working: pillar and room.

Ventilation by furnace.

Naked lights.

Hoisting engines: one winding engine, 22 in. cyl., 3½ ft. stroke; geared 2-1; drum, 4 ft dia., and one 22 in. cyl., geared 4 to 1, working endless haulage.

Pumps: one pumping engine, 15 in. cyl. 8 in. water cyl., 24 in. stroke; one Cameron pump, 14 in. steam cyl., 8 in. water cyl., 18 in stroke; one plunger, double, 6 in. diameter, 8 in stroke.

Boilers: nine boilers, 3 ft. dia., 30 ft. long, flash flues.

Screens: three in use, 20 ft. long.

Old Bridgeport Colliery, situate on north side of Lingan Bay, ten miles from the town of Sydney; Robert Robson, Superintendent; George W. Greenwell, Underground Manager. Total coal raised in 1893, 50,363 tons; to 30th June, 1894, 9,975 tons.

Phelan seam, 6 ft. worked; dip averages 1 in 11; shaft, 120 ft.; system of working, pillar and bord.

Naked lights.

Ventilation by furnace.

Two air compressors: one 20 x 20 x 24 in. stroke; one 24 x 24 x 30 in. stroke working 2 Stanley Coal Heading machines and 4 Ingersoll cutters.

Hoisting engines: one pair Lidgerwood, 10 in. double cyl.; 5 ft. drum.
Boilers: two 4 h.p. water-bottom, tubular, loco. type.
Pumps: none. (Level to sea natural drainage.)
Screen: one 3/8 mesh, 20 x 6 feet.

Dominion No. 1 Colliery, J. Johnstone, Superintendent. Coal raised to 30th June, 1894, 6,016 tons. A new winning opened by shaft 24 ft. x 10 ft. 6 in. sunk to Phalen seam 150 feet.

Compressors: Two Rand, Compound, each 48 x 30 capable of working 2 Stanley Headers and 20 Ingersoll Sergeant Cutters.
Winding engine, 20 in. x 4 ft. 6 in., with 8 ft. drum for hoisting coal.
Boilers: 3 Babcock and Wilcox.
Pump: Cameron, 18 in. steam and 7 in. ram.
Other engines: There are also 2 18 in. x 3 ft. engines underground for endless haulage.

Transportation and Rolling Stock—In addition to a larger number charter steamers the Company owns owns five cargo steamers, three steam tugs and five coal barges. It controls and operates 13½ miles of narrow gauge railway and 20 miles standard gauge, while 22 miles are now under construction. The rolling stock comprises 13 locomotives and some 600 passenger and coal cars. The line of railway to Louisburg is now open for coal and passenger traffic from Sydney to Glace Bay, a distance of 14 miles, while the second section under construction is expected to be completed by October, 1894. The maximum grade is limited to eight-tenths of one per cent.; it is being laid with steel rails, 80 lbs. to the yard, and constructed in all respects in a most substantial manner.

COAL DISPOSALS, 1893.

The following are the official returns furnished by the Company of its coal disposals during the year ending 31st December, 1893:—

Distribution.	Tons.
To Nova Scotia	109,822
" New Brunswick	35,391
" Prince Edward Island	9,834
" Quebec	499,873
" Newfoundland	30,054
" United States	13,664
" St. Pierre Miquelon	4,220
" West Indies	4,325
" Colliery Employes	10,024
" Colliery consumption (engines, etc.)	29,043
" Bunker steamers	32,195
	868,445

RETURNS OF OUTPUT AND SHIPMENT FOR SIX MONTHS ENDED 30TH JUNE, 1894.

Name of Colliery.	Coal Raised Tons.	Coal Shipped Tons.
Gowrie	65,000	52,290
Reserve	70,629	57,153
Old Bridgeport	9,975	8,208
Glace Bay	62,433	51,064
Victoria	48,683	41,628
Caledonia	15,867	11,183
International	60,333	45,208
Dominion No. 1	6,016	3,436
Total	338,936	270,170

COLLIERY CONSUMPTION.

	Tons.
Coal used by engines	19,458
" " workmen	7,781
Total (six months)	27,239

DISTRIBUTION.

	Tons.
Sold in Nova Scotia	44,731
" to Prince Edward Island	2,131
" " Mexico	1,527
" " Newfoundland	16,965
" " Quebec	157,252
" " West Indies	4,216
" " Columbia	521
" " United States	22,068
" " New Brunswick	4,476
" " St. Pierre	566
" " Bunker Steamers	15,717
Total for six months	270,170

The General Mining Association of London, Ltd.

Registered 1825. The capital was £274,690 in fully paid shares of £10, but in 1874 a return of £1 per share was made, and in 1880 a further £1 per share was repaid. There is now, therefore, a capital of £219,752 in shares of £8. Accounts to December 31st, submitted in April, but an interim meeting is held in November. A dividend of 2s. 6d. per share was paid in 1877; for 1878, 4s.; for 1879, 2s. 6d.; for 1880, 4s. 6d.; for 1881 and 1882, 8s.; for 1883 a dividend of 10s. per share was paid, with a bonus of 5s. per share out of the profits derived from the sale of shares in the Spring Hill Minjng Company; in 1884 a dividend of 8s.; for 1885 and 1886, 5s. each year; 1887, 7s. 6d.; 1889 and 1890, 6s.; 1891, 8s.; 1892, 10s. Reserve fund, £29,850 stg., carried forward £1,610. The company holds $429,700 shares in the Low Point Barrasois and Lingan Company.

Directors—J. D. Hill, chairman, Sir Charles Tupper, Bart., W. S. Cunard, Col. W. C. Western.

Head Office—E. E. Bigge, secretary, Bloomfield House, London Wall, London, E.C., England.

Mines Office—R. H. Brown, General Manager, Sydney Mines, C.B.

Canadian Agents—Messrs. Cunard & Co., Halifax, N.S.

In the year 1825 this company purchased the Duke of York's right to all the mines in Nova Scotia. In 1826 it sent out the late Mr. Richard Brown, father of the present manager, to survey and report upon the coal fields of Nova Scotia and Cape Breton. He found that the Sydney mines, first opened in 1785 and under lease to Messrs. T. S. and W. R. Brown, was not included in the grant to the Duke of York, and as their lease expired on the 31st December, 1826, and they they did not care to renew it at the heavy royalty of 4s. 3d. per ton, which they had been paying, Mr. Brown took the lease from the government for the General Mining Association. The opening out of works was commenced at the beginning of 1830, when the first shaft 200 ft. deep was sunk. Iron foundry and fitting up shops were then erected, and a railway from the pits to North Sydney for a shipping port was completed in 1834. Previous to this date the coal had been shipped at a small wharf outside the Bars. In 1834 a second shaft further to the dip was sunk. In 1854 a third shaft 400 feet in depth was put into operation. A still further move to the dip was made, as the underground workings advanced in that direction, and the fourth winning was got into operation in 1876. This last is known as the Princess pit (shown in our illustration). There are two shafts each 683 feet deep to the coal, which is being brought out thence from under the sea.

In addition to their works at Sydney Mines, the General Mining Association opened a colliery at Bridgeport in 1830, which colliery was closed in 1849. They also operated a small colliery at Bras d'Or from the year 1833 to 1849. They opened a colliery at Lingan in 1854 which worked until 1886, while they opened the present Victoria mines in 1882.

Sydney Colliery—Situate on the north side of Sydney Harbor. Main seam 5 feet 4 inches worked; dip averages 1 in 12; shaft, 800 feet; system of working, pillar and bord, the latter 16½ feet wide.

Lamps—Muesler and naked lights.
Ventilation by Guibal fan, 30 feet diameter.
Hoisting engine having two cylinders, each 36 inches diameter, 5 feet stroke, drum, 18 feet diameter.
Pumps—One Cornish pump, 68 inch cylinder, with two lifts of pumps, each 20 inch diameter. One forcing set of 8 inch diameter, with 12 inch steam cylinder.
Boilers—Eleven egg-end cylindrical and three tubular.
Screens—Five each, 5 feet wide by 24 feet long. There are also three locomotives and 220 coal waggons.

COAL SALES.

	Round.	Slack.
1890	143,365½ tons	9,316 tons.
1891	136,552 "	6,740 "
1892	151,884 "	7,631 "
1893	186,615 "	8,994 "

The Cape Breton Colliery.

Organized 1893. Owners: J. T. Burchell, New Campbellton; J. E. Burchell, Sydney; managing owner, J. T. Burchell, New Campbellton, C.B. This property, upon which mining operations were carried on as far back as 1861, was acquired by the Messrs Burchell, in June, 1893. It comprises an area of three square miles, and is picturesquely situated at Kelly's Cove on the northern side of the entrance of the Bras O'Or Lake, and about thirteen miles from the celebrated Sydney Mines, which for upwards of a century have been in extensive and successful operation. There are three seams on the property averaging 2 ft. 4 ft. and 6 ft. respectively, but operations to date have been entirely confined to the four foot seam, dipping at an angle of 12° and opened by a slope now in about 1,000 feet. The outcrop of the 6 foot seam occurs in a brook on the brow of the mountain some distance from the slope, and shows a bright, clean, compact bituminous coal. At date of our visit a Sullivan prospecting drill was being put down with the object of determining this seam near the present workings. About 100 persons are employed, and, while the work is mainly confined to opening out and placing the colliery on a working basis, a brisk shipping trade is being done. As an instance of this, among a number of vessels lying at the wharf, at our visit, we found, the schooner "Jeanie," loading coal for Nairn, a Moravian settlement in the 67°, the first instance, we believe, of a cargo of Cape Breton coal being sent so far north. The shipping facilities are excellent. A substantial pier capable of loading a number of vessels at one time and having a depth of water now at 18 feet, but which may be increased by a slight extension of the pier to a much greater depth, is connected with the mines by a well constructed narrow gauge line of railway running a distance of little over a mile from the present slope. The equipment of the colliery at date comprises: 3 boilers of 110, 35 and 40 h. p. respectively; one Ingersoll Sergeant 7 drill compressor, and five Ingersoll Sergeant coal cutters; one 16 ton Baldwin locomotive; one haulage engine having 4 ft. 6 in. drum; Sullivan prospecting drill, etc. The coal has been well received in upper Canada and is commended as a good steam coal by the customers of the new company. From the favorable situation of the colliery, its excellent facilities for economical extraction and shipment, and the success which this coal met with, even in competition with the other companies, the Messrs. Burchell seem justfied in their expectations of a large and profitable business when their colliery is fully equipped.

Boston and Nova Scotia Coal Company, Ltd.

Incorporated by an Act of the Legislature of Nova Scotia, May, 1893. Authorizd Capital, $5,000,000, in shares of $100, of which $500,000 was reported to have been subscribed at the date of last report.

Directors—Hon. John W. Candler, Boston, President; John Russell Gladding, Providence, R.I.; Hon. David S. Baket, jr., Providence; John McKeen, Mabou, C.B.; John C. Cobb, Boston; W. J. Fraser, Halifax; A. C. Ross, North Sydney; R. P. Fraser, Pictou, C.B.

Head Office—66 State Street, Boston Mass. A. C. Ross, North Sydney, C.B., Secretary.

The property acquired is known as the Broad Cove and Chimney corner areas, containing about thirty square miles of coal lands in Inverness County, C.B. At date prospecting with the diamond drill is being carried on, and we believe it to be the intention to equip the property with a suitable working plant at an early date. A line of railway connecting the mines at Broad Cove with Orangedale station on I. C. Railway is also reported under construction.

Broad Cove Coal Company, Ltd.

Incorporated by an Act of the Legislature of Nova Scotia, 1894. Authorized Capital, $3,000,000, divided into 30,000 shares of $100 each.

Directors—W. Penn Hussey, Danvers, Mass.; W. H. Munroe, Edgarton, Mass.; John Y. Payzant, Halifax, N.S.; Wm. H. Wiswell, Halifax; Hon. J. M. Raymond, Salem, Mass.

DOMINION COAL COMPANY.

The property is known as the Broad Cove area. The coal is of good quality, consisting of, according to analysis: Moisture 9·00; vol. matter 34·00; fixed carbon 57·00. The seam dips to the north at an angle of ten degrees, but, according to the late Mr. Richard Brown, no estimate can be made of the quantity of coal in the area, as its limits have not been defined. While there is a good deal of newspaper talk of immediate operations on an extensive scale, no work has been undertaken at date.

OUR TRIP TO CAPE BRETON.

By the Junior Reporter.

"I've had a real old holiday;
Things with me lately have been gay!"

Day was breaking as the good ship Bonavista stole quietly away from the wharf of the metropolis, and passing between the host of side wheelers, schooners and ocean tramps still asleep, headed down the great river.

It was a jolly party of some twenty members of the Quebec Mining Association, and ladies, bound to Sydney, Cape Breton, at the invitation of the Dominion Coal Company; and how can one feel otherwise than jolly when he knows that work and care, and all that wears heavy upon mind and matter, has been left behind, and that two whole weeks of sunshine and comparative idleness are ahead?

The Bonavista had been placed at our disposal through the kindness of Messrs. Kingman, Brown & Co., of the Black Diamond Steamship Co., of Montreal; and a good boat indeed we very soon found her to be. And when a really good boat has a really good captain, and the really good captain has a splendid lot of officers and the right sort of crew under him, what more under the blue of heaven could a mortal ask for—save it be an indefinite jotrney with never ending fair weather.

Fortunate indeed is he who can slip away from care for a week and spend that time peacefully amidst the beauties of the St. Lawrence, on board such a ship and with such a captain!

We were a merry lot—that is irrefutable. Indeed had there been a convenient barren island in the middle of the blue river when we were half way to the sea, it is quite probable that the captain would have set us ashore. As it happened, there was an iterated nautical threat to put the ringleaders in irons; notably one All-gall, who played so persistently and diabolically upon an instrument resembling in sound the horrors of the bagpipes and himself in attenuated appearance, that the crew threatened to mutiny unless All-gall was called off. Our first intimation, during these serene blue, dreamy days upon the big river, that any feminine and disturbing influences were doing their deadly work in the bosom of All-gall, was gathered from seeing him steal off with *her* to secluded corners where she would look bewitching under a cream lace parasol, and he would hug his knees and try to shave his chin on them as he gazed out over the rail with a vacuous stare toward the hills of Gaspé. Indeed, one morning, some of the crew, 'having some business'—reefing the windlass or spliciug the main hatch or something—found the two in the bow reading Herrick together. The second officer is ready to take his oath it was Herrick.

Of course, after that our eyes were open. But—enough—let us draw the veil; All-gall's billings and cooings would fill a page.

And oh! those long blue days of laziness on the broad bosom of the river! "Their memory haunts me yet!" I have read somewhere that we are composed of these same elements of air and ocean and surely there is a strong sympathy between us; for every wave we bound over, and every breeze we inhale seems full of life and health and energy and hope. One lingers in memory over the wide and glorious expanse of water, the sloping shores of green, the long range of fir-clad hills! And far beyond, the blue mountains rise faintly, and farther off more faintly still; like half-forgotten memories that have grown dim in the lapse of years!

And I see, too, more clearly still, the young man with the scrupulously clean cuffs who came and rang the bell betimes; and I hear the dizzy rush of many feet upon the deck, and I see the headlong and hungry dive down the stairway that indicated the eager desire to partake of something solid! And it is nothing but a dream now!

Our pleasant outing on river and ocean lasted for four days, terminating at North Sydney on the morning of the 10th July, in time to permit us joining forces with the Mining Society of Nova Scotia in a visit to the International and Victoria coal shipping piers, the first of a series of memorable excursions arranged for our instruction and entertainment by the hospitable coal masters of Cape Breton. With a hearty good-bye to Captain Fraser and the other officers of the Bonavista, who had been so good to us, we were soon speeding in a small tug across the beautiful harbor. At the International Pier, a jolly party, including the popular premier of Nova Scotia, the Hon. W. S. Fielding, was in waiting and received us with a right royal salute of fire-crackers, that was almost as warm as the kind assurance of genuine welcome and the hand clasp that greeted us as we stepped upon the wharf. At the International Pier we took the paddle steamer Marion, (a fine boat, of which more hereafter), and steamed away and saw the Victoria Pier, another splendid structure of its kind. And at length, elated with our reception and our surroundings, and with an intuition of the good things yet to come, we reached Sydney and wended our way, hungry and happy, up to the new Sydney Hotel—and to dinner.

THE NEW SYDNEY HOTEL.

The new Sydney Hotel is located upon Surprise Soap street, and overlooks the Harbor or Spanish River to the south-west. It is a fine, large, airy building with wide balconies, one of which faces the water, and commands one of the finest prospects in the Dominion. As is the case with the new Frontenac Hotel at Quebec, the "Sydney" strikes the eye before anything else as you run up the harbor toward the town, whether you are hungry or not. The table and all the prime factors impress you as being fresh from the country—even to the girls who wait. But the new Sydney Hotel is doing a great deal for Sydney itself. Already it enables the pilgrim's attention to be drawn to the existence of the town while still approaching the latter. There is more paint on the new Sydney Hotel than on all the rest of the town.

If we were appointed, in 1900, to take the census of Sydney, we would simply stay in the new Sydney Hotel. The local demand for the new Sydney Hotel tooth-picks is alarming. We have mentioned the hotel first because at first glance it impresses one as comprising the greater part of the town.

Before our arrival in Sydney, all the sidewalks of the town had been taken up and carried bodily away, for repairs. We appreciated the compliment; but so far as the Ottawa contingent was concerned, the Board of Works need not have been so very thoughtful. Speaking for our party generally, it was regrettable that the sidewalks had not been removed a little earlier than they were; for they were still being fixed up when we left. What we wanted was to have them fixed down.

But the air, and the freshness of each noon and afternoon! We know of nothing that can be compared to the matchless days of soft sunshine and serene blue waters about Sydney, and still be just. Save, indeed it be the blue eyes and the soft sunshine of the smiles that must ever make Sydney the loveliest place to linger in and the hardest to leave. And that is only a fair comparison in one sense; for lovely as the climate proved to be, the blue eyes of Sydney are by far the bluest and the sweetest in the world!

J. R. EXPLORES THE BOWELS OF THE EARTH.

A large party ran out by special train over the finely constructed International Railway, on a short visit to the various collieries terminating with the Caledonia mine at Glace Bay.

The day was delightful, and the Cape Breton country good to see. Grand Lake, a fine sheet, lay on our left; and farther, where the blue waves of the sea made merry in the sunshine, Lingan Head—a bold and rugged promontary—seemed, as the waters washed its base, like a weather-beaten veteran who smiles grimly at the attacks upon his front of an army of prattling grand-children.

Have you ever been "down in a coal mine"? It is an experience that will linger long afterwards in the memory, and from the very essence and quality of its darkness *lighten* and brighten recollection.

When you go down a coal mine, in an unofficial capacity, try and have on all the clothes that you have not paid for. If you share a room at your hotel with another man, it is also well to take any clothes of his that he is not wearing at the time. Put these on under some of your own before leaving for the mine, and the balance, those belonging to your tailor, can be conveyed thither in a valise. This precaution should be taken in case your friend might be visiting the mine at the same time, in the event of which contingency the sight of his belongings in your possession might lead to embarrassing results.

Having thus surrounded yourself with the annual output of two or three factories, you will be taken for a well fed man with a tendency to fleshify; and the gentlemanly janitor at the top will bring you a suit of yellow oilskin that may not be more than three or four sizes too big for you in your new and enlarged proportions. In any event the g. j. would insist on your losing yourself inside this Gog and Magog outfit No. 7; so that with your several layers of conglomerate clothes, you stand a one to three chance of eventually finding your way out of this buttonless bilious veneer which the gentlemanly janitor insists on putting over you.

Arrived at the slope, do not purposely avoid any substance that may strike you (except it be a pick or a cutting machine) as calculated to soil your nice new suit done in oils. Be bold, and let it come in contact with you as often as practicable. When you are tired, lean against any portion of the mine that will leave its impress upon you, first testing the capacity of the spot in this quality with your hands. By a careful application of these rules, the clothes of your tailor and your other best friend in which you are burried will absorb a great deal of opaque moisture that was only intended for the jaundiced epidermis you are wearing. As a result, neither your tailor nor your friend will insist on having his property back; and if you are not a fastidious man, you will have the opportunity for which you so oftened longed of paying off your tailor's balance without incurring further liabilities.

When you are in a mine, do not insist on sitting down on the wrong side of your body, even if the seat of your Turner's sunset pants appears to be there. The seat which you are sure you see there is like other modern furniture, not for use.

On returning from the mine, do not in a moment of absent-mindedness remove your friend's clothes. Even in their changed state your friend might recognize them and heap reproaches on you. Return as you came to the hotel, and at once engage a seperate room.

We stood at the head of the shaft and waited for the cage. It came up with a rush, and we stepped in; and then the blue sea and the fields of wild flowers and the arching sky disappeared and we went down! down! Daylight fled swiftly from us, and we could *feel* speeding by, rather than see, the wall of the black abyss, which seemed like an endless throat that was swallowing us with smooth and implacable swiftness.

But more impressive than the speed, more dramatic than the darkness, was the deep-throated accompaniment to this subterranean plunge: the rattle of the cables, the roar of the descent! The sound of the voices of the miners below us and the clatter of the cars in the slope came up and met us and grew louder as we dropped toward it. It was a great and harmonious discord: the thunder wedded to the clatter of descending rocks!

Coal in the mine is like coal in the city. It's on the rise the whole time. We ran up against the bottom, as it were, at last, and stepped off into space. We were greeted by a large and general smile from the miners. We knew the miners were there all right enough, although we couldn't see them, because their smile was as visible as a procession of torches on a dark night. Their teeth and eyeballs gleamed white as new sails in the light of a full moon.

We stepped around as if we expected at any moment to put our foot through somebody's hot house in Australia. They gave us each a little lamp about the size and shape of a five o'clock teapot. It was filled with oil and had a little wick growing out of the spout. I suppose these wicks had been planted rather late in the wick season, for we had to assist their growth every now and then by poking at them with a penknife. As our penknives were all in our hip pockets, and as we were battened and braced and done up in our lemon-colored capsules as if we had intended going into visiting mines permanently as a business, we borrowed from the first unsophisticated youth who had imprudently divested himself of his daffodil suit to get at his hip. He carried the suit back on his arm.

We tramped along in Indian file, with our little lamps on our fingers, looking a good deal like a superannuated ray of sunshine that had lost its way down a blind alley. There was no sound save that given forth by our crunching and irregular tread, and the whispered prayer of some one of our party as he collided with the wall, where he had gone off to pick coal for himself.

Algernon Charles Swinburne can write his overdone eulogies to Grace Darling and other daring young women; but when we go out of paragraphs and into poetry we shall apotheosize one with whom Grace Darling could never have pulled an *ore*, to use Grace's own favorite metaphor.

There are not many pretty girls who would care to venture into a long, black and seemingly endless slope, with a lot of desperate men who looked as *we* looked in those Niagara Falls uniforms. But we had one with us who didn't care if she did, and here's to bonnie Miss Fraser of New Glasgow! As the gifted premier of the Province of Evangeline said, she was the one redeeming feature of our party. And our feminine readers may not believe it, but she looked positively charming in her pyritic costume, with its baloon sleeves and bell-tent skirts.

We filed down the slope and saw the stables, where about fifty horses that never see daylight are fed and bedded. The stalls and surrounding walls are whitewashed; and considering its subterranean location, the stable is remarkably well kept and the animals well cared for.

Poor dumb drudges! We have heard that when, if ever, these buried vassals—serving their life sentence of eternal night—are borne upward to the green earth again, they become mad and delirious with delight. In the long, long day of drudgery and darkness a thousand feet below the waving grass and the free air, memory must have become dulled if not obliterated. And yet the consciousness of a glorious life once lived must be forced upon them, after the first moments of stupefaction, by this sudden sight of the flowered meadows, and the far blue sea, and the farther and bluer heaven! Or, is it but intoxication through contact with forces that contrast so sharply with those by which they have been surrounded?

We traversed the length of the main slope of this great and prospering mine, having to stand aside every little while out of the way of the long train of coal cars, as they went thundering by with their load, or clattered back empty. And now and then a party of miners with their little lamps in their caps would glide swiftly by us, like dark spirits, toward the open air and home. A thing of our visit that impressed one as we trudged along, as being humorous and human, was the way in which the short men of our party would duck their heads in portions of the slope where men six feet high strode along erect.

Wonderful and strange and impressive is a coal mine, with its gloom and capricious glimmer of small lights that seem like "will o' the wisps" or the tapers of the gnomes themselves. And then the ceaseless rattle and roar up and down the long and busy underground thoroughfare of the cable-drawn cars, the shouts of the men, the clatter of the upward-bound elevator with its freight, and the crash as it descends voraciously for more!

We were upward-bound, too, at last: tired, it may be, and grateful for the promise of the blue sky and the green earth; but satisfied and filled with admiration for all that we had seen of the wonderful forces of nature and the marvellous ingenuity and force of man. The dark walls sped by us and the voices of men and of industry below us grew faint and fainter. Then glad dawn broke and the daylight seemed to come down, shyly at first, but with growing confidence and strength. We saw the faces of one another, and dirty as they were, they wern't bad to look at. The walls grew brighter, and we shot as if at a bound, into the arms of the broad blue day!

Then we took our monochrome in oils off its frame, and removed the large circumambient wad of granulated gloom from our fair young face.

A RUN TO OLD SYDNEY MINES.

Right honestly have the Sydney Mines of Cape Breton earned their prefix of "Old." For it is now almost three-score years and ten since the late Richard Brown —he who in 1869 gave to the youth of Cape Breton and to the world the "only complete history that has ever been written of the the island"—was sent out to Cape Breton by an English syndicate, the General Mining Association, to operate the Sydney Mines, which had been opened forty years before.

Our drive from North Sydney, where we were met by his son Mr. R. H. Brown, General Manager of the colliery, with a number of comfortable vehicles, was over a hard, smooth road, and upon a matchless morning. On one side, close by, were the sparkling waters of the harbor, breaking white upon the beach; and on the other, fields of daisies and clover and wild flowers growing together, and forming a truly pastoral mosaic of nature. There were comfortable looking houses of the old school set back from the road and bordered by lawns and brightened by flowers. At intervals we passed through a natural avenue of firs, and then the country became more open. We saw the mining village, where the tiny houses lay in long regular rows, and the tall buildings of the mines; and beyond all, the sea!

The workings of the Old Sydney Mines extend for some distance below the harbor and out into the Atlantic. Of course we went below and enjoyed ourselves.

When we got out of our gamboge misfits and into our all-wool reliables again, we drove to "Beech Hill," the charming residence of Mr. R. H. Brown. We had been invited thither to lunch, and we think *that* lunch was the most dainty and enjoyable collation that we have ever had the gastronomic and fastidious pleasure of being collateral with. Of course, our appetites were keen and healthy after a long ride in the slope and the subsequent one in the open air; and that had a great deal to do with it. But isn't it a satisfaction, when a real feast is set before you, to have an appetite which you known will do full justice to that feast? Well, rather!

After a stroll about the flower beds and lawns adjoining the house, and viewing the coal seam where it outcrops in Mr. Brown's garden, we bade good-bye to our host and hostess and their charming daughters, and drove back to Sydney, as jolly a parcel of boys as ever were let loose upon a holiday.

OUR J. R. GOES TO LOUISBOURG AND——?

The next morning we were rattling along by rail to take the boat for Louisburg. We boarded the "Douglas H. Thomas," placed so kindly at our disposal by the Dominion Coal Company. And what a boat that is! Powerfully built and swift, she seems the embodiment of all that is best of combined strength and speed; as indeed she is. And then, we had Blakemore with us, and jolly Revere; and were mortals ever more blessed?

We passed through the narrow channel of the Glace Bay Harbor, which presented a scene of great activity, owing to the boats loading coal from the Caledonia and Glace Bay mines; and our craft was soon steaming merrily into the bounding blue of the Atlantic.

To our left were the rugged sandstone promontories so characteristic of the Cape Breton coast, well worn by the ebb and flow of countless tides and the wild washings of a hundred thousand storms. It is a fine, strong shore; and the heart leaps to see it on a fine morning, when the sun is streaming against its red weather-beaten face.

Beyond the waters to starboard, that glistened like a burnished coat of mail in the sun, a long beach of golden sand seemed running by; and behind us, beyond Glace Bay, the high chimneys of the Caledonia and Glace Bay pits belched their streamers of dark smoke, driven by the freshly blowing westerly breeze across the serene and cloudless face of the sky.

By now the water was white, and running high; and it became painfully evident to some and delightfully apparent to others that we were to have a sea. We passed Schooner Pond, from whence coal was shipped once upon a time. The rugged coast was still clearly to be seen, and beyond it were meadows dotted here and there with white cottages and fir-clad hills that were richly dark against the azure.

Flint Island, a mere rock, standing high and boldly above the sea, was left behind. It would be a nasty thing to run up against on a dark night if the lighthouse wick happened to burn out.

By this time the sea was as heavy as the foregoing paragraphs; and Thomas—the tug—was going through it like a pewter spoon through a pot of palpitant porridge. And it was sad to see the President! He and the Parasol had been sitting aft under the awning while the ocean was sober, and were as chummy as too pins on a full cushion, chatting away and applauding Sword's capital banjo solos and funny songs. Poor President! He hadn't dreamed at starting that there could be such a thing as rough weather on a morning like this, and during a little round-the-corner excursion to Louisburg. He started the ball rolling himself. Imagine the humiliation of having to excuse yourself from the society of a pretty girl, and then right under her very glance having to reach for the rail—and farther than that a moment later. There were others forward, too, who were passing a good deal of "condemned sustenance," as Bill Nye has aptly labelled it, overboard. Possibly they had heard that the boat needed lightening, and thought that was the best way to accomplish it.

We passed in safety the line of those who were checking off their dessicated nutriment, and found Harry W—— in the bow, singing: "What are the wild waves saying?" Poor B—— junior, evidently inspired with the idea that the capstan might be carried away any moment by the waves that were washing over the deck, and determined to prevent such a catastrophe at all costs, was holding that marine elevator as well as the despoiled and enervated condition of his interior would allow. His head declined upon his arms, and he was declining a good deal himself; and the big waves that washed across his lonely and forgotten feet were being kept busy keeping the deck nice and tidy. Altogether, you never saw such a lot of wasteful people in all your life!

We had got into a bit of a fog, too; but this raised partially at last, and through the lingering mist we saw the water dashing white as milk and wild as a cataract against the faintly perceptible and inexorable coast. It was a magnificent sight; but even those who had been so anxious to land a moment before, decided to tough it out and wait until they reached Louisbourg.

Louisbourg at last!

An interesting article, from a medical point of view, might be written on how Louisbourg was successfully stormed for the third time.

It was decided that the main body of our contingent should proceed up the lane leading to the village directly from the wharf; taking along the women and the sick. The baggage was left on board the tug, which was to have steam up in readiness for retreat, in case we should be routed and come back on a hop, skip and jump with the enemy in our rear trying to sell us relics.

Those who could sprint pretty well were ordered to sneak down the beach to the right for a bit, then cut up through the fields, and, by a flank movement, take the enemy in the rear of the town where the residences of the opulent were. Strict orders, however, were given that no looting should be done.

Well, the light infantry started off down the beach, making a great deal more noise than was proper for a skirmishing party. The main body plodded up the lane, armed with parasols, walking sticks, reticules, smelling bottles and shawls. The enemy was to be seen nowhere; and the General, fearing an ambush, was for entering a neighboring house and forcing the owner to execute an order of four (fingers) deep with something mild and innocuous for the ladies. He was, however, overruled, it being asserted by our guide—a deserter from the enemy's ranks—that better "stuff" could be obtained at a certain building on the main street. We proceeded, the enemy to a man remaining invisible. Following our scout, we stormed the gate of the building to which he had referred; and by a brilliant feat of arms gained an entrance, and that, too, without the loss of a drop of blood.

But imagine our dismay, when, on bursting into the room supposed to contain the ammunition which we so much needed to replenish our flasks, we discovered there the light infantry—our own men! seated round about upon barrels, and deal chairs, and soap boxes, and perched even upon the bar itself!

The room was wreathed in clouds of smoke, that hung with a grim aspect over all, giving evidence of a fierce conflict. But these exhalations soon proved to be but the result of an unparalled consumption of the weed nicotian—village-bar cigars, which must have been indeed weeds in the vilest sense of the word.

The light infantry greeted us hilariously from their various individual positions; and in a jocose, but injurious manner, discharged a preconcerted volley of ginger ale corks upon our front.

"Where's the enemy?" bellowed the General bravely, as he waved an umbrella of the vintage of '79 over his head, and forced his way through the smoke and debris of dead marines and corks and cigar stubs.

"Fired and fled!" shouted the captain of the party in possession. "Save this poor devil, sir!" and he indicated the bar-tender, a lean-bodied, brown-faced man of Acadian descent, who lounged upon the bar from an intrenched position and surveyed the destruction of his property, as his ancestors one hundred and forty years before had been compelled to do.

"Well, sir!" thundered the General, "what have you got to give us to drink?"

The gentleman of Acadian paternity shook his head and smiled in a deprecating yet suave manner.

"We have nothing but gingare hale," he said.

The General swore an oath, a good round oath, such as Colonel Vaughan may have sworn in 1746, when he learned that there were some cases of fine old wine left behind in the storehouses which he had fired.

"Do you mean to insult us, sir?" he thundered again. "Do these—these men of mine—" indicating the Light Infantry by a contemptuous sweep of one hand—"look as if they had been drinking ginger ale?"

"Ah, no!" replied the Frenchman, who seemed rather pleased and amused at the General's ebullition of wrath than otherwise. "Ah, mon Dieu, no! Dese gentlemen, dey comb here while I was try for to get soam slee—ep; for my wife, you know, she have de leetle baby, and for tree nights I don' can get no sleep hat tall, an' I have been walk de floor hup an' down! hup an' down! An' dese gentlemen dey comb here, an' dis one"—indicating the scribe—"he say: Ello, hole chap! WAKE HUP! An' I wake hup, an' by gar! dere was more as tree hundred men waant to drink hat my bar! An' dey take nothing but whiskey blanc! whiskey blanc! whiskey blanc! An' w'en de whiskey blanc she's hall gone, dey take rye an' hale. I tell you, Cap'n, I have whiskey blanc,—tree bottle. Hall gone! I have rye,—deux flacon. Hall gone! I have hale,—tree duzz—en. Hall gone! Pretty near hall de gingare hale, she's gone, too! Hevryting!"

We returned to our ship in a fog—especially the Light Infantry, who followed in an irregular manner and conducted themselves in such a way that had the enemy been quartered in ambush they would have been completely annihilated. There was a good lunch awaiting us on the tug, and we rushed at it and assaulted it with an enthusiasm and energy that would have been sufficient to take Quebec itself, let alone Louisbourg. And it was a pleasure to see the girls eat! Any misguided and dyspeptic pessimist laboring under the delusion that girls can't eat would have had his belief peremptorily and forever shattered upon that excursion. How intensely, pathetically human they do look, these angels upon earth, as they slap their knives across the face of a red slice of good old roast beef, and say they will take two slices in case you may forget them when you come around with the bread and butter!

But when the roll was called, four members of the main body who had trudged so bravely up the lane to storm the town, were found alas! to be missing. Had they been decoyed by some lurking prowlers of the enemy who had remained behind in secure hiding to loot the deserted houses? Oh, no! For we saw them shortly afterward on the farther end of the wharf about to drive away in a large, double-seated vehicle drawn by a stout team. They smiled sicklily at us, and waved their hands as if they might not see us again, and said they would not go back to Sydney in that awful boat across that horrid sea for all the annual output of the Dominion Coal Co.

EXCURSION TO THE BRAS D'OR.

Baddeck and thereabouts is a paradise in summer time that should be better known to the world. Not the tourist world, for it is the ubiquitous tourist who mars a naturally delightful place and makes it unbearable despite its supereminent charms. But for those simple people who love nature in a quiet and sincere way, and who desire to get away for a month or so from the jarring crash of the thoroughfare, to some sylvan spot where they will be surrounded by all that is most lovely in lake and shore and hill, where the air is sweet and cool, and the sky blue—where, in fine, upon a dreamful midsummer afternoon a thousand shades of green are upon the hillsides and meadows, and the water and the far mountain ridges and the farther heaven are soft and languorously blue—for those who seek such an arcadia, Baddeck is the place to which they should go. This is a long sentence; but that is what I should like to get if I was sent to Baddeck.

And who shall paint or tell with brush or pen the glories and azure bloom of the lake of the Golden Arm? From a thousand points of contemplation, delightful in themselves, are to be seen landscapes that hold the eye entranced, either of the dreamer or the painter; and which, if faithfully reproduced, must be the means of filling the heart of a true artist with proud delight as he gazes upon his canvas when his work is done!

We slipped away from Sydney on board the comfortable and roomy paddle boat Marion to these charming Bras D'Or Lakes, and upon a matchless morning of sunshine and breeze. The red shores of the rugged sea-facing coast were left behind, and toward noon we were gliding up the dimpled waters of the greater arm, with the long island of Boularderie upon our left hand. We had a jolly dinner, and as the afternoon wore on, we came in sight of that beautiful place, the residence of Alexander Bell, the inventor of the "Hello, Central!" The situation of Mr. Bell's fine summer house is truly magnificent, and the house itself as it shows itself beyond a fine grove of trees, seems to have risen to the occasion, as it were, for it is architecturally superb. Money talks.

The house stands some distance from the lake's edge and upon a fine expansive slope, commanding a far seeing view of the lake and country roundabout. This slope comprises about ten thousand acres of arable and timbered land, I believe, and seems to rise like a crown of prosperity and verdure from the blue lake, where it is bound by the white and perpendicular and exceedingly picturesque gypsum cliffs; that are in turn bound, like a rugged brow with a victorious wreath, by the overhanging growth of dark spruce.

There are lovely lawns and groves about the house, and beyond and to the right and left are meadows and farms and woods. Indeed, the whole ten thousand acres had been turned to good and beautiful account, and is nothing less than a great park; over all of which extends the fragile but potent telephone wire that has done all. If money talks, the telephone had the floor first in this instance.

Rounding this delightful Eden, upon which the eye feasts lingeringly until it has grown dim with distance or lost to view, we came opposite to Baddeck itself. It is a charming little village, lying whitely upon a gentle and verdant incline that runs back from the water for some distance until bounded by the spruce of the lower hills, that are in turn flanked by the blue mountains.

The view as you steam away from Baddeck, if you have the heart to leave it, is intensely lovely; that is, at least upon such a day as it was our good fortune to visit the place upon. But glorious weather is by no means rare about Baddeck; rather, anything other than fair is the exception. The village, with its white houses and steeples here and there, upon its lawn of green, seemed to smile pastorally and happily up at the higher and verdant elevation where the man of millions and unlimited connections dwells. Far away across the lake, the hills beyond the cultivated shores were blue in the summer haze, each farther range rising in more perfect and delicate loveliness, until the remotest of all seemed a part of the blue heaven itself. And blue was the lake; a slumbering sea of turquoise upon which we seemed to dream, and dreaming wonder if it all was real!

If there is a more delightful country than that of the Bras d'Or about Baddeck, and a more insufficient and weak-kneed description in print of anything almost indescribable, than the foregoing, I should like to know where to fine one and how to best avoid finding the other.

For an hour we ran up this Mediterranean, sunning ourselves and thanking our gods that we had not missed this opportunity of seeing Cape Breton at its best. For he who sees Cape Breton and sees not Bras d'Or, sees Cape Breton not at all, comparatively speaking, fine and picturesque as the country is. Certainly, no one viewing the coast of Cape Breton from the sea, would ever suspect that such soft loveliness of landscape and lake existed beyond those bluff, rough, tough old promontories, bless 'em!

And at length our feast of beauty drew almost to an end, and we ran up to the Narrows, which connects the arm with the great lake and is crossed by a fine iron drawbridge, across which run the trains of the I. C. R. It was evening by now, and the sun—for us—was setting gloriously beyond, and dimming in a blaze of orange and gold the summit of the blue hill. Farther we saw the great lake itself, and the distant hills, dim and pale and silvery, in the twilight and the distance.

We had to leave our steamer here, that we might take the Intercolonial Railroad train back to Sydney. We had a trifle over twenty minutes in which to take tea at the hotel at the base of the green and sloping hill near by, and we bolted down the wharf, happy and hungry. I have never enjoyed a day's outing more, and doubt if I ever will taste the like again, save it be by repetition.

THE COXHEATH COPPER MINES.

There were open, double-seated, four-wheeled rigs with phaeton tops, waiting for us early the next morning outside the hotel. It was a peerless morning; and the subsequent drive to Coxheath, in charge of genial Captain Gragg, was delightful and exhilirating. The party was merry, the teams in good fettle, the roads splendid, and the scenery and air superb and invigorating. We drove through many a delightful wood of fir and birch and maple, and over many a mile of shady road at a rattling pace, with here and there a glimpse of purling stream or still lake. As we rose with the country near Coxheath, our horizon widened; and when close upon our destination, with the Coxheath Hills before us and another range upon our other hand, the view of green and broad valley between, bright in the risen sun, that turned the foliage into a thousand shades of green, and the glimpses of lake to silver, was indeed lovely!

Arrived at the mine, we got into our primrose pants and roundabauts, so familiar to us all by this time, and armed with our little lamps, descended the shaft and paraded the tunnels. The latter were very fine to see, being splendidly high, having been blasted out or "stoped," as they call it. There was a picturesqueness and grandeur about these cross-cuts, owing to their rock formation and the bold ruggedness of their outlines, that were thrown into shadow at one moment, and at the next cast giant and flickering reflections in the light of our lamps. One fancied as he looked down the shadowy vista of one of these openings or into the cavernous gloom of the caves about, that here some mountain band of outlaws might be wont to hide their booty, as Indian Joe and his pal hid their treasure in the cave where Tom Sawyer found it.

Later, we had a stroll over the Coxheath Hills, inspected numerous outcrops and surface strippings of the ore, and then walked down to Colonel Granger's house near by.

We were not allowed to leave before we had experienced the hospitality of Mrs. Granger in the shape of wild strawberries and cream, and cakes and coffee, and other good things; to all of which, I am afraid, we did more than ample justice, as it is called.

We said good-bye at last, and then the rigs were brought up, and with our weeds going and our hearts merry, we bowled down the gravelled drive between the fine trees to the gate, and so on back to the Colonel's hotel.

PLAY CRICKET AND——?

If ever the Sydney Cricket Club forgets the drubbing it got at our inexperienced hands, it will only be because it is pleasanter to remember victory than ignominious defeat; and also because there is a world of truth in the old saying that there's no use crying over spilt milk.

When the Secretary decked out in a pair of flannel trousers that had once been white, cricketing shoes and shirt and a peaked cap, and carrying under his arm a wooden instrument that looked like a spade whose handle had stopped growing at an early age, while the rest of it kept on—I say when the Secretary came round to fifteen or sixteen of us and said we were to play cricket, as if he were summoning a lot of men to sit as a jury, we remonstrated.

It was a glorious afternoon for an outdoor match of any lively sort; but we had just had a good dinner, and the chairs we were occupying at an angle of forty-five degrees upon the harbor balcony, were intensely comfortable. We said we didn't play cricket much, and would prefer serving as an ambulance corps or something like that with a humanitarian life-saving turn about it.

But the Secretary said he had arranged the whole thing, and if we didn't turn up the Sydney Club would claim the match by default and insinuate that we were funkers and duffers.

We said we would rather be taken for cricketers even than funkers; and trotted off and got into all the available flannels and chappie caps and rubber-soled shoes and red belts we could find. Then we marched down to the grounds, looking about as variegated and dangerous as Coxey's army.

There was a great crowd of people who had come from all over Cape Breton gathered there to see the game, and seated on a long grassy slope above the field. Higher up on the rise were several old and tired looking buildings known as the Old Barracks. Near the Barracks was a tent, where a serious faced-man with a score sheet in front of him was seated at a small table; and by his side was the editor—nothing less than the editor, mind you—of one of the Sydney papers. Farther, at the upper end of the field, two or three bell tents had been raised for the comfort of the ladies and those who were to provide the fun. That was us.

They had it all arranged. Everything had been done so brown that we felt our goose had been cooked in advance. We sneaked out into the field, beaten men, and blinked up at the long black and white line of patient spectators; and at the ever present small boy, and the girls with their white dresses and parasols. Then we turned and stared at one another and felt like going back to the hotel and kicking ourselves—or better still, the Secretary.

The "crease," as they called it, ran parallel with the bluff overlooking the harbor; so that the field lay between the harbor and the slope where the spectators sat. At one end was the gate, and at the other the tents. There was absolutely no chance of escape. I thought, as I looked up at that sea of faces, of the old arenas of Rome where the men and the women looked down upon the poor devils who had to scrap for their living, as it were; and here were we, to be butchered to make a Sydney holiday! All this went with my blood; and I tell you, I felt sick over it. I had never wanted to be home so much as at that moment. I looked at the faces above me, and saw no mercy there, then at the pitiless sea, and lastly at the gate where the people were still pouring in without paying anything.

Meantime, some of our fellows had commenced making exhibitions of themselves by bowling the ball up and down and trying to hit it; to kill time, they said, but really with the idea of showing the people how little they knew about it, and in the hope of being left off. But the people took a different meaning out of these tactics, and thought we were burlesquing merely in the supreme confidence we entertained of being able to take the veneer off their team. They didn't like the way we acted, those people didn't, and I saw them whispering to one another with gloomy faces, as anticipated defeat settled down upon there several brows.

The crease was very near to the bluff. At the edge of the bluff, and a little below it on the incline, was a wire fence, and beyond this the beach.

The game had to start at last, of course, despite the delays we managed to create and the prayers several of us were sending up for rain. I don't think rain had ever been wanted so badly there before. The Secretary won the toss, and chose the field. Then he sprinkled us all over the premises, two of us in one place in some cases, so that if one muffed the ball the other could kick him and start a fight and so hinder the progress of the match.

The Sydney team had been practicing and training for weeks in order to stave off defeat, and were in the pink; while we had been living like a prize fighter trying to get out of shape as fast as possible. They had an imported bowler or two, and before the local team went to the bat, these two human cannon fired the ball around in a way that made our flesh creep.

They put two of their crack "bats," as they called them, in; and the way those fellows would knock the ball about when it didn't happen to go straight, was a caution. And when the ball *did* go straight, once in a while, they would jam their bats down hard into the ground, and the ball would run up fiercely against it and then roll back in a disheartened way, like a wave off a rocky coast. And at every run these chaps would make, the crowd of partizans on the hill-side would yell, and the old buildings would look as if they were on the point of tumbling down, they shook so with the noise. But they didn't applaud when *we* made a run (after the ball, I mean); and if one of us happened to tumble or pull up a sample of the grass grown in that region, instead of the ball, they would *laugh*; and those two chaps with their apoplectic shins would keep on galloping up and down the crease from wicket to wicket, and shout at each other wildly to "come on."

"Four!" their captain would shout; and the man in the tent would mark down four. "Well done, Menzies! Go it again!"

And they would "go it again."

Cricket is a good deal like croquet at a garden party when there are about ten playing. You think you are never going to get your turn; and when you do get it, it lasts about long enough for the man who comes next to gallop down to take your place as fast as his bulbous legs will let him. Cricket is not quite as exciting as croquet, because there are no pretty girls playing; and the element of danger is less than in the church social game. Cricket is played with a large brown ball, that looks about twice its natural size when coming toward you in the air; and as it gallops over the ground at a break-neck speed, in your direction, you generally manage to place your legs wide enough apart to allow it to pass between them and on its way undisturbed. Then you make a pass at the ground with your hands, pick up a large chunk of old Silurian and throw it hard at the man who struck the ball.

The wickets are three little sticks that look like the lonely and forgotten remains of a fancy fence, and there are two lots of wickets used in a match, one lot at each end of the crease. The crease is merely the ground between the wickets and upon which the ball never seems to want to strike until it reaches where you are standing. Then it either hits your leg, which they have bandaged up in advance, or runs past your bat, which you are holding firmly to the ground, and goes through the forgotten remains before referred to. Then they tell you that you are out, and they come and lead you away; and you are glad of it.

We had got two of their men out, when the Sydney captain rushed wildly down the slope, where he had been building some of his team up with ginger ale, and complained that the Secretary had fourteen men on the field. So he had, but it was a little thing to make a fuss about. They said we should only have eleven men playing; and the Secretary said he didn't know that, and was sorry about it, and ordered three of us off. Then the Secretary called us back, as we were all rushing off, and there was a squabble as to who should adjourn, as each one was anxious to show how unselfish he was. The trouble was settled at last, and the play continued; and at length we had them all out, and went in for our innings.

But we went in confidently. For we felt that the petty techinical protest the Sydney captain had entered about our having fourteen men on was made because he felt how the game was going against him; and you know, a drowning man will catch at a straw, though we never saw one idiot enough to do it. We had two of their men out, and they had only made about ninety runs between them, and as we had only eight more of their team to do up, you can easily see things were looking black for them.

When *we* got at the bat, the vast audience on the hill-side woke up. Williams was found using the round side of his bat; but we showed the Sydney team that we didn't intend taking any mean advantage of them, and Williams was ruled off. He said he was glad of it.

A little later on, when some of our smiters were in, they had to place a man down on the beach with a boat so that he could paddle out and get the ball when it fell into the harbor; as the wind seemed to be blowing the leather that way. But with all these artifices employed against us, we kept piling the score up; and then, when we had shewed them what we were made of, it appeared that we had yet another whole and consecutive innings. So there we had to go in again without any intervening rest out in the field. The congregation meantime had begun to file home, disgusted, I suppose, at the shewing their representative team, with its imported round-arm human Gatling guns, had made against a scrub aggregation.

Of course, the Sydney papers came out and said what a glorious victory their team had achieved, and so on, *ad nauseam*. But we had anticipated that sort of thing, and didn't mind it. It did our hearts good, too, to see our names in print without for once being connected with the police court; even if the game they were associated with was cricket instead of croquet or puss in the corner. And we all got copies of the paper containing the least unfair description of the match and mailed them home to our friends with the column in which our names blossomed forth marked with red pencil.

OUR PORTRAITS.

Mr. H. M. Whitney, President, Dominion Coal Company, Ltd.—Born at Conway, Franklin County, State of Massachusetts, 22nd. October, 1841. Educated at the public schools, supplemented by one year course at East Hampton Seminiary. Commencing with a clerkship in the Conway Bank and serving some time in the Navy Agent's Office, Boston, he ultimately became interested in the shipping business in New York. In 1866, was appointed Boston Agent, and in 1879, President of the Metropolitan Steamship Co., positions which he still retains. In 1887, he became President of the West End Street Railway Co., which he organized for the purpose of developing suburban property many acres of which he owned. The railway under Mr. Whitney's presidency absorbed all the street railways companies of Boston, making, we believe, the largest street railway company in the world. Mr. Whitney was one of the first to see the commercial value of the trolley system, and the West End Railway became the pioneer road in adopting the system. In 1870, Mr. Whitney became interested in coal mining in Cape Breton, and in 1893, as mentioned elsewhere, he successfully accomplished an amalgamation of the leading collieries in that section of Nova Scotia, under the name of the Dominion Coal Co., Ltd. In the same year (1893) he resigned the Presidency of the West End Railway. Mr. Whitney is also, we understand, president of five or six smaller companies and trustee of others.

Mr. David McKeen, M.P., Resident Manager, Dominion Coal Company, Ltd.—Born at Mabou, Cape Breton, his father being the late Hon. William McKeen, M.L.C.N.S. Educated at Halifax and Boston. Commenced practice 32 years ago as Provincial Land Surveyor. Has been sub-collector of Customs, United States Consuler Agent, a Municipal Councillor and Warden of the County of Cape Breton, which he now represents as a Conservative in the House of Commons. Prior to the formation of the Dominion Coal Company, he occupied the position of Treasurer and General Manager of the Caledonia Coal & Railway Company, Ltd.

Mr. W. Blakemore, M.E., Assistant Resident Manager and Engineer of the Dominion Coal Company. Ltd.—Born at Wolverhampton, England, 28th March, 1854, his father being a consulting mining engineer of large practice in the coal and iron districts of North and South Wales. Educated at Wolverhampton Grammer School, subsequently taking certificates in the Cambridge examinations. Prior to coming to Canada in 1893 and receiving his present appointment Mr. Blakemore practiced as a consulting and mining engineer in England. He was the first President of the South Staffordshire Branch of the National Association of Colliery Managers, and among other appointments held the post of Secretary to the Board of Examiners for Mining Certificates. He is a Member of the Federated Institute of Mining Engineers, (Great Britain), and takes an active interest in the work of the Mining Society of Nova Scotia.

Dr. E. Gilpin, Jr., Deputy Commissioner and Inspector of Mines for the Province of Nova Scotia.—Born in 1850, in the City of Halifax. Is the son of the Dean of Nova Scotia, and grandson of Judge Haliburton, so widely known under his *nom de plume* "Sam Slick." In 1871, he graduated from King's College, Windsor, N.S., and then served his time at the Albion mines, Pictou County. After this he spent some time in England at the collieries of Sir George Elliot and others. Upon his return to Nova Scotia he engaged in professional work and later succeeded Sir William Dawson in examining and mapping the iron ores of Pictou County. In 1879, he was appointed Inspector of Mines in Nova Scotia; in 1886, Deputy Commissioner of Public Works and Mines. Dr. Gilpin is a frequent contributor to technical literature among which may be mentioned the Transactions of the American Institute of Mining Engineers, the Royal Society of Canada, the Federated Institute of Mining Engineers, the Nova Scotia Institute of Science, and the Mining Society of Nova Scotia. He is also a valued contributor to the columns of the REVIEW.

Mr. John E. Hardman, S.B., M.E., President of the Mining Society of Nova Scotia—Is a graduate of the Massachusetts Institute of Technology. His first professional experience was in the Western States, where he gained an intimate acquaintance with metaliferous mining. He visited Canada in 1884, finally locating in Nova Scotia, where he is prominently identified with gold mining, being largely interested in the operations of the Oldham Gold Company, at Oldham, and the West Waverley Gold Co. (Ltd.), at Waverley. Mr. Hardman was one of the original members of the Gold Miners' Association, and since the formation of the Mining Society has taken an active part in all its proceedings, contributing frequently to the Transactions and evincing a lively interest in local mining legislation, many important amendments to which have been due to his wide experience and professional ability.

Mr. John Blue, C.E., M.E., President, General Mining Association of the Province of Quebec—Born and educated in the West of Scotland, where he practised as a civil engineer. His first professionaf work in this country was in the States, where he found scope for his ability in an important contract on a section of the celebrated Hoosac tunnel. He then became associated with the Eustis Mining Company, and for many years has had direction of the extensive mining work carried on at their productive pyrites property at Capelton, Que. He succeeded the Hon. George Irvine, Q.C., as President of the Quebec Association at the last Annual General Meeting, and is one of the most popular mining men in the Province of Quebec.

Mr. R. H. Brown, General Manager, Old Sydney Mines, C.B.—The highly popular manager of the Old Sydney Mines of the General Mining Association of London (Ltd.), is the son of the late Richard Brown, F.G.S., the first manager of the company's affairs in Canada, and the well known author of these standard works, "The Coal Fields and Coal Trade of the Island of Cape Breton," and "A History of Cape Breton." His first education was received at the Collegiate School, Windsor, N.S., and subsequently at the Engineering Department in the St. Lawrence Scientific School, Harvard University. After spending some yenrs as assistant manager at the Lingan mines, he visited England in 1863, gaining experience at one or two of the large collieries in Northumberland, under the celebrated mining engineer, Mr. Thos. E. Forster, of Newcastle-on-Tyne. On the 1st July, 1864, Mr. Brown succeeded his father in the management of the Old Sydney Mines. In addition to this important position, Mr. Brown had also charge of the Lingan colliery from 1871 until its closing down in 1886, and of the Victoria colliery from 1882 until 31st December, 1893, when it was sold to the Dominion Coal Co. (Ltd.) Mr. Brown is, we understand, Mayor of the important community in which he resides. He is also a member of the Council of the Mining Society of Nova Scotia, to whose Transactions he is a valued contributor.

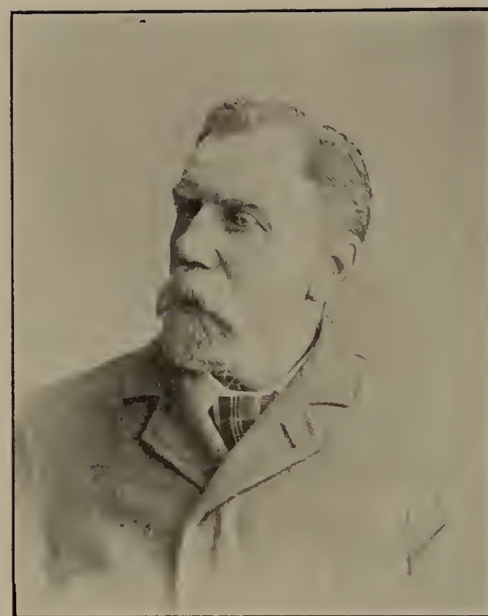
Mr. James Francis, Colliery Engineer, Old Sydney Mines—Through an unfortunate blunder the portrait of this gentleman has in a number of copies of this issue been designated as Mr. Isaac Greenwell. Fortunately the error was discovered in time to have the correction made before the greater portion of the issue was struck off.

Interesting Experiments with Coal Dust.

A series of interesting experiments in shot firing and its effects upon coal dust took place at the Lower Duffryn Collieries, Wales, on August 6. Te object of the experiments, which were conducted by Mr. Gwilym Jones, the manager, was to determine the behaviour of various explosives when covered with coal dust from the two-foot nine-inch and four-foot seams, both from roads and face of stalls. The first shot consisted of 1½ lb. of gunpowder covered with a small quantity of fine coal dust from the two-foot nine-inch seam roadways. The effect was a very large flame, which rose in the air to a height of about ten yards, and produced an intense heat. The same quantity of gunpowder was then tried with no coal dust, and resulted in a very much smaller and clearer flame. The next shot consisted of seven balls of compressed powder covered with some coal dust from the four-foot seam, and the same result was experienced as in the first experiment. A quantity of fine coal dust from the pit screens was tried with 1 lb. of gunpowder and two balls of compressed powder. This gave a larger flame still, accompanied with very great heat. The effect of experiments upon the dust from the face of the workings created some amount of surprise. A quantity of dust from the stalls in the four-foot seam was charged with 1 lb. of gunpowder and two balls of compressed powder, and resulted in a larger and a greater volume of flame and heat than that of the old dust. Half a pound of roburite (equalling 1½ lb. of gunpowder in strength) was tried in the same amount of dust. Fired electrically, it made a loud report, but there was no flame. Half a pound of ammonite fired with small coal from the face of the four-foot workings, and another charge of 1 lb. of compressed powder covered in fine dust and placed within a short distance of each other, were fired electrically. The former was fired first and the latter immediately afterwards to test the firing of dust in the air. The first shot caused no flame, but the second caused a large flame in the dust while in the air. Three-quarters of a pound of carbonite was also tried, but no flame was emitted. Mr. Jones then experimented in an arch 35 yards long, with the floor and sides constructed of crossed timber. Strips of boards were run along the sides in three rows to hold dust, so as to resemble the roadways underground, and coal dust was strewn about the floor, roofs, and sides. The first experiment was made with a charge of 1 lb. of gunpowder to resemble a volume of gas, and to see whether it would ignite the dust and produce a continuation of the flame through the arch. The powder fired in the ordinary way, but did not ignite the dust. One pound each of gun and compressed powder were tried, and ignited the dust immediately on the explosion of the powder, but, there being no current of air, the continuntion of the flame did not take place. Experiments with cannon were then made, but did not cause an explosion of dust, the place proving not very suitable for the experiment. The experiments were admirably conducted, and proved very interesting to the large number of people who witnessed them. The result showed very clearly that the ordinary gunpowder, both loose and compressed, would fire the dust, whereas the high explosives made no flame.

Novel Gold Amalgamation—A novel method of retorting small quantities of gold amalgam is announced by the Australian *Mining Standard*: We recently asked a miner, who was getting fine gold by sluicing, how he saved it. "I use quicksilver," he said, "and squeeze it through calico, and when I have got the amalgam as hard as I can—" "You retort it," we said. "No, I don't, and yes, I do—I don't as you mean, retort; but, I do, as I mean it myself. I get a potato, cut off one end, and scoop out a cavity in it large enough to take my ball of amalgam. I next take a spade or piece of flat iron, and place that over the fire, and then upon that I place the potato with the cut side down. As the amalgam gets hot the quicksilver evaporates and goes all through the potato; but it can't get through the skin, and neither can it escape by the iron, for the spud is stuck to the spade. When it is done, I take the spade off the fire and let it get cool, and then I have my gold on a button on the spade, and my quicksilver all in fine globules in the potato. I break that potato up under water and I have all my quicksilver."

Mr. R. H. Brown, General Manager, Old Sydney Mines, C. B.



Mr. James Francis, Colliery Engineer,
Old Sydney Mines.

Princess Pit, Old Sydney Mines, Cape Breton.—Operated by the General Mining Association of London, Ltd.

THE SYDNEY COAL FIELD, CAPE BRETON, NOVA SCOTIA.

Specially prepared on a reduced scale and amended for the Canadian Mining Review, from the Map of the Geological Survey of Canada, 1875, by kind permission of Dr. A. R. C. Selwyn, C.M.G., Director.

By C. O. SENECAL, C.E., Ottawa.

LEGEND

Cl	Coal Measures.	Coal crops:	
G2	Millstone Grit.	D° Exhibited:	
	Carboniferous Limestone.	Limestone:	
	Potsdam.	Direction of dip:	
	George River Limestone.	Roads	
	Laurentian.	Coal area boundaries:	

Scale of Statute Miles.

1 2 3 4 5 6 7 8

The Sydney Coalfield.*

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By Hugh Fletcher, B.A., Ottawa.

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

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

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

The first includes the beds of *conglomerate*, usually red, found along the foot of the Coxheath Hills. The *carboniferous limestone*, well exposed at Sydney Point, Point Edward and Kelly Cove, comprises thick beds of red and gray argillaceous shale and micaceous sandstone, beds of black and gray limestone with traces of galena and copper pyrites, and layers of gypsum here not more than five feet thick and unimportant, but largely worked in other portions of the province. On the shore of Sydney Harbor, a little above the South Bar it underlies the millstone grit and terminates at a fault near the mouth of Freshwater Creek, assumed to be a downthrow to the southwest of about 900 feet. Trunks of trees, fish-remains and shells, indicating brackish water life, are found in a three-and-a-half feet bed of calcareo-bituminous shale near Sydney Point and Point Edward. These rocks with the conglomerate are estimated by Mr. Robb to have a thickness of 4637 feet. Beneath them lie the igneous and metamorphic rocks of the Coxheath Hills; above them, the millstone grit, separated by a band of siliceous hematite.

The Millstone Grit, about 4000 feet thick, is well exposed on the roads from Sydney to Cow Bay and Mira Bay on Boulardarie Island, along the shores of Sydney Harbor and elsewhere. In the western portion of the field it consists of an almost unbroken series of beds of gray and rusty coarse sandstone, with great quantities of vegetable fossils, with occasional irregular patches of argillaceous shale and coal; whereas in the east the formation contains thicker and more regular beds of argillaceous shale, with a marked predominance of red shale and sandstone, and seams of coal, one of which at least is of workable dimensions and quality. In this eastern section are the Coal Brook seam of 1 foot 6 inches, the Tracy seam of 4 feet 1 in. and the Round Island seam of 2 feet, with smaller layers. Among these beds on the section at Mira Bay are exhibited changes both in color and in essential mineral characteristics. A stratum consisting at one place of coarse gray sandstone is frequently found when followed to no great distance, either on the strike or to the dip, to be replaced by red sandstone or by red or gray argillaceous shale. Such replacements are frequent also in the beds of the coal measures. Trunks and roots of prostrate trees are sometimes found converted into black crystalline carbonate of iron. No beds of limestone were observed in the Mira Bay section and carbonaceous shales are extremely rare and where found consist like most of the coal seams of this formation of very thin beds composed almost entirely of the matted and pyritized leaves of *Cordaites*.

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

The Coal Measures.—The boundary line between the millstone grit and the so-called productive measures, although important in an economic point of view, is a somewhat arbitrary one and may be regarded more as a matter of convenience than as of geological importance. As the upper beds are cut off by the sea, the entire thickness is nowhere represented. The productive coal measures, as defined by Mr. Brown and Mr. Robb, include argillaceous and arenaceous shales, for the most part gray, red and green marl, sandstone, underclay, limestone, black shales and coal, a thickness of about 1840 feet, of which from forty to fifty feet are coal and fifteen feet limestone, one set of seams running through the district. The coal contains more combustible matter than the Pictou coal and a smaller proportion of ash but a greater amount of sulphur, being at most of the collieries less inclined than at the Pictou and Cumberland mines, and therefore, as stated by Mr. Poole, not subject to the same proportionate waste in working and screening.

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

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

Numerous beds of sandstone constitute the most prominent, thickest and most persistent members of this series of strata and sometimes form the roof of the coal seams. They are usually of considerable thickness up to forty or fifty feet, coarse and pebbly towards their base and sometimes assume the character of conglomerates, false bedding being prevalent in the thicker and coarser grained strata which are generally charged with casts of plants and much carbonized vegetable matter in conditions which point to deposition in troubled waters, the trunks, stems and leaves having evidently been drifted from a distance and confusedly mixed together. Many of the sandstone beds are calcareous; a bed of this description at Lloyd Cove near Sydney Mines, furnished specimens of the footprints of a land animal, proving that it was deposited in a flat tidal estuary.

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

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

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

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

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

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

Subordinate Basins in the Coalfield.—Along the sea coast the three anticlinal and four synclinal folds are well exposed; but the upward slope of the strata from the sea causes the coal measures in the latter to rapidly run out inland, leaving large portions of the coal seams to be worked beneath the sea, as at the Sydney and Victoria mines.

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

The Glace Bay Basin.—The axis separating this from the Cow Bay basin skirts the northern shore of Cow Bay at Cape Percy or North Head, the opposite dips being visible in the precipitous cliffs. In striking contrast to the Cow Bay basin that of Glace Bay is wide and has uniformly gentle dips on both sides; and includes 610 feet of strata overlying the highest beds of that basin, among which occurs the Hub seam, the highest workable coal seam in this district. The attitude of all the seams in the Glace Bay basin, extending for a length of about twelve miles, is a striking proof of the general regularity of deposit and absence of faults which characterize this district; but the section shows considerable thinning of the beds between the several coal seams as they are traced westward. The most important cannel coal found in this field lies twenty-five feet beneath the Hub seam, is 1 ft. 2 in. thick, underlined by 9 inches of ordinary bituminous coal and by 1 ft. 9 inches of coal, clay and carbonaceous shale in eleven bands; attempts have been made to work it as it contains 30.07 per cent. of volatile combustible matter, 44.42 fixed carbon and 24.68 ash. In the Phelan seam, at a distance of half a mile from the shore, in the main level of the old Bridgeport mine, a shale parting has increased to twenty-eight feet. The Ross seam at and near the Bridgeport shore is only 1 ft. 8 in. in thickness, while at the Emery mine, not quite two miles and a half to the eastward, it averages 5 ft. 3 in.

* Paper read before the Mining Society of Nova Scotia.

New Coal Handling Towers at Point St. Charles, Montreal.

S. S. "Turret Bay" loading coal at Louisburg Pier, Sydney, C. B.

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

The Sydney Harbor Basin.—The next basin includes the Lingan, Barasois, Low int and Sydney mines districts, extends from Indian Bay and Bridgeport Basin to int Aconi and embraces all the coal seams in the field. An anticlinal axis which rts the north shore of Bridgeport Basin and runs thence westerly, parallel with the rth Head anticlinal, to a point midway between McPhee and McKay Brooks on dney Harbor, divides this basin from that of Glace Bay. On the north side of this s the rocks dip at angles varying from 12 to 16° at Lingan to 40° at Victoria Mines. m Lingan to Low Point lighthouse the strike is nearly parallel to the shore and gs the entire volume of the coal measures upon the cliffs in several fine sections ich show 349 feet overlying the highest strata of the Glace Bay section; and the ures on Sydney Harbor are equally fine.

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

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

On the northwest side of Boularderie Island the coal measures are exposed in an roken section, extending, in the direction of the dip, over a distance of about six les, from Point Aconi to the millstone grit, which here includes two coal seams not rkable. In the Boularderie district the coal has been very little developed. In the pe Dauphin district only the lower part of the productive measures, probably as h as the horizon of the Sydney Mines main seam, is developed; the principal seam rked at the New Campbellton mine is the continuation of the Blackrock or Num- r Three seam of the Sydney Mines section, and that underlying, cut in a vertical itude in the tunnel near the mountain, is the equivalent of the Collins seam of the ttle Bras d'Or. The Blackrock and New Campbellton collieries are situated within s district.

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

Table showing the Equivalency of the Principal Coal Seams, with the Intervals between each in the several Sections.

NAMES OF THE DISTRICTS AND BASINS.

COW BAY.

North Side.	Strata and Coal. Ft.	in.	South Side.	Strata and Coal. Ft.	in.
lock House	9	2	Block House	9	2
	319	1		285	8
eam D	1	0	Seam D	1	0
	130	6		107	0
eam E.	3	2	Seam E	2	6
	118	0		160	7
lcAulay	7	9	McAulay	4	11
	215	10		187	9
pencer?	5	0	Spencer (South Head)	3	9
	338	6		330	11
ong Beach	1	4	Long Beach	3	1
Total thickness coal	27	5	Total thickness coal	23	5

GLACE BAY.

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

LINGAN TRACT.

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

SYDNEY MINES.

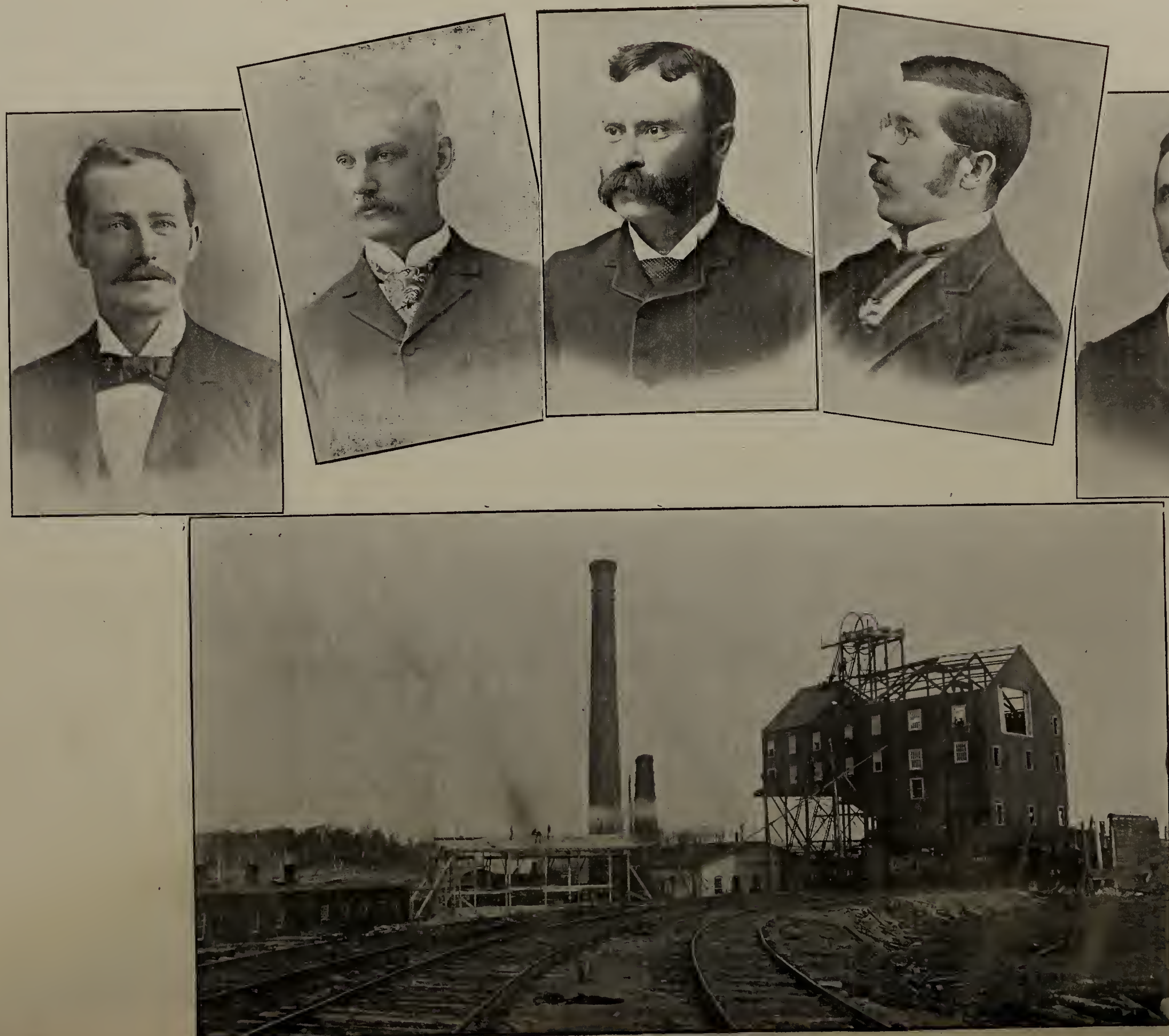
Sydney Harbor.	Strata and Coal. Ft.	in.	L. Bras d'Or.	Strata and Coal. Ft.	in.
Cranberry Head	3	8			
	281	4			
Lloyd Cove	6	4	Lloyd Cove	8	1
	269	1		231	7
Chapel Point	3	9	Seam B	4	2
	322	9		380	7
Sydney Main	6	0	Sydney Main	3	0
	315	10		205	0
Willie Fraser	1	4	Bryant	2	0
	117	0		78	0
Indian Cove	4	8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

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

DISCUSSION.

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

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



DOMINION COAL CO.—General Office Staff at Glace Bay and View of new Pit Head and Surface Works, Caledonia Colliery.

Mr. W. I. Patrick. Mr. H. A. Nicholson. Mr. I. R. Blackett. Mr. J. B. Couche. Mr. J. McKeigan.

The Organization and Development of The Dominion Coal Co. Ltd.*

By John S. McLennan, M.A., Boston.

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

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

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

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

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

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

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

A somewhat settled scepticism took possession of those locally interested as to whether such a scheme, desirable as it might be in the abstract, would ever be consummated, although the game of "collieries" and their relative value was the regulation amusement whenever the mine managers gathered about the hospitable board of their Dean. This was from time to time varied by discussion of the possibilities of advancement in the working of the mines, and the marketing of their product, which this project afforded.

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

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

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

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

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

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

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

So much for the organization of the Company. As for its development, the only safe way is to leave this to time. This much may be said for the aims of its management:

Already we have approaching completion, or under contemplation, a railway and piers looking to the concentratiom of its shipping business, the building of central workshops which will increase the efficiency of the various subsidiary industrial operations, which, in an isolated locality, such as Cape Breton, are unfortunately inseparable from coal mining. We are building dwelling houses of a good type at our new openings, which should make the conditions surrounding employment with the Company desirable.

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

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

Almost every form of administrative and economic error has been illustrated in the history of coal mining in Cape Breton. So too have been illustrated, with equal vividness, in the same little field, the principles which lead to success. To keep abreast of the progress of the art, to satisfy one's customers, and to establish relations of mutual confidence and goodwill with one's working men, are, beyond a doubt, the aims of all the enterprises represented in this room; and it lends color to a hopeful view of the future of the Mining Societies here assembled that their members may not immodestly congratulate themselves that what they have in the past achieved is the best guarantee of the attainment of these ends.

*Paper read before the Mining Society of Nova Scotia.

The Introduction of Endless Haulage into Cape Breton.*

By W. Blakemore, M.E., Glace Bay, C.B.

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

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

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

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

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

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

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

The next great advantage is that the speed of the rope (which in practical working I limit to 2 miles an hour) is so slow that the wear and tear is reduced to a minimum, and the liability to accidents arising from the trams jumping the rails, knocking out timber, and otherwise damaging the road which is so prevalent with high speeds is practically done away with, as it is possible if the signals are perfect to stop the rope at any point in a travel of 3 to 5 feet.

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

The disadvantages are:—

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

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

The greatest objection to its use comes from those who have not mastered my second requirement "*attention to details*" that is the whole secret of its success or

*Paper read before the Mining Society of Nova Scotia.

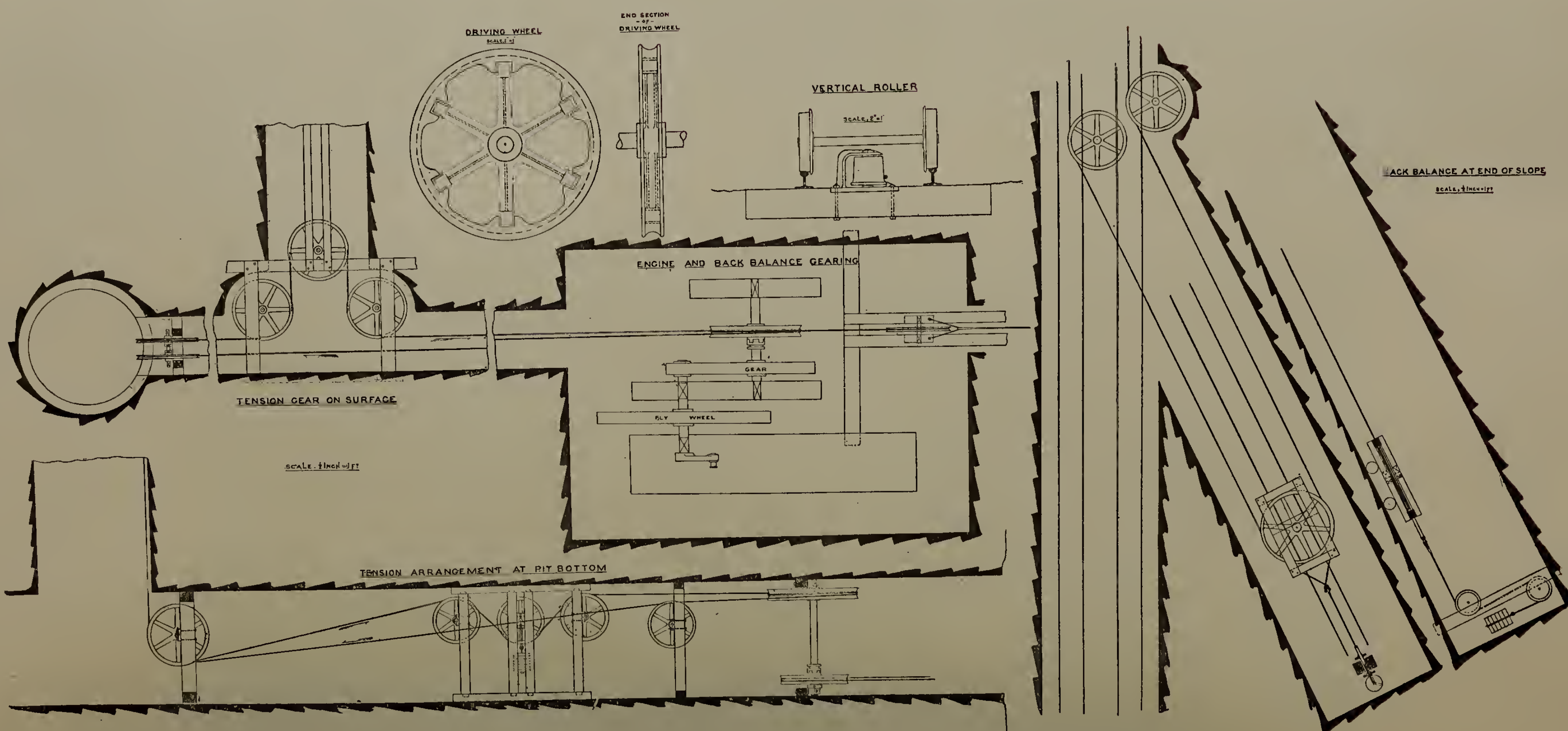
THE INTRODUCTION OF ENDLESS HAULAGE INTO CAPE BRETON.

Plate I.—Illustrating Mr. W. Blakemore's Paper.

PLAN

—OF—

FITTINGS FOR ENDLESS HAULAGE



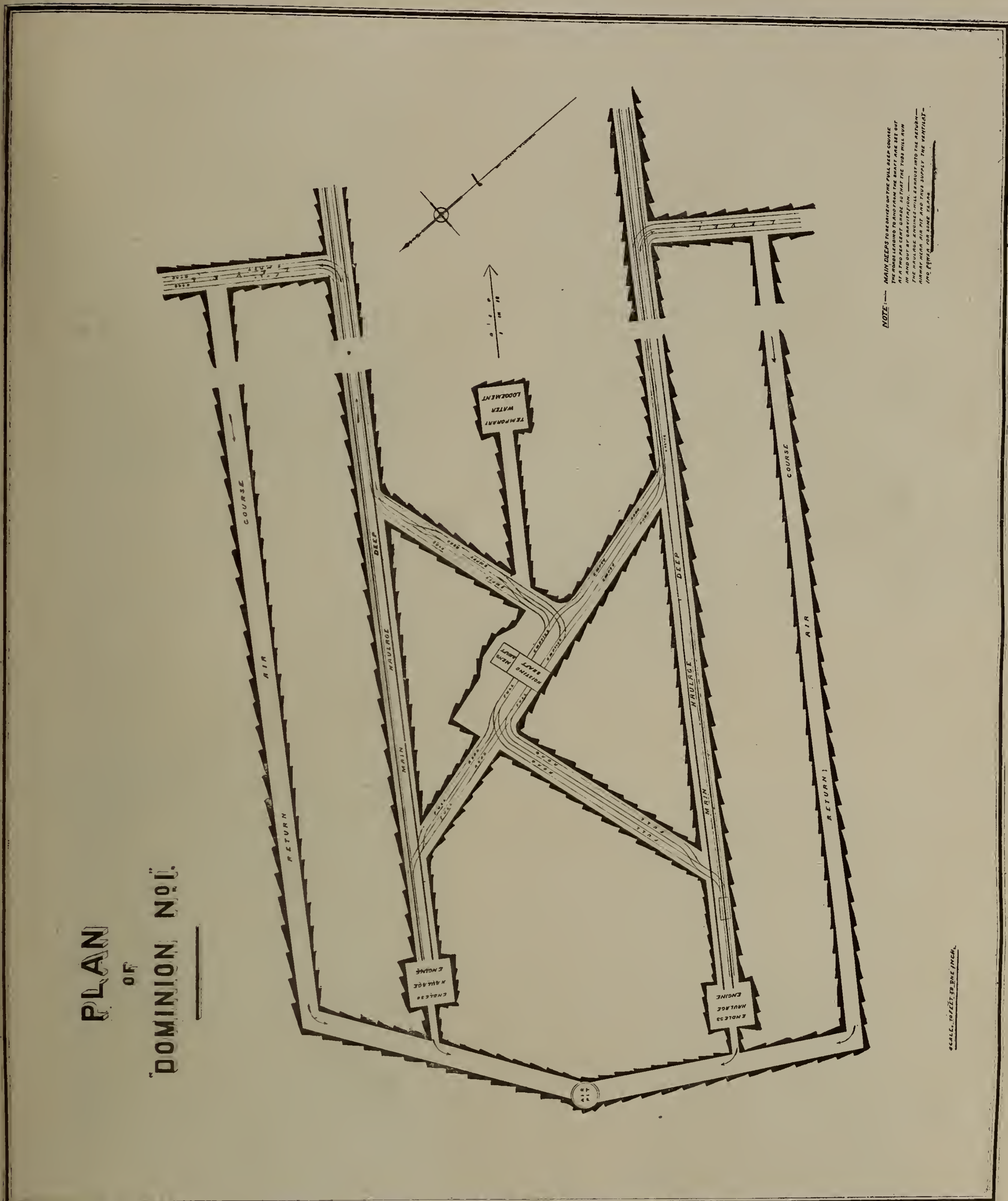


Plate II.—Illustrating Mr. W. Blakemore's Paper.

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

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

At the Reserve Mine of the Dominion Coal Company, the Phalen seam lying at a grade of 1 in 12 is being worked. There are two slopes from the surface the "Main" and the "French" the former is down about 3000 feet and the latter 4000. Each slope has an independent single engine with cylinder 23 in. dia., and 3 ft. 6 in. stroke, the steam pressure is 50 lbs. to the square inch. Last year 500 to 600 tons a day were being raised from the French slope (which had the bulk of the working places) in the following manner: First, one engine hauled the journey of 10 to 12 tubs half way up the slope, then the second engine took hold of it and hauled it the other half, whilst the first ran the empties down to the bottom and got ready for another trip. Between times engine number two hauled an occasional trip from the Main slope which however under this arrangement only yielded 150 to 200 tons a day. The reason of all this is clear, the French slope had passed the limit at which it was possible for a single haul to fetch out the required quantity of coal. To obviate this complication as well as to increase the output, endless haulage was introduced in the following manner :—

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

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

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

(*a.*) That it is much simpler and cheaper.

(*b.*) That it furnishes an element of safety inasmuch as the rope will slip on the drum in the event of any obstacle or breakdown in the mine instead of continuing to haul and so cause a breakage either of rope or machinery as in the case of grooved or clip wheels.

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

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

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

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

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

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

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

The Railway System of the Dominion Coal Company, Limited.*

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

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

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

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

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

The instructions given to the officer in charge of the survey parties were to find a line having no grades opposed to the traffic greater than one half per cent. or 26.4 feet per mile, and no curves with a less radius than 1,433 feet.

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

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

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

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

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

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

The total length of the line from Sydney to Louisburg when completed will be 37 miles in length. The maximum gradient opposed to the traffic will not exceed 42¼ feet to the mile on tangents, and is equated for curve resistance. The sharpest curve on the main line has a radius of 1,433 feet, and even this curve has been sparingly used. The width of the road-bed in cuttings is 22 feet, on embankments 16 feet ; there will have to be moved in the formation of it about 600,000 cubic yards of material, of which a large percentage is rock. For the passage of streams and proper drainage of the road-bed there will be required about 7,000 cubic yards masonry of a class not surpassed by any on this continent. The important structures on the line, taken in their order from Bridgeport to Louisburg, are as follows : Little Glace Bay Brook, Big Glace Bay Brook and Black Brook steel trestles 150 feet in length each, and in heights from 25 to 30 feet ; Mira River bridge, three spans of steel and iron of 100 feet each, of which one is a serving span ; outlet of Catalone Lake, a span of 50 feet and a steel trestle (between the crossing of Catalone Lake and the Summit), 360 feet in length and having an average height of 50 feet.

There will be over 3,000 cubic yards of ballast per mile, the rails are of steel, weighing 80 lbs. per lineal yard, and these will be supported on cedar ties placed two feet centres.

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

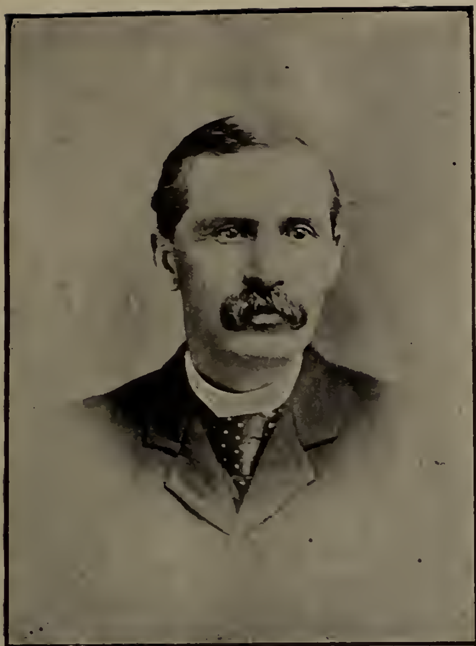
In addition to the roads now in use and under construction, the writer has received instructions to extend the Victoria Mines Railway a distance of one mile, and also to make surveys for and to report upon the best location for a railway to serve the Low Point coal fields.

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

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

*Paper read before the Mining Society of Nova Scotia.

The Production of Silver and Lead in New South Wales.—The value of the silver and lead output in New South Wales during 1893 was £3,031,720, which was only exceeded once—in 1891—since the opening of the silver mines. The silver mines at Broken Hill, on the Barrier Ranges, contributed nearly the whole of the output, and approximately the quantity of silver produced from these mines during 1893 was little short of 16,000,000 ounces. This would probably be considerably increased should the companies be successful in devising a mode of treating their low grade sulphide ores at a profit.



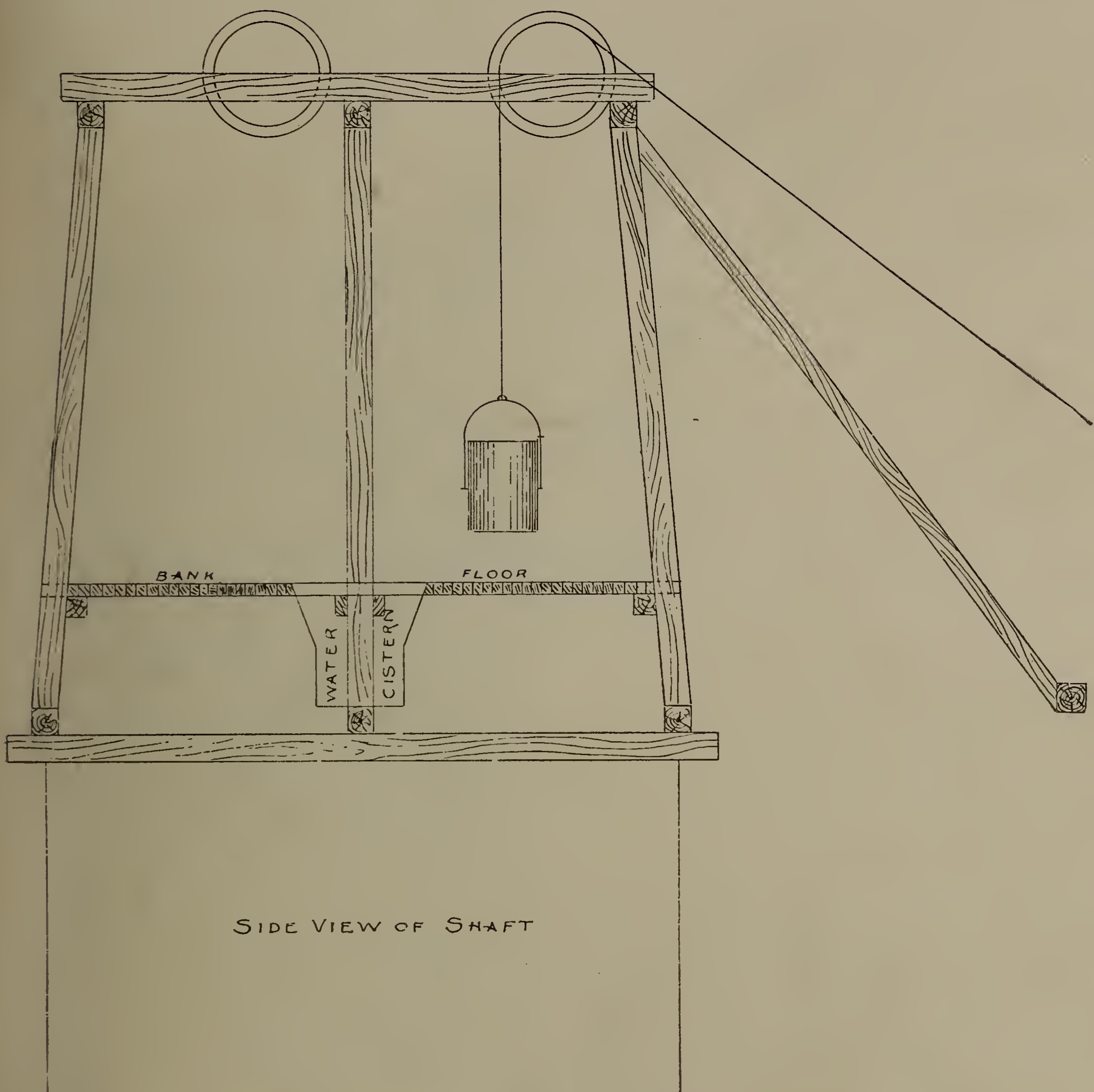
Mr. John Blue, C.E., M.E., Capelton, Que.,
President Quetec Mining Association.

Mr. John Hardman, S.B., M.E.. Oldham, N. S.,
President Mining Society of Nova Scotia.

Mr. P. Neville, Deputy Inspector of Mines for
Cape Ereton.

Mr. J. E. Eurchall. Sydnev. C. B., Owner
Cape Breton Colliery.

DOMINION COAL COMPANY, Ltd.



The Sinking of Dominion No. I. Pit.—Plate Illustrating Mr. J. Johnstone's Paper.

Notes on Coal Cutting Machinery at the Collieries of the Dominion Coal Company.*

By J. G. Hudson, M.E., Glace Bay, C.B.

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

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

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

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

The next test was in a level adjacent to the room already mined, and was 9 ft. wide, 4 ft. deep, and was undercut in 40 minutes. The undercut, or low wheels on the machine were then changed, and the machine placed on high wheels to enable it to shear the coal from top to bottom. The changing of the wheels occupied 15 minutes, and the level was sheared 5 ft. high, 4 ft. in depth, in 23 minutes, ready for the holes to be bored for blasting. It was estimated that each machine should mine and work 45 tons of coal in one shift.

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

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

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

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

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

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

Pit worked 11 days.

Two rooms to each machine.

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

McIntyre and Pass, employing two loaders, 427 tons.

Campbell and McDonald, employing two loaders, 463 tons.

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

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

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

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

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

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

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

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

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

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

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

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

* Paper read before the Mining Society of Nova Scotia.

Sinking of Dominion No. 1 Shaft. *

By J. Johnstone, Superintendent, International Colliery.

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

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

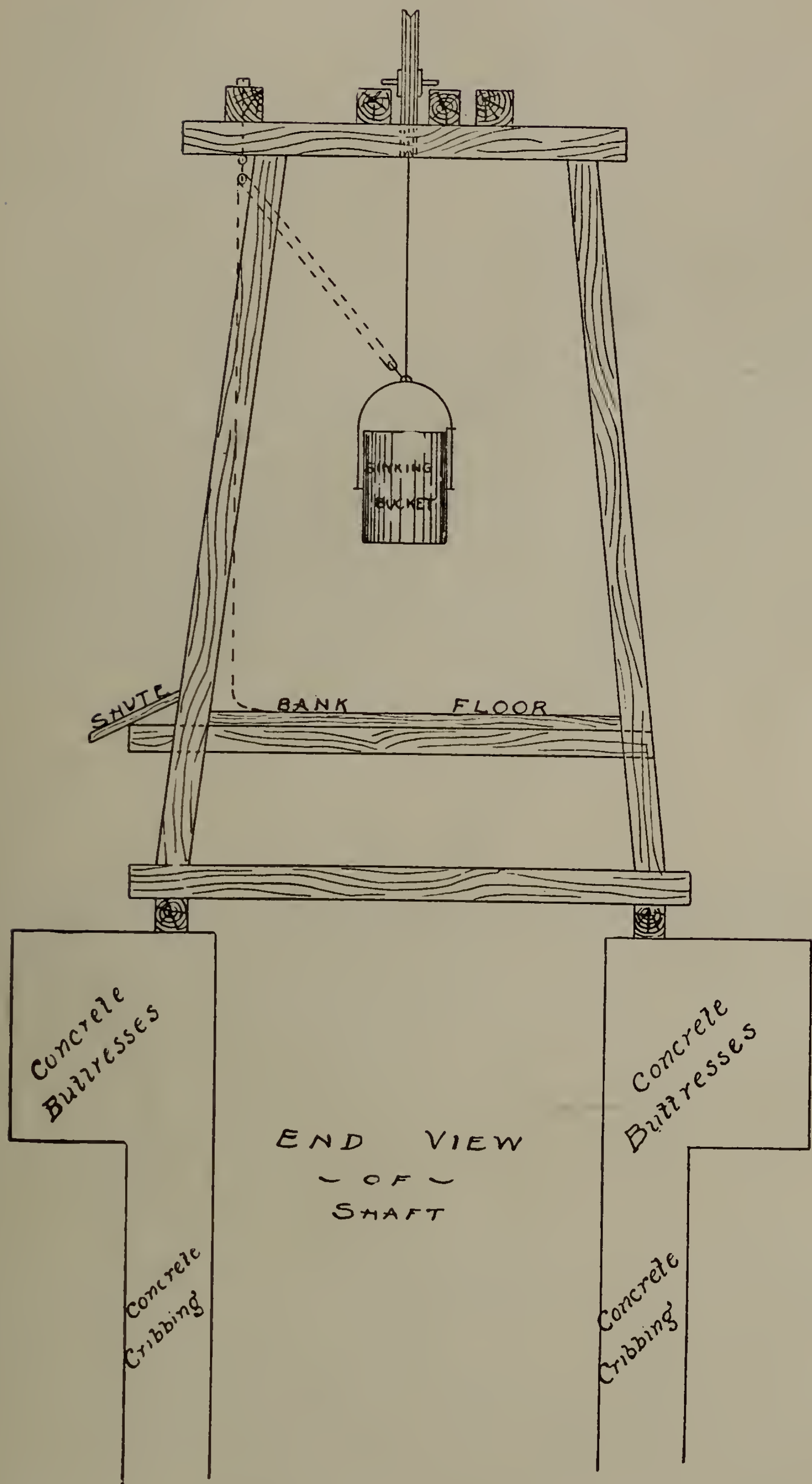
The concrete wall was carried up from two to three feet all around the shaft to the height of ten feet from the crib bed. At four feet from crib bed there were also four additional buttresses on each side of shaft carried up with the wall, which projects out five feet by three feet wide, for the purpose of strengthening the wall, all of which was raised one foot three inches above surface line, to prevent water from flowing over and into the pit while sinking operations were going on. The wall and buttresses were completed in eight days of ten hours each, and contained 114 cubic yards of concrete, 178 barrels of cement being used.

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

The concrete was allowed to stand for 12 days, during which time the necessary pulley-wheel and heap-stead were put in position for the purpose of raising the material and water, when sinking properly would begin. As soon as engine, boiler and heap-stead, with the necessary appliances were in readiness, sinking in rock began on December the first, and continued without interruption, (except by the usual delays caused by ice forming on the sides of the shaft from frosty weather.) It was finally completed on February the 17th, 1894, at the depth of 161 feet from the top of concrete. The shaft was sunk six feet below the main seam for the purpose of holding water which is continually running from the small coal seams and strata passed through in the course of sinking. The whole work of sinking was completed with but one accident, which was caused by the carelessness of the engine driver. After raising a tub of rock from the bottom of the shaft, he allowed the reversing handle of the engine to misplace, the tub returned to the bottom, striking one of the sinkers, and injuring his leg. Section "B" shows the surface line, also height of concrete above same, and down to crib bed, continuing down and showing the strata and small seams of coal sunk through to the bottom of the shaft. Being aware of the importance of keeping the material away from the sinkers, and also the removal of unknown quantities of water, which always has to be contended with in the course of sinking, buckets made of iron were provided with a carrying capacity of one ton for rock, two of which were constantly kept at work, one on the bottom while the other was being hoisted and emptied. There were also two water buckets provided, with a carrying capacity of 100 gallons each, one of which was kept on the bottom to receive the water from a ring which was cut round the shaft, at the bottom of the second coal seam, fifty feet from the surface to prevent the necessity of bailing by manual labor. The other bucket was used for taking the water from the bottom. At a depth of 25 feet the shaft was making 600 gallons of water per hour, from that to 50 feet it increased to 800 gallons, at 80 feet it increased to 1000, and at 100 feet it was 1200, until the bottom was reached, when it had increased to 1500 gallons per hour, all of which was hoisted to the bank in addition to the rock, by the buckets, and sinking was completed without the use of a pump in the shaft. Owing to the buckets being made so large, with a carrying capacity of one ton, it was quite evident that the usual method of dumping rock at the pit's mouth would neither be advisable nor safe. So as to dump the rock within as little time as possible, and not make the work laborious for the banksman, there was a pulley placed six feet from the centre of shaft with a rope over same, and hook attached so that when loaded bucket came up to the bank-floor, the hook was attached to the handle, and the bucket was hoisted about seven feet above bank-floor, the other end of the rope had a short chain attached, which was placed into a catch on post of bank-frame.

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

* Paper read before the Mining Society of Nova Scotia.



DOMINION COAL COMPANY, Ltd.

The Sinking of Dominion No. I. Pit.—Plate Illustrating Mr. J. Johnstone's Paper.

The above arrangement will be better understood by referring to section "C" It also shows that it prevents the falling of rock from the bucket into the pit when the sinkers are at work, as it is not over the mouth of the pit when emptied. It also does away with the necessity of having an extra bucket on the bank, as the bucket is not detached from the rope until it returns to the bottom of the shaft again. The water was disposed of by placing the cistern beneath the floor of the bank, so that when the bucket came up, and the centre was in line with the floor, the link was removed, the bucket turned over, and the water was emptied into the cistern. From thence it was conveyed to a drain by pipes, so that it did not get back into the shaft. The water buckets were hung from the centre while the stone buckets were hung three inches below the centre, so that they would empty without any effort on the part of the bank top man. The following is a statement of labor and supplies for the sinking of shaft.

STATEMENT.

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

The S. S. "Turret Bay"—Novel Type of Coal Steamers employed by the Dominion Coal Company.

Among our illustrations this month we reproduce a photograph of the S. S. "Turret Bay," one of the three new type of cargo steamers employed by the Dominion Coal Company in handling their extensive St. Lawrence trade. These vessels are of an entirely novel type of construction, and have been designed, patented and built by Doxford & Sons, Ltd., Sunderland. The new design is essentially adapted for cargo steamers, and it is therefore with vessels of that kind that she may most profitably be compared. The chief virtue of the design from a commercial point of view is the large deadweight and measurement capacity it gives in terms of the registered tonnage.

If the same deadweight capacity, draught of water, and co-efficient of displacement that are embodied in the design of the "Turret Bay" were adopted in a partial awning deck steamer of the usual type, the net register tonnage would be about 20 per cent. greater. It is needless to point out what this would mean, as the working expenses of a cargo steamer may be said to vary with the register tonnage, and the one-fifth additional cargo carried would therefore be clear gain to this extent, a fact which would mean a handsome profit to a vessel of the Turret design, whilst an ordinary well decker would be working possibly at a loss. It should be stated, however, that the internal capacity for measurement of cargoes is 7 per cent. less in the Turret design than in the partial awning deck vessel.

Perhaps a closer comparison can be made between this new type of vessel and spar deck vessels. In this case also the Turret design shows an advantage in the matter of register tonnage over that of spar deck vessels, the tonnage in the latter case being 13.3 per cent. greater than in the former, whilst the cubical measurement would be 7.5 per cent. less than with the Turret type. It is claimed by the inventors that there are no special disadvantages in their new arrangement to set off against the advantages gained in this manner.

In the matter of strength it is doubtless unnecessary that we should say much, for the superiority in this respect is apparent at a glance; for the want of continuity in well deck steamers is naturally a great source of weakness in regard to provision for hogging and sagging strains, and this is well illustrated by the insistence of the classification associations upon local strengthening in the parts most affected. In Messrs. Doxford's design, what are known as the weather decks—*i.e.* the side decks—are continuous from stem to stern of the vessel. These decks are made of plating, of the same thickness as the shell of the vessel, and are in a straight line throughout, there being no sheer. The sides of the Turret Bay also afford a continuous line of plating, lying practically in the same vertical plane. We have, therefore, what may be described as a pair of continuous "angles" on each side of the ship, running for her whole length, and adding enormously to the strength of the structure. The turret deck extends at one level from the bow to a point considerably abaft amidships, where it is raised, and so continues to the after end, in order to provide sufficient storage capacity for cargo, so that the vessel may trim by the stern.

The dimensions of the "Turret Bay" are: Length between perpendiculars, 297 feet; extreme breadth, 40 feet; depth moulded ordinary deck line, 24 feet; depth in centre from keel to turret deck, 29 feet 11 inches; freeboard, 10 feet 4 inches; gross register, 2,198 tons; net register about 1,375 tons; register, horse power, 250 h.p.; dimensions of turret, 16 ft. 6 in. wide, 5 ft. high; dead weight capacity about 3,800 tons; cubical contents of hold about 180,000 cubic feet; capacity of main bunkers, about 250 tons.

The question of trim is an important point in the new design. The tendency of the partial awning deck steamers, which, it may be remarked, are the popular cargo carrying vessels of the day, is to trim by the bow when loaded with a homogeneous cargo. In order to meet this, they are invariably loaded leaving an empty space in the fore 'tween decks. With the Turret design the vessel can be filled up from the collision bulkhead to the machinery space, and she will yet be several inches by stern. This trimming by the stern is gained by the additional trunk space, due to the raising of the turret deck. The space thus gained is not large, but it is sufficient for the purpose. It will be understood that the raising of the turret deck involves a very different problem to the broken fore-and-aft line of the upper flange of the girder, which is entailed by the ordinary quarter deck in a cargo steamer of the usual type. As already stated, the weather decks of each side are continuous from bow to stern, and therefore the raising of the turret deck only necessitates provision for strengthening being made over one-third of the breadth of the vessel. The problem is, therefore, much simpler, and the danger of local weakness far removed. The main sheer strake, and main stringer, though not continuous in level, are continuous in regard to strength, the web of the girder being carried throughout at the turret deck level. A spar deck vessel, of the same general design as that illustrated, would have from 15 to 20 per cent. less depth of girder than vessel of the Turret type; the exact percentage depending on the trade for which th Turret vessel was designed.

In the matter of taking in and discharging cargo, the Turret has the usual facil ties. In the matter of steering gear some modifications have been introduced. quadrant is keyed to the rudder stock, and this quadrant is actuated by a worm, being geared for the purpose. In order to meet the shocks of the sea on the rudde the worm is fitted on a feathered shaft, so that it has motion in line with the axis the shaft, but this motion is restrained by powerful springs on each side. The shaft actuated by an ordinary steering engine, fitted in the engine room, and thus near th steam supply. The Turret design affords exceptional facilities for the carrying of boat It will be seen that the boats are at any time available for launching in a ve simple manner. Access to the vessel is easily obtained by the usual ladde operated in a manner similar to that adopted for the boats. An interestin detail in the design of this vessel is the arrangement for discharging ashes ove board. The usual ash hoisting arrangements have been abandoned. The a paratus consists of a flap discharge valve, upon the ship's side, above the wat line. Leading from this to the hopper is a strong cast iron pipe. The ash are placed into the hopper, which is connected with the cast iron pipe referre t, the manner shown. There is also a branch connection from the ballast pump. Wh the apparatus is operated, the water is directed into the pipe, and the velocity wi which it enters carries it up the pipe and overboard, the ashes being drawn in fro the hopper by the induced current caused by the passage of the water. The lid of t hopper need not be closed when the apparatus is in use, as the velocity with which t water is discharged carries it directly up the iron pipe. The comfort to all han obtained by this apparatus is very great, and the saving in labor is considerable.

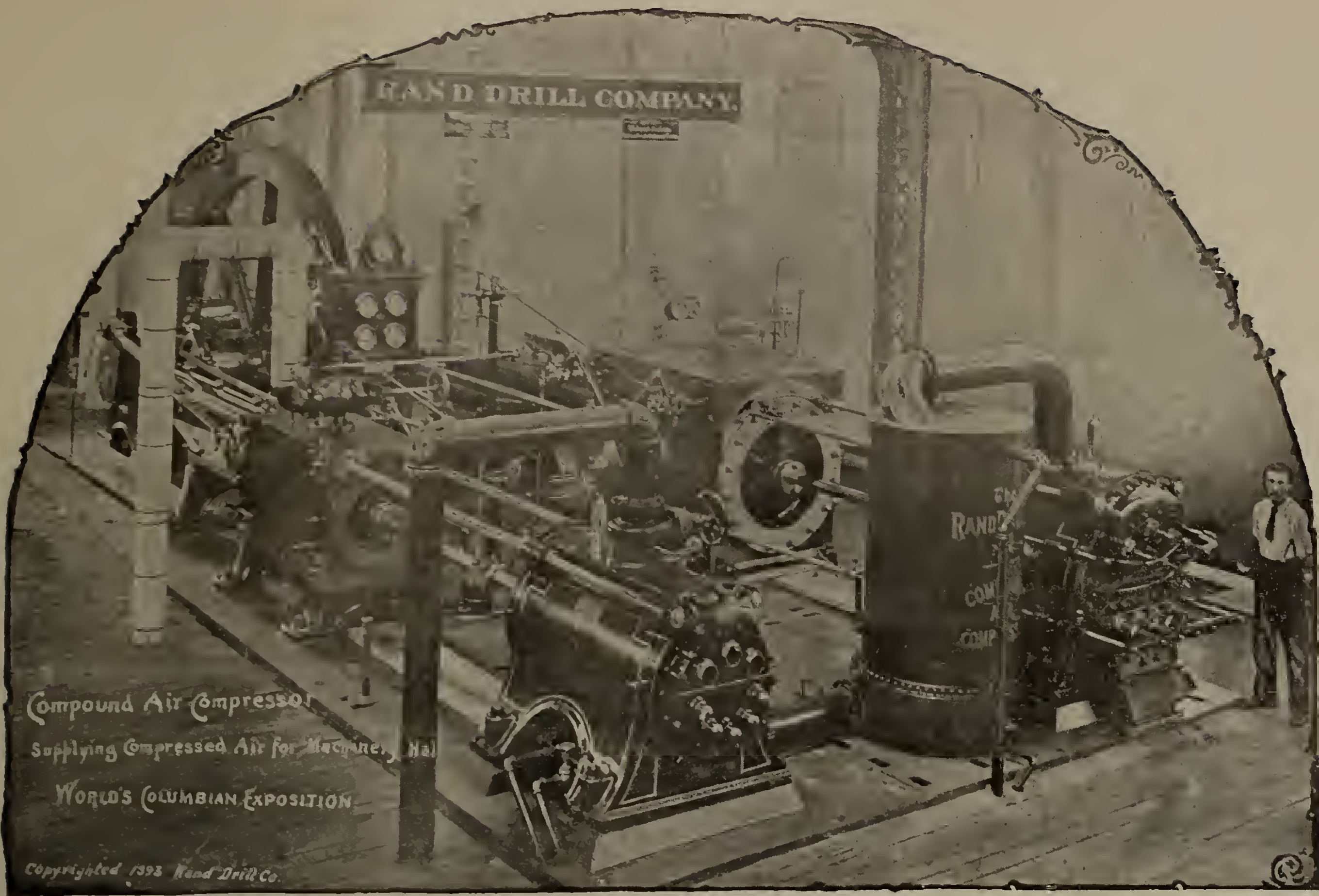
Dominion Coal Company—Notable Introduction of Improved Air Compressor Plants at the Caledonia and Old Bridgeport Collieries.

Formerly, when the applications of compressed air were more or less tentati and the whole system was little more than experimental, engines of a comparativ cheap type were naturally employed for driving the compressors, at the expense course of economy of fuel. With the rapid development of recent years in the vario uses of compressed air, the point was reached where users began to inquire carefu into the cost of production and a demand arose for compressors embodying the high and most advanced construction, both as regards the compressors themselves and t engines for driving them.

The Rand Drill Company, New York, have been pioneers in meeting t demand for machinery of the most advanced type. An example of their latest co struction has been supplied the Dominion Coal Co., and is here illustrated. T machine is driven by a Corliss engine of the cross compound condensing type. T air cylinders are compounded in order to make the compression in two stages, and b tween the two cylinders is an inter-cooler through which the air must pass in its pr gress from the low pressure to the high pressure cylinder. This inter-cooler has function analogous to the intermediate receiver of compound steam engines, but addition to that, it has a more important function, which is the chief reason for t compound system as a whole, viz., the cooling of the air at the middle of its compr sion. As is well known, the compression of air develops a large amount of he which by expanding the air consumes a portion of the power which is subsequen lost, in consequence of the air becoming cooled before use. The purpose of the co pound system is to diminish this loss by taking the air from the first cylinder wh partly compressed, and hence heated to a moderate degree only, and cooling the sa down to its original temperature by means of a water jacket, after which it is discharg into the second cylinder and the compression completed. There are thus two stag of compression, the second of which is begun with cold air, whereas in the usual sing cylinder system the compression is continuous, the latter half being done on air alrea heated during the first half.

If the indicator cards from the two cylinders be combined in the manner comm with compound steam engines, the result would be to show a break in the compressi line, that portion which represents the completion of the compression being set ba nearer the end of the card, the results indicating a considerable saving in power.

The air end of this machine is fitted with the Rand Drill Company's well kno mechanically moved air valves, which constitute a marked advance on the regulati spring valves heretofore almost exclusively used. The mechanical attachment to th valves operates upon the springs with which the valves are fitted. The ordinary st of compressor valve is in principle the same as the valves of pumps, being open by the pressure of the air and closed by springs which constantly press upon th backs. In use, such valves, as is well known, have a chattering action due to t constant conflict between the air which is trying to open them and the springs wh try to close them. The action of the mechanical gear is to retract the pressure of t springs from the valves, during the period when the valves are required to be op thus leaving the valves under the influence of the air only and doing away with t chattering. The final result, however, is much more far-reaching than this descr tion would at first indicate. The chattering of the valves necessitates a small lift, order to limit the violence of the action, and this by reason of the accompanying sm opening, necessitates a large number of valves to give the required total openi With large compressors this multiplicity of valves becomes formidable and comp cated. The action of the mechanical gear stops the chattering, as before mentione and the necessity for a small lift no longer remains. Consequently, the valves a given a high lift, so as to give a free and unobstructed opening, and the total numb of valves is, consequently, very largely reduced. The machine is also fitted with t Rand Drill Company's differential pressure regulator, the operation of which attra the attention of the mechanical eye. This regulator operates upon the knock-blocks of the Corliss gear, much after the manner of the usual ball governor, w which the compressor is also supplied, and it is the combination of these two govern acting upon the same set of knock-off blocks which forms the interesting feature ferred to. When the machine is started without pressure in the air pipes, the throt valve is thrown wide open, and the machine runs up to the highest limit of its spe until checked and controlled by the ball governor, after the manner of ordinary Corl engines for motive power. As the pressure rises, it soon reaches a point to which t plunger of the regulator is loaded; this plunger then rising shortens the cut-off a slackens the speed, when the ball governor drops, and the compressor remains unc the control of the pressure regulator, which shortens or lengthens the cut-off as may necessary to give the speed which shall maintain the air pressure, any drop of press being accompanied by an increase of speed, and any rise of pressure with a diminuti of speed. Should, however, the demand for air exceed the capacity of the machi the pressure will drop below that to which the regulator is set, when it will go out action, and the speed will increase until the ball governor acts as at the start. times, when the demand for air approximates the capacity of the machine, this int change of action between the two regulators is constantly taking place.



New Rand Compound Steam and Air Compressor, at the Caledonia Colliery of the Dominion Coal Company.

The Ingersoll Cross Compound Duplex Piston Inlet Air Compressor, at Dominion Coal Co's Old Bridgeport Mine.

The diameters of the air cylinders of this machine are 22 inches and 34 inches, and the diameters of the steam cylinders 22 and 40 inches, while the stroke of 48 inches is common to all.

This machine proved the chieftain of the Rand Drill Co's exhibit at last year's Chicago fair, where it received marked attention. The Dominion Coal Co. is to be congratulated upon securing so excellent a compressor.

The following is a synopsis of the features of the fine new air compressing machinery being erected for the Dominion Coal Company, by the Ingersoll Rock Drill Co. of Canada :—

High pressure cylinder 22 in. bore, 48 in. stroke. Low pressure cylinder 36 in. bore, 48 in. stroke. 2 air cylinders 22¼ in. bore, 48 in. stroke. The valve gear of the engine is of the well known Corliss type, simple in construction, with all parts easily accessible and adjustable. The bed plates are of the girder type, of tasteful outline and of ample proportions and strength. The cranks are of the disc pattern balanced. The guides are circular shaped. The governor is provided with an automatic stop, which will shut off the steam and stop the engine in case the governor belt should break or come off the pulley. The cross heads, all pins and rods, are of steel and of ample proportions for severe service. The main pillow blocks are provided with removable shell boxes. The fly wheel is constructed in the most substantial manner, having oval shaped arms, the sections being held together by turned bolts in reamed holes.

In the Air Cylinders.—Free air is under thorough control. Air cylinders are completely filled at every stroke. Valves open and close by natural momentum. Cooling by water jackets and complete jacketing of heads. The new patent unloading device for air cylinders. The cylinders are driven direct from the piston rods of the engine.

All pins, including crank, cross head and valve gear pins, are made of steel, accurately turned and polished. All bearings about these pins are made of phosphor bronze, except that of the crank pin, which has brass boxes lined with genuine babitt metal, scraped to fit. The shaft in the bearing is half the diameter of the cylinder. The main bearing has an upper and a lower shell, also quarter boxes lined with genuine babitt metal scraped to fit and provided for taking up wear. The back pillow blocks are made extra heavy. As to the polished or bright work, the ends of the cylinders, cylinder head and steam chests, together with all turned parts about the valve motion and connecting rod are beautifully polished. The cylinders are lagged, the spaces between the lagging and the cylinder are filled in with the best known nonconductor.

The compressors are of the latest and most perfect device invented for the compression of air. The free air, before admission into the cylinders, is under thorough control, and may be taken from that point which is most favourable in its dryness, reduced temperature, and freedom from dust and other foreign matter. The free air is admitted into the air cylinder through a tube (which also acts as a piston guide rod) creating a uniform draft of air in one direction only, this uniform movement giving a certain momentum to the air, causing it to fill the cylinders to their fullest capacity at each stroke.

The air inlet valves are large wrougtht iron rings which open and close by the natural momentum caused by the movement of the piston admitting of a large area of the inlet with but a small throw of the valve.

Cooling is effected by means of a new form of water jacket, the construction of the air cylinder admitting of complete jacketing of the heads and discharge valves, thus presenting a large cooling surface to the compressor at the end of each stroke, where the air is hottest. Another important feature is the unloading device, maintaining a uniform pressure in the receiver and a uniform speed of the engine by means of connections with a discharge valve on each end of the air cylinder. The discharge valves on the compressors are of the most approved design, and the result of many years experience.

These machines are being built at the shops of the Ingersoll Company in Montreal.

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

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By John Rutherford, M.E., Stellarton.

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

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

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

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

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

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

What the writer now proposes to do is this: To briefly, and as summarily as possible state the result of the operations in the different localities, as regards the yield of gold; dividing the inquiry into decennial periods, beginning with the year 1862, to make such remarks as occur to him in the course of the inquiry and to adduce the opinions of others, competent to form them, on the causes of unsteadiness in the operations which have occasionally occurred. It is hoped that this course, without elaboration, will in its results justify the ultimate opinion arrived at in reply to the inquiry with which the subject is started.

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

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

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

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

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

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

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

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

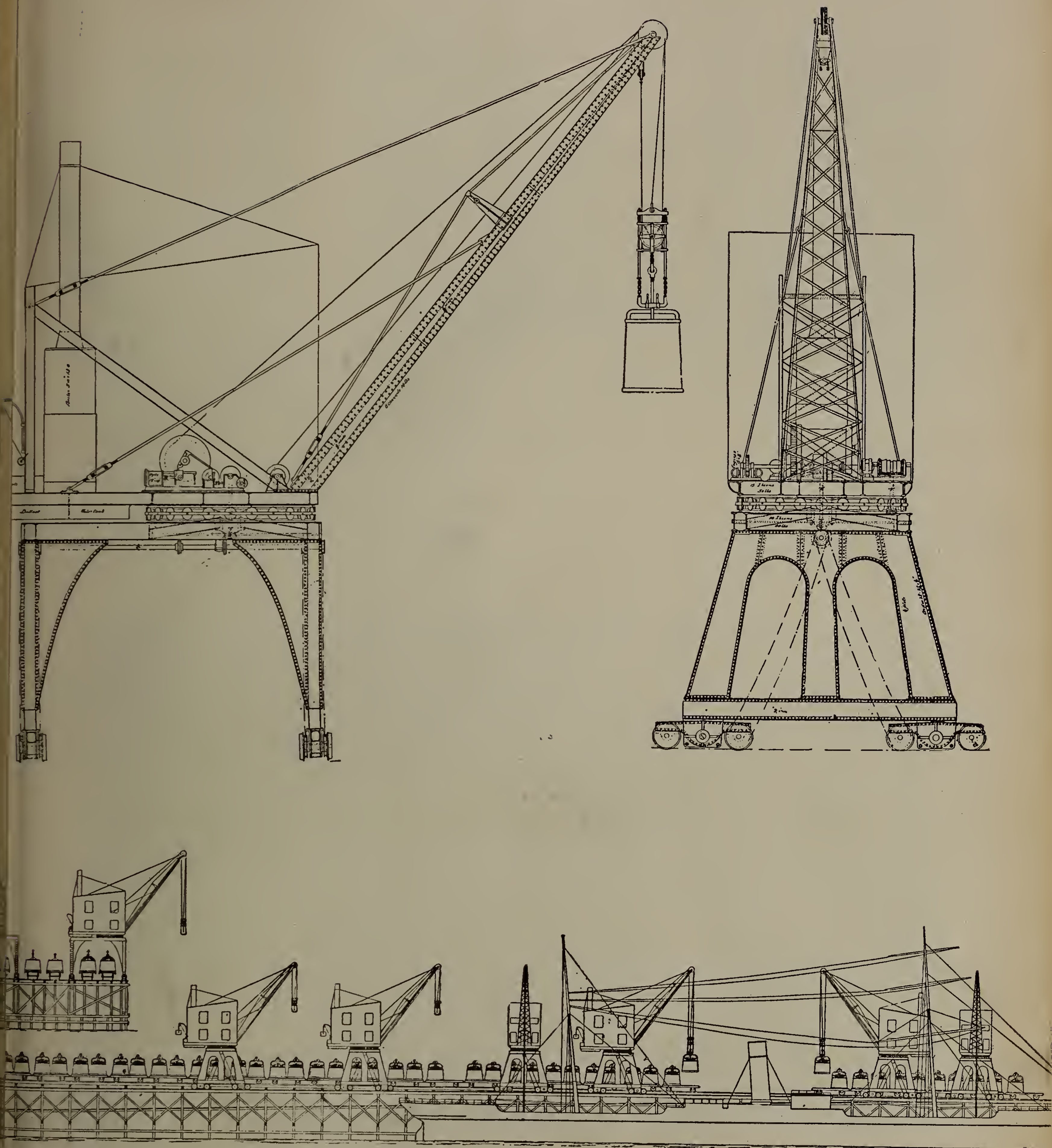
It may be permitted here to refer to the discontinuance of the personal report of the Chief Commissioner of Mines. Up to the end of the year 1872 this report was a distinct feature in the general report issued from his department, and it frequently contained information of much interest, inasmuch as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

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

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

"Much has been written on the general want of method attending gold mining in Nova Scotia, and sweeping condemnations of the management and want of skill shown while working the mines have been published. Much, doubtless, most justly, and yet somewhat hasty comparisons would seem to have been drawn between the wide and comparatively easily wrought leads of other districts and the thin leads of this Province enclosed in hard and tough country rocks.

* Read before the Mining Society Nova Scotia.



Dominion Coal Co. Ltd., International Pier.—The above illustrations show the improved coal-handling appliances now under construction by the Ludlow Manufacturing Co., Cleveland, Ohio. The pier is of following dimensions: Length, 605 feet; width, 92 feet; height, 27 feet. The derricks—12 in number—are of new design, 6 on each side of pier, and are built entirely of steel and iron, including the house, which makes them strictly fire proof. The main engine which does the hoisting and rotating are double 12 x 14 cylinders. For propelling a separate pair of engines, 6 x 8 cylinders are used. The lifting capacity of these machines is 15 tons. The buckets used are of the latest patent bottom dump, 100 inches in diameter and 64 inches high, and are tripped or discharged by the engineer at such depth in the vessel as he may desire. The buckets are placed upon flat cars and taken to the mines where they are loaded from the tipple. The cars are moved upon the dock by gravity. This is the largest and most complete bucket plant in the world.

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

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

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

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

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

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

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

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

As it is not the intention of the writer to deal minutely with each particular district in explanation of the cause of this difference of yield, but rather to treat the subject in the general sense, the production of gold in the next decennial period, viz., 1881-91, will now be given.

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

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

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

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

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

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

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

A general statement of the average annual yield of gold, embracing all localities, for the 30 years 1862-91, is given in the report of the Department of Mines for the year 1891, which shows an average yield over that period of 15 dwts. $7\frac{66}{00}$ grs.

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

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

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

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

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

	Oz.	Dwts.	Grs.
Tangier	—	6	22
Wine Harbor	—	6	18
Sherbrooke	—	7	09
Stormont	—	6	06
Renfrew	—	6	03
Oldham	—	10	21
Waverley	—	4	18
Montague	1	0	07
Caribou	—	9	13
Uniacke	—	6	00
Other Districts	—	5	05
And a general minimum average of	—	8	04

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

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

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

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

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

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

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

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

There has now been placed before you such a representation of the circumstances of yield of gold and comparative cost of mining and treating as the writer has been able to abstract from authentic records, as regards the yield, and, as he believes, from very reliable sources of information as regards the cost of production. It remains to assert the conclusion to which the inquiry has led. What are the facts that have been adduced ? Do they or not permit a positive answer to the query stated at the beginning of this paper viz., "Is Gold Mining in Nova Scotia worth carrying on ?" In every locality in which gold mining has been carried on in Nova Scotia the average yield of gold has been from a minimum of —oz., 8 dwts., .04 grs. to a general average of —oz., 15 dwts., .07 grs. over the extent of country in which the various localities are situated ; the area of auriferous rocks covering this extent being estimated as probably over 3000 square miles.

A large field of inquiry is open for tillage in connection with the auriferous rocks of Nova Scotia ; numerous very interesting and important features are worthy of study and development, but, as has been stated, it was not the writer's intention to treat the subject from that point of view. No reference has been made to the number and variety of composition of the lodes in the respective localities, no suggestions have been made respecting the pay streaks and their probably profitable extension downward, no speculative ideas have been ventured with regard to the alluvial auriferous deposits that may exist of which a very competent authority has recorded his opinion that at several localities there appeared "all the conditions required for the occurence of rich alluvial diggings. (*d*.)

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

DISCUSSION.

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

DR. GILPIN—Unfortunately, I did not hear all of Mr. Rutherford's paper. There is one point, however, regarding the question of averages to which I would like to draw the attention of the Society and those here interested in the matter, and that is : That the annual average for any particular district may be misleading. For while it may be fairly true for the whole province, in a given district a small amount of quartz crushed may yield a very large average, and upon the following year a large amount of quartz may be crushed and give a very small yield. Consequently, the average for that district for a number of years is vitiated. Mr. Rutherford spoke of the yield as being from a maximum of eight pennyweights and upwards. I would only remark that there are a great many gold miners I know of who would be very pleased to have eight pennyweights as a maximum, and go a great deal below that point. In my opinion, the statistics show that the prospect of an increased output from the small rich leads is not very encouraging. In the future the greatest returns must be sought for in the mining and milling of low grade ores and by paying greater attention to the tailings.

THE CHAIRMAN—The paper which Mr. Rutherford has just read, possesses, as I have already remarked, perhaps more debatable points than any other which has been presented this evening. It is too late to permit of a lengthy and detailed discussion, but I would like to call attention to one or two points the discussion of which could be elaborated at a future meeting. The first point has reference to the statement that the early milling was crude and that probably 30 per cent. of the gold in the quartz was lost. In the course of ten years' experience, I have never found a dump of tailings that it would pay to work over, nor which probably contained 30 per cent. of the original value of the quartz. I think this statement of the large early loss of gold should be stamped out, as it would lead to the influx of patent process men who guarantee to take out 100 per cent. of the assay value. The gold ores of Nova Scotia are of such an easy free-milling character, that even with the crude appliances of 30 years ago, it would have been impossible to lose so large a percentage unless in

(*a*.) Hind's Report on Uniacke, Renfrew and Oldham, 1872, pp. 53-56.
(*b*.) Hind's Sherbrooke Report, p. 58.
(*c*). Selwyn's Report on Gold Fields of Nova Scotia, Geological Survey of Canada, 1870-71, p. 281
(*d*.) Selwyn, ante. p. 16.

Col. Granger, C.E., Sydney, Manager Coxheath Mines.

Dr. E. Gilpin, F.G.S., Halifax, Deputy Commr. and Inspector of Mines.

Capt. Isaac Gragg, Boston, President Eastern Development Co.

Coxheath Copper Mines, Coxheath, Cape Breton. Operated by the Eastern Development Co. Ltd.

the sulphurets; and my experience has been that the sulphurets in most of the veins are of too low grade a nature even when concentrated to be payable. The average value of the concentrates or clean sulphurets in Renfrew, Cariboo, Chezzetcook, Beaver Dam and Waverley, that have come under my notice would not exceed $20 per ton; and with the prices of chemicals at present ruling in Nova Scotia this grade could not be profitably worked. Another point, and one which I would mention with hearty endorsation, is the reference to the personal report of the Chief Commissioner in early Mines Reports. The position of the Chief Commissioner permits a reference to many points which could not be individualized in the tables of the reports and to suggestions and criticisms which I am sure have due weight among the miners.

The Uses of Asbestos for Fire Departments.*

By E. Wertheim, Chicago.

Much has been said and written about asbestos, the wonderful fibrous mineral, which will stand heat and fire to a most surprising degree.

It gives me particular pleasure to be in a position to speak on the subject to an assemblage like the one at present gathered to discuss the methods and new designs and inventions, all destined to fight the fire, to reduce its occurre ce and to protect us against it. I consider it an honor to be permitted to address a body of sturdy heroes who have made the fighting of fires the noble object of their lives, all of whom know the dangers connected with their occupation, all of whom have risked their health and life in order to protect their brethren from the common fiend.

It is also particularly satisfactory that I have been given an opportunity to address you on the subject of asbestos in this province of Quebec, the very home of the mineral, in a country which I have learned to love, in a city which I have always admired.

I am no stranger in this section of the country, having been engaged in the mining of asbestos for a number of years at a distance of less than 200 miles from Montreal. Down where picturesque mountains border the Canadian territory, and are visible far across the line of the United States; down where the clear, cold mountain streams form the abodes of the swift brook trout, where the country is covered with innumerable lakes and immense forests, where cariboo and moose still reign in almost inaccessible regions; there is the home of the wonderful mineral which for many years has invited the study of mineralogists, geologists and other scientists.

Very little was known about Canadian asbestos until a railroad (the Quebec Central) was built across that portion of the province of Quebec which lies between Quebec and Sherbrooke.

Many a sturdy fisherman, who had penetrated the forests to reach the lakes in the county of Megantic, had seen the mineral and wondered what it was. Some had carried small pieces with them, but none of them ever expected to find an industry in that section, which gives work to 2,000 men, which is turning over millions of dollars a year and which has now attained an importance never dreamed of.

The uses to which the mineral has been adopted are very numerous, and I will not take up your time describing them, in as far as they are not closely connected with your own profession.

I will limit myself to the uses which interest you mostly, and which are liable to be regarded by you as something worth seeing and worth knowing.

I am referring to the inventions which have recently been made and which consist of safety appliances against accidents from heat and fire.

Asbestos as a non-combustible, flexible fibre, which can be spun into threads and woven into cloth, naturally suggests its use as a protection against heat. Fireproof canvas, if it can be made light and strong enough, must surely command a place amongst the numerous designs and plans destined to protect a fireman's body.

Asbestos has been known for a great many years, and you will naturally be wondering why it has not been used for so many years. My answer is simply that not until recently have we succeeded in spinning an asbestos thread fine enough, and to weave a cloth fine and strong enough to allow us to make a suit which will allow a fair amount of rough wear.

Asbestos fibre is so fine, so delicate and so difficult to manipulate that experts, not more than ten years ago, would not have believed that it ever would be possible to spin a single strand which weighs less than an ounce to 100 yards, or a cloth which weighs less than 8 ounces to the square yard, and yet we have accomplished it at our works in Germany. It was not an easy job, I assure you, and many attempts have turned out unsuccessful, until shortly before the World's Fair opened, and we were in position at Chicago to exhibit samples of the goods which I have just described.

Of course such fine cloth is not very strong, and we do not recommend it for fire departments' uses—we only prove that it is possible to spin a thread and to weave a cloth of asbestos almost as fine as a cotton cloth. The thicker we spin the thread the stronger the cloth, and by doubling a number of fairly strong threads, we produce a cloth which will stand a fairly large amount of rough handling. We make an asbestos cloth now, and we have it on exhibition ready for your careful inspection, which will satisfy any reasonable expectations regarding its strength. The cloth is strong enough to be worn by a fireman, when it is a question of saving human lives and valuable property.

I will show you, by entering a burning shed which we have erected back of the Skating Rink, that it is possible, with such a suit to get near the flames and if necessary to pass through them.

I will also show you that the cloth is flexible and soft enough to allow me to walk and work in it. You will also convince yourselves that it is by no means too heavy.

You must not think for a moment that we suggest asbestos suits to be used by firemen on duty altogether instead of their present uniforms. We have not got quite that far yet, and when we have we will let you know. But what we mean to offer you is a life protecting arrangement, which will allow you to venture in dangerous places, which, without such an arrangement, you are unable to reach.

We mean to suggest that such asbestos suits should be worn by one or two men of each company, at every fire, and when there is need to enterr a burning building, they are ready to do so without the amount of danger which they would enter into, were they not provided with such suits.

As you will convince yourselves, the asbestos suit covers every part of the body, and we have constructed a mask for the face which will enable a man to wear underneath one of the Smoke Respirators, which the Loeb Respirator Company of New York is exhibiting in connection with our fire-proof suits, and which will be practically demonstrated by the inventor, Mr. Loeb, of Germany, who is here amongst us. I will also wear one of his apparatus, especially constructed for the purpose of entering heat and fire. The apparatus is protected from the heat by asbestos and is as safe as the body of the man. This apparatus which will thus be shown consists of two main parts. The function of the one part is to purify and cool the smoky and hot air; the other part is to enable the inhaling of the purified air, and exhaling the consumed air in such a manner that both cannot mix. Both parts are connected by a flexible hose. The apparatus is consequently perfectly independent of air pump and air supplying hose. Eyes as well as nose are protected independently by separate devices.

Such apparatus have been in use for a number of years in the English and Imperial German Navies, and are now being adopted in a good many European fire departments and large factories.

I would draw your attention to the practical tests which will be made with these respirators in your presence, and which will show surprising results.

For further details I would politely refer you to Mr. Loeb, as also to the catalogues which he will be pleased to hand to you.

Our asbestos suit consists of a pair of strong boots, protected by an iron sole; asbestos pants and gaiters, asbestos jacket, asbestos apron, gloves, mask and headgear.

There is no part of the whole outfit which is liable to be damaged in a fire—it is fire-proof in every sense of the word. When exposed to the heat long enough, of course, the suit will get quite hot, but it is one of the valuable qualities of asbestos that it is not only fire-proof, but also a non-conductor of heat. On that account asbestos will not suddenly become hot, but very slowly, and a man will notice the heat before it becomes unbearable and it will be a warning to him to leave the fire when he finds the suit to be getting warm.

Water will not hurt it. On the contrary, if a suit is becoming warm the water will cool it and will allow the man to stay longer in the heat.

Asbestos suits in their present perfection, such as we put before you, I am sure will give you the impression that they are worth your consideration.

Amongst other important inventions for the use of fire departments, I would like to draw your attention to fire-proof asbestos ropes, such as we also have on exhibition. We manufacture two kinds of such rope, one is pure asbestos, the other has a core of steel wire and is naturally much stronger. We have had such ropes with a wire centre tested by the German Government, and I have here with me, subject to your inspection, the official certificate, according to which a ¾ in. asbestos rope with a steel wire centre carried almost 2000 lbs. and then only one of the seventy odd strands of which the rope consists broke.

The tests made by the German Government are also interesting regarding the stretching of the asbestos ropes. With a weight of 100 kilos (220 lbs.) attached, the ¾ in. rope only stretched $\frac{3}{10}$ per cent.—with a weight of 400 lbs. it stretched less than one per cent.

The asbestos rope without the steel wire core is sufficiently strong for ordinary firemen's purposes. A ½ in. rope will carry fully 200 lbs.—a ¾ in. rope over 300, and a 1 in. rope is safe for 500 lbs.

The weights of these ropes run as follows:—

½ in.	rope	weighs	about	10	lbs. to 100	feet.
¾ "	"	"	"	20	" "	"
1 "	"	"	"	40	" "	"
1¼ "	"	"	"	70	" "	"

The wire centre does not materially increase their weights.

By this you will see the ropes are by no means heavy and very strong, and can be conveniently used as life lines. They are not slippery and will not suffer by water.

We have also on exhibition a 30 feet asbestos fire escape or rope ladder, which is tested to carry 500 lbs. I request you to kindly inspect it.

We have, further, on exhibition two lengths of fire hose, both covered with asbestos. The cover on one is braided closely by machinery, and seamless; the other is covered with an asbestos cloth, which is sewn together with asbestos thread. Both covers are absolutely fire-proof and burning cinders falling on such hose will not injure it.

We also exhibit various kinds of asbestos cloth, which can conveniently be used for extinguishing small fires, for drawing partitions between rooms and buildings, and to cover valuable property during fires.

Asbestos cloth is already extensively used for theatre curtains and side-scenes, as also is asbestos paper for fire-proofing buildings. We have a collection of such goods on exhibition, and I shall cheerfully give you any further information which you may desire.

I will now close my address, and if I have succeeded in convincing you that there is some importance in asbestos goods in their present perfection for fire departments, I have filled the task which I have undertaken.

Gentlemen I thank you very much for your attention.

* Paper read before Montreal Convention National Association of Fire Engineers, August, 1894.

Silver Mines of West Kootenay, B. C. *

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

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

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

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

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

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

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

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

Before passing then to the subject proper of this paper, it may be well to point

* Paper read before the General Mining Association of Quebec.

out on the map here, the various other districts in the province where veins carrying argentiferous ores have been found and more or less worked.

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

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

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

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

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

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

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

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

The veins cutting the black shale series, shew very similar characteristics to those described later as occurring in the Slocan district. They carry galena as the chief ore in ribs and masses, in a gangue which is generally ferruginous. At places much zinc blende is intermixed, especially where larger bodies of ore occur in connection with the *lime belts.*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

COMPANIES.

The Golden Era Mining Company—Registered at Vancouver 16th July. Authorised capital $ 8.000. Formed to carry on placer mining in the Province of British Columbia, with headquarters at Vancouver. Directors: George L. Allan, H. Rhodes and Robert Hamilton.

Fraser River Mining and Dredging Company Ltd.—Registered 13th June 1894. Authorised capital $ 2,500,000 in shares of $ 10,00. Head office: Vancouver B. C. Directors: W. H. Gallaghar, Jas. A. Wood and Chas. E. Crockett of Vancouver; and C. A. Duncan and Marshall H. Alworth, Duluth, Minn. Formed to work placer ground on the Fraser River B. C.

The Quesnelle River Hydraulic Gold Mining Co. Ltd.—Registered 14th August, 1894. Authorised capital $ 600,000 in shares of $100,00. Head office: New Westminster B. C. Directors: J. Barnet McLaren, New Westminster and F. S. Reynolds and W. C. Fry of Quesnelle B. C. Formed to take over mining leases on Quesnelle river British Columbia, now held by J Barnet McLaren and F. S. Reynolds.

Georgian Bay Portland Cement Co. Ltd.—Authorised capital $ 95,000 in shares of $ 100. Head office at Owen Sound Ont. Directors: H. B. Harrison W. Taylor, N. P. Horton, A. E. L. Malone, W. Masson, John Lemon and A. J. Frost. The undertaking will be the manufacture and sale of Portland cement, putty, whiting, bricks, drain and other tiles, fuels and fertilzers, barrels and boxes or such

DOMINION COAL COMPANY.

COLLIERY MANAGERS AND OTHER OFFICIALS OF THE COMPANY.

H. Donkin, C.E.
(Engineer Int'l R. R.)

P. L. Naismith, Ba. Sc.
(Supt. Int'l R. R.)

J. W. Revere
(Purchasing Agent.)

A. M. Evans
(Supt. Gowrie Colliery.)

Jas. McVey
(Supt. Reserve Colliery.)

F. C. Kimber
(Asst. Shipping Supt., Int'l Pier.)

C. H. Rigby
(Supt. Shipping, Int'l Pier.)

J. G. S. Hudson
(Supt. Glace Bay Colliery.)

Robt. Robson
(Supt. Old Bridgeport Colliery.)

T. J. Brown
(Supt. Victoria Colliery.)

D. M. Butchall
(Superintendent of Stores.)

John Johnstone
(Supt. Dominion No. 1 Colliery.)

other packages as may be required for the shipment or storage of their products, and also such other articles of commerce the manufacture of which shall be decided upon from time to time by the company.

The Ledyard Gold Mines Ltd.—The prospectus of this Ontario company has been issued to the public. The authorised capital is $ 1,000,000 in shares of $ 10,00 each; of which $ 150,000 is reserved for working capital. The officers are T. D. Ledyard, Toronto, *President;* T. H. Yeoman, Toronto, *Vice-President;* Head office; 57 Colborne St., Toronto. The mines are situated in Belmont Township, Peterboro county, Ont., and are located on the east ½ Lot 19, 1st Con. Belmont, containing 100 acres. The machinery at date comprises 40 h. p. engine and boiler, Dodge Rock Breaker, Huntington Mill and equipment and Golden Gate Concentrator. The ore supplies are contained in several veins which have all the appearance of being true fissure veins, and in a large knoll or small hill which appears to be the junction of the several veins, from whence the ore can be quarried very cheaply. Shaft No. 1, which is well timbered and has a good derrick hoist, is sunk to a depth of 60 ft. on an E. and W. vein, which is from 4 to 6 ft. wide, with well defined walls of talcose schist and a dip of about 7c°. At a depth of about 30 ft. a drift has been run east from the shaft for 30 ft. on the vein. Both shaft and drift contain ore showing some free gold, but carrying considerable quantities of sulphurets which assay richly in gold. The average of seven assays of sulphurets from Shaft No. 1, was $325 in gold per ton. There was no visible gold in any of these samples assayed. Sulphurets from the knoll, 200 yards W. of Shaft No. 1, showing no visible gold, assayed $47, $96, $127 and $210 respectively in gold per ton. The sulphurets from another vein 10 ft. wide, 80 yards further W., assayed $102 gold per ton. A mill test of 3 tons of ore taken from Shaft No. 1, about a month after it was started, gave $25.40 per ton, or 92% of the assay value.

The Silver Wolverine Co. Ltd.—The first and final dividend of this Port Arthur silver company is to be declared at an early date. The liabilities amount to £772, and the assets available for dividend £80. The liquidator is Mr. C. J. Stewart, 33 Carey street, London, W.C.

Lake Opinicon Phosphate Co. Ltd., has made application for Ontario charter, to acquire and work phosphate lands in that province. Capital, $50,000, in shares of $100. Head office: Kingston, Ont. The directors are: Jas. Swift, Kingston; D. H. Johnson, W. S. Johnson, John Kelderhouse, C. B. Armstrong, W. H. Davis, Buffalo, N.Y.; and O. S. Johnson, Scranton, Pa.

Nova Scotia Gypsum Company Ltd., has been incorporated with an authorized capital of $2,000,000 in shares of $20. Head office: Parrsboro, N.S. Directors: Vincent C. King, New York; J. E. Peters, Port Greville, N.S.; and James Taggart, Parrsboro. Formed to quarry gypsum in the Province of Nova Scotia.

Wine Harbor Gold Mining Co. Ltd., has been incorporated with a capital of $160,000, to acquire and work gold mining areas at Wine Harbor or elsewhere in Nova Scotia. The incorporators are: T. G. McMullen, C. A. Kent, A. S. Archibald, A. T. Dalrymple, H. T. Harding, all of Truro; A. Kirkpatrick and J. A. Kirkpatrick, Shubenacadie; J. P. Chipman, W. P. Shaffner, of Kentville; W. H. Knowles and Frederick Knowles, Avondale, N.S.

Kootenay Mining and Smelting Co.—This company with a paid up capital of $2,250,000 is now rapidly pushing forward to completion the new smelting works at Pilot Bay. Pilot Bay is the geographical centre of the Kootenay country, commanding on the one hand the rich Slocan with its high grade silver lead ores, and on the other the copper, silver, and lead of Ainsworth and Nelson, with all their intermediate points. At Pilot Bay, and owned by the company, is the Blue Bell mine, one of the largest and most valuable deposits of fluxing ores in America. Such is the favorable location which the company has selected as the base of their operations. The plant as designed will accommodate four stacks each of 100 tons capacity. Seven large buildings have already been completed for the works and three others are under way. Over 200 tons of the most modern machinery has been received and is now being put iuto place, while several carloads more are on the way from the East. The plant will be the most modern and complete that money can buy. Extensive wharves are being erected along the water front, and apparatus will be placed for the handling of ores in large quantities. The works will be in operation before the first of October next, with one 100 ton stack in full blast for the reduction of silver lead ores. The three other stacks will be added as fast as the district develops, and it is designed to give the treatment of copper ores the same attention as lead ores. In fact, all ores that can be handled to profit and advantage will be purchased and treated by the company. In addition to the smelter proper, the works will include a 300-ton sampling plant, a 200-ton concentrator, a refinery capable of treating all the bullion produced, and the finest laboratory and assay office in the west. The Company has been promoted by Mr. A. B. Hendryx of New Haven, Conn., and consists of: E. W. Herrick, a Minneapolis capitalist; R. P. Rithet, of Victoria, B.C., is the Vice-President, and Joshua Davise, E. Crow Baker, W. H. Ellis, W. P. Sayward, W. J. Macaulay, James Hutcheson and H. Chapman are directors, and all of whom are well known in British Columbia.

Crystal Gold Mining Company of Rathburn Ltd. is appling for Ontario Charter to carry on Gold Mining operations in the Township of Rathburn, in the district of Nipissing, Ontario. Authorized Capital, $1,000,000, in shares of $100. Head Office: Mattawa, Ont. Directors: Hon. Peter White, Pembroke Ont.; John L. Caverhill, Montreal; Thos. Hale, Pembroke; Wm. Anderson, Ottawa; Rinaldo McConnell, Mattawa, Ontario.

GOLD MINING NOTES.

[FROM OUR CORRESPONDENTS]

Nova Scotia.

Caribou District—The consolidation of various properties in this district has been effected with the aid of St. John, N.B. capital, and partial payments made. It is rumored that Mr. Geo. W. Stuart has been offered the management, but has declined.

The Lake Lode Company has prepared plans for a new 15 stamp mill, which will be built by the Truro Foundry Co.

Cochrane Hill—The management hopes to have the 20 stamp mill in commission by the 1st of October. Work is pushing in the mines, and milling material is fast accumulating.

Goldenville—It is reported that old workings east of the Wentworth have shown some rich samples and specimens from a lode left in the foot-wall. The district is livelier than it has been for many years.

Country Harbor—The excitement caused in the early part of July by the finding of gold bearing lodes about 6 miles back from the shore, has somewhat abated, the lucky finder being apparently unwilling to work the lodes for fear of losing the showing already made. From an excellent authority who has visited the district we learn that the promise is very good for a permanent district. The lack of a road and the exorbitant price at which properties are held, will, however, probably retard the development of this promissing field until next year.

Chester Basin—Mr. T. N. Baker who has been diligently prospecting a large block of areas on the north side of Gold River district, has cut several promising lodes, one of which measures from 30 inches to 4 feet in width and shows gold freely.

Waverley—The Nova Scotia Gold Mines, Ltd., have sold their property in this district to Mr. Frederick Taylor of Lowell, Mass.

The West Waverley Gold Company, Ltd., will transfer all its property and rights to the Tuder Gold Mining Co., Ltd., a newly organized corporation.

Quebec.

DuLoup—Mr. E. B. Haycock has a good working force developing his quartz and placer claims on the DuLoup. Mr. Haycock reports that the work done has given satisfactory results.

Ontario.

Rainy Lake—A dispatch under date of 23rd says: "The steamer Dixon bought in a 5 stamp mill this morning to be shipped to Ward Bros. It will be put in a mine near Rainy Lake City. The little American vein is now 25 feet wide and the owners propose building a 40 stamp mill on the Island on which the mine is located. The present mill on the mainland is to be used as a custom mill."

The first clean up of the Little American mine is reported to have been $750 gold from forty-eight hours crushing in the 10 stamp mill.

A private advice reports the sale of a quarter interest in a location taken up by a man named Wiggins for $55,000.

Lake Wahnapitae—Mr. R. McConnell of Mattawa, was in Ottawa the other day with some fine samples of quartz carrying free gold from a recent find in this section.

British Columbia.

Cariboo—During the month two bricks were received by the Bank of British Columbia from the Cariboo country, which have stimulated an interest in the famous diggings of this section. The largest one weighs 302½ ounces, and is from the Cariboo hydraulic mine. It is valued at $5,142, and is the result of 47 hours washing gravel. The other is from the claims of the Horsefly Hydraulic Mining Co., and weighs 287 ounces, valued at $4,879, and is the product of 106 hours washing gravel, with an average of 921 miners' inches of watter.

The Kootenay Hydraulic Mining Company last month completed an important clean up. Their operations have been directed to ascertain precisely the value of their property on the north bank of the Pend d'Oreille river. To this end they collected all the water from the Seven Mile and Nine Mile creeks and directed it into their main ditch with a head of 250 feet above the monitors at the level of the Pend d'Oreille river. They sent through their sluices 2,200 yards of gravel, and the weight of the quicksilver amalgam shows a yield of $25 in gold, equal to nearly 24 cents per cubic yard, some of the nuggets being of a good size, the largest being worth $5.85. When it is remembered that 8 cents per yard is regarded as enormous, and that many of the great placers in California are worked at high profit even at 3 and 4 cents per yard, this result must be regarded as most encouraging.

The reports of recent discoveries of rich gravel at Cariboo creek has resulted in a rush of prospectors to the new field, which is located about 20 miles from Kakusp.

Early last fall a party of four went into that section prospecting and struck colors, but nothing more was done until a short time ago, when the men again went in, taking with them abundant supplies and tools for the construction of sluice boxes. Operations were speedily commenced by panning, with the result that coarse gold was found in abundance, each pan running from 25 cents to $1.25 per pan. The gold has apparently not travelled far, as points can be discovered on it with the naked eye, clearly showing that ledge croppings of great richness must be in close proximity. While some of the men are getting the ground in shape for working, others are endeavoring to locate the ledge proper. The news of the discovery could not be kept a secret long, and soon prospectors were on their way to the ground. Their numbers will be speedily increased as numerous applications have been sent in for miners' licenses. Applications have also been made by various parties to the government for the privilege of staking out land, one man asking for half a mile. Gold was found in Trout creek early this spring, and it was surmised more would be found further up. It was the intention of a number of prospectors to have followed this lead up later on, but they have been forestalled.

Respecting this excitement, the Nakusp *Ledger* writes: "It has been a great surprise to the Recorder at New Denver where all the money is coming from that he is receiving for licenses and record fees. Last week he took in upwards of $200, all resultant upon the gold excitement. Every descending boat has conveyed a new detachment from Nakusp and other points to Trout creek, particularly so on Tuesday. Last Friday morning the Illecillewaet specially chartered for the occasion, conveyed

Works of the Northey Manufacturing Co. Ltd. at Toronto.—Interior of Pump Works.

to the new town, Burton city, that is springing up at the Narrows, several thousand feet of lumber and tons of supplies, besides having a passenger list of 18. At the gold fields proper, everything is in the initial stage at present, although preparations are rapidly prosecuting towards development. The bulk of the prospectors form themselves into companies, and in this way work more expeditiously and cheaply. The principal claims thus formed, apart from the Discovery mentioned last week, are the Crown and Sceptre, located by a party of eight from Waneta, and the Lady Sampson, owned by a local company, with which H. Madden, W. C. Sampson, L. Dansereau, C. H. Osler, and others are identified. On the Crown and Sceptre the most work has been done, and the owners being experienced men they hope to be able to commence sluicing in a few days, and thus obtain results setting at rest all fears as to the permanency of the camp. So far as indications go there is no reason to doubt but that the strike is a very rich one. Washings have been made over an extent of country covering 28 miles, and in each instance colors were obtained. This was the case even to the mouth of Trout creek. The bed rock of Cariboo creek inclines away from the current and thus serves to catch all particles that wash down. In the crevices along high water mark, small nuggets, sometimes as large as a finger nail and about as thin, have been pinched out, while from the sediment on the rock shelves, the colors have been freely extracted. In several places trial shafts have been sunk in the gravel and the same returns continue. At the mouth of Grouse creek is believed to be the best ground."

The Waneta Company has been sluicing for some time and have secured some coarse gold from the cement gravel. It is reported that they are averaging $7 a day to the man. Not long ago they offered a half interest in six of their claims for $100, but suddenly raised the price to $1400. This company do not want to be bothered by visitors, and prefer to surround their operations with air of mystery.

The Pembroke hydraulic property at Thompson Siding, near Lytton, will be operated for the present by a powerful duplex pump, capable of elevating an eight-inch stream 200 feet high. If this should be a success it will redeem thousands of acres of good hydraulic claims not available for want of water. Col. Underwood, representing this company, has just secured Letters Patent from the Dominion government on a novel dredging machine for mining on the Fraser and other gold bearing streams. The machine consists of a combination of the suction process with a dredge. It is shaped like a plough and of heavy steel bars terminating in a plough point, far enough apart to admit only such boulders as will readily pass through the suction pipe and thence to the sluice boxes. This device is attached to the end of a beam, similar to the ordinary steam shovel or dredge; and is to be operated in the same manner. The colonel is of the opinion that this machine will practically dispose of the question of handling the 60 to 80 per cent. dead work to be overcome in subaqueous mining on the Fraser. A machine of this kind will be put to work on the Quesnelle river at an early date.

The Nelson Hydraulic Mining Company, is in a fair way to prove the value of its ground on Forty-nine creek. About $15,000 have been expended in flumes, ditches, wasteways, pipes, monitors and sluice boxes. The flume and ditch is over a mile long, and the head of water is upwards of 300 feet. At present about 300 inches runs through the flume, which is barely enough to fill the pipe when a three-inch nozzle is used on the monitor. The ground is favorably located for working, but as it contains more boulders than gravel, it cannot be moved as rapidly as was expected. Fred Rice is acting as superintendent, and enough bedrock will be cleaned within the next two weeks to prove the value of the property.

Mr. A. N. Beaton one of the partners in the Vandall mine on French Creek, reports the mine as paying handsomely, over $100 having been taken out in one day by four men. Mr. Beaton says: "On our claim we took out $250 in the last two days before I left, and since spring the total output has been several thousand."

The wing dam on the Consolation property is in, and by the end of the month they will be drifting again. As they were on the pay streak when the flood struck them, they will soon be producing bullion after the old rate of $100 a day.

"Some splendid specimens," says the Kootenay *Mail*, "of free-milling gold quartz were brought down by Laforme's pack train on Monday from two minerals claims located by Harry S. Howard on McCulloch Creek last week. The gold could be seen in large patches all over the quartz, and it was estimated that if the ledge at all equals the samples shown, the ore would assay $500 to the ton. It was not necessary to use a glass, as the gold stood out encrusted on the ore in rich clusters. These claims were recorded the same day by Mr. John Burke, of the Senate Hotel, who has a part interest in the claim. One of the claims is the Monarch, located on the 1st of August at the head of McCulloch Creek, on the divide between that creek and Camp Creek, and adjoining the Gold Hill claim on the north. The other claim is the Eureka, located on the 2nd of August on the divide between Camp and McCulloch Creeks, about a mile below the divide between French and McCulloch Creeks, and adjoins the Panhandle on the east. Both claims are 1500 feet square. If the ledges are similar to the specimens brought down, Mr. Howard has a bonanza."

Mr. W. Hamilton Merritt, M.E., A.R.S.M., Toronto, has been appointed engineer to the Strathyre Mining Company, operating at Fairview, in the Okanagan country.

From the number at work, the placer ground on Hall creek must be paying fair wages to the men. At the canyon Eugene Montreuil and his two partners have dammed the creek and utilize water power to work their ground. The gravel is hoisted to the sluice boxes by a Chinese pump; the small boulders are carried to the waste dump in cars; and the heavy boulders are yanked out of the way by a windless. All this is done by power developed by an overshot wheel. The scene of operations is less than a mile from Hall Creek siding on the Nelson & Fort Shepard railway, and about eleven miles from Nelson.

Exterior View of the Northey Manufacturing Co's Works.

MINE PUMPS.

ieir Manufacture in Canada at the Works of the Northey Manufacturing Company at Toronto.

With the steady and persistent growth of mining in Canada has sprung up in the ious provinces, notably, in Nova Scotia, Quebec and Ontario, a corresponding exsion of the home manufactures of mining machinery. Among these may be ntioned the manufacture of special lines of air compressors and drills by the Ingersoll Rand Companies at Montreal and Sherbrooke, hoisting engines, coal mining chines, and a general line of mining machinery by the Jenckes Machine Co.; stamp lls and a complete line of gold mining machinery by the Truro Foundry and chine Co., at Truro: and the Messrs. Matheson, at New Glasgow; and by no means least important, the large establishment operated by the Northey Manufacturing ., Ltd., at Toronto, for the production of mine and quarry pumps, two excellent ws of which are reproduced in this number. The Messrs. Northey commenced siness in Hamilton, as far back as 1842, and in 1882 the works were removed to ronto. The rapid extension and success of the business, however, necessitated its orporation into a stock company, and this was accomplished in 1892, under the me of the Northey Manufacturing Company, Ltd.

The machine shop, 250 feet long and 75 feet wide, is divided into three bays, the tre one of which is used for travelling crane, surface railway and heavy tools. The outer bays are equipped with special and general tools for the manufacture of mping and general hydraulic machinery. The tools used are all modern, and inde duplex boring machines, gang millers, horizontal and vertical boring machines large work, heavy planers, milling machines, lathes and the usual complement of ls used in modern machine work. At one end of the main shop is the tool room, ere a number of hands are constantly employed in the production of special tools, s, gauges, etc., required for the purposes of the business.

The engine supplying power is located at end of centre bay in machine shop, and ves two shafts running entire length of each side bay, leaving centre clear of shafts d belting, and free for the erection of machinery, and the operation of overhead ne.

Testing tanks are conveniently located below floor level, and are supplied with ld and hot water, to allow of thorough tests of pumps for the various duties required. test pressure is put on all pumps very much in excess of that which they are requirto work under, and each machine is shipped in perfect working order, and requiring further adjustment.

The building shown in left foreground of engraving, is the pattern shop, which is roughly equipped with power machinery for wood working. Adjoining the pattern op are the public and private offices, and draughting room; the latter is fitted with awing tables, cabinets for finished drawings, and for supplies, and complete equipent for the making of blue prints. The main and private offices are spacious rooms, ndsomely furnished, and finished in natural woods. The main office is provided with a large plate glass window, with cut glass heading, which commands a view of the entire length of machine shop.

At the further end of main building is the boiler house, smithy and brass foundry, all specially adapted to their purpose.

A very marked characteristic of the works is the ample light obtained at all points by the judicious arrangement of skylights and windows, and the shops being lofty and well ventilated, present a contrast to the old-fashioned, dingy and crowded quarters, so frequently considered quite suitable for machine shop premises.

The Northey Manufacturing Company's shops were erected from special designs, prepared by Mr. E. J. Lennox, of Toronto, and are consequently very fully adapted to the requirements of the business. The firm's trade has experienced a healthy and continuous growth, their pumping and other machinery being universally recognized as quite equal to standard English or American makes.

We are pleased to note that they have lately been entrusted with orders for important pumping machinery for some of the large Canadian mines. They make a specialty of mining pumps of all classes, and up to the largest sizes.

ONTARIO MINING INSTITUTE.

The First Quarterly General Meeting of the Institute, for the Transaction of Business, and Reading Discussion of Papers

WILL BE HELD IN THE

PRIVATE BILLS COMMITTEE ROOM

PARLIAMENT BUILDINGS, TORONTO,

— ON —

Wednesday 12th, & Thursday 13th Sept.

Chair to be taken at two o'clock in the afternoon and at eight o'clock in the evening of both days.

All interested in Mining and the development of Ontario Mineral resources, are cordially invited to be present.

JAMES CONMEE, President. B. T. A. BELL, Secretary.

GENERAL MINING ASSOCIATION

— OF THE —

PROVINCE OF QUEBEC.

THE AUTUMN MEETING of this Association will be held at Sherbrooke, Que., on WEDNESDA and THURSDAY, 26th and 27th September, next.

JOHN BLUE, President. B. T. A. BELL, Secretary.

W. PELLEW-HARVEY, F.C.S.

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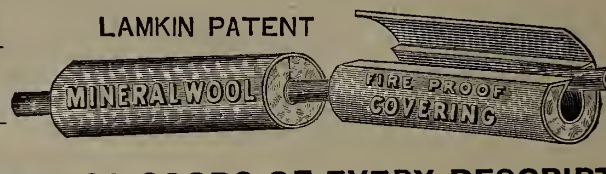

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MINING LAWS OF ONTARIO.

ANY person may explore Crown Lands for minerals.

Mining lands may be taken up as surveyed locations or staked claims.

Locations range from 40 to 320 acres.

Claims range from 10 to 20 acres on vein or lode.

Locations may be acquired in fee or under leasehold.

Price of locations north of French River, \$2 to \$3 per acre, and south of it, \$2 to \$1.50, according to distance from railway.

Rent of locations first year 60c. to \$1 per acre, and subsequent years 15c. to 25c. per acre.

Rent of claims, \$1 per acre each year.

Claims must be worked continuously.

Royalty on ores specified in the Act, 2 per cent. of value at pit's mouth less cost of labor and explosives.

Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.

Original discoverer of ore or mineral on claim entitled to stake out a second claim.

Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines.

TORONTO, May 25th, 1894.

HOW IS THIS?

Something unique even in these days of mammoth premium offers, is the latest effort of Stafford's Magazine, a New York monthly of home and general reading.

The proposition is to send the Magazine one year for one dollar, the regular subscription price, and in addition to send each subscriber fifty-two complete novels during the twelve months; one each week.

Think of it. You receive a new and complete novel by mail, post paid, every week for fifty-two weeks, and in addition you get the magazine once a month for twelve months, all for one dollar. It is an offer which the publishers can only afford to make in the confident expectation of getting a hundred thousand new subscribers. Among the authors in the coming series are, Wilkie Collins, Walter Besant, Mrs. Oliphant, Mary Cecil Hay, Florence Marryat, Anthony Trollope, A. Conan Doyle, Miss Braddon, Captain Marryatt, Miss Thackery and Jules Verne. If you wish to take advantage of this unusual opportunity, send one dollar for Stafford's Magazine one year. Your first copy of the magazine, and your first number of the fifty-two novels (one each week) which you are to receive during the year will be sent you by return mail. Remit by P. O. Order, registered letter or express.

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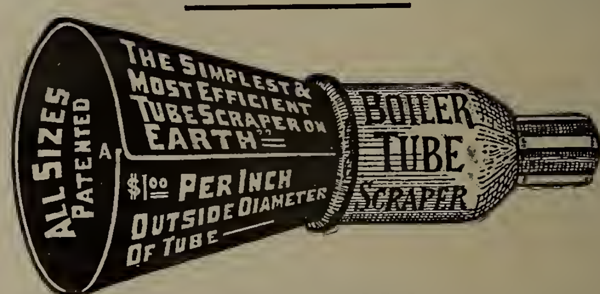

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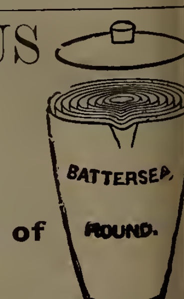

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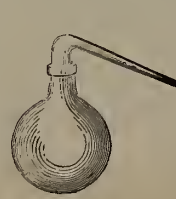

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MINING REGULATIONS

TO GOVERN THE DISPOSAL OF

Dominion Lands Containing Minerals other than Coal.

'HESE REGULATIONS shall be applicable to all Dominion Lands containing gold, silver cinnabar, lead, tin, copper, petroleum, iron or other mineral posits of economic value, with the exception of coal.

Any person may explore vacant Dominion Lands, not appropriated or reserved Government for other purposes, and may search therein either by surface or sub-rranean prospecting for mineral deposits, with a view to obtaining under the egulations a mining location for the same, but no mining location or mining claim all be granted until the discovery of the vein, lode or deposit of mineral or metal ithin the limits of the location or claim.

QUARTZ MINING.

A location for mining, except for iron or petroleum, on veins, lodes or ledges of artz or other rock in place, shall not exceed 1,500 feet in length and 500 feet in readth. Its surface boundary shall be four straight lines, the opposite sides of which all be parallel, except where prior locations would prevent, in which case it may be such a shape as may be approved of by the Superintendent of Mining.

Any person having discovered a mineral deposit may obtain a mining location erefor, in the manner set forth in the Regulations which provides for the char-cter of the survey and the marks necessary to designate the location on the round.

When the location has been marked conformably to the requirements of the egulations, the claimant shall within sixty days thereafter, file with the local agent the Dominion Land Office for the district in which the location is situated, a eclaration or oath setting forth the circumstances of his discovery, and describing, as early as may be, the locality and dimensions of the claim marked out by him as foresaid; and shall, along with such declaration, pay to the said agent an entry fee f FIVE DOLLARS. The agent's receipt for such fee will be the claimant's uthority to enter into possession of the location applied for.

At any time before the expiration of FIVE years from the date of his obtaining he agent's receipt it shall be open to the claimant to purchase the location on filing with the local agent proof that he has expended not less than FIVE HUNDRED DOLLARS in actual mining operations on the same; but the claim-ant is required, before the expiration of each of the five years, to prove that he has performed not less than ONE HUNDRED DOLLARS' worth of labour during the year in the actual development of his claim, and at the same time obtain a renewal of his location receipt, for which he is required to pay a fee of FIVE DOLLARS.

The price to be paid for a mining location shall be at the rate of FIVE DOLLARS PER ACRE, cash, and the sum of FIFTY DOLLARS extra for the survey of the same.

No more than one mining location shall be granted to any individual claimant upon the same lode or vein.

IRON AND PETROLEUM.

The Minister of the Interior may grant a location for the mining of iron or petroleum, not exceeding 160 acres in area which shall be bounded by north and south and east and west lines astronomically, and its breadth shall equal it in length. Provided that should any person making an application purporting to be for the purpose of mining iron or petroleum thus obtain, whether in good faith or fradulently, possession of a valuable mineral deposit other than iron or petroleum, his right in such deposit shall be restricted to the area prescribed by the Regulations for other minerals, and the rest of the location shall revert to the Crown for such dis-position as the Minister may direct.

The Regulations also provide for the manner in which stone quarries may be acquired.

PLACER MINING.

The Regulations laid down in respect to quartz mining shall be applicable to placer mining as far as they relate to entries, entry fees, assignments, marking of localities, agents' receipts, and generally where they can be applied.

The nature and size of placer mining claims are provided for in the Regulations, including bar, dry, bench creek or hill diggings, and the RIGHTS AND DUTIES OF MINERS are fully set forth.

The Regulations apply also to

BED-ROCK FLUMES, DRAINAGE OF MINES AND DITCHES.

The GENERAL PROVISIONS of the Regulations include the interpretation of ex pressions used therein; how disputes shall be heard and adjudicated upon; under what circumstances miners shall be entitled to absent themselves from their locations or diggings, etc., etc.

THE SCHEDULE OF MINING REGULATIONS

Contains the *forms* to be observed in the drawing up of all documents such as: "Application and affidavit of discoverer of quartz mine." "Receipt for fee paid by applicant for mining location." "Receipt for fee on extension of time for purchase of a mining location." "Patent of a mining location." "Certificate of the assignment of a mining location.' "Application for grant for placer mining and affidavit of applicant." "Grant for placer mining." "Certificate of the assignment of a placer mining claim." "Grant to a bed rock flume company." "Grant for drainage." "Grant of right to divert water and construct ditches."

Since the publication, in 1884, of the Mining Regulations to govern the disposal of Dominion Mineral Lands the same have been carefully and thoroughly revised with a view to ensure ample protection to the public interests, and at the same time to encourage the prospector and miner in order that the mineral resources may be made valuable by development.

COPIES OF THE REGULATIONS MAY BE OBTAINED UPON APPLICATION TO THE DEPARTMENT OF INTERIOR.

A. M. BURGESS,
Deputy Minister of the Interor

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Established 1882

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Established 1882

fficial Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

. T. A. BELL, Editor. Published Monthly. OFFICES: Victoria Chambers, Ottawa.

VOL. XIII., No. 9. SEPTEMBER, 1894. VOL. XIII,, No. 9

EN PASSANT.

Mr. Robert Archibald, C.E., M.E., the subject of this month's rtrait, succeeded, about a year ago, Mr. James Baird, in the manage-ent of the Joggins Colliery, operated by the Canada Coals and Railway o., Ltd., in Cumberland County, Nova Scotia. Like many of our ining engineers, Mr. Archibald is a Scotchman, born and educated in lasgow, where he also served his indenture as apprentice to a well nown firm of civil and mining engineers. His first professional work as an engagement as surveyor and assistant manager at one of the rgest collieries near Motherwell, after which he was employed for some ght years by the Summerlee and Mossend Iron and Steel Co., in the ried capacities of assistant manager, underground manager, and ulti-ately manager. Then Mr. Archibald received the appointment f assistant general manager to the Carron Company, Ltd., where e acquired valuable experience and found full scope for his energy and bility in the supervision of this important company's Scotch collieries. rior to his present engagement with the Canada Coals and Railway o. Ltd., he had been promoted to the position of manager of one of e Carron Company's largest districts. Mr. Archibald's intimate ac-uaintance with Scotch colliery practice is evidenced by many notable nprovements and a rapidly increasing output at the Joggins Colliery.

As we go to press the Autumn meeting of the General Mining ssociation of the Province of Quebec is being held at Sherbrooke, the roceedings opening in the Magog House on Wednesday evening, 26th nstant. Among the papers to be presented we note: "The Canadian late Industry," by Mr. Harry Williams, Supt. of the Beaver Asbestos o. Ltd.; "Chromic Iron: its Composition and Uses," having particular eference to the important new discoveries at Black Lake, Que., by Mr. J. T. Donald, M A, Montreal; "Repairs to Rock Drills," by Mr. A. Sangster, of the Canadian Rand Drill Co., Sherbrooke. Mr. J. Burley Smith, M.E., is also down for a paper, the subject of which, however, is not announced. On Thursday the members will be the guests of President Blue, at the Capelton pyrites mines of the Eustis Mining Co., where they will, after an inspection of the works, be entertained to luncheon. On Friday, party will leave by special train over the Quebec Central Railway, visiting first the large quarries operated at Dudswell by the Dominion Lime and Marble Co. Ltd., and then at Black Lake, the new workings of chromic iron which have caused some excitement in that district. By courtesy of the various managers, an opportunity will also be afforded for inspecting Quebec's great mining industry, the asbestos mines of Thetford and Black Lake. Luncheon will be served in the Club House at Black Lake. In the evening, the Hon. W. B. Ives, Q.C., M.P., President of H. M. Privy Council, will entertain the members of the Association at his charming residence in Sherbrooke. By arrangement, special rates have been provided, on the certificate plan, with the Canada Atlantic, Grand Trunk, Canadian Pacific and Quebec Central Railways. There is a likelihood of a large attendance and the success of the gathering is assured.

The Ontario Mining Institute will hold its next meeting in the city of Kingston, some time in January, under the auspices of the staff of the new School of Mining.

In view of the very marked progress in the introduction and application of coal getting machinery in Canada, some statistics from Illinois, where machine mining has passed from the experimental and become fixed and successful, will be of interest. The following comparative table for the last six years shows the record of machine mining:—

Year.	Mines.	Machines.	Tons cut. Lump coal.	Men employed.
1888	39	272	2,248,210	3,088
1889	35	235	2,346,713	3,439
1890	34	266	2,881,983	3,141
1891	34	241	2,423,080	3,005
1892	41	300	3,002,893	3,646
1893	41	310	3,541,944	4,314

The total number of tons of all grades mined by machines during the year 1893, was 4,595,130 tons, or over 25 per cent. of the total product of the State, and giving employment to 4,314 men. A record of 288 machines at 37 mines, shows that with an average force of 14 men, operating 250 days, 15,193 tons have been produced on each machine. There are 22 other machines located at four other mines, which have cut 219,504 tons; these are at mines where coal is partly mined by hand.

Some particulars relating to Crabb's patent clip for endless rope haulage in mines, &c., have reached us. It is described as the latest and most efficient clip in the market, and does not damage the rope. It is claimed to be cheap, simple and substantial in construction and certain in action on rising and falling gradients; automatically attaching and detaching itself at crosses, junctions and terminals; it drags the tub or waggon on the centre line; requires no adjusting, it being always in position to receive the rope; and can be adapted either to the top bottom or side of the tub. The patentee is Mr. G. H. Crabb, of Bunker Hill, Fence Houses, Durham, England.

Vancouver Island, with its rich resources in coal and iron, gives promise at no distant date to become the centre of an important iron smelting industry. Mr. J. P. Witherow, of Pittsburg, has been pushing for the establishment of a works at Victoria, with the result that Alderman Ledingham has given notice of the following motion for an early meeting of the City Council of that city:—

"Whereas the raw materials for the manufacture of iron and steel have been shown to exist in abundance and under favorable conditions for profitable manufacture in Vancouver Island;

"And whereas it would greatly increase the commercial importance of the city of Victoria and would otherwise benefit the inhabitants thereof if a first-class plant for the manufacture of iron and steel billets were to be established in or near the city;

"And whereas the government of Canada is authorized by an Act passed on the 23rd day of July, 1894, to pay a bounty of $2 per ton on all pig iron made in Canada from Canadian ore, a bounty of $2 per ton on all iron puddled bars made from such pig iron, and a bounty of $2 per ton on all steel billets made in Canada from such pig iron;

"And whereas J. P. Witherow has undertaken to organize a company in London with a capital stock of $3,000,000 for the purpose of establishing and operating such a plant at some convenient point in British Columbia;

"Be it therefore resolved that if a company is organized with a capital of $3,000,000, and at least half of such capital is subscribed for, and if the company shall have expended to the satisfaction of the mayor and two persons to be nominated by the City Council, the sum of $20,000 in acquiring a site and commencing to build a plant in or near Victoria for the manufacture of iron and steel billets, with a capacity of not less than 50,000 tons per annum, that the council will cause a by-law to be submitted to the ratepayers to authorize the city to guarantee the interest at the rate of 5 per cent. per annum on the company's bonds to the extent of $1,000,000, for a period of twenty years, such guaranteed bonds to be issued from time to time as the work progresses, and to be secured by a charge on the assets of the company and the bounties available from the Canadian government, or otherwise to the satisfaction of the council."

In the course of the discussion on the paper read by Professor Clowes before the British Association, in which that gentleman describ-his apparatus for detecting the presence of foul air in collieries, Dr. Haldane, Oxford, gave the result of his observations on the effect of the deleterious gases met with in coal mines upon human health. He said that his own experiments, repeated on many different individuals, showed conclusively that air containing as much as 20 per cent. of carbonic acid could not be breathed even for a minute without serious consequences. Even 5 per cent. of carbonic acid caused distress of both body and mind, while any proportion higher than 10 per cent. produced distinctly poisonous effects. He pointed out that the danger in mines often arises from a deficiency of oxygen, or from the presence of poisonous gases such as sulphuretted hydrogen and carbon monoxide, rather than from the presence of carbonic acid.

A new apparatus for concentrating sulphuric acid, which has been invented by G. Siebert, consists of a flat, closed vessel, in an inclined position, the bottom of which is terraced or stepped, with each step inclined backwards so as to form a shallow trough. The upper part of the vessel has a dome for carrying off steam or vopors and the lower end an outlet for the concentrated acid or liquid. At the upper face of the vessel is an inlet surrounded at the outside with a basin and protected internally by a screen, so that the liquid in the basin forms a hydraulic joint. In one form of the apparatus each step or terrace has a metal ridge or rib, which is shorter than the entire length of the step, so as to leave at one end a gap for the passage of the liquid; and the gaps being on the alternate sides in successive steps, the liquid traverses at each step the whole length to and fro as it flows, step after step downwards. The vessel is heated underneath.

In his review of the Florida phosphate industry in 1893, Dr. David T. Day (*Mineral Resources of the United States*) says: "As is well known reports have made the foreign consumers think of western Florida as a smooth tract of phosphate, of which it was possible to state the available tonnage by the cubic contents of that part of the State obtained from the acreage multiplied by a theoretical depth. The utter recklessness of such a method is realized when it is understood that the floor of the phosphate section is limestone rock, with an extremely irregular surface. At places the limestone outcrops; at others it is covered with still more irregular deposits of phosphate rock, clay and sand. In one place the phosphate rock will be visible at the surface, and a few feet away it is likely to be found covered with many feet of barren sand or clay, or both. The rock must be sought, therefore, above the pitted, often jagged, surface of the limestone, and below the equally irregular piles of sand and clay. And even then the phosphate boulders and pebbles must be separated from the sand and clay with much labour and mechanical ingenuity, which has developed a system of mining that is somewhat novel, and, therefore, requiring comparatively costly supervision to adapt it to the constantly changing details of occurrence, even after expert and costly prospecting has defined the defined the deposit. With the uncertainty as to the persistency of a given deposit, the phosphate is not, as a rule, followed below water level. It will be understood that the writer is endeavouring to represent the condition of things in what is generally thought of as the Florida phosphate field, i e., the "hard rock" region. The pebble region, which, by the way, is developing more satisfactorily than the rock phosphate, is susceptible of more systematic treatment; but even here the necessity is recognized for the greatest skill in selecting only here and there a property which may be profitably worked. After the usual primitive and careless methods of effecting sales characteristic of a new mining region, have had time for teaching their costly lessons, it might be expected that the financial results would be as good as the condition of demand and supply could possibly warrant. But there is general doubt as to whether this condition has been realized. It is confidently asserted by producers in the best position to judge that the price should be nearly double that which is now realized, and further, that the foreign manufacturers, who are the best customers for high grade phosphate rock, are perfectly willing to pay this high price provided they can be assured that all must pay it, and there is to be no great deviation in the price. The most evident policy which suggests itself, that of combination, still seems difficult to effect."

Mr. Titus Ulke, reporting to the United States Geological Survey, on the soapstone mine at Hewitt's, in North Carolina, says: "The mine is located on a hill side, from which the crude talc is lowered in a chute to a grinding mill having a capacity of from 8 to 10 tons per day of ten and a half hours. Most of the product is ground, but some block and pencil talc cut to order is also shipped. The blocks are usually 6 by 4 by 1 inch in size; the pencil talc is cut to about 4 by ¾ by ¼ inch sizes. During 1893 the mill was running continuously for about three months only. The pencil and block talc is shipped in cases according to the amounts ordered; the ground talc is packed in sacks of 220 pounds each. At the mill the crude talc is first passed through a 'rumble,' *i.e.*, a rotary screen, 6 feet long by 4 feet in diameter, which removes the dirt from the talc, and the dirt thus removed passes through longitutional slits into a water spout which carries it away. The good talc remaining in the rumble is dumped into a car, from which it is fed into a buhrstone grinding mill. The ground material is then hoisted to the floor above and emptied into a silk bolting cylinder. The bolted talc is caught in a dust-collecting chamber, into which it is drawn by an interposed centrifugal fan. The fine white ground talc is finally sent to an automatic packer and filled into sacks, each holding 220 pounds.

Gouverneur, Saint Lawrence County, New York, continues to furnish the entire product of the fibrous variety of soapstone. This mineral is used almost exclusively as a filler in the manufacture of medium grades of paper, a small amount being used in making dynamite. The product in 1893 was 35,861 short tons, valued at $403,436, against 41,925 short tons, worth $472,485, in 1892. The year of largest production was in 1891, when an output of 53,925 short tons, valued at $493,068, was reported. At the beginning of 1893 prospects were bright for a good year's business, and until the first of June the production was about equal to that of the first five months of 1892. After the first of June, however, the demand fell off, and while prices were fairly well maintained, the amount of business for the rest of the year was about 75 per cent. of that of the preceding year.

An American inventor has devised a machine for making gas for illuminating purposes out of wood instead of coal. The machinery is said to be very simple, consisting merely of a retort and purifying chamber, with a tank for holding the gas. It is claimed that the machine can be used for domestic purposes, and that by attaching it to an ordinary cooking stove enough gas to last a day can be made by the fire necessary to do the cooking. We would rather not make any remarks about this machine. We have not seen it ourselves and we don't know anybody who has.

Robert Archibald, C. & M. E.

Canada Coals & Railway Company.

ONTARIO MINING INSTITUTE.

Federation Endorsed—The Nationalization of Mines—Ontario's Cement, Brick and Building Material Production—Successful Meeting of the new Ontario Institute.

The Ontario Mining Institute, organized in April last, held its first meeting for the reading and discussion of papers in Toronto, on Wednesday and Thursday, 12th and 13th September, and notwithstanding many drawbacks, notably the attractions of "Fair" week and bad weather, was eminently successful. The sessions were held in the commodious Private Bills Committee Room at the Parliament Buildings, kindly placed at the disposal of the Institute by the Government. The proceedings opened on Wednesday afternoon, Mr. James Conmee, of Port Arthur, President, in the chair. There were present: Messrs. J. J. Kingsmill, Q.C., Toronto; J. McAree, D.L.S., Toronto; A. Blue, Director of Mines, Toronto; J. Bawden, Kingston; Prof. Nichol, Kingston; T. D. Ledyard, Toronto; J. H. Chewitt, B.A. Sc., Toronto; Edgar J. Jarvis, Toronto; R. W. Prittie, Toronto; Dr. A. P. Coleman, School of Practical Science, Toronto; B. J. Townsend, Toronto; J. M. Clarke, Toronto; J. F. Latimer, Toronto; Dr. Burwash, School of Science, Toronto; L. A. Morrison, Toronto; Fred W. Gray, Guelph, Ont.; T. W. Gibson, Toronto; B. T. A. Bell, Ottawa, and others.

Election of Members.

The following were elected 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 SECRETAY 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 meeling 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 organisation 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 and 7 of the Constitution and By-Laws by providing for the appointment of two auditors and defining their duties.

The meeting then adjourned.

EVENING SESSION.

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

The Nationalization of the Mineral Domain of Ontario.

MR. J. BAWDEN—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 and 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 new functions. It is merely requisite to make the nominal an absolute ownership in order to nationalize our mining property.

It is not 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 to-day 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 little beyond 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 guise 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 encourage 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 to-day. The amount of money which has been turned from the lines of honest enterprise into this profitless channel is very great, and the consequent loss to the community very large.

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 pocket 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 10 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 conditions 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 nearby gardening or farming meets with no encouragement. The population is migratory, and employment precarious—dependent quite as much, or more, on 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. If the enterprise of this country shall be so enfranchised by law and endowed from the public domain that it shall be able to maintain that the right to a maximum dividend involves the subjection of the miner to the minimum of comfort, our political life will require to be reconstructed at no little expense, probably of blood as well as of treasure. The most dangerous critics of the legislation of to-day are the social forces growing daily in strength and intelligence.

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—men whose patriotism so nerves them that they turn not a hair while their mills roll out rotten steel for the nation's steel-clad cruisers—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 to-day 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

surely 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 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. Not protect our forests against wholesale arson? Has it come to this, that we say this cannot be done?

Prof. Coleman's description, in recent issues of the *Globe* newspaper, of his own experiences 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 home 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 to-day. 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 individual 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 5 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 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 would 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. By all means then let us have instead another system of economy, under which this commonwealth of Ontario shall build the best school houses and raise the best men on this planet, with the help of the revenue to be won from the public mines.

The following draft of a bill for the establishment of a Department of Mines, and with various provisions respecting the management of public mines, are 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 times and at such prices as may be fixed by the Lieutenant-Governor in Council.

3. 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.

4. 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.

5. 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 respectiveiy, viz.: Gold mines, silver and lead mines, copper and nickel mines, iron mines.

6. 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.

7. 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 sub ect 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.

8. 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.

9. 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 per centage as may be found requisite for securing to the family of such miner or workman insurance in case of death, illness or accident.

10. 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.

CLAUSES RELATING TO THE MANAGEMENT OF PROVINCIAL MINES.

11. 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' consumptfon for the furnaces of Ontario and Quebec shall be kept in stock.

12. 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.

13. Miners, while engaged in the pubiic mines, their wives and families, shall be afforded the means of procuring groceries, provisions and necessary clothing at an advance of 2½ per cent. on the cost thereof laid down at the miner's dwellings, and no officer or workmen engaged in any public mine shall sell goods on his own account or for other persons, to any miner or other workmen 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.

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

15. 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-paytng 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 ownership 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 advertisemant 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. Lawaence 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 minaral 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 goodwill 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.

MR. A. BLUE—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 necessaries 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 Trades Tables give us the quantity as well as the value of 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 costs of freight and insurance and the profits of imrters, in reckoning the price paid by the consumers—an aggregate of not less than ,250,000. In these seven years the increase in quantity was 123 per cent., and in lue 113 per cent. But a more striking evidence of the growing demand is afforded a comparison of the imports of Portland and Roman cements for 1880-81 and 92-93. In the former year their value was only $45,646, and in the latter it was 16,179, being an increase of nearly 600 per cent. in twelve years. This is a rate at perhaps has not been equalled in any other article of Canadian importation. hat 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 ry modern usuage on this continent, viz., good roads. The setting in of the era of od roads in this counrry, as well as in the United States, does not date back ten ars, but in that short period much has been learned on the subject, and the street gineer is now as much of a specialist and quite as useful in his way as the military gineer or the mining engineer. The Roman roads of Europe, which have lasted out e traffic of two thousand years, have taught him the invaluable lesson that the only re way to make a good road is to lay a good and strong foundation. But instead of ing stone material, as the Romans did in constructing their great military roads, he s adopted the concrete used by them in the construction of temples and other public ildings, some of whose walls have been standing 2,400 years. The great dome built Agrippa, the friend of Augustus, "the immortal monument of the Pantheon," as ibbon described it—now the church of Santa Maria della Rotonda—is an edifice in ncrete, and though ravaged by fire and assaulted by the Huns and Goths, it is still act after more than 1,900 years. Concrete is the street engineer's material for street ilding, and his chief reliance in the making of it is not Roman or any other kind natural cement, but the stronger and more durable Portland. In Toronto during e last five years not less than 150,000 barrels of cement have been used in making ncrete for street construction, and of this quantity Mr. Rust tells me that not more an 4,000 barrels have been the native hydraulic cement. "Up to the last year or o," he says, "it was all imported Portland cement from Europe." In other towns d cities of the Dominion cement is also being used in steadily increasing quantities building sewers and streets, and the results are so uniformly good that the material omises to grow steadily in favor. It is almost certain then that for many years yet come the demand for Portland cement will continue as experience proves the utility d permanency of the concrete roadbed.

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

Mr. Rathbun told me that it cost him five years of testing, with the aid of a emist, before he was convinced that it would be safe to start his works. Mr. tchart also told me that it cost his company several thousands of dollars, a visit to me of the best Portland cement works in England—where he was admitted as a ecial favor—and the service of two experts in the construction of a suitable plant, fore they could produce a commercial article. But the Rathbun Company and the wen Sound Company have succeeded, and during the last two years they have been oducing a Portland cement which satisfies every requirement.

Mr. C. H. Rust, Deputy City Engineer of Toronto, makes this statement con- rning 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 o. at Napanee mills, and by the Owen Sound Co. at Shallow Lake. Both these rands are quite equal to the majority of the imported cements, and no doubt, when eir facilities for manufacturing are increased nearly all the cement used in this city ill be of home manufacture."

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

The only other Portland cement works in the Province are at Marlbank in the ounty of Hastings. The site was chosen because of its nearness to a very large de- sit of marl; but although English capital was put into the business, and presumably nglish experience also, the enterprise had to pass through the usual ordeal of disap- intment 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 ot start until late in the season, and another worked only half the year. Had their pacity been six times as great they could hardly have supplied the quantity of Port- nd cement imported by Canada during the fiscal year 1892-3, and obviously there- re there is ample room for home manufacture to grow. With raw material so abun- ant and accessible, and with capital seeking new channels of investment, and labor eking employment, why should we not produce in the country all the Portland ement that our market requires. An article of uniform quality will always be in quest by customers, and with care on the part of the manufacturer there is no reason hy he should not be successful in supplying a distinct brand. But as long as we are ependent on foreign makers we cannot hope to be supplied with cement of uniform uality, for where large orders have to be filled it is the common practice even of large ill owners to buy lots from other manufacturers and so make a prompt shipment. he result is that there are as many brands as makers, and with cements of different ualities, some quick setting and some slow setting, it is hardly possible to make a rst-rate concrete. This is a risk which may easily be avoided if orders are placed at ome, with the home manufacturer, and the good results obtained from our Ontario ements are no doubt due to the fact that orders are honestly made up, each manufac- urer being jealous of his own reputation.

As regards the products of clay, it is not necessary that much should be said. aking the various articles of common and pressed bricks, terra cotta, tile, sewer pipe, nd pottery, the number of men employed in their manufacture in Ontario last year as 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 ame year. This fact alone suffices to prove the importance of our clay industries; et it is obvious that they are capable of greater development. The manufacture of ressed brick and terra cotta began here only five years ago, and last year, in spite of he 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 improvement 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. PRITTIE 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 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.

Dr. A. P. COLEMAN—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 have 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 an admirably equipped 5-stamp mill at work actually turning out bricks of gold at the present time. The mill, though small, is very 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, bnt 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 Wiggins, 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-okan 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 acompliment, 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 euthusiastic 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 dovelopment of the industry, but what ever 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. T. 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. NICHOL, 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.

Nickel Steel—In the course of a paper lately read, on "Nickel," before the Society of Arts, London, the author, Mr. A. G. Charleton, A.R.S.A., mentioned that it was not till 1779 that it was recognised as a metal. The growth of production and of consumption have been slow, but of recent years its uses as an alloy have attracted the attention of metallurgists, and as a result of experiments many important adaptations have been discovered. Mr. Charleton states that whilst 1,000 tons of nickel flooded the market in the early years of the century, 10,307,375 lb., or, roughly, five times as much, was produced in 1891, consequently the large excess of metal produced must have gone into nickel steel, yet this alloy has scarcely begun to be used in the arts of peace. As its price tends steadily downwards, he confidently expects that it will eventually enter into competition with other materials for other purposes than armour plates and guns. The ordinary carbon steel used for steel propeller purposes, has a tensile strength varying from 60,000 lb. to 65,000 lb. per square inch, whereas the nickel steel shows a tensile strength of 90,000 lb. per square inch, the elongation in both cases being about the same, 20 per cent. Use of this stronger steel will warrant boring ont the shaft, materially lessening the weight whilst preserving its efficiency, and such cored shafting can be hollow forged when the hole islarge enough to admit a mandril. If it is found possible to apply it to the constructi on of boilers the tensile strength of nickel steel being 1½ times that of ordinary steel, it will enable their thickness to be reduced one-third, effecting a saving in weight, which is a great consideration.

Gold Ore Treatment in South Africa.

(Abstract of paper by Mr. H. De Mosenthal on "The Treatment of Gold Ore at the Witwatersrand Gold Fields," read before the Chemical Society, London.)

The Witwatersrand gold fields are situated on one of the highest points of the South African plateau, some parts of the main reef being 5,000 feet above sea level. It is worthy of note that on this account air compressors have to be made some 25 per cent. larger than they would need to be on the coast. Johannesburg, which is only about six years old, now contains some 30,000 white inhabitants, whilst the mines employ 21,000 native laborers. It is only the discovery of coal in close proximity to the gold fields that has made the present great development of these latter possible. The cost of transport of fuel is, however, still high, owing largely to the refusal of the local railways to carry coal in bulk. It now costs about 22s. per ton delivered at the gold mines. It only yields a very inferior coke, so that this article has to be imported for assaying and smelting, imported English coke being worth about £14 per ton.

The ore is different from any known elsewhere; it consists of pebbles of quartz held together by a siliceous cement, which contains in the lowest levels crystals of iron pyrites. At the surface the pyrites was oxidised and the ore was more friable, but the greater the depth attained the higher the percentage of pyrites appears to be. The gold is contained in the cementing material; it is so fine as to be scarcely ever visible to the eye, and much of it is combined with sulphides of the base metals, which latter are known as "sulphurets."

The ore when mined is hoisted up by means of head gears, which are seen dotted in all directions over the area covered by the gold fields. They are of two types. The first is a simple head gear, which delivers the ore into trucks, which are then run into the mill-building where the ore is dumped on to a "grizzly" made of bars of iron, and then passes into a rock breaker, from which it falls broken into a hopper to go to the stamp mill. As the country is very flat, and the mills are often some distance from the mines, it was found more economical not to have the rock-breaker in the mill building, but rather to place it on the head gear, and most modern head gears are so constructed. Rock-breakers are either of the well-known Blake or of the Gates' or Comet type. In these the ore is broken down to about 2 in. cube.

The mills are of the usual California pattern, with self-feeders. Their weight used to be 850 to 900 lbs., and they used to have a 9 in. drop. The most modern mills have 1,200 lb. stamps, and are worked with an 8 in. drop; some of these modern mills run as fast as 92 drops per minute. In consequence of having such powerful mills, the best are able to crush 4½ to 5 tons per 24 hours per head, through a 900 mesh screen. The average for the entire gold fields for the month of December last was 3·7 tons crushed per head per 24 hours.

The batteries have amalgamated copper plates inside them, and the crushed ore is discharged on to copper tables 12 ft. long and 6 ft. wide, these tables being amalgamated so as to catch the gold. It is found that most of the gold is caught inside the battery, and on the first 3 ft. of the ouside copper plates. The amount of gold caught on the plates is 55 to 60 per cent., an amount which compares unfavorably with many other plates where the percentage is said to be 80 to 90. The amalgam is collected, and is cleaned in pans, and then heated in retorts, when the mercury is driven off and recondensed; the spongy gold so obtained is then melted. The loss of mercury in the entire treatment is about ¾ oz. per ton of ore; at the Robinson mine it is 0·65 oz. The melted gold is usually 800 to 825 fine. It contains silver, lead, copper, and other base metals.

After the pulp has passed over the plates it is run into concentrators, which extract the sulphurets. There are various kinds of concentrators used, but the Frue vanner is the most popular. The percentage of concentrates obtained is about 3, and these sulphurets assay from 5 oz. to 8 oz. of gold to the ton. Most of the mines sell their concentrates to one of the two combination works on these goldfields, the price given being 90 per cent. of the assay value, less £4 per ton. In the chlorination process 95 per cent. of the gold contents of the ore is extracted. This process, is however, only suitable for rich material; it is not, like the cyanide process, suitable for poor grade stuff, such as are the tailings.

The concentrates are roasted in reverberatory furnaces, this being the most important part of the whole operation. The roasted stuff is then damped till it contains 6 per cent. of moisture, and charged into vats furnished with covers fitting gas tight. Chlorine gas is then passed upwards through the roasted ore: this combines with the gold, forming soluble chloride of gold, which is then washed out, the solution being filtered off and the gold precipitated from the solution by means of sulphate of iron, which is made on the spot. The process is costly, owing to the high price of sulphuric acid, which costs £25 per ton. The consumption of acid is 300 to 400 tons per annum.

After the pulp leaves the concentrators it is run into dams, where the tailings are allowed to settle. These tailings constitute about 60 per cent. of the ore, the remaining 40 per cent. forming the slimes, which are run to waste and are totally lost. The tailings contain 4 dwt. to 7 dwt. of gold to the ton, and the slimes 4 dwt. to 5 dwt. The tailings are charged by hand into huge vats, the largest holding 400 tons. Then a solution of cyanide of potassium is allowed to flow through them. Some mines employ a system of repeated percolations of this solution, whilst others object to it. A strong and a weak solution are employed, the first cantaining from 0.6 to 0.3 per cent., and the second from 0.3 to 0.1 per cent. of cyanide. The whole tendency recently is to work with very weak solutions. Each solution is allowed to act from between 12 and 18 hours, and is then run off into zinc boxes, where the gold is thrown down by means of zinc shavings. Theoretically, 100 oz. of gold should be dissolved by 4.3 lbs. of cyanide, but in practice 300 lbs. of cyanide are required. Some mines consume as much as 2 lbs. of potassic cyanide for each ton of ore treated. The zinc precipitates the gold from the solution, forming a mass of so-called zinc residues, which contains a very great deal of zinc and other impurities. The zinc residues are calcined, and then melted with a mixture of carbonate of soda, borax, and fluorspar, when gold is obtained 720 to 750 fine, the principal impurity being lead. There appears to be no difficulty in refining this gold, which is very brittle. The average extraction of gold by the above process in 1893 was 14 dwt. per ton, the assay value being about 15 dwt. 8 gr. per ton.

John G. McGuigan, one of the owners of the Noble Five group, in Slocan district, was in Nelson the other day. He says there are 8½ feet of ore in the breast of No. 2 tunnel in the World's Fair, and that the mines never looked better than at the present. Three tunnels were started on the Bonanza King, two of which are now in the World's Fair. No. 1 tunnel is in 200, and an uprise made from it to the surface. No. 2 tunnel is in 310 feet, and an uprise connects it with No. 1 tunnel, near the mouth of the latter. At 98 feet a level was run from the uprise a disance of 102 feet. This level is connected with No. 1 tunnel by a winze. No. 3 is in 300 feet. On the World's Fair a tunnel is in 75 feet, There is ore in the breasts of all the tunnels except No. 1. A thousand tons will be shipped this season, part of which is now being sacked.—*Tribune.*

On Cage Conductors in Shafts.

By Mr. T. C. Hair.

(South Wales Institute of Engineers.)

In introducing this subject it would perhaps not be out of place to take a brief survey of the commencement of the system of tubs, cages and guides.

The writer is indebted to Mr. Robert Simpson, of Ryton-on-Tyne, for the plans and particulars of the first tubs, cages, and guides, that were used for coal winding. That gentleman, as an assistant of the late Mr. T. Y. Hall, was immediately connected with the introduction of this system.

To Mr. Hall is due the credit of introducing it. It would be superfluous at the present day for the writer to attempt to describe the great advantages that have followed upon this change of system.

The following extract from the *Mining Journal* of September and October, 1858, will place the position of affairs previous to Mr. Hall's improvements, clearly before the members of the Institute:—

"In the whole history of mining industry there is no chapter more interesting than that unwritten one which relates to the introduction of the tub, cage, and guide-rod system.

"It is impossible to exaggerate the importance of the change which the adoption of that system wrought, not only upon the coal trade generally, but especially, and in a marked manner, upon those by whose industry that trade has flourished and become great. For the first time since the invention of the Davy lamp, science was brought to bear powerfully and successfully upon the means of preserving life and limb; and that which was considered an unenviable, because a most dangerous, occupation, was rendered more tolerable because infinitely less hazardous. A brief description of the state of things which existed prior to the change is necessary to a full comprehension of the benefits derived from its adoption. Within the recollection of the then youngest mining engineer, the produce of the pit was brought to the surface in what was called a corf, or corve. These corves, composed of wickerwork, in the shape of huge baskets, varied considerably in size and appearance in different localities. Originally constructed to hold about ten pecks of coal, equal to about three cwts., they had for some time previous to their abandonment attained much larger dimensions, and were generally capable of holding sixteen or twenty pecks, equal to five or six cwts. of coal, the size being regulated in a great measure by the height of seam and by the strength and lifting power of the machinery employed to raise them to the surface. Much breakage was occasioned in the journey through the mine, but in the ascent of the shaft, the corf, in swinging to and fro, frequently struck so violently against the side as to shatter its contents until they were small and almost useless. (See Fig. 1, Plate 26.)

"Arrived at the surface, the spring hook by which the corf was attached to the rope had to be removed and an empty corf substituted; and as during this operation the engine did not stop, the rope had sometimes begun to descend again before the empty corf could be affixed, and there was no alternative but to fling the corf in also, which, accordingly, went crashing and smashing down the pit to certain destruction of property to a very large amount annually.

"In addition to these inconveniences, the ascending and descending corves frequently came into collision, and sometimes the corf which was on its way to the pit's mouth would bring up that which should have descended, occasioning much trouble and confusion.

"The means by which the miner descended to and ascended from his labour, was of the most primitive and dangerous description. The rope, with its terminal chain, to which the corves were attached, formed the sole vehicle of his transit. To this he must cling, and run the risk of being severely bruised against the sides of the shaft, besides enduring the pain which the chain produced upon the legs and hands.

"The general practice in proceeding to or leaving the shaft bottom was for two men to sit, each with a leg in a loop of the chain; and frequently five or six boys would cling to the rope, one above another, trusting their lives to their capability of holding fast while the rope traversed a distance of 1,600 or even 1,800 feet.

"Remedies for all these inconveniences had been the subject of much study among professional men, but no very satisfactory plan had been devised. About the year 1825 or 1826, Mr. Thomas Easton, of Hebburn Colliery, brought into operation an improved plan of conveying the coals from the workings to the bottom of the shaft by placing the corves upon bogie wheel trams; but the difficulty of keeping the baskets upon the trams, and the objections of the boys employed as putters to continue their employment, compelled him, after a short trial, to fall back upon the old arrangement.

"A little earlier, a very imperfect plan of raising the coals by means of 'skips,' and a kind of conducting rod, was introduced by Mr. Curr, of Sheffield, and partially adopted in some of the Yorkshire and Derbyshire collieries, where the pits are of little depth; and several eminent engineers from the North of England, accompanied by the Rev. John Hodgson, of Heworth, compiler of the 'History of Northumberland,' visited a few of the mines for the purpose of ascertaining the applicability of the plan to pits in their own locality. Their impression was favorable, though it could not be satisfactorily adopted in the great northern coal field, where the thinness of the seams required shafts to be of an extraordinary depth, and the large demand for coal for exportation rendered it necessary to raise such enormous supplies.

"From this it may be inferred that the new plan was slow in its operation.

"In 1833, Mr. Hall, when at South Hetton colliery, introduced the tub system of drawing coals, which consisted of a number of tubs of oblong shape, mounted on wheels. The tubs being made low compared with corves, admitted of being filled with greater ease and quicker despatch. The contents of four of these were emptied at the bottom of the shaft into a large round iron tub, constructed to hold 1¼ ton of coal, which was drawn to bank and struck on to a tram to convey it to the screens. A division for each tub in the shaft was cleaded round slightly larger than the size of the tub, so as to enclose it, thus using the whole surface as a guide, thereby rendering guides in this case unnecessary, without having any guides fixed to the shaft or shoes on the tubs. This plan of guiding the iron tubs was used in the first cages adopted by Mr. Hall, at South Hetton, in December, 1834." (See Fig. 2, Plate 26.)

The next improvement by Mr. Hall was of great importance, viz.: the introduction of conductors or guides and shoes fixed to the cages. So strong was the adverse opinion and prejudice against the adoption of such a great change as the introduction of cages, which in those days caused considerable delay in changing at bank (keps or fans not then having been invented), that on the occasion of Mr. Hall leaving South Hetton, the iron tub system was again introduced, and the cage laid aside; but the advantages of the cage and tub system soon became so apparent that they were quickly resumed. The advantages of this system were so manifest by what had been done at South Hetton colliery, that Mr. Hall, without delay, next introduced it in a more complete form, viz.: cages fitted up with shoes running on wood conductors fixed in the shaft, as seen in Fig. 3, Plate 27, at Woodside Pit, Townley Main, and Whitfield, collieries belonging to the Stella Coal Company.

CAGE CONDUCTORS.

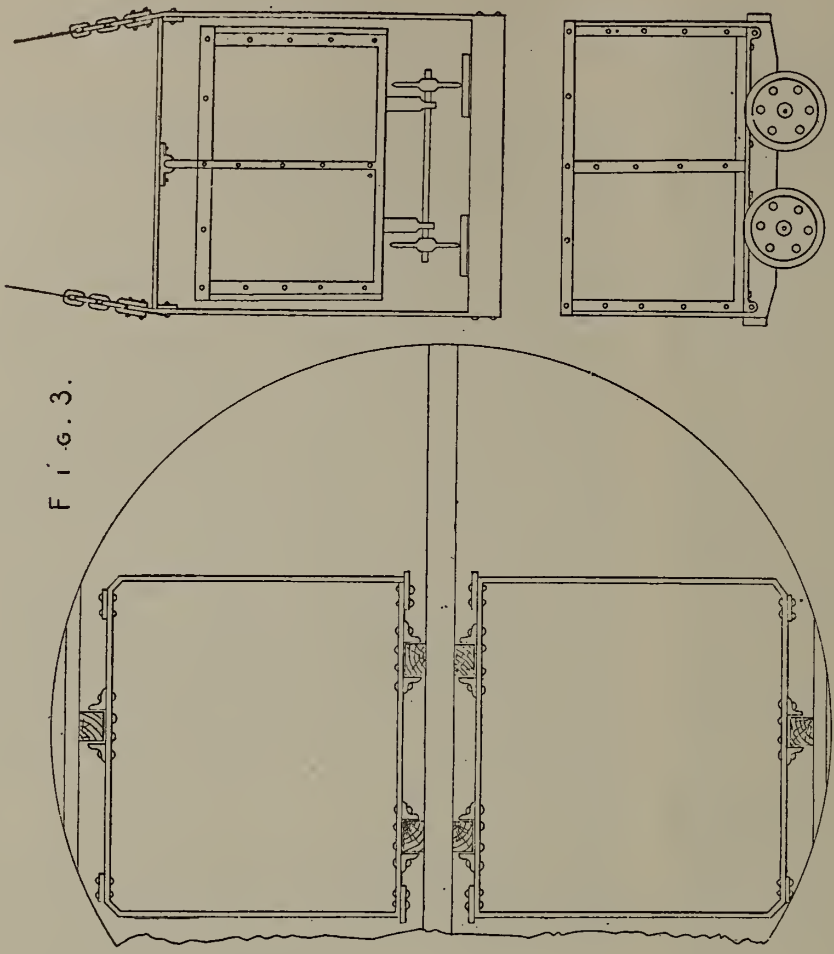


FIG. 3.

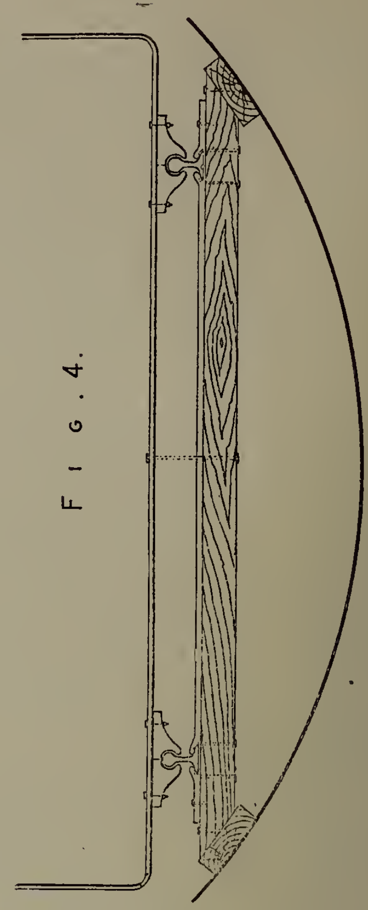


FIG. 4.

CAGE CONDUCTORS.

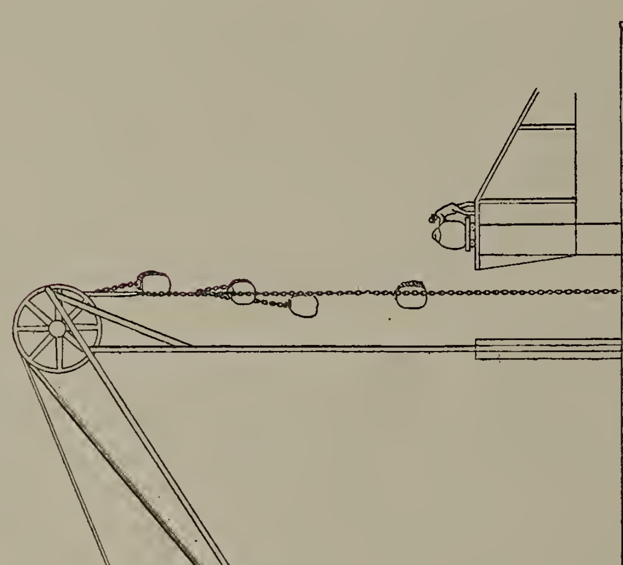


FIG. 1.

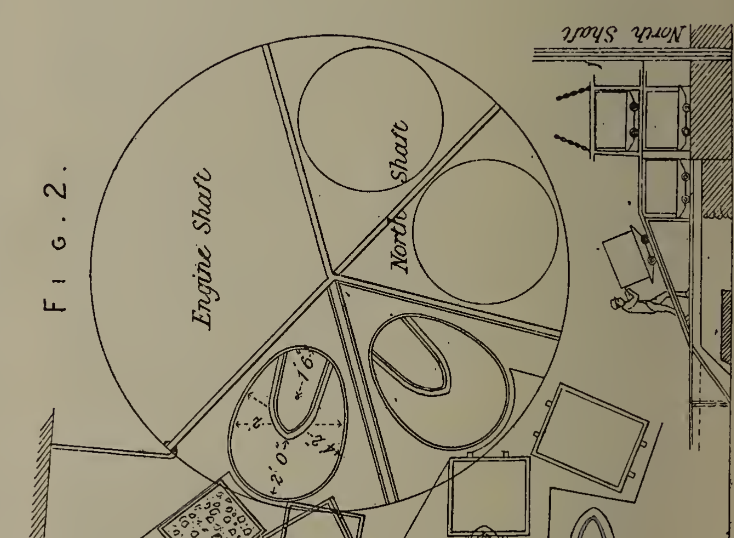


FIG. 2.

In this case he gave most powerful proofs of the practical utility of his innovations, as some termed them at that day, in more than doubling the quantity of coal drawn from the pit. Here, with an engine of only 20 horse power, he drew from one pit, 65 fathoms deep, 100,000 tons of coal per annum, being more than double the quantity previously drawn by the old system. This increased quantity was not only due to rapidity in winding through the guide system, but also to the improvement in changing tubs at bank by the introduction of keps or fans.

The advantages of the numerous improvements originated and carried into practice in the adoption of Mr. Hall's new system of winding soon became publicly acknowledged by the adoption of it by one colliery after another, until it became the acknowledged system in the coal trade, and to Mr. Hall is due the honour of producing one of the most beneficial revolutions in the system of winding coals that has ever been introduced into colliery operations, not only in the interests of the employer, but in the interest and safety of the employed.

Having thus referred to the practice and conditions under which the winding of coal was effected up to a comparatively recent time, it will be readily understood that it is beyond the compass of a single paper to do justice to the various systems of fixing pit cage guides. The diagrams will show the progressive stages that have taken place since their adoption in the year 1833.

Fig. 1, Plate 26, shows the system in use before cage guides were adopted.

Fig. 2, Plate 26, the tub used as a cage and guided by the sides of the shaft, used at South Hetton. Year 1833.

Fig. 3, Plate 27, the first cages fitted up with shoes and wood conductors in the shaft, at Woodside Pit, Townley Main, and the Whitfield collieries, belonging to the Stella Coal Company. Year 1835.

In the year 1854, Mr. Hedley first used iron rail guides for cage conductors at Kelloe colliery, in the County of Durham, and in 1859 wood guides, faced with iron, were tried at Thornley and Thresiltone collieries, which led Mr. Johnstone, of Seghill, to the idea of trying rail guides.

After that date rails were used at several collieries, and shortly after came into general use in the Northumberland and Durham coal field.

Fig. 4, Plate 27, is a fair sample of rail guides as adopted with cast iron chair sleepers, at Cowpen, Backworth, and other collieries.

Fig. 5, Plate 28, shows the single chair made of wrought iron with rebated rail joint, at Lambton colliery, Durham.

Fig. 6, Plate 28, shows the chair sleeper made out of rolled wrought iron having two recesses planed out ¼-inch deep to receive the rails. This forms a good and cheap chair, and may be used with advantage where the load is not very heavy. Used at Kimblesworth colliery.

Fig. 7, Plate 28, is a forged iron chair sleeper with four recesses planed out to receive two sets of guide rails, as used at Harris's Navigation colliery. This plan, in the writer's opinion, seems to be the most complete of any yet adopted that he has been able to obtain information of, for deep and quick winding with heavy loads. It provides for a spare set of guides, which, with a proper adaptation of gauges and shoes, can be made to assist and strengthen those in use.

Fig. 8, Plate 29, shows a narrow gauge of road of only 18 inches for the rail guides, fixed only on one side of the cage, used at Elswick colliery, and by comparison with the other examples it will be seen how the gauge varies in different places to suit the special circumstances of each case.

Fig. 9, Plate 29, gives the channel iron guide applied to the opposite ends of the cage at Ryhope colliery, and which with a few modifications has been introduced in other places both in the North of England and South Wales. In one of the pits at Ryhope the channel iron guides run into sidings at the meetings 1 foot out of plumb, and in another case run into sidings at meetings 2 feet out of plumb.

Fig. 10, Plate 30, shows a section of guide rail and shoe used at the Avon colliery, Abergwynfi, and which, in the writer's opinion, makes a very suitable, secure, and durable conductor.

Fig. 11, Plate 30, shows the wire rope-guides used in the Clydach Vale colliery, and exhibits a fair sample of this class of guide, and also the practice of using intermediate wire rope guides between the cages.

Fig. 12, Plate 30, shows the wood guides at the Wearmouth colliery, B pit, which have been in use for twenty years, and are still in good condition; they also run into sidings at the meetings, 3 feet out of plumb, and at the point where the cages pass each other the space between them is 4 inches, and the clearance from the corner of the cage to the side of the shaft is from 1 to 3 inches.

The A pit shaft at the Wearmouth colliery is fitted with wire rope guides, giving a distance at meetings of 14 inches, and the nearest point at the corners of the cage is only 1 inch from the side of the shaft. As might be expected, the corners of the cage rub against the side of the shaft, notwithstanding that a load of 11½ tons is raised from a depth of 600 yards. Although not desirable to run cages in wire rope guides so near the sides of the shaft, this affords a striking instance of what may be done.

Fig. 13, Plate 31, shows a class of girder which when put in the middle of the shaft makes a strong, secure girder, but it failed to secure the guide rails, which were only fixed on with bolts and side clips. The present tendency is to adopt iron girders for carrying the guides, but the writer's experience leads him to the conclusion that they are inferior to the recessed chair sleeper, as in the iron girder all depended on the bolts, but in the chair sleeper the solid recess secures the guides against transverse side strain, as well as keeping them in correct gauge. Of course the chair sleeper could be bolted to an iron girder as well as to an oak byat. If iron girders could be made of suitable size, and recessed properly to receive the rails, at a reasonable cost, then they would be equal to the recessed chair sleeper on oak byats, but even then the writer fails to see any advantage they would have over the latter.

The system of securing the joints by a fishplate on the back of the rail is in some cases adopted, and the joints are made between the byats and not on the byat; where this is done, and screw clip bolts or dogs similar to railway fastenings used to secure the rails to the byats, it is evident the whole weight of the guide rails rests on the bottom, with the only other holding assistance of the grip of the dog clip. This, it will be readily seen, makes it more difficult to renew or change the rails in the shaft. In those systems where the rails are held secure in their position by their own fastenings, they were more easily dealt with for repairs.

It has been stated in former discussions (in other places) on cage conductors, that very little power is required to retain the cage in position when in motion. It may be so, but the exact amount of force necessary for this purpose has not yet been satisfactorily demonstrated by experiment. All practical colliery officials, however, know that if sufficient and secure fastenings are not adopted for the conductors there is a considerable amount of trouble and annoyance in maintaining them in working order.

RAILS.

In the use of iron and steel rails for pit cage guides one deficiency is very apparent, viz., the section of the ordinary F. B. rails, which, although suiting the purpose, might be greatly improved upon; the drawback to this being the cost of altering or preparing the rolls for so small a quantity as would be required for one shaft, users not having agreed on a uniform suitable section. This being the case, the selection has to be made from the sections of rails designed for another purpose, and the railway sections are all that can be obtained, causing a heavier rail to be used than is actually necessary. As an illustration of this see sections of rails Figs. 14, 15 and 16, Plate 31, which have been in use. The black or outer lines show the size of rail when new and put to use, and the dotted lines show the section of the rails after having worked (Fig. 14) 6 years, (Fig. 15) 12 years, and (Fig. 16) 6½ years. It will be seen that the flange at A is the same in both the new rail and the old worn rail, but at B the amount of wear is shown by the dotted lines. The simple deduction from these facts is that more wearing surface is required at B to have rails to last longer and do more work, and this can only be obtained by having suitable rolls for making the rails as required.

With regard to the various rail sections used as guides, it is interesting to note the weight per yard used for guiding the loads to be raised. In some instances the proportions are as follows:—

RAIL GUIDE SECTIONS.

Weight per Yard of Rail Guide.	Weight of Load.	Guide Rail, Weight per Yard per Ton of Load.
Lbs.	Tons.	Lbs.
42	3	14·00
46	7½	6 01
80	12	6·66
72	20	3·60

WEARING SURFACE.

Wearing Surface.	Weight of Load.	Wearing Surface per Ton of Load.
Inches.	Tons.	Inches.
Wood Guides, 11	6	1·83
Channel Iron, 10	12	0·833
Rail Guides, 8	12	0·666
9	20	0·45
7	5	1·40

DURATION OF GUIDES.

Some of the wood guides in Killingworth Colliery, Northumberland, were in use for 40 years, especially the guides in the lower portion of the shaft, where they were wet. The upper portion of the same shaft, where the guides were dry, had to be renewed. At the present time there are wood guides that have been in use for 35 years at Bebside colliery, Northumberland, the depth of the pit being 200 yards, and load, 6 tons, and they are still in good condition.

At Cambois colliery, Northumberland, rail guides have been in use for 26 years, and are still in good condition. The depth of the pit is 220 yards, the load 7½ tons, and the weight of the rail guide 46 lbs. per yard.

At Abergwynfi the rail guides have worked for nine years, and are still in good condition. The depth of the pit is 502 yards, the load 12 tons, and the weight of rail guide 80 lbs. per yard.

At Merthyr Vale colliery, in the upcast shaft, the guides wore out in six years, the depth of the shaft being 500 yards and the load 11 tons. Section of rail used is shown in Fig. 16, Plate 31.

At Harris's Navigation colliery in the upcast shaft, the guides wore out in six years, the depth of the shaft being 735 yards and the load 14 tons. The section of rail used is shown at Fig. 14, Plate 31.

In the downcast shaft, 700 yards deep, with a load of 20 tons, the section of rail guide, Fig. 15, Plate 31, worked ten years.

These facts go to show that light loads, shallow pits, and downcast shafts are very much more favorable for the working life of guides than upcast shafts in deep pits with heavy loads.

The section of rail for a suitable guide, in the writer's opinion, should give sufficient strength to resist the vibration of the cage and ropes, and have a size of flange for properly fixing them to the byats, depth of web to allow ample room for the shoes, and size in the head to allow a thorough grip of the shoe on it, and should also have an ample substance for wear and tear. They are usually made of steel and in 27-foot lengths, and should be perfectly straight and cut quite square at the ends.

In the writer's opinion, the system of putting dowels into the ends of the rails is unnecessary, and does not give additional security to the joint; the most secure joint, and the one that seems to be the least objectionable, is shown in Fig. 21, Plate 31. At the parts marked A it will be noticed that the bolt heads are thoroughly locked in the recess of the chair sleeper, thus preventing them coming loose.

Sleepers, or chairs, with a recess in them to receive the rails, either made of cast or wrought iron, seem to be the most secure way yet adopted in which to fix the guides. Girders, or byats, either of H iron or channel iron, are much used, but as in ordinary girders there are no recesses, and the security of the guide depends entirely on the bolts, this is an objectionable feature.

Oak or pitch-pine byats, on which the chair sleeper can be bolted, give a much better fastening. (See Fig. 20, Plate 31.) It may be mentioned here that provision can be made in the chair sleeper for an extra set of rail guides, which can be put in when required for renewing the guides. This can be all done and completed without in any way interfering with or stopping the pit working, and the only thing necessary is to change the portion of the shoes on the cages to put the new guides in use. These extra guides can be fixed in such a position as to assist and strengthen the guides in use by allowing proper space for the back of the shoe to be slightly guided by the

CAGE CONDUCTORS

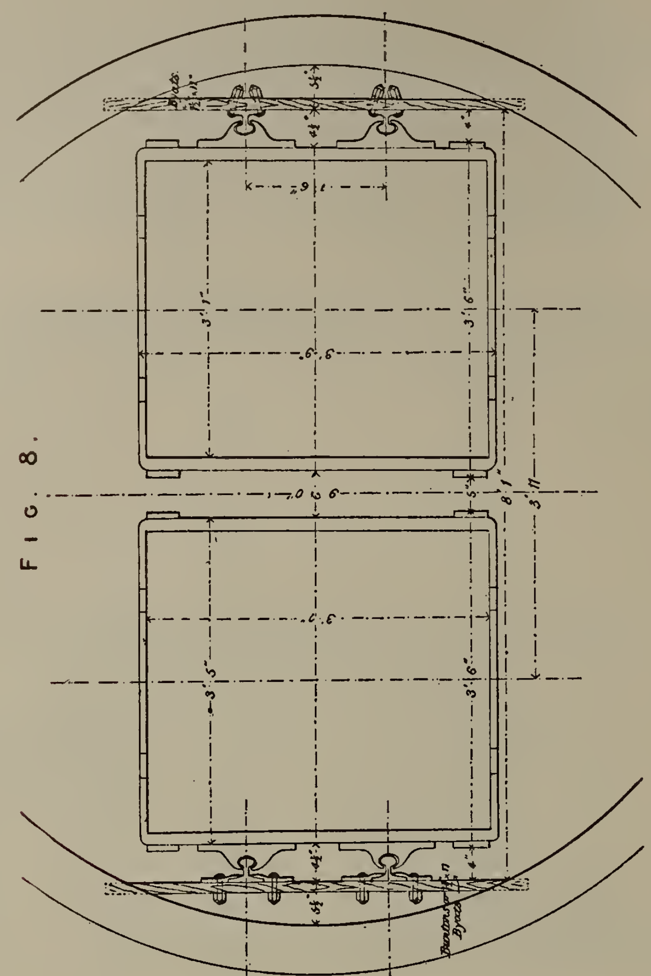


FIG. 8.

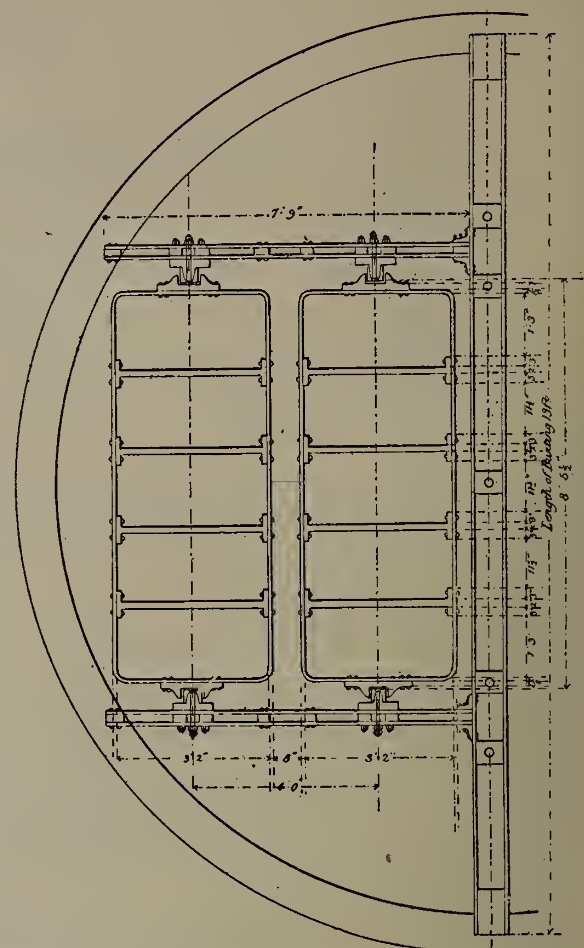


FIG. 9.

CAGE CONDUCTORS.

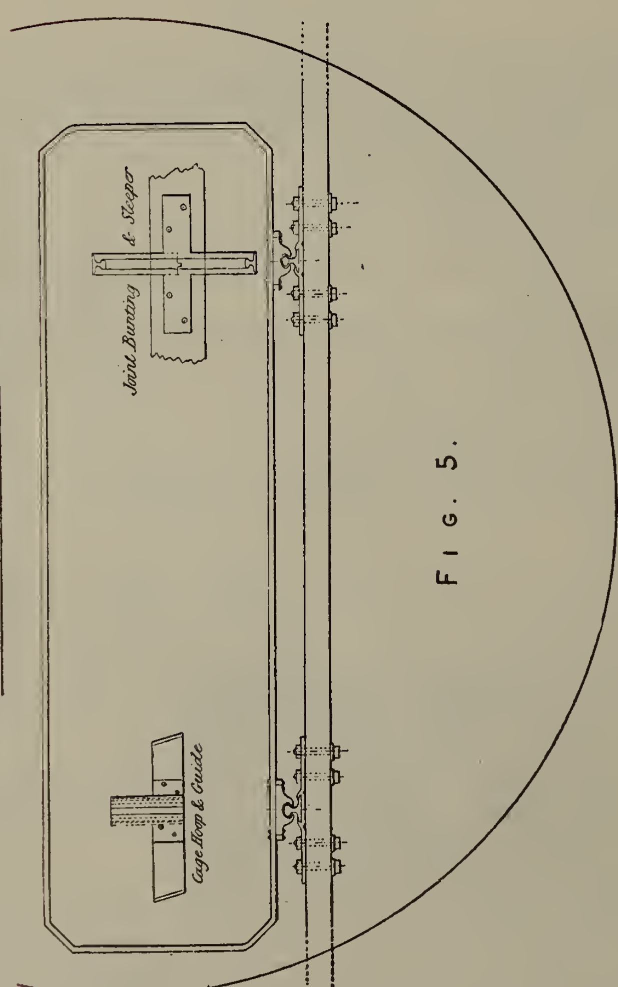


FIG. 5.

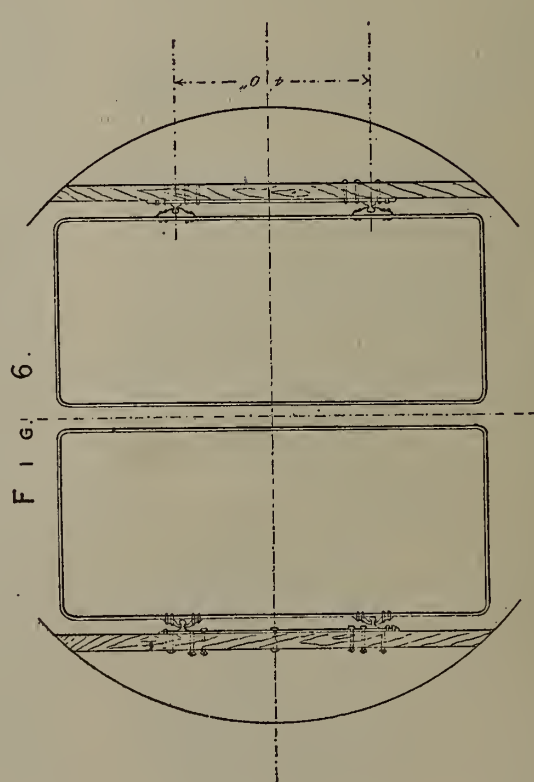


FIG. 6.

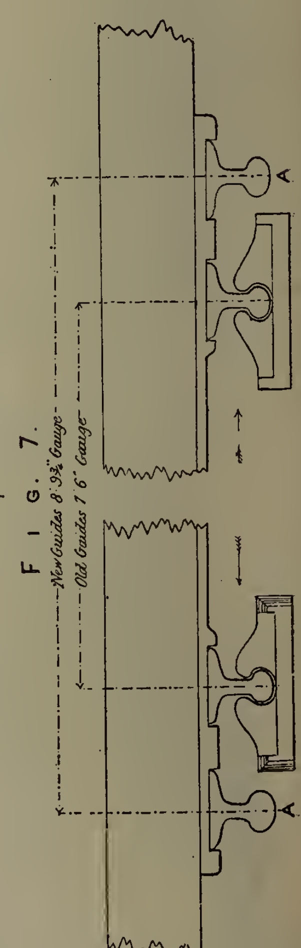


FIG. 7.

are guides. (See Fig. 7, Plate 28.) It is important that the sizes of the shoe and earance be carefully made to get them to work right.

Special conditions will determine in a large measure whether the byats should be ed either at the side of the shaft or in the middle of the shaft. Of course it will be adily seen that a byat in the middle of the shaft has advantages over the byats on the de of the shaft, and can more easily be secured.

LANDINGS.

In fixing main girders, buntons, or byats for surface landings, it is desirable that ey should be a sufficient distance from the cage, to allow the cage, or anything that ay happen to project over the cage, to pass without touching, or putting any undue rain on the cage. rope, cap or bridles. From $4\frac{1}{2}$ inches to 5 inches from the outde end of the cage to the nearest part of the girder in some cases works well. The am rails or sheets can be put $1\frac{1}{2}$ inch from the cage, as these do not offer much restance or give excessive strain should the cage come in contact with them. For other ndings in the shaft it is desirable to give even more allowance than this; 7 inches ill not be too much in some cases.

It will be seen from the table that considerably less guide area is required in the aft by wire rope guides than any other form of guide, and thus they are more favourle for ventilation.

EXPANSION.

It would appear that there are no acknowledged rules for allowing space at the ints for expansion, as in some cases the rails are put close to each other, and in hers $\frac{1}{16}$ inch, $\frac{1}{8}$ inch, and even $\frac{1}{4}$ inch space is allowed between the ends of the ils.

The proper allowance to be made for expansion will of course, depend on the riation of the temperature in the shaft. Assuming that the difference of temperae does not exceed 40° F. between the coldest day in winter and the hottest day in mmer, the expansion of steel from 32° to 212° F. for temperature raised, 1° F. = 00000636 per foot in length, thus making the expansion for each rail 27 feet long = 006868So.

The practice of allowing $\frac{1}{16}$ inch or $\frac{1}{8}$ inch is ample, and the writer's experience rees with this.

In upcast shafts where mechanical ventilation is used the same rule will hold od, but where the furnace is used it is very doubtful whether rail guides are suitable; ey have been tried and had to be taken out on account of the displacement of the ils by the expansion which took place.

SHOES.

Shoes are made of cast iron, steel, and wrought iron. Steel shoes seem to be the ost suitable and meet the requirements best, and they also last longer than the thers.

It is necessary to have the shoes properly fixed to the cage and in such a manner at they can be readily renewed, for defects in doing this will materially affect both e efficient working and the durability of the cage and guides. To ensure this being one properly, the shoes are fitted into a gauge, and all correctly drilled to the same emplate, so that any shoe will go on to any part of the cage and be a correct fit. imple as this is, it is very important, for when badly fitted, the shoes put extra fricon and strain on ropes, cages and guides, and therefore wear them out sooner.

It will appear from the information gleaned by experience that the most suitable uides for quick winding are iron or steel guides and wire rope guides. It is obvious at the special circumstances and conditions in each case must have considerable inuence in deciding on what is most suitable to adopt.

Wood guides, although they make an excellent conductor and have doubtless one good service, are being superseded by wire rope and iron or steel guides. There one feature in connection with them which is the same in reference to channel iron uides and wire rope guides, and that is, as a rule, where they are used it is necessary o have guides on the opposite sides or ends of the cage, and in the case of wood and hannel guides they require byats on opposite sides of the cage; whereas in the use of ail guides it is only necessary to use guides and byats on one side of the cage, thus eaving the pit more open and with less material in the shaft.

It would be presumptuous of any one to lay down a rule that any special class of uide should only be used, as it is evident the conditions in each case require careful onsideration before deciding what class of guide should be adopted and is suitable for e requirements. Different circumstances must be met and dealt with according to heir conditions.

It may not be out of place to suggest a few of the salient points worthy of conideration, such as space at meetings between the cages, and at the corner of the cage nd side of shaft; depth of pit, weight of load, speed of winding, and to avoid reversng guides at pit top and bottom; what effect water and upcast air will have on the uides, also whether there is any diplacement in the shaft from pressure or otherwise.

When the guides are out of plumb, or necessary to put them out of plumb for ant of space, and the depth is over 600 yards, rail guides seem to be preferable. The advantage of this class of guide under any of these conditions appears to be the grip of the shoe on the head of the rail to keep the cage better in the guides, and in cases of drawing water out of old shafts by cages or water tubs, the rail guide is superior to any other class of guide the writer has seen used for this purpose, the water tub or cage being best retained in its position while under water, and stops can be put on the bottom ends of the guides to prevent them going over the guide ends.

It is evident that where wire rope guides can be used to advantage, they can be put in at less first cost than either wood, channel iron, or rail guides; but one very necessary condition of their success is that they must be put in quite plumb, thus preventing vibration, which with the wire rope guides is a very objectionable feature; also proper precautions should be taken to prevent the possibility of their being "stripped" by the shoe of the cage taking hold of a stray wire. This occasionally is a source of danger with this type of guide. So far as the writer can ascertain, their life varies from two to ten years or even longer.

The transverse strain on the class of rail guides acts in the direction shown by the arrow on Fig. 20, Plate 31, and the only resistance to this strain is the security of the fastenings.

The same strain on the fastenings does not take place on either wood or iron channel guides, where they are fixed on opposite sides or ends of the cage.

Where the safety catch for cages is used, provision in strength of guide and fastenings is necessary to provide for any strain that may occur in case the catch comes into operation.

LUBRICATION.

The lubrication of cage guides is a matter that deserves some attention. The practice differs very much. In some cases it is not thought necessary, and no lubrication is used; in others oil, soft soap and water, and water alone are used. The writer has used liquid grease similar to tram grease, put into small boxes on top of the cage, with just a sufficient outlet to allow of the necessary quantity of grease to run on to the rails while the cage is in motion. These boxes are fitted with hinged lids, so that when the box is filled with grease the lid can be closed, and thus prevent dirt or other matter mixing with it; the application of the lid alone has in some cases made the difference of effective greasing. Before the lid was put on the greasing was very unsatisfactory, but afterwards it was all that could be desired. As an illustration of the necessity of some sort of lubrication being required, it can readily be imagined what would take place if the guide bars or other working parts of an engine were not lubricated. Although the illustration may be extreme, it points in the same direction both in pit cage guides and in engine guide bars.

How best to obtain a good, safe, and durable pit cage conductor, is worthy of careful consideration. This, it will appear, is more easily accomplished in shallow pits with light loads than in deep pits with heavy loads and quick winding; for depth, weight of load, and speed in winding are all important factors to take into consideration on this subject. And as future mining operations will tend to increased depths and weights to be raised, any addition to our limited stock of information and experience on these matters cannot be other than interesting to responsible persons connected with mining.

It would appear for depths up to 600 yards, with loads not exceeding 13 tons, and where no displacement in the sides of the shaft takes place, by pressure or otherwise, that wood, channel iron, and wire rope guides can be used to advantage; but over that depth, and for loads exceeding 13 tons, so far as experience indicated at present, it would seem that rail guides are the most suitable, and meet the requirements best.

It may be advanced that channel iron guides have many advantages over any other class of guide, such as more wearing surface, greater strength, and practically they can be used to any depth. This will be admitted by anyone who carefully considers the subject. The disadvantages appear to be, as they are fitted up at present, the narrow joint surface and the necessarily small number of countersunk bolts fixing them at the joints. But what seems a greater disadvantage as compared with rail guides under some conditions is, for instance, where displacement takes place in the sides of the shaft, with the channel iron guides at opposite ends or sides of the cage; and where this occurs the guides may be put out of position, so that the cage will come out of the guides altogether; or the displacement may take the opposite direction, and thus be thrust too near together, so that the cage will not pass down the pit, and therefore sticks in the shaft. This is not an imaginary case, for such occurrences have happened in the use of channel iron guides. But take the same circumstance and condition where rail guides are used with the chair sleeper. The chair sleeper maintains and keeps the guides in proper gauge, and in whatever manner they are thrust out of position to a certain extent the cage follows. Cases are known where the guides have been displaced as much as 14 inches out of their proper position, and not interfered with the working of the cage. Of course it is desirable and necessary to have them put back into position as soon as opportunity affords. It is an advantage where a system of guides will thus allow of the work to be carried on until this can be done.

The writer may here be allowed to introduce a quotation from Mr. Herbert W. Hughes' work on coal mining, giving a description of a French system; but as there is no data of the length of time they last, or the depth of pit, weight of load, or speed in winding, it is not so valuable as it otherwise would have been had this additional information been given.

Rollers are used on the rail guides, and a system of fixing the guides to a centre iron girder with "notches or recesses" in the flange is adopted, and by a simple pair of glands with only one bolt used to hold them in position. It is very interesting to observe the different designs used in fixing guides, and, in comparing the French system with the practice adopted in England and Wales, the system described by Mr. Hughes seems to be of a good temporary character, but only a temporary one. The novel application of the double glands with one bolt, to meet the difficulty of the rails being opposite each other, to a practical man seems only a temporary expedient.

"On the Continent the common system of fixing rail guides is that due to M. Al. Briart, which consists in dividing the shafts by a single series of buntons of H steel girders. . . . They are notched to receive the rails. To secure the rails to the buntons two steel glands are fixed, one on each side of the rails, which they firmly grip, a bolt passing from one gland to the other. To prevent any chance of movement a block of cast iron is placed between the rails, and is furnished with a slight projection, which lies in a corresponding groove rolled in the flange of the rail. At buntons where joints occur, two sets of these glands and blocks are fixed, one above and one below, but at intermediate buntons only one set at the top of the girders is used.

"With a view of reducing resistance, rolling has been substituted for sliding friction, and at Anzin Colliery, France, the guide shoe is composed of two wheels, one on each side of the rail guide, revolving on a pin bolted to the side of the cage."

The duty which cage conductors had to perform might now be appropriately considered. They were all aware that mineral products were brought to bank at a speed almost unknown a few years ago; but as this fact has a very important bearing on the cage and conductors, the annexed table, giving some of the working particulars of a few collieries, may be of interest. From this table it will be seen that the greatest maximum speed of the cage in the shaft appears to be attained in the Rosebridge Colliery, where it reaches 5,100 feet per minute—*i.e.*, equivalent to a little over 57 miles an hour—a speed which almost comes up to the fastest railway trains.

The average speed indicated in the table is given at 47.4 feet per second, or 32 miles per hour, which is generally admitted to be a safe working speed. In addition to these data, the table gives the average time occupied in landing to be only 26 seconds, and in one case as low as 15 seconds; whilst the average number of single cage up and down journeys is represented by 516 in a double shift of 24 hours, on the 1876 table. In the 1893 table this is increased. It is interesting to compare the loads dealt with before and when cage conductors were introduced. At that time 5 or 6 cwt. of coal in one corve and the cage with $1\frac{1}{4}$ ton were considered very large loads.

At the present time loads of coal of 4 and 5 tons or more, and a total load of from 10 to 20 tons, are not unusual. Having increased the speed and increased the load, it necessarily follows that additional strength of conductor is required to do the extra work.

Take, for instance, a cage on conductors at rest and without any motion; it is evident they would last in that position until their component parts naturally decayed by rusting away.

Again, take a cage on conductors and imagine it possible to put it into the highest possible motion (say lightning speed, as far as our limited ideas can grasp such a state of motion). Under these conditions we would expect, from our knowledge of the component parts of the cage and conductors, that they would be destroyed and rent asunder.

Now between these two extreme cases it is desirable that some reliable knowledge may be obtained from the practical experience of our daily work of what is the highest safe point of speed compatible with the strength of the materials and construction of colliery cages and conductors.

The following tables of speed indicate what was done in some collieries in the years 1876 and 1893:—

CAGE CONDUCTORS.

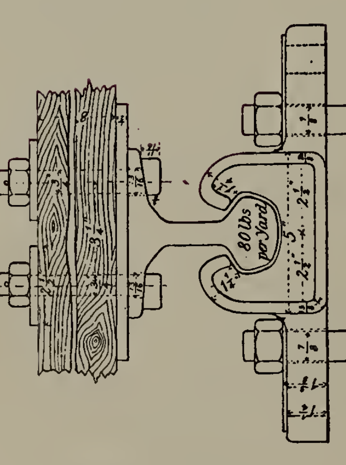


FIG. 10.

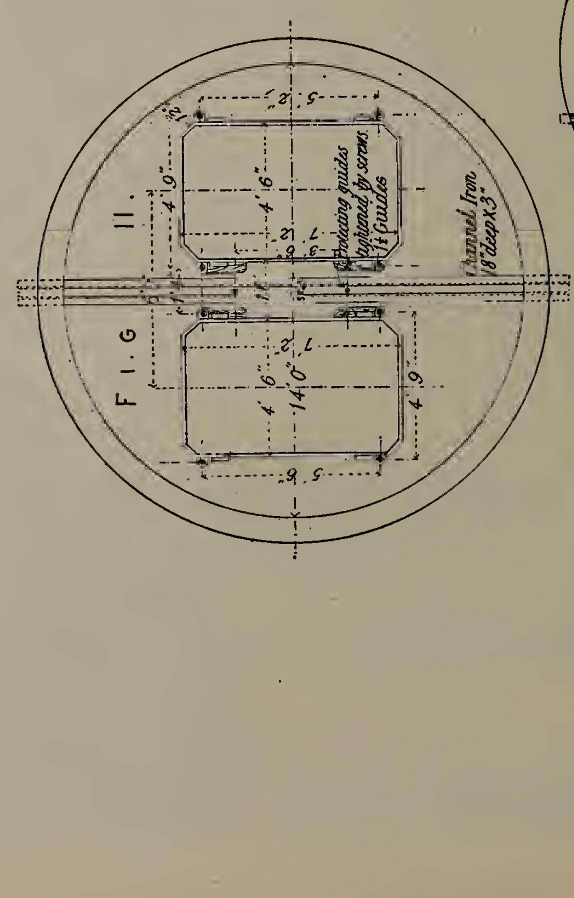
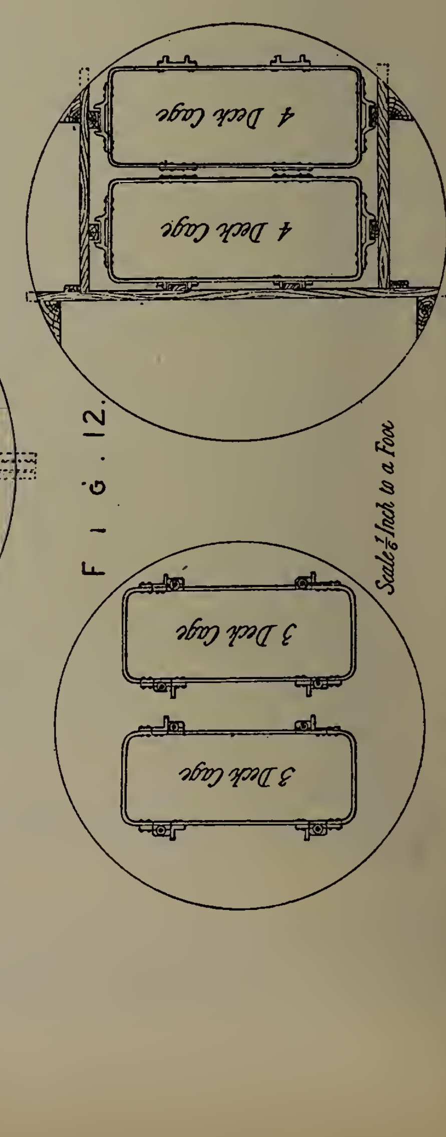


FIG. 11.



A. PIT. B. PIT.

FIG. 12.

CAGE CONDUCTORS.

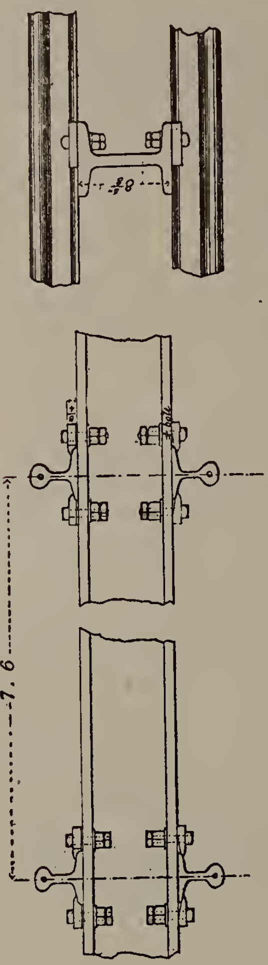


FIG. 13.

FIG. 14.

FIG. 15.

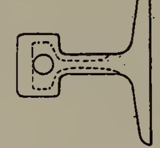


FIG. 16.

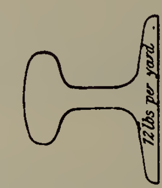


FIG. 17.

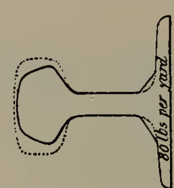


FIG. 18.

FIG. 19.

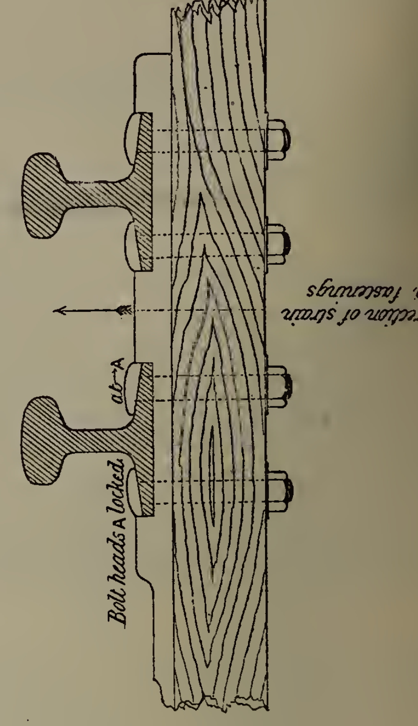


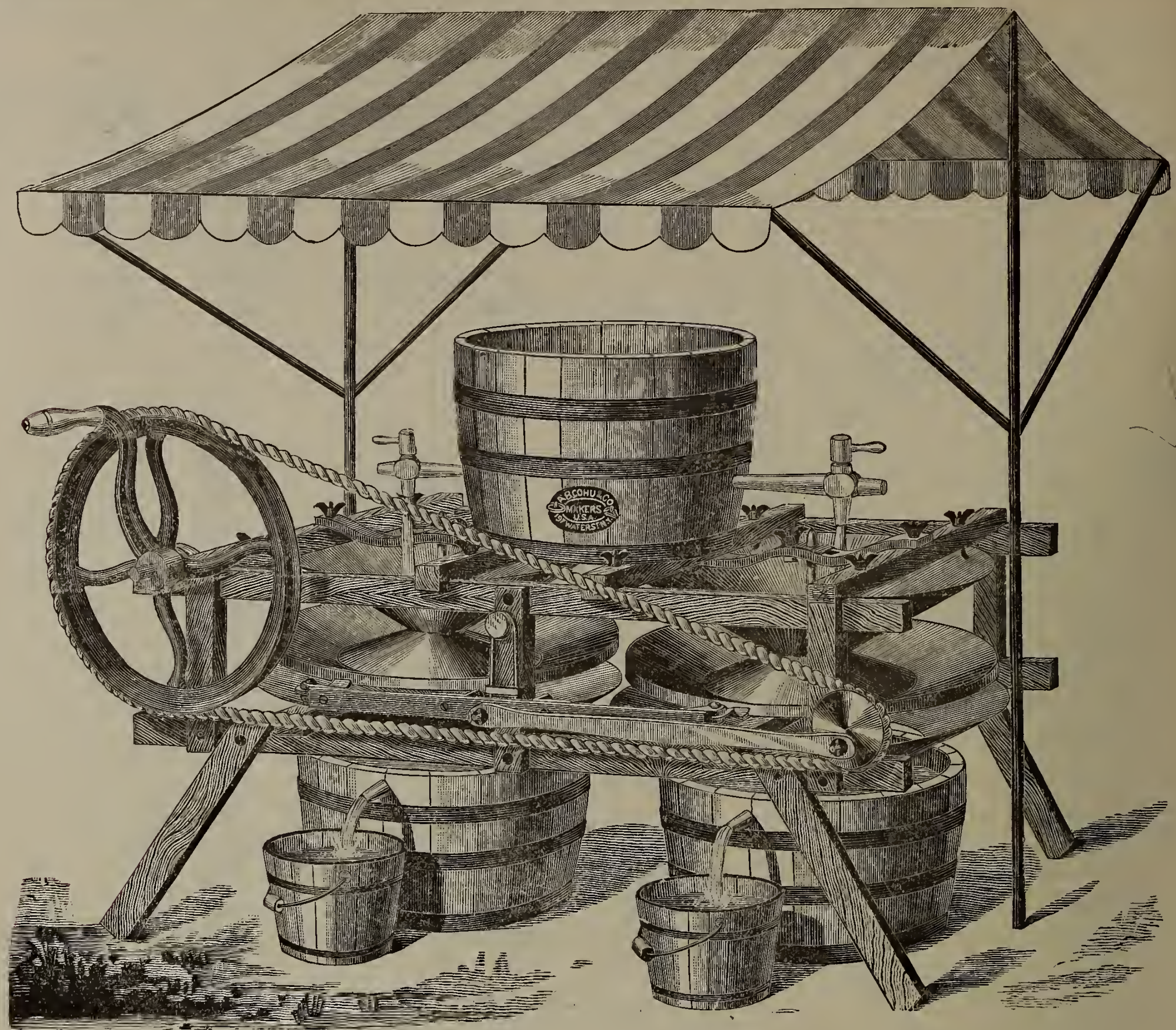
FIG. 20.

Coal Winding—Table of Cage Speed from North of England Colliery Engineers' Transactions, year 1876.

COLLIERY.	Weight of Cage.	Weight of Load.	Mean Cage Speed in Shaft.	Maximum Cage Speed in Shaft.	Depth of Pit.	Time Occupied in Running.	Time Occupied in Landing.
Year 1876.	Cwt.	Cwt.	Feet per Minute.	Feet per Minute.	Feet.	Seconds.	Seconds.
..sworth	60	80	2,180	3,560	1,620	44	40
..rton	50	..	1,020	......	1,278	75	30
..don	40	..	1,689	2,788	1,548	55	..
..armouth	42	110	1,180	......	1,770	90	20
..worth	22⅓	..	1,300	1,706	966	45	..
..naby	48	..	1,691	3,080	1,351	47	21
..uglas Bank	20	..	1,765	3,100	1,530	52	25
..sebridge	22	..	2,590	5,100	2,418	56	25
..ughton-le-Spring (upcast shaft)	35	55	1,278	1,750	745	35	35
..wdenhill, No. 1	25½	..	1,320	......	666	30	30
..cknall	30	..	1,652	......	1,239	45	25
..erton Park	20	..	1,624	......	1,218	45	15
..dick	9½	..	821	1,500	684	50	..
..hope	27	193	1,080	......	1,524	85	22
..worth	21	54½	1,306	1,882	1,002	46	50
Year 1893.	Cage.	Trams and Coal.					
..rris Navigation, South Wales	120	152	2,100	4,600	2,100	60	15
Cage Bridles and Rope from the Pulley to Cage at Pit bottom	..	128	......	......	....	..	..
Cage	..	120	......	......	......	..	..
Total	..	400	......	......	......	..	..

Table—Coal Winding, 1893.

Name of Colliery.	Diameter of Shaft.	No. of wood guides on cage ends.	No. of steel or iron guides on one side only	Lifetime of Guides	Depth of Pit	Distance of Byats apart	Highest speed of winding per minute	Time changing Trams at top and bottom	Clearance of Cages at meetings	Clearance of Cage from side of Shaft.	Allowance for expansion of Rails at joints	Total Weight of Load, including rope	Size of Joint Byats	Size of Intermediate Byats	Weight of Steel and Iron Guides per yard	Wire Rope Guides	Wire Rope Guides between Cages	Weight on Wire Rope Guides	Size of Wood Guides	Diameter of Downcast Shaft
	Feet.			Years.	Yards.	Feet.	Feet.	Secs.	Inches.	Inches.	Inches.	Tons.	Inches.	Inches.	Lb.	Each Cage.	No.	Tons.	Inches.	Feet.
..xon's Colliery	..	2	2	Upcast. 6½ Downcast. 12	No. 1. 436 No. 2. 500	9	..	..	4½	6	¼	11	14 × 5 Oak.	12 × 4½ Oak.	..	..	..	..	..	..
..edegar	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.	..	..
..wlais	..	..	..	..	..	..	..	..	..	.	..	.	..	..	..	..	..	..	..	.
..rris Navigation	.	..	2	6 to 10	735 700	9	4600	15	7	6	$\frac{1}{16}$	14 20	11 × 5	11 × 5	72	..	..	..	..	..
..ean Collieries.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..ydach Vale, No. 1	15	..	..	..	395	..	..	..	.	..	..	..	..	..	..	..	..	..	..	..
" No. 2	14	..	..	..	430	..	..	.	..	..	..	10	..	..	..	..	..	..	..	..
..wpen Colliery.	..	..	2	Still in use.	220	6	..	..	6	3	..	..	9 × 4½	..	46	..	.....	5½	..	..
..wis' Merthyr	.	..	..	..	370	..	..	..	10	.	..	9½	..	..	..	4	2	4	..	..
..earmouth Coal Co.	..	..	..	20, still in use.	600 Upcast and Downcast.	7	..	..	14	1	..	13½	11 × 3 Redwood.	..	..	4	..	2½	6 × 3 Oak.	13½
..arton Coal Co.	..	..	..	.	..	..	..	..	..	..	.	..	..	..	..		..	..	..	..
..on Colliery	..		..	Still in use.	502	9	..	.	14	6	..	12	14 × 10 Pitch pine	10 × 9 Pitch pine.	80	..	..	..	..	..
..swick Coal Co	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..ebside Coal Co.	..	2	..	Still in use.	200	..	..	..	..	..	..	6	11 × 3 Redwood.	..	..	..	..	..	..	..
..deby Main Colliery	16	..	2	..	750	8	..	.	18	18	..	15	8 × 5 Steel Channel	..	65	..	..	..	..	..
..enaby Main Colliery	14	2	..	..	450	8	..	..	16	16	..	11	6 × 5 6″ sqr.	..	..	..	..	..	..	-



A Portable Gold Miner.

The want of a machine that will diminish the labor and lessen the cost of mining, and at the same time increase the earnings of the miner has long been felt. Our illustration this month shows a novel appliance invented by Messrs. A. B. Cohn & Co. 197 Water Street, New York.

In the first place it is portable, and is made with special reference to its durability and facility of repair wherever used. It will wash from three to five tons of pay dirt per day, and one man can operate two machines by hand with ease. By the use of a small improvised undershot or overshot wheel of four feet in diameter, one foot wide, about sixteen buckets, six or ten machines can be driven with perfect regularity, or any desired number can be operated by any available power, reckoning one horse power for every twelve machines. It is claimed that a single machine will accomplish the work of ten expert miners with the pan, and yield a greater percentage of gold. It is also claimed that the actual labor is one-fourth less than the ordinary miner's labor, and, furthermore, that no skilled labor is required in operating it. One important feature of this machine is that it can be worked without the use of water if necessary, provided the dirt is well dried before being used ; however, it will not work up quite as much material. It will concentrate black sand, rich sulphurets or any precious grain metal, all of great value to the miner. A rather important feature is that the amalgamating process can be used with the best of results, and that it is as perfect an amalgamator as any now in use. The following is a table showing what one man can do with one of these machines as compared with hand labor. Beginning with 10c. pay, which is known as poor pay, (meaning 10c. per pan) :—

ONE MAN PER DAY.

10 cents pay	$5.00
5 " "	2 50
1 " "	50

MACHINE PER DAY.

—	$50 00
—	25 00
—	5 00

In this estimate is given the maximum capacity of the hand panning and the minimum capacity of the machine, thereby showing what the machine will do in poor diggings heretofore unavailable except by sluicing, with its uncertain results and difficult management. The machines are provided with tubs and other adequate means so as to economize the use of water ; the tubs when full will work a whole day, sustaining only a trifling loss.

From figures furnished by the makers we are able to give the cost of a complete outfit for from one to five men :—

One "A. B. C." Portable Gold Miner	$125 00
One Tent	35 00
Three Short Handle Steel Shovels, railroad point	3 00
" " Long " " " " "	3 00
Three Prospecting Picks	4 50
One Light Hoe	50
" Dredging Hoe	75
" Miner's Hook	1 00
" Prospecting Trowel	50
" Miner's Axe	1 25
" Hammer Head Hatchet	1 00
" Perforated Shovel	1 00
" Miner's Sieve	2 50
" Saw, one File, one Magnet	3 00
Total Outfit	$182 00

The Colliery Fireman : His Training, Treatment, Position and Duties.*

By Mr. George Elce, Altham Collieries, Accrington.

In choosing a subject for a paper to read before such a society as this there are a least two important points to be decided, viz., its importance to colliery managers, and one's own authority to speak upon the point. But in taking the present one, it is repeating an axiom to say that it is one of extreme interest and importance to every colliery manager, and I can fairly claim that it is a matter in which I have taken a deep interest for many years, and about which I have learned a little from experience. In the working of a colliery, then, the fireman is a very important factor indeed. Upon "the manner of man he is, depends the conduct of most things in the mine underground." His training, then, is a matter of vital importance, and indeed it is not too much to say that he ought to be in some measure "to the manner born," at any rate he should begin to work in the mine at the earliest age at which it is deemed expedient for a boy to enter a mine at all, having first received such an education as will enable him to perform any ordinary calculation, and to pick up at evening classes and private study, the principle of all the appliance he comes across in following the work of a miner lad, he should be put to every kind of work in the course of his youthful years, both in connection with datalling and coaling, by which two terms I mean to include all the work done in a mine underground. He ought to be taught early the value of observation in dealing with roof (especially timber drawing and its effects upon adjacent places); ventilation, whether bratticing, sheets, doors, stoppings, regulators, crorsings, or what ; arching and the securing of rods, roof, and sides generally, hauling, jigging, hooking, and all matters pertaining to the expeditious output of minerals. He should be made an expert in understanding other men and boys, their various grievances (real or imagined), and one matter of vital importance is that he should be able, in due and reasonable time, to perform any part himself ; so that in the years to come, "None may rise up and make him afraid."

* Paper read before the National Association of Colliery Managers, Lancashire Branch, June 1894.

When a man has had a course of training in the mine like this extending over a rm of, say, nine or ten years, and has acquainted himself with the elementary portion f the principles involved in what goes on around him, he will not be the sort of man s a rule) who will lie down and request someone to jump on him, and he will cerinly not expect or tolerate such a thing being done without his special request. The ct is he will know that, given the opportunity, he is a more useful man than the erage miner, be he coaler, dataller, ripper, sinker, or what else he may, and therere entitled to greater consideration and remuneration. I recall the story of a hookern, who claimed more money and authority from his manager because he said the en abused him a good deal. "Well," said the manager, "I cannot afford even 1s. er week in wages, but I will give you 5s. per week in authority." The law gives the reman certain statutory powers which are presumably sufficient to enable him to carry ut his duties as defined by the special rules, and I believe it is only proper that these rivileges, so far as they really are such, should be maintained in their pristine force, nd that the pay should be such as to place him above a workman, especially in regard the exigencies of trade, sickness, or accident. So much for the qualifications of a an who is to become a fireman, but then he is only in the position of the man who t married; after the ceremony the minister complimented him, saying, "Well, you re at the end of all your troubles now, at any rate." Seeing the parson some time ter, the man suggested that he had more troubles since his wedding than ever before. Of course," was the reply, "there are two ends to everything, I meant the rst one."

Thus it is with the young fireman; he finds that many of those whom he had preously counted friendly, give him the cold shoulder, suggest that he is about the most nlikely, unfair, injudicious person ever tried as a fireman; or maybe they confine eir observations to questioning the means by which he attained to that position; but hatever line they take, it will mean that he will have considerable discomfort for a me, even under the most favourable circumstances, and will need all the help and omfort that his fellow firemen and superior officials can give him, as well as a strong etermination to succeed on his own part, and a firm conviction in his mind that 'Blest are they who to the end endure." He should (from first becoming a fireman) ot have anything to do with a workman's union, I say nothing of a fireman's union, that he can deal fairly as between man and man, when it is bewteen the miner and e owner. It is quite necessary that he be a man of temperate and regular habits, as briety, attention, and order are as essential, if not more so, to direct the work of a ine as any other business, and this will save him from much discomfort, as most unalled-for controversies are carried to their acute stages under the influence of "Old ohn Barleycorn." He should (generally speaking) seek his pleasure in the company f men other than miners, especially avoiding such as are under his personal superision. So much for his training and treatment up to assuming the position of a fireman. At first he will be apt to think that his power and authority are too limited to nable him to adequately perform his multifarious duties, and will have to learn the ard lesson that, like any ordinary implement, this authority is only equal to its work n skilful hands, and he will be like a miner I knew, who apprenticed his lad to a oiner, and, at the end of the second year, said to his son, "Well, lad, what hast tha' earned to mak'?" "Why," replied the lad, "I can make a wedge an inch long." Our friend hastly replied, "Any fool can do that. Reach me axe and saw," which he lad did. The old man cut an inch from the end of a narrow board with his saw nd began to taper it with his axe. After doing a bit at this he missed the inch of ood and hit his thumb, upon which he desisted. The lad then sharpened the end of board wedge-wise and cut an inch off it with the saw, as a joiner should.

However, our fireman should be made to understand from the first that in all right hings, and in such only, he will be backed up by his superiors. He should be treated ith sufficient confidence to know what are the ideal conditions aimed at in the conuct of the district under his care; because we know there is a little divergence beween the actual and ideal build and system of a colliery, and the intelligent fireman hould have a vision in his mind of the complete picture. In any case of radical hange in the programme the opinion of a fireman should be one of the earliest things btained (whether it be in the method of timbering, working, or ventilation), and if e has, or is supposed to have, or believes himself to have any objection to it, some re should be taken to afford him reason to change or modify the same, so that when he as to supervise the result he can put his heart into it, and intelligently lead the men herein. His ordinary duties, as defined by special rule and as generally known to us, re as follows: — Charge of his mine or district, safety examinations, danger signals, eports, visiting men and withdrawal during danger, sending men out on rule violation, ropriety of air-doors, and other air appliances, lamps (frequent examination of), suply of timber, and its use when requisite, and generally enforcing the rules. And as egards these well-defined and printed duties, I content myself with saying that they re delicate, onerous, responsible, omnipresent ones, and for their due fulfilment reuire men of strong calibre and strict conscientious endeavour and integrity.

But there are other duties pertaining to an unwritten law, such as dealing with he payment of the men and boys under their supervision, and of this duty I desire to say that, avoiding fear on the one hand and rashness on the other, a fireman should seek to fairly balance the value of any service rendered by those under him, and ever seek "To do unto others as he would that they should do to him," were their relaive positions reversed. If any hindrance or inconvenience arises to his workmen, he should (whether there be any rule in the matter or not) do his best to set the matter right, so far as his influence will carry him. And as regards his services to his employers, he should be willing to try to serve their best interests in every way so far as his conscience will allow him (one must bear in mind that an unscrupulous man may ask more than an honest service can yield). There is a story current that the Messrs. Rothschilds wanted to send a man abroad on a very important mission, and they called before them one of their senior clerks, and asked him how he would like to go abroad in their service, he inquired particularly as to the remuneration, and asked if it was not possible for him to have time to consider, &c. They called the next man, and he was willing to go, but when asked how soon he could be ready, he said he thought in two or three weeks. Upon his retirement they interviewed a third, who at once intimated his willingness to go anywhere in their service, and when asked how soon he could be ready, he replied, "I am ready now," and he went, and where no principle is involved I commend his example to a fireman. At the same time, I must say that one of the most exasperating of firemen is the one who, like a looking-glass, reflects one's own opinions, and never, never has one of his own.

If any large body of gas by accident accumulates the firemen are the men to deal with it, of course under the supervision of their superior officers. I think the firemen in a pit should occasionally change districts, so that each man is acquainted with the whole pit. So far as is reasonably practicable a fireman should not be the supervisor of his own relations by blood or marriage, as man "cannot serve God and Mammon," and so, whilst it may be impracticable to secure men who have no relatives as firemen, there should be a gulf fixed to divide the little family parties which are so apt to form. One of the unwritten duties of a fireman is that of preventing waste, and this can only be done hy a continuous active striving—waste of timber, nails, plates, rails, brattice, tools, or coals, by having left in (what a collier calls) a screen, which is variable from a foot thick to half a dozen yards. In observing what goes on under a fireman, careless in these matters, one is reminded of two lines in the "Ancient Mariner," with the variation :—

"Timber, timber, everywhere,
And not a prop to set."

A very important habit in a fireman is the one of method or order, because a man who is himself unsystematic cannot keep either men or work in any sort of regular order. A retentive memory is well worth cultivating by a fireman. We have lost one very urgent necessity for a fireman being a keen gas detector since the candle went out of general use, and I regret to be able to say that I am afraid there are still firemen who "look for what they don't want to find." If a fireman is to examine the effects of the ventilation he must be provided with a good, I would say the best known, lamp for detecting gas, and he must hunt for the slightest indication of it with the pertinacity of a sleuth hound, and not have in his mind the idea that if they have to miss firing the shots it will be a serious matter. His idea ought to be, and he should be drilled and re-drilled in it from time to time, that if there is gas to be found he will find it, leaving the economic results to people who are more affected by them. The examination of roof and sides and the timbering in his district ought to be a labor of love to him, and he should never tire or weary of taking pains in these matters. When timbering or packing is done within his direction he ought (from the beginning) to form the unalterable resolve never to have poor or slipshod work or material put in; far better no timbering than poor or mistaken, as he will realise if he bears in mind that more delays to traffic occur and more limbs and lives are lost from such causes than any other in our coal mines. An important thing for a fireman to observe is the effect changes in the atmospheric conditions (such as pressure and temperature) have upon the roof, floor and sides of the particular mine he has charge of. I know many roofs which are very liable to fall upon a rise of the barometer, especially in pillaring, and also when the weather changes from hot in the day to cold at night, thus favoring the deposition of moisture from the hot air upon the roof and sides of the roads, particularly the intakes. The tricks and manners of the roof, floor, coal and packs under his charge should be his constant care, such as, for instance, where does the gas come from—coal, roof or floor—and when? Is it a regular constant yield, or is it erratic, following weighting and heaving, forming outbursts, &c.? What shape of the face (in any method of work), is most favorable—first, to safety and the workmen; second, to the owner and round coal? Are they identical or not, and if not, why so, &c.? All these are problems which he will find worthy of his consideration, and with which he can profitably concern himself.

One thing which I personally do not care to have to deal with in a fireman is extra density: he should be alert and active, mentally as well as physically. To one inclined to be waited on and carried about, I would commend the study of a pathetic little incident in the history of a stout colliery manager of the last generation. One Saturday he got a drawer to take him into a district of his pit (when it was nearly giving over time). The young man rather growled about it, but our friend sauced him well, and so he ran him where he was requested. And then, while taking him along a low length of road, the drawer swayed the tub off the road, and told the manager to get out as best he could—he himself was going home. On Sunday morning the manager's friends became uneasy, and a search was made; he was found in the tub where his quondam friend had left him. A good quality for a fireman to cultivate is a thoroughly sound judgment, not to decide about a matter upon the first plausible tale he comes across, but to learn every possible detail concerning it from all the available evidence, and judge accordingly, and in order to become so he must learn "that great events from little issues spring," or, in other words, that there is no detail of his work too insignificant for his attention, and that it is only by keen attention to the small items that the apparently large ones come out correct.

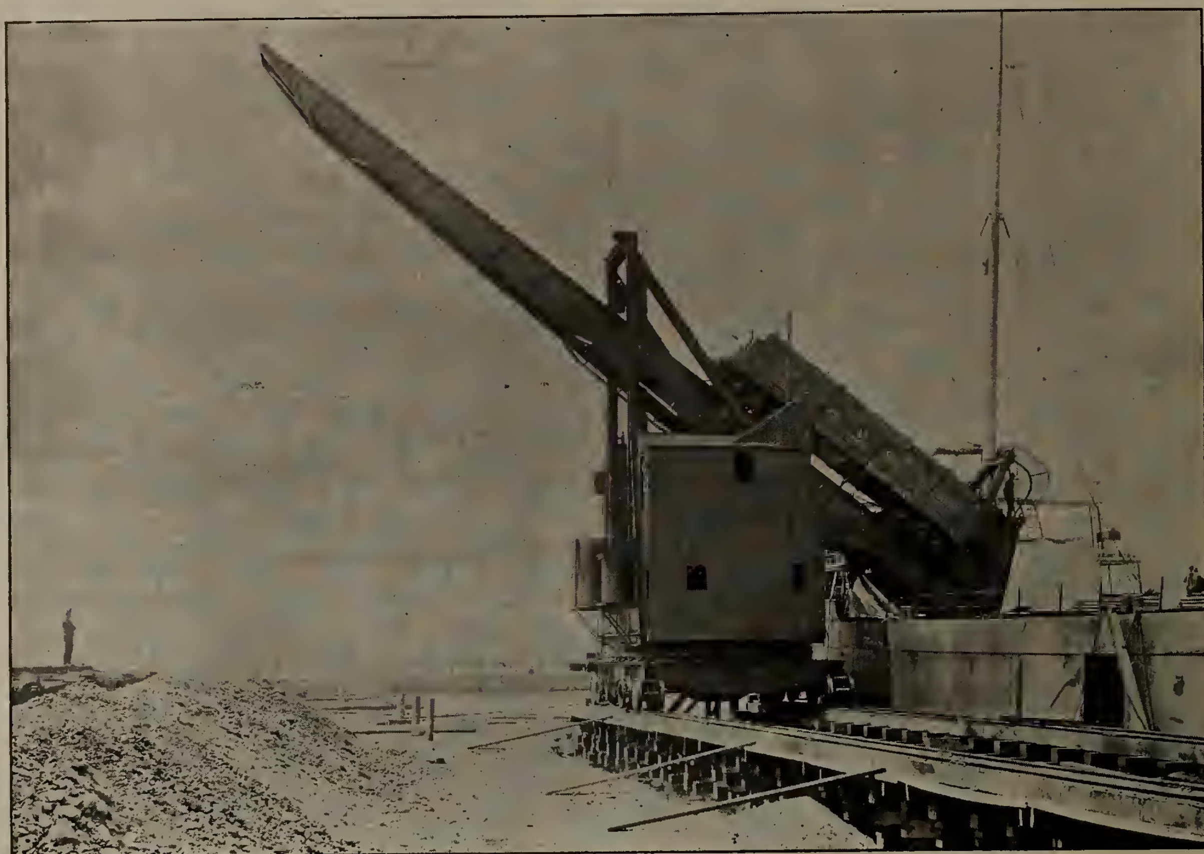
One of the most difficult duties, and quite as important as difficult, is for a fireman to maintain the necessary discipline amongst those under his charge, and on that head I can only say that whenever he has got a fool to deal with he must himself be extremely wise and circumspect and in every case walk in the line of strict law and equity. His troubles will not often come from competent, sensible men. At the same time, malice is a luxury never to be indulged in by him; he should rather adopt the attitude (towards an unruly member), of a wrestler who carefully watches every move of his opponent, and applies just the requisite pressure in the weakest place, in order to prevent his own overthrow. It cannot be too strongly impressed upon him that it is his duty (except in special cases and at certain set times), to see that other men do the actual work, and not to demonstrate to the admiring eyes of all his datallers, &c., that he can do the work of two with three watching him. Mr. Hyslop, in his splendid work on "Colliery Management," speaks of someone he knew who was a "do-all-the-work-himself" sort of a man, but he naively concludes, "His friends lament his early death, and his employer had early to replace him." I am reminded of a story of an overman, who said to one of his men, "Why, man, it takes me half of my time to watch thee alone." "Aye man," replied the workman, "it takes me all my time to watch you," and a fireman should observe the principle embodied here. It may possibly be said—Why, you ask for the qualities of a manager in a fireman; and I should remind the author of the sentiment that a Mr. Burns, from over the Border, has said:—

"The rank is but the guinea stamp,
The man's the gow'd for a' that."

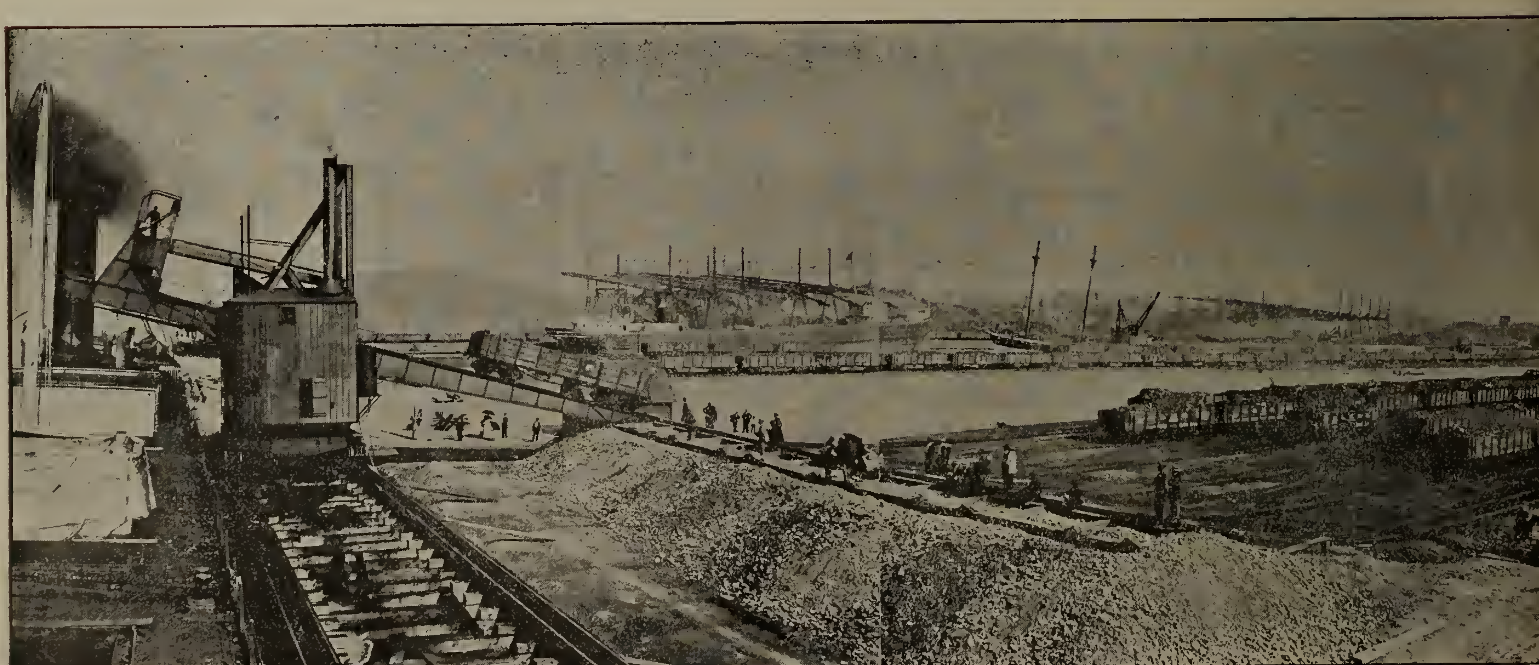
And I would further say that from the ranks of a host of such ideal firemen should come the men who in after years are to receive the guinea stamp of colliery manager's certificates, both first and second class. Because, firstly, they are most fit and qualified; secondly, they are most deserving; and thirdly, no other class of men can be really as fit and as deserving as these should be. And as an important argument in favor of this special and particular training of our subordinate colliery officials I would like to point out that, if all the firemen in all the pits in this kingdom had this trained intelligence constantly directed upon the daily problems of our mines, the result would be that every detail, every mechanical contrivance used therein, would be continually improved and developed, and the results could hardly be realized by anyone. Collieries would become what even the most optimistic dreamer has never seen in his wildest dream—in fact, "what it has never entered into the heart of man to conceive."

There are many things done, and suffered to be done, in our mines now which are barely fit for men and boys to do. Anyone who has had a fair trial at bolt and chain drawing, ventilator turning, pushing coals by hand down a too flat scuttle, turning at a crab week in week out, stiff slant waggoning, hooking at a wet pit bottom, or any such lofty, soul-inspiring pursuit, to earn his daily bread, will be able to appreciate my meaning when I say that some work is not of itself elevating. There is also the class of useless labor, such as blowing floor to make roads in seams where the roof requires artificial support almost every yard, straight cutting where every practical man must feel the longwall would be more fit, jigging coals down hill to haul them up again, drifting at random after coals where faults intervene, where following the natural signs would give proper results, etc. Such soul-destroying, debasing, and useless work would be speedily reduced to a minimum if it came under the observation of the ideal fireman I have sketched, because he would be like the Oldham man who went to gaol and was put on the treadmill. Says he to the turnkey, "Ow'd mon, have they allus turn't this wi' their feet?" "Yes," was the reply. "By gum, but if they had it i' Owdam they'd have a little engine to it i' quick sticks." It is possible for an argument to be advanced that it would be indiscreet for a manager to continu-

IMPROVED COAL HANDLING MACHINERY.



The McMyler Coal Car Dumping Machine—Tilted to Hatch.



The McMyler Coal Car Dumping Machime—Taking a Car.

ly make men qualified to take his place, but I am afraid it would be a weak prop deed to sustain a colliery manager if he could only do it by having a body of incomtent subordinates. And indeed he would be much more likely to fare reasonably ell by having a thoroughly competent set of firemen who owed all they knew to his ndness. He would be taking the line of the farmer's boy who was left to mind the ouse and the children whilst his master and mistress went off for the day. The aster cautioned him to be quite sure and keep the children away from the fire. hen the couple left home they had a fair length of a straight road to go, and, lookg back just before the turn, they were horrified to see flames coming up their house imney: returning, they found a great fire piled up in the grate. "Why is this?" quired the farmer. "Well," replied the lad, "you wanted the children kept away om the fire, and none 'em dare go near that one."

There are, I believe, one or two things which the law might be made more defin- e about in favor of the fireman: for instance, if he gives an order to a man about s work or place the workman ought to take all the responsibility for non-obedience. he law ought to define what percentage of gas, and how determined, should be condered to prohibit working or passing in, and more particularly define the time ter his visit for which he can expect to be called upon to answer. And lastly, the ty of a manager to his fireman (and the under manager in his place and degree) is treat them and so to act before them that they may look up to him in all matters as true gentleman and competent adviser. You cannot look up from the summit of owdon and Menai Bridge, and a fireman cannot look up to a man who is not in all sentials his superior. So a manager should see to that point, and, having selected d secured a staff of good firemen, he should "bind them to his soul with hoops of eel," so that at all times, but especially when the time comes, as it very well may, at his place, fortune and reputation depend on their true estimate of him, he may d that he has not "built his house upon the sands," but upon the rock of genuine erling human nature under its best and truest aspects.

Improved Coal Handling Machinery.

Last month we gave our readers particulars of the extensive improvements in coal andling appliances at present under construction for the Dominion Coal Co. Ltd., and the question of rapid loading and discharging of coal cargoes with a minimum ount of breakage is of prime importance to our coal masters, we have pleasure in blishing a few notes respecting a new plant recently put on the market by the Mclyler Car Dumping Machine Co., Cleveland, Ohio. Next to the traffic in iron ore tween the mining regions of Lake Superior and the furnace districts of Illinois, Ohio d Pennsylvania, the movement of bituminous coal from Lake Erie ports to the orthwest is the most important item of Lake commerce. For several years past ipments of coal from Pittsburg, Hocking Valley and West Virginia districts have veraged about 3,000,000 tons each season. This coal is of a high grade, suitable for el and steam purposes and for the manufacture of gas coke, and shippers have tried arious methods of loading it into vessels without damage from breakage.

As far back as twenty years ago attempts were made to handle coal on the lakes y means of chutes, and on the Cleveland docks, of what is now the Big Fourth railay, as much as $65,000 was expended on a single plant that had to be entirely abanoned soon afterward, on account of damage to the coal in handling it. With the dvent of big steel steamers and wooden boats of largely increased capacity, rotary erricks, handling, first, buckets of ordinary size, and later on buckets of five tons apacity, were introduced into the trade, but even with these the largest vessels were elayed two to four days in loading and with eight to ten men shovelling into buckets rom a car three feet deep, and not taking probably more than 20 lbs. to shovelfull, here was still the disadvantage of separation in the coal and consequent breakage. The effort, therefore, has been to secure dispatch for vessels approaching that obtained the ore trade, where ships of 3,000 to 3,500 tons are loaded in a few hours, and at he same time avoid loss in the commercial value of the coal by overcoming as far as ossible the breakage referred to. A machine that, in the opinion of coal shippers enerally, meets these requirements, is illustrated herewith. From an engineering tandpoint it is a very novel affair, but it has been given sufficient trial in actual service t Ashtabula, O., to demonstrate its entire practicability and to warrant the statement hat it will within another season revolutionize the business of handling coal on the akes. Patents on the machine are controlled by the McMyler Car Dumping Machine ompany, a new corporation, and the first of them was built by the McMyler Manucturing Company for Pickands, Mather & Co., who are the Cleveland representatives f the Minnesota Iron Company, and who conduct a larger business in iron ore, pig ron and coal than any of the several Cleveland firms that are engaged extensively in hese associated industries. Instead of the old system of derricks and buckets, the achine takes up a loaded car of about 23 tons capacity and dumps its contents into he hold of a vessel in a manner that avoids practically any fall of the coal, as the car s loaded to the mouth of the hatch, and the entire load allowed to slide out in a conentrated mass through an ingeniously arranged chute. Of course a car of 50 tons apacity could be handled in the same way and the efficiency of the machine thereby greatly increased. Several records as high as fifteen cars of twenty-three tons each, 345 tons, unloaded in one hour, have been made with the apparatus, and steamers anging in capacity from 2,000 to 3,100 tons have been loaded in eight to twelve hours. The machine is entirely self-contained and portable, having the rotable features of a evolving derrick, with the addition of the girder or bridge, by means of which the entire car of coal instead of a loaded bucket is taken up and discharged. All trestle work is avoided, and there is nothing complicated or expensive about the apparatus. Aside from the machine itself the only expense is that connected with the arrangement of the surface railway tracks.

Viewing the machine from a mechanical standpoint, its elements may be describd as a bridge of two place girders turning on trunnions near the river or dock end of he bridge. These trunnions are carried on a framework of the house, which is in urn carried on about 100 12-inch wheels arranged in a circle after the manner of a raw bridge. The circular track on which these wheels move is supported through eavy plate girder framework by 16 large car wheels moving on four tracks, the outer nes of which are 24 feet apart. Back of the machine and its docks are six double ines of railway tracks, which are for loaded and unloading cars, and which are spaced about the same as the hatches of vessels and perpendicular to the line of the dock. The power is furnished by a pair of suitable engines which control the hydraulic power and all operating parts are controlled by friction clutches, requiring but one operator to handle the entire machine and only four men in all engaged in connection with the plant. The other three are a fireman, a man employed on the bridge and a man to attach the cable to the drawhead of the car.

An hydraulic ram of 18¾ inches in diameter, mounted on trunnions, tilts the bridge, which is so balanced that it rights itself, the ram forming an effective brake for it. From an accumulator having at one end an hydraulic piston and at the other a steam piston ten times the area of the hydraulic piston, is taken the pressure to operate the clutches for pumping, hoisting and driving, laterally, and also the brake controlling the winding drum that pulls the car up the incline.

In operation, the vessels being placed so that the hatches are opposite the tracks, or nearly so, the machine is moved to the hatch which it is desired to load into, the steel cable, size 1¼ inches, is hooked into the drawhead of the car and the car pulled up to the upper or shorter end of the bridge, which is so constructed as to form a bumper, against which the end of the car rests when tilted. The end bar being withdrawn automatically through the tilting operation, the coal flows out through a discharging chute, and is concentrated in a telescopic trough or spout, which at the first flow of the coal may be lowered to within a few feet of the bottom of the vessel, when the work of loading begins at any of the several hatches, or to the surface of the coal itself after the bottom of the vessel is covered. In double decked vessels this chute may be lowered to the bottom deck combins. After the load is discharged the bridge is tilted back, the cable on the end board detached, the car allowed to run down and off the incline on to the track provided for "empties," a loaded car again taken up, and so the operation continues, the machine moving from one set of tracks to another and from one hatch to another as may be required by supplies of loaded cars, or in permitting of trimming of cargo. Through this latter operation a great saving in time is gained, as occasion for shifting a vessel while the work of loading goes on is very rare. Not only can the machine be moved laterally in either direction with a car on the bridge or platform, but it may be swung at the same time to avoid spars or any other obstructions on the vessel. One of the best features of the machine is its adaptability to the kind of railway car in general use in the bituminous coal trade. The only change required is that of fitting sliding end boards in the cars at a trifling cost. Immediately upon preparations being made for the erection of this first machine at Ashtabula, the management of the Lake Shore & Pittsburg and Lake Erie railways, the two coal lines running into that port, had 1,000 cars fitted with sliding end boards, and work has been started on 1,000 more of the same kind.

The capacity of the surface track plant shown on the large engraving, and from which cars are moved on to the platform of the machine by a locomotive constantly in attendance, is 140 cars, or about 3,300 tons. Of course the number of sets of surface tracks for loaded and unloaded cars depends entirely upon the number of cars it is desired the plant shall handle, and as the entire transferring apparatus is arranged to move along a dock line it can therefore be made to accommodate any desired number of tracks and length of dock.

Note re Prospectors' Classes.

By Wm. Hamilton Merritt, F.G.S., Assoc. R.S.M.

In a young country, whose mineral resources have not even been well prospected for, such as the Province of Ontario, and a great portion of the Dominion of Canada, the first steps to be taken looking toward mineral development, naturally, is to find the mineral, and then to persuade local capital to develop the same. If this is correct, it is advisable, in a new country, to educate men to look for minerals, and the general public to take an intelligent interest in their development. The first country which has adopted this policy, so far as the writer is aware, is the Colony of New Zealand, where excellent results are stated to have accompanied prospectors' classes. Following the example given by New Zealand, the Kingston School of Mining recently inaugurated a so-called "Prospectors' Class" in the gold mining district of Marmora, in the Province of Ontario. As this is the first instance of such a class in Canada, it is thought that a few notes on the same may be of interest.

Marmora is a small village, in the vicinity of which gold quartz mining operations have been from time to time carried on for many years. The class consisted of some 20 pupils ranging from the ages of say 70 to 17. It was composed of present and past mine foremen, prospectors, hotel keepers, merchants and other investors in mining claims, thereby leading to an increased and more intelligent interest on the part of business men in mining development, as well as by those who are actual workers.

The idea of the course was more to give those attending it a start, or basis from which to start, in the direction of personal mineral investigation, or an idea of what books and outfit to obtain to assist them.

Enough Chemistry was given to enable the student to understand what a mineral is, and to grasp the distinction between an acid and basic mineral, and numerous experiments were made to illustrate. Enough Mineralogy was given to enable the student to use a mineralogical text book, and to enable him to distinguish the common ores and the minerals entering into the composition of the ordinary rocks. Specimens illustrated this part of the subject, and rough field tests were made upon the same. Sufficient Geology (accompanied by typical rocks) was given to enable the student to form a general idea of the formation of the ordinary rock families, and in connection with ore deposits, the typical classes and their mode of occurrence was touched on. Finally, prospecting and the rudiments of mining operations concluded the course.

In practical work, assaying of gold and silver was given, and a course in blowpiping, which embraced the testing of the common minerals and cupellation; also panning and short trips to geological sections and local mines. The course occupied only two weeks, and the students were working for three hours in the morning and two hours in the afternoon of each day.

This preliminary Prospectors' Class was conducted by the writer, and it had as a result the formation of a local club to carry on geological and mineralogical work, and the collection and preservation of minerals and geological specimens, thereby proving in a substantial manner the sustained interest of the class.

An Ambulance for Use in Mines.—The difficulty of carrying injured men in mines through narrow and uneven passages has often been recognized. An apparatus invented by Dr. Paul Troisfontaines, is described by the *Semaine Industrielle*, of Brussels, and seems to be simple and convenient, as well as cheap. It consists of a sort of hurdle or litter, made of hoops about 8 mm. in diameter, placed parallel and joined by a fabric of cord or mat, somewhat like a hammock, thus giving when required, rigidity in one direction and flexibility in the other. The injured man is laid in the litter with his legs extended and his arms at the side of his body; the upper part of the litter is then folded over and secured by three or four straps. The man then forms a package and can be carried without the slipping and jolting of an ordinary litter, no matter how narrow or rough the workings may be. In case of fracture there is believed to be less danger in carrying a man in this way, holding him immovable, than in attempting to keep the broken limb in place by rough splints or bandages extemporized on the spot. These litters can be easily stored in a small space, and their cost, in Belgium, is 3 fr., or about 58c. only.

Photography in Mines.*

By Herbert W. Hughes.

In a recent contribution† on the same subject the writer dealt with the difficulties met with in photographing mining operations, and the methods he had found successful in overcoming them; but as the members he was addressing were familiar with the apparatus employed and the manner of using it, no reasons were then supplied, either for the preference given to certain forms of lenses, etc., or for the manner in which the operations were conducted. Photographs of places inaccessible to the general public are usually interesting, and mining pictures do not seem to be an exception, if the writer may judge from the numerous letters he has received on the subject. Many mining engineers have expressed a wish for further particulars in language less technical than that used in the paper already alluded to, in order that they may take up similar work in their own collieries. The field is a very large one, and it is to be hoped that members may be induced by this paper to enter into the work, because the results are valuable, both from a scientific and educational standpoint, and indicate clearly how many operations are performed far better than an ordinary drawing.

The writer took up the work to obtain views showing how the ten-yard coal was worked, as he found that there was considerable difficulty in doing so with diagrams. To further instance the value of such photographs, he may say that one view obtained by Mr. J. C. Burrow showed the heavy timbering in the 412 fathoms level at Dolcoath. This place was subsequently the scene of a terrible disaster in which seven men, including the foreman timberman, lost their lives owing to the collapse of the timbering as it was being strengthened, while an eighth man was rescued unhurt after 37 hours' entombment beneath the fallen *debris*.

The subject is particularly appropriate at the present time, because our President, Mr. Arthur Sopwith, was the first to obtain a complete series of views showing the various operations from the bottom of the shaft to the working place. These were taken in 1881 and 1882, but previously Mr. W. E. Debenham, in 1864 or 1865, had obtained several photographs in the Botallack metal mine in Cornwall. In 1884 Messrs. G. M. Bretz and F. P. Dewey,‡ photographed several places in the anthracite collieries of Pennsylvania; while in 1891, a series of views by Mr. H. Börner,§ illustrating the methods of working the Freiberg metal mines were published in book form. The latter are probably the best series from a photographic standpoint that have been obtained, and many of the views, such as (17) "Fixing iron settings in the Hohebirke lode," and (18) "Setting contracts at the forebreast in the Seligtrost lode," are also excellent from their technical accuracy. Several, however, have been completely spoilt by the endeavours of the photographer to produce a good picture, two being especially mentioned, viz., (3), Inset at the twelfth level in the Abraham shaft," where a miner is depicted breaking a large lump of loose rock placed at the edge of the shaft, and (5) "Sending down timber from an intermediate landing in the Abraham shaft," showing a man engaged in sawing a piece of timber, one end of which projects over the shaft.

With the exception of several isolated attempts, nothing seems to have been done in this country since Mr. Sopwith's experiments until about eighteen months ago, when Mr. Burrow and the writer took up the subject and endeavored to obtain a complete series of views showing the methods of mining where the excavations are larger than usual. A selection of the former's results have just been published in book form.‖ For mining work it is necessary that the operator should either be an engineer or have an engineer associated with him, and in this respect Mr. Burrow was happily situated, as he was assisted by Mr. William Thomas. Mr. Burrow and the writer have been in communication with each other, and both finally used similar apparatus and materials, the only difference being in the appliances used for illuminating purposes. The writer has much pleasure in admitting his indebtedness to Mr. Sopwith for many useful hints and advice which assisted him in overcoming several difficulties.

Cameras—For many obvious reasons it is necessary, for underground work, that a camera should be of the lightest and most compact form as it often has to be erected in awkward and confined situations. The writer's first experiments were made with the club camera of Underwood & Co., half plate size (6½ inches by 4¾ inches), which is of the light tourist pattern possessing the several movements common to that class of camera; its construction is, however. not rigid enough to stand the rough usage to which it is subjected underground. Several other designs were inspected, and for many reasons the whole plate Acme camera of Watson & Sons, giving a view 8½ inches by 6½ inches was preferred.

Like many cameras, the Acme, when closed, has a thickness regulated by the combined substance of base board, bellows-front, and focus glass, for the front folds into the base and the bellows occupy the space between it and the focussing screen, but unlike the majority of cameras, all the operations of erecting in this one are released and locked by spring catches. When setting up, the spring on the top of the body is first moved aside and the body revolved on its hinges, when the struts run down in the grooves in the side until they fall into a niche near the bottom; at this point the clamping nuts are tightened and the body is held at right angles to the base. The front is then lifted up, and two projecting pins at the foot are slipped into grooves in the front of the base, and are held there by spring catches which rise automatically and secure them. The locking of the front is an exceedingly ingenious and convenient arrangement, for while it firmly holds the bottom portion and allows of the front swinging in a vertical plane to any practical amount, yet by inclining the front backward to an angle of 45 degs., it draws loosely from its fittings and is ready for closing.

The bellows are taper, but not square in section, being deeper than they are wide, thus allowing the rising front to be used with freedom when wide angle lenses are employed. The ordinary clamping screw for the rising front is dispensed with, the fixing being obtained by means of a rack and spring ratchet on the side. The back of the camera is made with the usual reversing frame so that horizontal or vertical pictures may be taken, but it is held in each position by a spring, and is also kept in proper register by another spring.

The dark slides which carry the plates for exposure are fitted with special stops and springs to the shutters; the former dispense with the projecting screws ordinarily employed and leave the slides clear for the reception of carriers for smaller sized plates (if required), while the springs automatically hold in the shutter when closed after exposure. In addition, the dark slide itself is held by a spring catch as soon as it is pushed into the proper position for exposure, and cannot be withdrawn until the catch is pressed back, thus preventing any possibility of the slide moving by accident and spoiling the plate. The numerous spring catches alluded to are valuable on the surface, but are still more so underground, where the various movements have to be gone through in semi-darkness. It is a source of considerable satisfaction to know that the different parts are in their proper position when a click is heard.

The usual double motion is supplied for focussing and for the application of wide-angle lenses, as the front can be extended by rack work and the back moved up to the front. In order that the back may be set parallel with the front after it has been moved, marks are cut across the two grooves in which the back slides. The base of the camera may either be panelled, with a screw socket in the centre to be fitted to a separate tripod and held by a T-screw, or preferably may have a turntable. Although the latter is generally made of brass, yet it is of light construction, and as the base is cut away for a diameter of 6¼ inches, the metal introduced weighs little heavier than the wood removed. When aluminium is used in the construction the reduction in weight is considerable. For many reasons the turntable in the base is to be preferred; in the first place it saves one extra part (the tripod head), cannot be left behind, and reduces the time required for erecting, while when the latter is done the camera is sure to be rigidly attached to the tripod.

A tripod stand with the lengths of the legs adjustable is convenient on the surface, and is necessary underground, as the camera has often to be erected in confined situations and on very uneven ground. The threefold stands are best, but many of these where the joints are supposed to be held rigid by a screw are worse than useless. In the new pattern stand, the middle piece folds down into the same plane as the top third, and is then pushed upwards about an inch, thereby locking it between two brass strips, one on each side. A clamping screw is provided to hold it in this position, and forms an additional security; but even if this screw becomes loose the leg cannot bend outwards, as before it can do so the middle part must drop away from the upper piece: the weight of the camera effectually prevents this. Practically the legs are as free from any chance of collapsing as if they were made in one piece.

After the care which has been taken in perfecting small details, it is surprising to find that indicators for determining whether the back and front are vertical are conspicuous by their absence. On many occasions it is impossible to set the camera level, and consequently the back part carrying the dark slide cannot be set truly vertical unless a plum-bob is improvised from a piece of string and a stone. The better plan is to purchase two plumb indicators and attach one to the side of the back and the other to the front of the front. There ought not to be any necessity to go to this trouble; such an instrument should be fitted with indicators in the first instance.

Lenses—Within the limits of this paper it is impossible either to describe the various types of lenses which have been used underground or even the advantages possessed by several forms under certain circumstances, except in a general manner. The action of a lens is never perfect, but in many of recent construction the imperfections have been reduced to such an extent as would hardly have been thought possible a few years ago. The chief defects which have to be minimized are: Spherical aberration, caused by the rays of light being refracted more at the edges than in the centre of the lens; chromatic aberration, due to the lens bringing light of different colors to focus at different distances; astigmatism, the inability to focus horizontal and vertical lines at the same time when such are near the edge of the plate; and curvature of field, that is to say the lens brings rays of light to focus on a field more or less curved. As the plate on which the image is received is flat the latter defect is very serious.

Under varying circumstances certain of the above defects may be admissible, but others must be absent. Hence the numerous types of lenses adaptable to different uses; in one form a certain defect is allowed to exist in order to better correct some other fault, which, if present, would render the lens useless for the purpose it is intended to serve.

Practically speaking, it may be said that the rapidity of a lens depends on its aperture and focal length, and as in underground work speed is of the greatest importance, a lens possessing such advantages should be secured. The portrait lens is of the greatest intensity possible, and was used by Mr. Sopwith in his experiments, but it has not the power when working at full aperture to either focus the image sharply at the edges of the plate, or to represent objects in the background with the same sharpness as those in the principal plane on which the focus has been made. In many cases the latter is an advantage from an artistic point of view, as most people prefer to see the background subordinated to the principal object forming the picture, but in many mining operations objects of importance are situated in several different planes and if the photograph is to be of value for scientific purposes such objects must all be in focus at the same time. In order to obtain this advantage the aperture of the lens has to be reduced by the insertion of what are known as stops into the brass mount carrying the several elements of which most lenses are constructed. These stops are now generally expressed not in actual measurement but as a fractional part of the focal length, thus *f.* 8 is an aperture having a diameter equal to one-eighth of the focal length of the lens it is associated with. Most English lenses are now marked with the diaphragm apertures recommended by the Photographic Society of Great Britain, each of which is half the area of the preceding one. Provided the time for correct exposure is known with any stop, the amount necessary with the others is easily calculated, as when using the next smallest stop double the time must be given. The diaphragms are marked thus: *f.* 4, *f.* 5.6, *f.* 8, *f.* 11.3, *f.* 16, *f.* 22.6, *f.* 32, *f.* 45.2, *f.* 64. The unit aperture is *f.* 4, and if an object required one second exposure with that stop, it would require two seconds with *f.* 5, four seconds with *f.* 8, eight seconds with *f.* 11, and two hundred and fifty-six seconds with *f.* 64. This at once shows the necessity of using the largest possible aperture where either the light is poor or the subject likely to move.

At one time the stops supplied with each lens were either arranged on a rotating wheel, or were separate and were pushed into position through a slot cut in the side of the lens mount. Within the last few years the iris diaphragm has come largely into use, thus allowing the opening to be contracted or enlarged by simply moving a pointer. Every lens for underground work should have an iris diaphragm as the number of things to be carried about is thereby reduced, and the operation of altering the stop is made easy and comfortable; the risk of fogging the plate is also done away with. When the lens mount has a slot in it, and plates of extreme sensitiveness are used, sufficient light may pass in through the slot to spoil the plate.

It may be thought that what are known as wide angle lenses which are of short focal length, and include a large angle of view on the plates they are made to cover, would be best for work in mines, but although they sometimes have to be employed, yet they do not give satisfactory results. They often exaggerate the perspective to such an extent as to make the resulting negative look very unlike the original, and owing to the principles on which they are constructed have to be used with a comparatively small aperture; as a rule the largest stop they are supplied with is *f.* 16, but the majority do not work satisfactorily above *f.* 22.

Mr. Burrow first tried a portrait lens, but as the only advantage this form possesses is speed, he abandoned it for others on the introduction of the rapid plates now to be obtained. The writer's first experiments were made with a Ross rapid symmetrical lens having *f.* 8 for its largest aperture. At that date such types were perhaps the best, for although they are slow compared to portrait lenses working at *f.* 4, yet they cover the plate better at the margins, and naturally have more depth of focus, but they include a narrow angle, and as the elements are rather widely separated in order to obtain flatness of field, the plate is not so evenly illuminated as is desirable.

The introduction of several new varieties of glass made at the Jena factory has put

* *Transactions Federated Institute of Mining Engineers.*

† "Photography in Coal Mines." *Journal of the Photographic Society of Great Britain*, vol. xviii., page 93.

‡ *Trans. American Inst. of Min. Eng.*, vol. xvi., page 307.

§ *Der Bergmann in seinem Berufe*, Freiberg, 1891.

‖ *'Mongst Mines and Miners*, London, 1893.

into the hands of opticians a power which they did not previously possess. At one time lenses were made achromatic by cementing crown and flint glass together to form the separate elements, but as the glass which possessed the higher refractive power also had a higher relative dispersive power, a certain amount of astigmatism remained uncorrected, and the lens defined indistinctly in the marginal portions of the field. In the Zeiss lens designed by Dr. Rudolph,* achromatism is obtained by employing two elements, in which the one having the higher index of refraction has the smaller relative dispersive power, while the astigmatism of one combination neutralizes that of the other. The field is flattened by the combinations themselves, and consequently they can be placed near together, thus increasing the angle of view and giving more even illumination. Practically, owing to the greater covering power, the lenses are more rapid than those we have been previously accustomed to, as they do not require to be stopped down to such an extent.

Both Mr. Burrow and the writer have used the series III. lens, having an aperture of *f.* 7.2, with much success, but Ross & Co. have recently taken up the manufacture of another type which promises better results, viz., the Goerz † lens, which has two symmetrical combinations. The double anastigmat, series III., *f.* 7.7, permits the use of the largest stop without diminishing the sharpness of the image at the margins of the plate up to an angle of 70 degs., while definition and flatness of field are uniform all over the picture.

The writer need only mention another construction of lens which has been found invaluable under certain circumstances. The Ross concentric lens is constructed on a different formula from that of all other lenses, as the two exterior surfaces of each combination are concentric, while the cemented surfaces are flat. Without a special kind of glass made at Jena such construction would be impossible. The field is quite flat, evenly illuminated, and definition is equal over the whole of it. Unfortunately the largest stop that gives sharp definition is *f.* 22, but in situations requiring a wide angle lens none better can be employed. It is claimed that the concentric more nearly yields the theoretical amount of depth of definition than any other lens, and may consequently be said to possess greater depth of focus over the whole field.

As lenses for different purposes vary considerably in diameter, it is usual, if several are to be used with the same camera, to attach to each an adapter: this is a ring of metal exactly filling in the space between the screw of the smaller lens and the flange of the largest one, which is firmly screwed to the front board of the camera. The writer has lenses of 5 inches, 7 inches, 8¼ inches, 9 inches, and 12⅜ inches focus, and the four first named are each fitted with its own adapter, which is kept permanently screwed on to the lens. Underground the camera can often be erected in one spot only, and as soon as this is done, by the assistance of the adapters all the lenses in succession can be tried in a few minutes to determine which includes the best view.

Plates—Photography is based on the sensitiveness of certain silver salts to the action of light, and the modern dry plate consists of a thin film of gelatine in which the sensitive silver salts are held in suspension in a fine state of division.

The method of preparation is to first soak suitable gelatine in water until it becomes soft, and at the same time to add the requisite quantity of an haloid salt, either either ammonium or potassium bromide, or both. A solution of nitrate of silver in water is prepared and added to the first solution in such quantity as will be completely decomposed by the haloid salts therein. The silver salts thus formed do not possess their maximum sensitiveness, and for that reason the mixture is subsequently heated for one or two hours to a temperature near that of boiling water.

If the gelatine solution on cooling is of the proper consistency, it is thoroughly washed by squeezing it with cold water through canvas, this being necessary in order to remove the excess of haloid salts which remain in the solution. If such were not done the surface of the film, on drying, would be destroyed by the crystallization of these salts; and in addition, the potassium or ammonium bromide left in the emulsion would act as a restrainer on development, thereby practically diminishing the sensitiveness of the plate.

The preparation of the exceedingly sensitive plates which have been placed on the market within the past eighteen months is a trade secret, and a valuable one. The method of obtaining this extra sensitiveness cannot therefore be described in this paper. It is, however, known that in order to obtain the maximum amount of photo-chemical decomposition from the minimum exposure, the film must contain some halogen absorbent. By photo-chemical decomposition is meant the invisible change undergone by the salts of silver contained in the film when it is exposed to light and it is generally admitted that one of the results of this decomposition is the liberation of the halogen element previously combined with the silver. Now, gelatine possesses the power of absorbing with ease large quantities of liberated halogen, but slow gelatine plates are common articles of manufacture, hence the mere presence of gelatine is not sufficient. As may be expected, almost every imaginable salt or material has been tried as an absorbent, even the nitrates, which are extremely powerful, but without obtaining any results of practical value. The writer is informed by a firm of leading plate manufacturers that as far as their present knowledge goes, no better halogen absorbent than gelatine is to be found, and that the method of cooking the emulsion is the main factor for obtaining extreme sensitiveness.

Since the writer commenced underground photography the sensitiveness of plates has been enormously increased; indeed the most rapid now on the market are nearly three times as quick as those obtainable two years ago. Mere speed is, however, not the only point to which attention has to be paid, as the quality of the film is of equal importance. Good, rapid plates are an essential where artificial illumination has to be employed, more especially in mining, where any figures in the view necessarily occupy somewhat strained positions. The writer's first satisfactory results were obtained on the Mawson plate, which then had a speed of about 80 on the Watkins scale, but the introduction of the Cadett lightning plate proved a perfect boon, as it allowed the exposure to be reduced one half. Most manufacturers have quickened up their plates during the past year, but from the last table published by Mr. Alfred Watkins of the trials which he has made, it appears that the Cadett plate still holds its own as the fastest on the market. The average speed issued is from 160 to 180 on the Watkins scale, and the numbers, which are marked on each box, may run in rare cases to as high as 228. All the writer's latest results, and also those of Mr. Burrow, have been obtained on such plates, and both can bear witness, not only to the great speed but the good quality of the film.

Methods of Illumination—The incandescent electric light is practically useless. The writer has exposed a plate for 30 minutes at the bottom of a shaft which seemed brilliantly illuminated, using stop *f* 16, and only succeeded in obtaining an impression of the incandescent lamps themselves and of their surroundings to a distance of not more than 6 feet.

The arc electric light gives far different results, and is somewhat largely employed in obtaining portraits on the surface. Underground, the conditions are different. Portrait lenses do not give good results, and if the next best lens is employed, it means four times the exposure necessary on the surface; it is also practically impossible to arrange reflecting surfaces in the happy manner that can be carried out in the studio. The inconvenience of carrying the electric cables into the working places is left out of consideration.

Messrs. Dewey & Bretz obtained a series of views in the mammoth seam at Kohinoor colliery, Shenandoah, Pennsylvania, with the aid of the arc electric light specially erected in the mine for such purposes. They used five lamps, each giving 1,600 candle power, but even with a diaphragm of *f.* 16, exposures of from 10 to 30 minutes had to be given. At the Chicago Exhibition the South Duffryn Colliery company exhibited two underground photographs taken by the Photophane Company of London, at the Abercanaid colliery, which were obtained with the aid of the arc electric light. The plates had an exposure of from 15 to 20 minutes, using stop *f.* 16. Anyone who is acquainted with the working of mines, need not be told that this is too long for a person to remain perfectly steady if he is to be shown in the act of performing any operation connected with getting coal, and no man can stand still for such a length of time, even when placed in a lounging attitude and supported. Putting aside the inconvenience, even with moderate lenses and rapid plates, the electric light seems quite inapplicable to photography in mines.

When artificial illumination is employed, the light must not only have a high degree of intensity, but be rich in rays which are chemically active, viz., green, blue and violet. The metal magnesium, when burnt in air, gives a powerful light rich in actinic rays, and as early as 1863 it was used for obtaining photographs by artificial light. Messrs. Debenham and Sopwith both employed it in the form of ribbon. The former cut a number of lengths of the ribbon, tied them together at one end, and thrust the other end into a lump of clay stuck against a sheet of tin, which was used as a reflector, and held in the hand. Mr. Sopwith's lighting arrangements consisted of a number of tin reflectors, usually from three to five, shaped into parabolic curves, to concentrate the light, before each of which was burnt from 6 to 10 inches of magnesium ribbon. The art of lighting consisted in using the lamps at suitable distances, and frequently the foreground was made up by secondary lighting after the holder of a lamp had withdrawn from his position. At the time when these photographs were taken the ordinary flash lamp was unknown.

The writer first used two regulating magnesium lamps, the ribbon being wound out as fast as it was consumed in the burner in front of the reflectors. An exposure of from 2 to 4 minutes was given, using stop *f.* 16 and a Mawson plate. It became at once apparent that while similar illumination had been successful in Mr. Sopwith's case in the comparatively thin seams of his district, it was useless in the 30 feet seam and its large working places. Only one of the numerous attempts made in the ten yard coal was successful; but fairly good results were obtained in the Silurian limestone mines, where the working places are similar in size and arrangement.

What is required is a very brilliant light for a short period, and to produce it a large quantity of magnesium must be rapidly burnt. Flash lamps, in which magnesium in the form of fine powder is blown through a flame, usually burning alcohol, satisfy these requirements, and provided a sufficient number be used, any desired illuminating power may be obtained, and if these be distributed softer effects in the lighting result. Often, however, the space in which the camera has to be operated is so confined that it is impossible to properly use one lamp; and in some cases it cannot be fixed on a stand, but has to be held in the hands of an assistant. Mr. Burrow found the smaller flash lamps ordinarily purchasable to be useless for the principal lighting, and designed two powerful ones, each having three orifices, and consuming ¾ ounce of magnesium powder for each flash. The two were supplemented in large areas by a few smaller lamps, and sometimes by one or two oxy-hydrogen limelights.

Anything burnt in oxygen gives a far more brilliant light than when burnt in air, and it is stated that magnesium gives twelve times its ordinary illuminating power when so consumed. All the writer's best results have been obtained by employing the lamp designed by the Platinotype Company, in which magnesium powder is burnt in the oxy-hydrogen blowpipe.

The impossibility of properly composing the picture on the ground glass screen adds a considerable amount of doubt to the uncertainty of obtaining any desired view. What is generally done is to arrange a series of lamps or candles about the main objects, and endeavor to get all these on the screen. After this has been done, it is sometimes possible to burn a short length of magnesium ribbon and examine the view thus revealed, but in many cases that procedure is impracticable, as the smoke produced will not clear away in reasonable time. Focussing is equally uncertain. What is done is to place a light somewhere in the middle distance and get that point sharp. Now, if the view could be seen on the screen as it is when working on the surface, it is often possible to sacrifice sharpness in an unimportant part, and thereby obtain a a clearer representation of several other points of importance. It sometimes happens below ground that the uninteresting points are in focus while the important points are indistinct.

Development—Having made the exposure, the subsequent treatment of the plate may be considered. The action of the light does not produce any visible effect, and the plate has to be treated with a chemical solution known as a developer to bring out the latent image. Developers act by reducing those portions of the silver bromide which have been exposed to light in proportion to the amount of light action, leaving unchanged those portions that have not been altered. In this way a negative is obtained which is the reverse of the original as regards light and shade, for the greatest deposit of silver is found where the image was brightest, and the smallest deposit where the object was in shadow.

Some developing agents act by themselves, but the greater number ordinarily employed require the addition of an alkali before they commence working. The quantity of alkali depends on what plate is being worked with; if an excessive quantity be used, general fog is apt to be produced, that is to say, a deposit of silver is formed all over the plate, even on those portions which have been unacted upon by light. To prevent either general or chemical fog, a soluble bromide is almost invariably added to the reducing and accelerating agents, so that the normal developer consists of three solutions.

The writer has obtained the best results with pyrogallic acid and ammonia in 10 per cent. solutions as follows:—

	Ounces.
1	
Pyrogallic acid	1
Sodium sulphite	3
Citric acid	¼
Distilled water to	10
2	
Liquid ammonia 0·880	1
Distilled water to	10
3	
Potassium bromide	1
Distilled water to	10

With a correct exposure 1 ounce of developer is best formed by taking 10 minims of each solution Nos. 1, 2 and 3, and diluting to 1 ounce, but in order that develop-

*English Patent No. 6,028, 1890.

† "A New Astigmatic Lens," C. P. Goerz. *Jour. Phot. Soc. Great Britain*, vol. xvii., page 253.

ment may be well under control, it is better to commence with half the quantity of alkali. Indeed, as the great majority of the writer's plates have been considerably under-exposed, he usually takes 40 minims of No. 1, 40 minims of No. 2, and 20 minims of No. 3, and dilutes the mixture with from 4 to 6 ounces of water (for the whole plate size). At intervals of about 10 to 15 minutes a further quantity of 10 minims of the ammonia solution is added. Development is slow, but usually all the details can be coaxed out and sufficient density obtained. When development is complete, the plate is fixed by immersing it in a solution of hyposulphite of soda, which dissolves out the unaltered silver bromide. Intensification of the image is, however, often necessary. This is generally done by first bleaching the negative with a solution of bichloride of mercury, and after washing for at least an hour in running water, treating it with a dilute solution of ammonia. If all the hyposulphite of soda has been eliminated from the negative by washing before placing the negative in the mercury solution, and if the washing be complete after bleaching, the writer's experience is that the image is practically permanent.

With very thin negatives, the writer prefers to use the ferrous oxalate developer in place of the ammonia solution, as the bleaching process and treatment with oxalate can be repeated over again, if sufficient density be not obtained with the first application. If this process be used it is of the greatest importance that the washing water shall not contain a trace of lime. Indeed, with a valuable negative, it is best to soak the plate in distilled water, after the preliminary washing and before applying the ferrous oxalate solution.

Many persons prefer the pyro-soda developer where sodium carbonate in its impure form (commercial "washing soda") is used as the accelerator. This rarely produces green fog, and if the proper proportion of bromide is employed is less liable to produce general fog. The writer has not been so successful with this mixture as with pyro-ammonia, probably because of his greater familiarity with the use of the latter. There is, however, little doubt in his mind that success in underground photography depends largely on efficient development, and as Mr. Burrow uses pyro-ammonia developer and is a photographer of long and varied experience, his opinions and practice are alike valuable. It is in development and the subsequent treatment of the negative that the professional excels the great majority of amateurs.

General Remarks—The difficulties to be overcome are not many, but are hard to surmount. In all classes of mines the smoke re ulting from blasting, the moisture-laden and misty atmosphere, and the dripping of water from the roof are customary drawbacks supplemented in coal mines by the presence of coal dust, which not only thickens the atmosphere, but deposits particles on the lens and plate. The condensation of water on the lens and plate is perhaps the most difficult matter to avoid. So far as the plate is concerned, one has to trust to luck; but with the lens, the best preventive is to carry it in the trousers pocket, and so warm it up to the temperature of the body. Even with all precautions, and after an examination has been made to see if the lens is clear immediately before exposure, the opening of some door in one of the airways may momentarily divert the regular current, and cause some cooler air to enter the place which is being photographed, with the result that the glass is chilled, and as soon as the ordinary warm air again comes into contact with it, the lens fogs and the plate is spoiled.

The difficulties of focussing and composing the picture have already been alluded to. Often on development it is found that the figures are very badly situated, or that some desired point is not included, or even that an important part is out of focus, and consequently the plate is spoiled. None of these things should happen if it were possible to examine the view on the focussing screen.

The smoke produced by burning magnesium is very dense, and if it gets in front of the lens it will spoil the plate. For this reason it is best that the current of air should be from the object to the lens, or the clearness of the picture will be sadly interfered with, even if not completely spoilt. Mr. Burrow has found on several occasions that where he could only get dull pictures looking, say, from east to west, he got clear ones of the same spot looking from west to east, and this was apparently not due to a change in the direction of the air current. He cannot explain the matter, but mentions it as a curious and oft-repeated experience.

The writer is of opinion that only one half the illumination is required in a metalliferous mine to obtain the same result as compared with a similar view in a coal mine. Rocks in metal mines such as fluorspar, quartz, etc., have a more or less metallic lustre, especially when wet, and reflect a considerable amount of light, while dull, black coal has rather a tendency to absorb it. Comparisons of the amount of light required in the limestone workings, and that necessary for similar views in the thick coal, support the above view. The only satisfactory instantaneous view that the writer has ever obtained, was in a gate road passing through a basaltic dyke, an excavation similar in all respects to those made in metal mines.

The invariable practice of the writer has been to burn weighed quantities of magnesium powder, for with the comparisons thus obtained, some guide can be formed or future occasions. If two platinotype lamps are employed, burning 60 grains of magnesium in each, supplemented by 20 grains in an ordinary flash lamp, and using the lens with stop *f.* 16, sufficient light should be obtained to illuminate the largest areas met with underground. The writer does not wish it to be inferred from the remarks made as to the smaller amount of light required, that photographs in metal mines are easier to obtain than they are in coal mines, indeed statistics of the Cornish and the writer's exposures seem to show that both are equally difficult. Mr. Thomas states that the average in the Cornish experiments has been about 17 per cent. of good negatives; 70 per cent. of the writer's exposures have been complete failures, and out of the remaining 30 per cent. only about one half are good.

The Sultana Gold Mine.

A correspondent writes as follows regarding the operations at the Sultana mine: "The Main Shaft is down now 150 feet below deck. It is well timbered with a separate ladder-way and a good ventilation shaft. Two drifts have been started from this shaft, one at 60 feet level and another at 120 feet. The drifts running north have not been pushed far. The 60 ft. level running south had to be stopped on account of a large open cut along the outcrop which averages about 30 ft. deep. The vein in the shaft has varied from 3 ft. up to 8 ft. in thickness of solid quartz. The 120 ft. level going south was in 35 ft. when I was there on the 10th inst. and they were pushing it ahead with power drills at the rate of 56 ft. per week. In the breast of this drift the vein was fully 3 ft. 6 in. thick of solid quartz. In the open cut to the south of the shaft house the quartz has ranged from 3 ft. to 8 feet thick. All the quartz that has come from these drifts, cuts and shaft has yielded an average of nearly one ounce bullion to the ton of 2000 lbs. Mr. Weir, manager of the Imperial Bank told me that the bullion from this mine sells far $16.00 per oz. Mr. Caldwell, the owner, claims that all the quartz crushed in his mill has yielded an average of fully fifteen dollars per ton from the battery and plates. But the concentrates do not add very much to this value. They amount to less than one per cent. of the ore and are valued at less than $1.00 per ton. Immediately behind the mill there is a second shaft down only 45 ft. so far. It is on another vein, which apparently merges into the main vein somewhere near the Main Shaft. During my visit orders were given to resume sinking in this shaft with the intention to cross-cut under the mill and connect with the 120 ft. level from the main shaft. This second vein averages about 27 inches of quartz in this shaft. All the quartz formerly taken from it yielded an average of over $20.00 per ton in the mill.

When the site for the mill was being graded on the edge of the lake, they uncovered a great body of quartz on the edge of the water, which measured twenty feet across and from a careful average sample assayed over $14.00 per ton. Caldwell is eager to undercut this great vein of rich quartz just as soon as possible with this 120 ft. level. But he has still almost 200 ft. to drive. However, he is sinking No. 2 shaft now as fast as possible with the intention of crosscutting into this mass of quartz as soon as they reach the same level. There is no chance of opening this great mass of ore from its surface, because it lies on the very brink of the Lake of the Woods and is only a few inches above water level. The main vein here is a renticular contact vein between schists and granite. It varies greatly in thickness and richness both horizontally and vertically. But every ton of quartz that has ever been crushed has yielded *at least* four dollars per ton. It ranges from this to upwards of fifty dollars per ten. Sa ples frequently assay up to $150.00 or $200.00. The shaft house is a very large substantial wooden building covered with steel shingles. It contains a 60 h. p. boiler, a Rand air compressor and receiver for 4 of their No. 3 drills and a steam hoist. Close alongside is the forge, which is well stocked with tools and with steel and iron. The mill stands about 235 ft. south of this shaft house. It is a solid substantial frame building 45 x 50 ft. covered with steel shingles. In the top story there is a feeding floor and grizzly, with a friction hoist to haul the cars over the tram from the shaft-house (and also to hoist the ore from shaft No. 2). Just under this floor is a Blake crusher set just above two strong ore bins. From these bins the ore is fed by automatic feeders to the two batteries of five stamps each. These weigh 850 lbs. and drop 90 per minute. Shoes and dies are chrome steel. Most of the amalgam is collected in the batteries. But there are large amalgamated copper plates in front (which are kept in fine order). The pulp flows from these plates into two Frue vanners and then runs to waste.

Close alongside of the mill is a very snug frame house used as an office and for sleeping quarters for the staff. I should mention that the mill is run by a 60 h. p. Waterous engine and a 75 h. p. Waterous steel tubular boiler. In the engine room there is also a small engine to run a dynamo supplying 52 incandescent lights for the mill, shaft house, assay office, house, etc. Alongside the mill is a large shed covered by steel shingles and heated with a large quantity of steam coils, which was built for a costly cyanide plant. Most of the plant has been torn out and cut up for other things, as this ore is not at all suited for the cyanide process. Some distance to the north-west of the shaft-house a well defined quartz vein averaging fully ten feet wide crops out in the ridge of some rising ground. This vein shows very distinctly at water's edge. I have always been surprised that the owner has never tested it in any way. He has not even taken samples for assay. I estimate that ten thousand tons of quartz could be quarried here and delivered to the mill at a cost of one dollar per ton without stoping below lake level. I had no opportunity to break out any fair samples of this quartz, but I see no reason why it should be any poorer than the average of the Main Vein where so much work han been done. There are about 30 hands employed altogether. Mr. Caldwell has a first-class Swedish mine foreman there who has got some very good sober Swedish miners under him. The engineer and amalgamator in the mill are very good men. Mr. Bell, the assayer and mill superintendent, is a well educated and competent official. You never hear any noise or rowdy conduct of any kind from the men's quarters. They are charged $4.00 per week for board. There is a capital wharf directly in front of the mill, where the largest steamers on the Lake of the Woods can discharge. An excellant steam launch capable of steaming about 10 miles an hour is part of the outfit.

Mr. Caldwell has been crushing about 80 tons of quartz per week, yielding an average of $1,200.00 worth of bullion. But during the last few weeks his small force of miners has been so busy with the re-timbering of the Main Shaft, putting in the new ladder-ways and the ventilating shaft that they have not crushed nearly as much quartz as usual. While not in a position to speak officially I am informed on good authority that the total amount of gold won to date exceeds $30.000, the whole obtained from what may fairly be called dead work.

NEW COMPANIES.

British Columbia Gold Dredging Co. Ltd., has been incorporated under the laws of British Columbia to take over and work mines in that Province. Capital, $1,500,000, in shares of $10. Head office, Vancouver, B.C. Directors: W. A. Shahan, J. E. W. Macfarlane and J. W. Campion.

Anglo-American Gold and Platinum Hydraulic Mining Company Ltd., is another British Columbia company, incorporated during the month. Capital, $250,000, in shares of $5 each. Head office, Vancouver, B.C. Directors: J. Barnet MacLaren, S. F. Scott, G. D. McKay, and R. Hughes. The secretary of the new company is Mr. A. E. Tregent, New Westminster. Operations are to be carried on in the Smilkameen country.

Slocan Milling Co. Ltd.—Registered 24th August, 1894.—Authorized capital, $100,000, in shares of $10 each. The directors are: A. E. Humphreys and John G. Williams, Duluth, Minn.; N. D. Moore, John Vallance and Howard Donnally, New Denver, B.C. Head office and works, New Denver, B.C. The company proposes to work mines and to carry on the business of milling ores in the Slocan District, B.C.

The Alamo Mining Co. Ltd., is the name of a new company registered, with headquarters at New Denver, in the Slocan District, B.C. Authorized capital, $500,000, in shares of $1. The directors are the same as those of the Slocan Milling Co. given above.

The Minnesota Silver Co. Ltd.—Registered with an authorized capital of $1,000,000, and headquarters at New Denver, B.C. Directors: G. J. Atkins, Howard Donnally, J. S. Blackaller, and Walter Marshall, of New Denver, B.C., and A. E. Humphreys, of Duluth, Minn.

Bridgeville Mining and Improvement Co. Ltd. has given notice of application for charter of incorporation under the laws of Nova Scotia. Authorized capital, $3,000, in shares of $20. The chief place of business is at Bridgeville, Pictou County,

..S. The directors are: C. F. Ross, W. E. Young, Thos. McMillan, Wm. Mc-herson and Thos. Williams, all of Bridgeville.

The Oromocto Coal Mining Co., with headquarters at Fredericton Junction, ew Brunswick, has been incorporated with an authorized capital of $40,000, in ares of $10. The directors are: Parker A. Nason, Gladstone; E. Moore, redericton; Luke E. M. Dewitt, Blissville; and Wesley D. Nason, of Gladstone.

British Columbia Stock and Mining Exchange—Messrs. F. C. Innes, J. W. cFarland, and George De Wolf, of Vancouver, have applied for charter of incor-oration under this designation, with the object of buying and selling shares and deal-g in mineral claims, leases of mines, and in all kinds of properties that are dealt in by e London Stock Exchange. The capital is $5,000, in shares of $25 each. Head ffice: Vancouver.

The Provincial Mining and Dredging Co., Ltd., is the title of a new com-ny seeking incorporation with an authorized capital of $1,000,000, in $10 shares, r the purpose of prospecting, dredging for and mining all kinds of precious and base etals in British Columbia. The directors are: Norman McLean, Hugh McLean, d W. F. Gore, and the head office is at Vancouver, B.C.

Horsefly Gold Mining Co., Ltd.—Application under the Foreign Companies ct, B.C., is made for incorporation by this company, with headquarters in San Fran-sco, Cal., with the object of taking over leases and mining claims, and to carry on e business of hydraulic and other processes of mining, in the Province of British olumbia. Capital $1,000,000, in shares of $10.

Scott Mining Co.—This company has been registered under the Foreign Com-nies Act, B.C., with an authorised capital of $100,000, in shares of $100, and head-arters at Seattle, Wash., to carry on mining in the Province of British Columbia.

Canadian Mica Co., Ltd.—This company with a capital of £90,000, in £1 hares, was registered in London, Eng., on 24th ult., to acquire properties in counties Frontenac, Ont., and in the counties of Saguenay and Ottawa, in the Province of uebec. The following are the signatures to the articles of association, each for one are: G. Atkins, West Dulwich; J. Robertson, West Dulwich; R. H. Willats, olborn Viaduct; A. G. Larker, Heine Hill; F. Spencer Hendon, W. Spencer endon, F. Page, Victoria Park, London.

The Marmora Mining and Milling Co., with chief place of business at Toronto, is ing incorporated with a capital stock of $24,000 to take over and operate the reduc-on mill plant and machinery of the Hastings Mining and Reduction Company at armora, Ont., and for other similar purposes.

The Baltimore Coal Mining and Railway Co., is seeking incorporation in Nova cotia. Capital stock $300,000. Head office, Hillsborough, N.S. Among the incor-rators are Charles Archibald, Blowers Archibald, William F. Wortman, Frederic eeves, Warren Taylor and Francis Ritchie. Power is asked to construct and operate railway from near Baltimore mines to some point of shipment on the Petitcodiac ver. It is asked to exempt the property from taxation for 10 years, and power is sked to issue bonds to the extent of $10,000 per mile of the railway. The object of e company is to develop the coal mines at Baltimore.

The Otterville, Ont., Brick and Tile Manufacturing Co., has been corporated with a capital stock of $5,000, to manufacture bricks, tiles, terra cotta are, etc.

Memramcook Gold Mining Co.—A dispatch, under date of 18th inst., says: Another one of the many meetings of Memramcook Gold Mining Co. was held at orchester to-day. The following are the officers elected: J. W. G. Smith, presi-nt; E. C. Cole, Moncton, vice-president; H. J. Logan, Amherst, secretary; C. E. reeman, Amherst, treasurer; A. C. Vannicter, Moncton, and Dr. Gaudet, St. seph's, directors; and M. G. Teed, solicitor. It will be seen that Mr. Neily has cated his seat as president and also retires from the management. The new board directors held a meeting this evening in which they decided to pay up all the liabil-ies and give the property another test."

Bras d'Or Marble Co.—This company was re-organized on the 17th May with llowing gentlemen as directors: R. Macdonald, of Macdonald & Co., Halifax; eorge E. Francklyn, Halifax; R. Uniacke, president Halifax Banking Co., James Hattie, of Hattie & Mylius, Ald. Mosher, Henry Saunders and G. Hobrecker. t a subsequent meeting of directors the following officers were elected: President, Macdonald; vice-president, George E. Francklyn; secretary-treasurer, George attie. The capital required to develop the property and carry on the work of uarrying marble has been subscribed, and work is to be carried on under the super-sion of D. MacLachlan, manager. A road is in course of construction which will ring the quarry within five miles of the railway. Some $10,000 have already been pended in testing the quarry. Samples sent to Great Britain have given great tisfaction. The property has been examined and approved by Mr. Underhill, of ermont.

A new Form of Rail.—Mr. William T. Manning, chief engineer of the Bal-more and Ohio railroad, has recently been granted a patent on an improved form of il. The head of this rail, instead of being symmetrical, as is customary, is made ne sided. Mr. Manning claims that a large proportion of the rails on curves are rown away before they are worn out, for the reason that the inside of the head is orn off, and that by placing this rail in the track with the wider side of the head on he inside, and after it has become pretty well worn either turning the rail end for end r placing it on the other side of the track, it will last twice as long as a rail of the ual form. It is not claimed that this rail will have any great advantage over the ommon form in straight track, but its great advantage will be found on roads where here is a large percentage of curvature. It is stated that on such roads the high rail n the curves is often replaced several times without disturbing the inside rail.

GOLD MINING IN BRITISH COLUMBIA.

"It would seem," says the Nakusp *Ledger* "that the excitement caused by the discovery of gold on Cariboo creek, would be the means of a rich quartz region being opened up in that section. On the 15th of August, Chas. Vader acting on a sugges-tion from Nelson Demers, left his placer ground and proceeded up Mineral creek to prospect for quartz. When three miles away from Cariboo creek, and about six miles in a direct line from the Columbia river, he ran across a stringer of solid mineral in a granite, slate and phorphyry formation. Tracing it up he discovered a ledge of quartz eight feet wide and traceable for 300 feet on the surface. He staked a claim and called it the Orpheno, an assay from it giving returns of $175 in gold and six ounces in silver.

The Le Roi is rapidly developing into a mine. Forty men are at work and ten tons of ore are exported daily to the Tacoma smelter via Spokane. Air compressors and other machinery are about to be put in. Col. Peyton has just bought three car-loads of merchandise in Spokane for this mine.

From Forty-nine Creek we learn that J. F. Ritchie has returned from a visit to the works and reports that a want of water alone prevents them from working a good bank of gravel. One sluice box gave $18 worth of gold from old tailings. The com-pany intend this winter to increase the size of their flume and sluice boxes so as to take full advantage of the 2,000 inches of water which flow for some ninety days every year. The flumes and boxes will be covered with loose rock to hold them in position and prevent their being disturbed by a washout. This will entail an expenditure of some four or five thousand dollars, but the ground shows up well and fully justifies the further investment of capital.

The Nakusp Mining Co. and the Goat Canyon Co. have at last bottomed on bed rock. Their prospects are good, the gravel being rich in coarse gold. But there is no disputing the fact that the boulders are large and numerous and will give a great deal of trouble.

The Cullough Creek Tunnel Co., is opening up the old works and are drifting to strike the old rim rock. The previous company spent $20,000 on this claim without striking bed rock. Work will be continued all winter.

On Smith creek, Haskins & Co. are sinking a shaft on their property, and are down 20 feet. They expect to reach bed rock at a depth of 50 feet. The top gravel contains pay dirt. A wheel and hoisting gear are being brought in and this claim will work all winter.

SILVER LEAD MINING IN B. C.

[FROM OUR EXCHANGES]

The Cumberland, which immediately adjoins the Idaho and St. John, until the last few days had only been able to show 18 inches of clean ore at a depth of over 100 feet, can now lay claim to have one of the finest showings in the Slocan. The exten-sive ledge of clean ore recently exposed on the Idaho has now been traced and strip-ped for some distance on the Cumberland ground by Martin Clair, one of the owners, and so far a four foot vein of clean ore has been uncovered.—*Tribune.*

The owners of the Thompson group of claims to the south of Four-mile, have every reason to be satisfied with the result of the development work done by them on their claims. The ledge appears to be very similar to that on the Fisher Maiden. The surface showings were dry ore mixed with galena, but the greater the depth the less the galena until it can be called an entirely dry ore. With two such promising milling propositions as those referred to, both situate within a short distance from Silverton, the Alpha group shipping ore, and the Read and Robertson group employ-ing a large force of men, we may look for considerable activity in the Four-mile camp this fall and winter. —*The Miner.*

Six men are at work on the Northern Belle No. 2, in Slocan district, on which the vein is from 8 inches to 2 feet in width. Ore has also been struck in the R. E. Lee tunnel. Both these claims are in the neighborhood of the Washington.

In sinking a shaft at the mouth of the tunnel on the Josie, in Trail creek district, a fine vein of ore was struck at a depth of 50 feet.—*The Tribune.*

Returns have just been received from the first car of Skylark ore sent out this year by the Spokane and Great Northern Mining Co. The ore yielded 199.4 ounces in silver per ton, $26.60 gold per ton and 5.6 per cent. lead. This ore will net $100 per ton even after paying for packing and waggon freight to Marcus. A second car load goes forward in a day or two.

Mr. J. A. Mara, M.P., has secured the free entry of the 100 ton concentrating plant of the Slocan Milling Co., which they intend to build between New Denver and Three Forks.

"The Silver King on Toad mountain has about 60 men working," said Mr. Le-Bau, of Nelson, "and has just let the contract for the hauling of 50 tons of machinery from Nelson to the mine, a part of which is now on the ground. The consulting engineer is expected out from England in September, to decide upon the nature of additional machinery needed. The mine will soon ship 400 tons of ore to Denver." —*Spokane Review.*

The following are the particulars of the Humphreys-Moore concentrating plant, now being constructed by Fraser & Chalmers, Chicago, at the mouth of Howson Creek, about one mile from Three Forks, Slocan district, to handle the output from the Idaho and Alamo mines:—

An elevated tramway running straight down the creek will discharge the ores on the upper levels of the concentrator building, and the lower level, where the finished product comes out, is only a few feet from the railroad grade. The building itself is 153 feet long by 53 feet wide with an elevation of 80 feet. It is divided into six compartments at differing elevations, and in the foundation there are four stone and mortar retaining walls. The rest on the structure is of wood. The ore enters the mill on the upper floor at an elevation of 62 feet, and on that level it is crushed. From the rock crusher it drops 18 feet to the first floor through an ore bin, from which a self-feeder passes it to the grand rolls where it is crushed again. The ore is then elevated to the first floor where it passes through a conical screen 36 x 42 inches by 6½ feet. From this screen the rock falls to the second floor again where the coarse rock goes through a set of rolls and is elevated again to the first floor, the fine rock going direct to the elevator. The ore then passes through three different screens. From these it goes to different compartment jigs. The coarse rock then goes through a Huntingdon mill and from that into three 4-compartment jigs, 12-inch mesh. Everything then goes into a settling tank and from that into four Calumet & Hecla buddlers where the final separation into waste and concentrates takes place. The plant was manufactured by Fraser & Chalmers, of Chicago, and cost $11,715, but with necessary additions will foot up to about $14,000. There are 150,000 feet of lumber in the buildings and 175 yards of stone and mortar work. The buildings will cost in the neighborhood of $30,000. The capacity of the mill will be 100 tons of ore in 24 hours. There will be extensive ore bins placed on the hillside above the mill and the company will put in an elevated tramway next spring to transport the ore from the hill. It is not the intention to do custom work unless in lots of 1,000 tons and over. The company however mean to buy ore as soon as the mill is running. The work is being held back by the delays in railroad construction.

The *Slocan Times* gives the following estimate of the shipments of ore from the Slocan district during the coming winter :—

	Tons.
Slocan Star	2,000
Noble Five	1,500
Other claims on Reucau Mountain	1,000
Wonderful	500
Idaho	1,500
Alamo and other claims in Idaho Basin	500
Grady group	1,000
Fisher Maiden	500
Mountain Chief	500
Dardanelles	500
Ruby Silver and Surprise	300
All other claims	1,000
Total	10,800

The deal has been closed which consigns to the Omaha & Grant smelter 800 tons of ore from the Alpha mine, and the shipment will begin without delay. A $3 rate from Silverton to Nakusp has been secured. This will be the largest individual shipment yet made from the Slocan country, and the largest, but one, made from West Kootenay, the exception being a shipment of 1,000 tons made from the Le Roi, at Trail Creek, last spring.

At the joint tunnel on the Black Diamond and Little Phil mines, work is still going on. It is now in 368 feet. They have cut two veins so far and are now driving for the third. The first vein cut was 75 feet from the mouth. It showed a body of galena eight feet wide. Five feet of it is quite clean, assaying 42 ozs. silver and 60 to 70 per cent lead. The other three feet is very good concentrating ore, being a three to one proposition. The second vein cut was quite 11 feet wide, but was virtually barren where they crossed it, only carrying galena in small particles. The third vein that they are now running for shows very well on the surface, the ore being of a good grade in the two shafts sunk on it, 80 ozs. and 68 per cent. lead being the average of some 20 samples taken from these shafts.

Mr. E. D. Carter, lessee of the No. 1, is now in Wisconsin getting his company in organization. They are also owners of the Comfort and Highland claims, and as two of the company are here and two in Wisconsin, Mr. Carter has gone there to fix things up. Heretofore all has been in the names of the two owners here. Mr. Carter is expected back this month to start up the mine and mill again. On their last run the mill proved adapted to the ores, and on a run of 51 days produced 69 tons of concentrates that sampled and sold at the smelter in Great Falls, Montana, 304 ozs. silver and 7 per cent. lead. The mine shows several large bodies of fine ore and as it has been practically untouched they have a great area of virgin ground known to be ore bearing.

Forty tons of Silver King ore, valued at $4,000, were, the other day, shipped to Denver, Col., from Nelson. The freight rate was $14 a ton.

It is reported that a concentrator will be built at the Silver King. The new machinery at the mine is being placed in position.

The latest shipment from the Skylark gave, for the carload lot, 215 ounces of silver and $26 gold per ton, and six per cent. lead. Another car goes forward this week that will be of the same grade.

Fifteen tons of ore from the Alpha mine was brought in on Monday and 60 tons the following day. This is the first ore shipped over the Nakusp and Slocan railway, and will be followed by 700 tons from the same mine. The ore goes out of the district via Revelstoke.

The *Mining Journal* (London) for August 25th, gives lengthy extracts from the report of the British Columbia Board of Trade on mining matters. In an editorial on the subject, after detailing the wonderful richness of specimens from the Slocan, Toad Mountain and West Kootenay generally, it says : "Taking these samples to be fair average specimens of the products of these districts, as certainly they may be presumed to be, a happy history of successful working would seem to be awaiting British Columbia. Nothing but financial depression is responsible for the fact that the day of great things has not yet arrived."

Manager Hendryx is reported as saying that the smelter company at Pilot Bay will be ready within two months to purchase all ore offering. If so, and the price is equal to that paid by outside smelters, there is no reason why every ton of ore mined in Kootenay should not be treated at Pilot Bay. The operation of that smelter means employment to quite a number of men, and every man drawing pay regularly in Kootenay is a factor in the development of the mineral resources of the district.

MISCELLANEOUS ITEMS.

On 22nd inst., while a number of men were loading ore on the 7th level of the Copper Cliff mine, a mass of rock, estimated to weigh seven or eight tons, fell from the roof, crushing two men under it, one being killed almost instantly, and the other living about one hour in an unconscious condition. The names of the unfortunate men were Thos. Lintley and Samuel Mattson, both Finlanders. A companion, who was close beside them, escaped with a slight bruise on one leg. One piece of the rock which fell was six feet long, three feet wide, and over two feet in thickness. An inquest is being held.

From the new chrome iron deposits being worked at Black Lake, Que., we learn that the Lambly-Nadeau Co. has taken out over 180 tons first grade ore, containing over 50 per cent. sesquioxide of chromium. Mr. Joseph Lemelin has mined over 140 tons from the property of Dr. Reed. The other operations are reported to be meeting with encouraging results. Shipments have been made to the Baltimore chrome works, the Tyson's, Baltimore, the Kalvin Chemical Co., Philadelphia, and to the Carnegie Iron and Steel Co., at Pittsburg.

Wellington Coal Co., Nanaimo, B.C., have ordered an electric mining locomotive for their mines, from the Royal Electric Co., Montreal.

The output of coal from the Joggins mines of the Canada Coals and Railway Co. is now close upon 450 tons per day. A correspondent writes : We have three slopes working, but I might state that No. 1 is presently lying under water, but is being rapidly unwatered with a view to extending our workings in this direction. It is intended to fit up a winding engine and boilers at the slope, and in due course an extensive output of good clean coal is expected. At No. 2, two new double-flued boilers have been placed down, and the output from this slope is in consequence steadily increasing. At No. 3, two new, seven feet diameter, double-flued Lancashire boilers have been put in and one large coupled horizontal winding engine. This work has just been completed, and in course of time the output from this slope will be more than the other two combined, in fact, within a year from now it is certain the output will exceed 1,000 tons daily. A haulage engine on the tail rope system has also been erected at No. 3 to draw the coal to No. 2, where it is prepared for the market. This work has all along been done by horse. The engine has been built by the Ingersoll Rock Drill Co., Montreal, and has the appearance of being a first-class piece of workmanship. The Lancashire boilers, fitted with Galloway tubes, were built by the the Robb Engineering Co., Amherst, N.S. The winding engine is second hand, and was bought from the proprietors of the Chignecto colliery, Maccan. A great many other improvements are going on, including arrangements for shipping slack etc., by water, and improvements at the wharf, which has been entirely re-modelled.

A flow of natural gas, capable of supplying a town the size of Edmonton has been struck at Athabasca Landing by the petroleum boring party under the supervision of Dr. Selwyn, of Ottawa, and the direction of the Dominion government. Farther down the Athabasca river, natural gas has come up from fissures in the rock for years, and the bubbles that rise to its surface are easily ignited. At low water, these fissures being exposed, can be lit, and the weary traveller is often spared the necessity of cutting wood to boil his kettle, by merely putting a match to them. They are easily put out, but more often they are left until the river rises and extinguishes them. The fact of such a flow of gas being struck at a depth of 400 feet, shows the amount of pressure existing in the overlying strata, and will assist the party in making calculations on the distance yet to go before oil is reached. As sand, suitable for making plate glass can be extracted from the tar sands along the river, this discovery of natural gas may, in future years, prove a boon to glass manufacturing industries.

MINING REGULATIONS

TO GOVERN THE DISPOSAL OF

Dominion Lands Containing Minerals other than Coal.

ESE REGULATIONS shall be applicable to all Dominion Lands containing gold, silver cinnabar, lead, tin, copper, petroleum, iron or other mineral its of economic value, with the exception of coal.

ny person may explore vacant Dominion Lands, not appropriated or reserved vernment for other purposes, and may search therein either by surface or subean prospecting for mineral deposits, with a view to obtaining under the ations a mining location for the same, but no mining location or mining claim be granted until the discovery of the vein, lode or deposit of mineral or metal the limits of the location or claim.

QUARTZ MINING.

location for mining, except for iron or petroleum, on veins, lodes or ledges of or other rock in place, shall not exceed 1,500 feet in length and 500 feet in th. Its surface boundary shall be four straight lines, the opposite sides of which be parallel, except where prior locations would prevent, in which case it may be h a shape as may be approved of by the Superintendent of Mining.

ny person having discovered a mineral deposit may obtain a mining location or, in the manner set forth in the Regulations which provides for the char- of the survey and the marks necessary to designate the location on the d.

When the location has been marked conformably to the requirements of the lations, the claimant shall within sixty days thereafter, file with the local agent e Dominion Land Office for the district in which the location is situated, a ration or oath setting forth the circumstances of his discovery, and describing, as y as may be, the locality and dimensions of the claim marked out by him as said; and shall, along with such declaration, pay to the said agent an entry fee IVE DOLLARS. The agent's receipt for such fee will be the claimant's rity to enter into possession of the location applied for.

At any time before the expiration of FIVE years from the date of his obtaining gent's receipt it shall be open to the claimant to purchase the location on with the local agent proof that he has expended not less than FIVE NDRED DOLLARS in actual mining operations on the same; but the claims required, before the expiration of each of the five years, to prove that he performed not less than ONE HUNDRED DOLLARS' worth of labour during year in the actual development of his claim, and at the same time obtain a wal of his location receipt, for which he is required to pay a fee of FIVE LARS.

The price to be paid for a mining location shall be at the rate of FIVE LLARS PER ACRE, cash, and the sum of FIFTY DOLLARS extra for the y of the same.

No more than one mining location shall be granted to any individual claimant the same lode or vein.

IRON AND PETROLEUM.

The Minister of the Interior may grant a location for the mining of iron or petroleum, not exceeding 160 acres in area which shall be bounded by north and south and east and west lines astronomically, and its breadth shall equal it in length. Provided that should any person making an application purporting to be for the purpose of mining iron or petroleum thus obtain, whether in good faith or fradulently, possession of a valuable mineral deposit other than iron or petroleum, his right in such deposit shall be restricted to the area prescribed by the Regulations for other minerals, and the rest of the location shall revert to the Crown for such disposition as the Minister may direct.

The Regulations also provide for the manner in which stone quarries may be acquired.

PLACER MINING.

The Regulations laid down in respect to quartz mining shall be applicable to placer mining as far as they relate to entries, entry fees, assignments, marking of localities, agents' receipts, and generally where they can be applied.

The nature and size of placer mining claims are provided for in the Regulations, including bar, dry, bench creek or hill diggings, and the RIGHTS AND DUTIES OF MINERS are fully set forth.

The Regulations apply also to

BED-ROCK FLUMES, DRAINAGE OF MINES AND DITCHES.

The GENERAL PROVISIONS of the Regulations include the interpretation of ex pressions used therein; how disputes shall be heard and adjudicated upon; under what circumstances miners shall be entitled to absent themselves from their locations or diggings, etc., etc.

THE SCHEDULE OF MINING REGULATIONS

Contains the *forms* to be observed in the drawing up of all documents such as: "Application and affidavit of discoverer of quartz mine." "Receipt for fee paid by applicant for mining location." "Receipt for fee on extension of time for purchase of a mining location." "Patent of a mining location." "Certificate of the assignment of a mining location.' "Application for grant for placer mining and affidavit of applicant." "Grant for placer mining." "Certificate of the assignment of a placer mining claim." "Grant to a bed rock flume company." "Grant for drainage." "Grant of right to divert water and construct ditches."

Since the publication, in 1884, of the Mining Regulations to govern the disposal of Dominion Mineral Lands the same have been carefully and thoroughly revised with a view to ensure ample protection to the public interests, and at the same time to encourage the prospector and miner in order that the mineral resources may be made valuable by development.

COPIES OF THE REGULATIONS MAY BE OBTAINED UPON APPLICATION TO THE DEPARTMENT OF INTERIOR.

A. M. BURGESS,

Deputy Minister of the Interor

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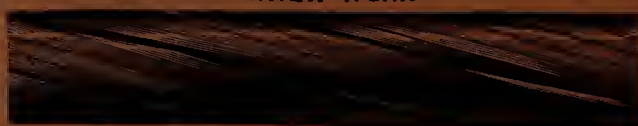

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Canadian Mining Review

Established 1882

Vol. XIII No 10 — 1894—OTTAWA, OCTOBER—1894. — Vol. XIII.—No. 10.

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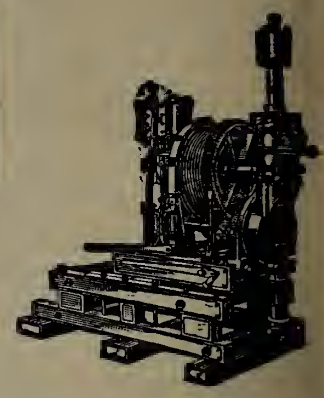

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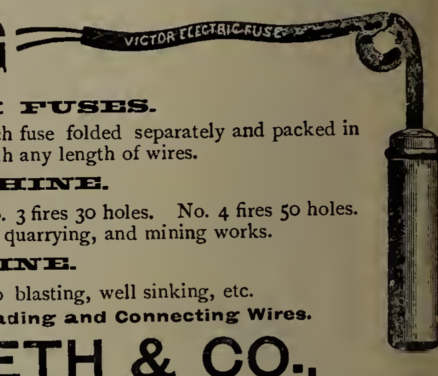

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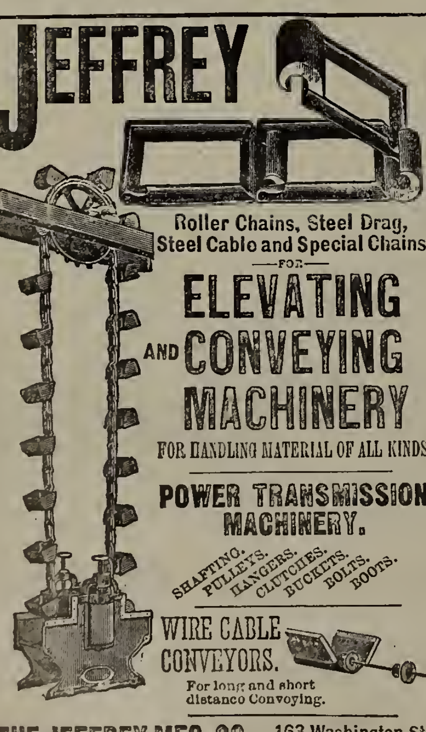

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The Canadian Mining Review

Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Victoria Chambers, Ottawa.

VOL. XIII., No. 10 OCTOBER, 1894. VOL. XIII,, No. 10

Drawing the Long, Long Bow!

If you're a great financial man,
And you want to start a Co.,
You'll find the most successful plan
Is to puff and gas and blow.
You'll scoop the curate's little store,
And ruin widow's by the score,
And bag the half-way man ot war
By drawing the long, long bow.
You put the money into a mine
Away in Mexico,
And then with booty large and fine,
You seek the distant Argentine,
Like other men who used to shine
In drawing the long, long bow.—[*Opera.*

A phosphate miner, who announced his intention of taking up the production of mica, was warned by a brother miner, "Don't you do it! everyone who has anything to do with mica becomes a monumental liar!" But it was replied: "I suppose he has first had an education in phosphate." It was admitted that in that case he might not have much to learn in the way of prevarication. Canada has been through an experience in phosphate mining, the history of which would be instructive and entertaining in spite of its unfortunate issues. Many honest and faithful attempts were made to mine phosphate, both with private capital and by joint stock companies, where the money was carefully and judiciously expended. The uncertainties of the deposits, and finally the reduction of the market price by one half, owing to the discovery of phosphate in Florida, made the business unprofitable and caused the industry in Canada to be practically abandoned, though let us hope this is only temporary. All this time, in the midst of genuine operations, there was a constant booming of the business by schemers, who, by the aid of extravagant romances, sought to unload properties upon confiding capitalists or the unwary public, at prices often infinitely in excess of their value, for they were so worthless in many cases that their operation meant the sinking of all the money that could be put into them. These "wild-cat" enterprises culminated in the grand swindle of the General Phosphate Corporation, by which more than half a million dollars were absolutely lost, and one more deterrent was given to English capitalists against investing in Canadian enterprises. It looks now as though a similar experience was to be gone through with mica mining. Owing to the recent discovery of the value of mica as an electrical insulator there has arisen a considerable demand for it. Many properties have been worked for its production, but mainly at a loss, and operations have been reduced to a few exceptionally favored properties, which, under economical and careful management, can make a fair commercial profit. The difficulties encountered consist in the uncertainty of the continuance of the deposits, the great variation in quality, and the difficulty of procuring large sizes. As the price varies from 1 cent to 50 cents per pound, it will be seen that the profit depends upon the securing of large sizes. When the producer comes to find a market for his product he realizes the truth of the scriptural adage, "It is naught, it is naught, saith the buyer." If his mica will not cut large sizes he is told it is worthless and that small mica is in unlimited supply. If the color is dark it is said that only a silver-grey is wanted. If it is hard only soft mica can be used, and if it is soft nothing will do but hard. If no fault can be found with his product, he is told that there is no demand and that a substitute for it has been found in brown paper. He then in despair accepts the offer of a travelling agent who claims the privilege of culling it, and after his selection the miner finds a large quantity left on his hands, and not enough paid for the balance to cover the cost of mining. These are some of the difficulties, and they may as well be faced and frankly acknowledged, for a country is not benefitted permanently by having money squandered in it for unprofitable enterprises. A reaction comes that injures legitimate work and hinders the development of promising industries. Experience, however, has shown that if good mica lands can be secured at a moderate price and be judiciously worked, they can doubtless be made to pay. The air and the press are full just now of a mica boom. Lands that were valued at a few hundred or a few thousand dollars are now quoted in the hundred thousand We are gravely informed in the *Ottawa Free Press* of a shipment of "350 tons of dressed white mica of large sizes," from the Beaver Lake Mines, Que., a quantity which would be worth nearly two millions of dollars, and exceeding in bulk the production and consumption of the whole world during a long period. An attempt was lately made to float a mica company in New York with a capital of a million dollars, based upon a few properties that would be dear at ten thousand dollars. Now we hear of an English company with a capital of £90,000 that is going to pay great prices for lands, and is setting every owner of mica or of mineral lands agog to realise an immediate fortune for his holdings. Reporters in search of a sensation crowd the papers with fictitious stories, that they take no trouble to verify by consultation with men versed in the industry. Every person who has any practical knowledge of mining and marketing mica knows the utter falsity of these statements; and what can be the object af such absurd exaggerations can only be conjectured. It seems most probable that the intention is to bond properties to be unloaded upon English investors by the wily London company promoters. The Phosphate Corporation had about half the phosphate properties in Canada tied up for two years, causing expense and worry to the owners, and they finally selected a few properties, some of which were bought, not on account of their mineral richness, but because they belonged to men prominent in political life, whose influence might aid in floating the company. These politicians, who had scarcely if ever seen a lump of phosphate, secured immense prices, and most of the mining men who had toiled in the development of lands and had bonded them with great expectations were doomed to disappointment. This should be a warning to owners of lands to be cautious about tying up their properties. Many companies are registered in London with £100,000 capital that do not possess £100 in cash, and it is not as easy as it once was to persuade the British public into bogus investments. It is astonishing though how much of this still goes on. A promoter who had floated a disastrous concern started another enterprise soon after the wrecking of the first. He was asked if he thought anything would go with his name on it after this last fiasco. "Oh, that does'nt matter," he replied, "there's a new fool born every minute." All the interests and sentiment of the REVIEW are of course in favor of the promotion of Canadian mining enterprises, and it is for this reason that we raise a warning against the misrepresentation of the true state of affairs and utter a caution against inflation of values and exaggerated estimates. It is said that the counterfeit is the proof of the existence of real value, and so a lie is often evidence of the truth. The immorality that hovers around mining only exists because there is a genuine basis to the industry, and fortunes often come to the steady workers who persistently and pluckily delve in the ground for its mineral wealth. To promote mining in Canada, we need to instil a conviction into the minds of foreign capitalists that there is not only mineral wealth in the country but that there is a sense of moral responsibility in the use of capital for legitimate work. While we deprecate swindles and exorbitant sales of unpromising lands as in the end injurious, we are eager to promote the development of the mining industry, and we believe there is a good chance for profit for those who intelligently engage in *Moral Mica Mining*.

Mining Education in Canada.

In the course of a recent interview with a McGill graduate in Mining Engineering, we were forcibly impressed with the conventional character of the curriculum adopted by Schools of Mines generally. Necessarily such courses of study must aim at as complete a scientific education as is possible in the time allotted, yet the particular branch of the profession which the future engineer is to adopt limits the utility of many of the studies undertaken. An engineer of mines, to be proficient, must be enough of a civil engineer to make his own surveys, above and below ground, lay out his railway curves, etc., etc.; enough of a mechanical engineer to select his machinery with a view to its best utility and economy, and to oversee its erection and maintenance in a proper manner. He must be enough of a chemist to thoroughly understand the composition and nature of his ores, country rock and associated rocks and minerals, and to know the possibilities and impossibilities of inorganic reactions. He should be skilful with the blow-pipe to determine readily the value of common ores and minerals, and be able to afterwards make an accurate assay for the precious metals. A knowledge of structural geology to enable him to work out or recognize the character and probable origin of his ore body, is indispensable. Now-a-days the mining engineer must go a step farther, and be physicist enough to be thoroughly familiar with the laws of gases, especially for the utilization of compressed air, and likewise he must know enough of that mysterious force we call electricity to enable him to utilize it intelligently for power and lighting. Such a training cannot be given without abundance of time, usually four years are required by the schools. Whether the proportion of mathematics now embraced in the course as usually adopted could not be reduced with advantage, to permit of a larger amount of time being given to quantitative work in chemistry and assaying, and to more practical work in the physical and other laboratories, we submit as an inquiry to those within whose jurisdiction the course of instruction at the various schools lies. We feel safe in saying that practical engineers—men who have passed the full course as now laid out and have had ten or more years in active professional work afterwards, will endorse the idea and will probably go farther A wider range of instruction in the shape of compulsory visits (for the purpose of study) to neighboring mining and metallurgical establishments, is most desirable, demanding close and comprehensive reports from each student of what *he has seen* and understood, of what he has *seen* but *not* understood, and a final report by the instructor to each student of what he *should* have seen, and *why* he should have looked for this and that. In the new school which has just been opened at Kingston we think that an opportunity has been neglected for a reform, (or perhaps it would be more becoming to say an experiment) in this direction. The establishment in connection with this school of a good working metallurgical laboratory is greatly to be desired. There are very many promising 'prospects' in Ontario which are so remote from testing laboratories as to preclude the idea of making mill run tests, and no other test for the precious metals is of any value. The cost of a small but complete plant that would take as small a batch as 200 lbs. and give a working result from the same, would not be large and should prove self-sustaining from costs collected, besides furnishing just the element of instruction to students, which is, in these modern days, an absolute necessity.

Canadian Capital for Canadian Mining.

Elsewhere in this paper mention is made of the manner in which the authorities of the recent Triennial Provincial Exhibition at Halifax treated the exhibit of the mining industries of Nova Scotia. We do not propose to comment on the same further than to make it the text for a short paragraph on the folly of expecting this Canada of ours to grow and prosper without the support of its own citizens. "Canada for the Canadians" has been the cry of an especially self-satisfied and contented (and we might add stupid) portion of our population. But we take it that a more liberal and far-seeing portion would say "Canada—not only for Canadians. but for all aliens who will bring in their capital and sojourn among us." And to induce such capital to enter Canada and remain here, and be a profitable investment is, we submit, one of the proper and lawful objects of exhibitions, be they Provincial or Dominion. In crowding the exhibit (which we understand was an exceptionally fine one) into a little room in the gallery about six feet by ten in area, the powers that be in Nova Scotia were very short-sighted; of the 25,000 people visiting the exhibition very few were enabled to see the exhibit and thousands were ignorant that any such was on view. It has been a constant source of surprise to the REVIEW to find Canadians (without distinction of Province) so ignorant of their own resources in minerals of economic value. There is, we venture to say, an abundance of capital in Canada for full development of its mines and quarries, —but this capital is not only timid, but is ignorant of the chances for successful investment which exist on every side about it, and which are seeking to be made known and to be investigated that such capital may be induced to embark in the business of mining, milling, smelting and manufacturing the products to be obtained. We can conceive few more legitimate objects of Provincial exhibitions in the future than to take up the subject of a properly classified and well displayed exhibit of minerals and metals of economic value. The REVIEW is well aware of the enterprising spirit of some Canadian gentlemen who, for years now, in the various provinces, have pluckily demonstrated their faith in our resources by the expenditure of very considerable sums. The development of the phosphate, mica and iron industries of Quebec furnish conspicuous examples. Nevertheless the fact remains that much home capital is both unconscious and chary of the opportunities offered it. and a large measure of publicity is desirable as an agent to help in removing this ignorance or mistrust.

The paper published in this issue, read by Mr. A. Sangster, Jr., of the Canadian Rand Drill Co. at the Sherbrooke meeting of the General Mining Associatson of the Province of Quebec, on "Repairing Rock Drills," will be read with interest by every superintendent, mine manager or contractor, who has had occasion to use machine drills in his work. The suggestion made by President Blue, in the discussion following the paper, that the first cost of the drills should be reduced from 25 to 50 per cent. of the present price and the drill could then be thrown away when used up, will commend itself at first sight, but is not a satisfactory solution on further investigation. We have been promised a public discussion of this paper, supplemented by actual costs of repair, at the next meeting of the Association.

Mr. E. D. INGALL, A.R.S.M.,

Chief of the Division of Mines and Mineral Statistics, Geological Survey of Canada.

EN PASSANT.

The next ordinary meeting of the members of the Mining Society of Nova Scotia will be held in the rooms of the Society, at Halifax, on Tuesday, 6th November next. The business will include the consideration of the report of the committee on federation, and discussions on the various papers submitted at the Cape Breton meeting. The members will sup together in the Halifax hotel after the evening session.

Dr. A. R. C. Selwyn, C.M.G., Director of the Geological Survey of Canada, has gone to England on a three months' vacation. Rumor is current that Dr. Selwyn will then be superannuated and Dr. G. M. Dawson, the present acting Director, will succeed to the position.

Two individuals, named Baumgarten and Starke, are cutting a considerable figure and creating no end of a stir just now in Canadian mica circles, in connection with the operations of the Canadian Mica Company (Ltd.), lately registered in London with an authorized capital of £90,000 stg. These people talk very big, and if we may judge from a reported interview in the Ottawa *Free Press*, a great deal of nonsense. They claim to have purchased the Beaver Lake mine in the Saguenay district, Que., an entirely undeveloped property by the way, for "$150,000, *spot cash*," and the Hayes mine, Murray Bay, Que., for "$35,000, *spot cash*." Readers of the REVIEW, cognizant of the Canadian mica industry, will hardly be surprised to learn that there is absolutely no truth in these assertions. Careful enquiry shows that only very small payments in cash have been made and are offered, although stock in the venture is freely offered in exchange for lands. Whether it is intended to unload these properties on the company at the inflated prices named in the *Free Press* remains to be seen. In the meantime until better evidence of the *bona fides* of these people is forthcoming we recommend owners of lands to exercise caution before tying up their properties on "options," or promises of stock in a doubtful venture. Investors in the company, if there be any beyond the promoters, will also do well to ascertain by competent expert examination and advice, the true values of the properties to be acquired. Canadian mining men have no desire to have the good name of the country tarnished by any repetition of the tactics of Knud Sando and the late General Phosphate Corporation.

A meeting of the shareholders of the New Glasgow Iron, Coal and Railway Co. (Ltd.) and the Nova Scotia Steel and Forge Co. (Ltd.) was to have been held in New Glasgow this month, to consider a scheme of consolidation. As the stock of both enterprises is very largely held by the same people and many advantages will accrue, there is little doubt but that the proposition will go through. The new enterprise will be worked under a charter obtained at the last session of Parliament in the name of the Nova Scotia Steel Company, Limited, with an authorized capital of $5,000,000.

The coal shipments to the St. Lawrence by the Dominion Coal Co. (Ltd.) from the opening of navigation to 30th ult. are as follows:

Montreal	426,510 tons.
Quebec	23,740 "
Three Rivers	5,550 "
Sorel	2,200 "

While the price of Canadian asbestos still lags below the standard of former years, the industry is steadily recovering its old position as one of the most important of our mineral producers. Shipments have been brisk and are likely to continue so until the end of the season, and altogether the outlook is brighter than it has been for the past three years. A notable feature has been the falling off in the production of Thetford No. 1. These mines used to produce as high as 75 per cent. of this grade, but with increased depth of working the output has been reduced to from 15 to 20 per cent., and it is therefore clear that prices for this standard quality must stiffen considerably. Operators are confidently looking forward to an active season and brisk prices next year. In our December issue we will, as heretofore, present our readers with a complete review of the year's operations.

The following comparison of the mechanical and electrical methods of transmitting power was given by Mr. L. B. Stillwell at a meeting of railway men. A steel cable 1½ inches in diameter, travelling at the rate of 12 miles per hour, can transmit nearly 2,000 horse power. But by taking a copper wire, 1 square inch in section, and applying it to a potential equal to that which is in use to-day in at least one place in this country, viz.: 10,000 volts, at 1,000 amperes per square inch, we find we are transmitting in an invisible form over that wire more than 13,600 horse power, which is enough to rupture iustantly 6 such cables as are ordinarily used in operating a cable railway. As much power can be transmitted through such a copper wire under the conditions named as through 6 such belts as were seen at World's Fair, 6 feet wide and running at the rate of a mile per minute.

Mr. F. A. Halsey, who has been identified for a number of years with Canadian mining affairs has, we understand, permanently severed his connection with the Canadian Rand Drill Co. and will in future reside in the States. Mr. Halsey's marked ability as a mechanical expert and his many good qualities, have gained him a wide circle of mining friends who heartily wish him well in his new sphere of professional work. The name of a popular and prominent asbestos mine manager is associated with the succession to the management of the Rand business here.

The Newfoundland asbestos property owned in Halifax has been examined by experts this season but still remains unopened. The producers of Quebec may therefore rest for another six months before fearing a deluge of the Newfoundland mineral.

Mr. John E. Hardman, S.B., President of the Mining Society of Nova Scotia, and Mr. Thos. Cantley, Secretary of the New Glasgow Iron, Coal and Railway Co., were in Ottawa during the month.

We are informed officially that Mr. R. G. Leckie has not resigned his position as general manager of the Londonderry Iron Co. (Ltd.), as currently reported. The furnace at last report was being re-lined..

Mr. Graham Fraser, managing director, and Mr. R. E. Chambers, mine superintendent, of the New Glasgow Iron, Coal and Railway Co. (Ltd.) are at present in Michigan on business connected with the company.

The continued improvement in the condition of the electrical manufacturing industries of the United States is exercising a correspondingly beneficial effect on the production and shipment of Canadian mica.

A well known property of chromium is the wonderful degree of hardness it imparts to steel. But pure chromium which has been recently prepared for the first time by M. Moissan, proves to be incapable of scratching glass, and soft enough to be filed easily. It is whiter than iron. It is untarnishable and acids have no effect upon it, but at a red heat it decomposes carbonic oxides, uniting with the carbon—a fact that explains the failure hitherto to obtain chromium free from carbon. It is purified by M. Moissan in the electric furnace in the presence of a double oxide of calcium and chromium. New alloys of chromium with aluminium and copper are tough, malleable and untarnishable.

PORTRAIT SKETCH.

Mr. E. D. Ingall, A.R.S.M., Chief of the Division of Mines and Mineral Statistics, Geological Survey of Canada.

Mr. Elfric Drew Ingall, was born at Greenhither, in the County of Kent in England, in 1858, and comes of a family most of whose members have shewn strong scientific tendencies. He was early led to take an interest in science by his father, Mr. W. T. F. M. Ingall, who, although pursuing a financial calling, occupied his leisure in scientific studies, so that the subject of our sketch was early familiarized with microscopic, spectroscopic, electrical and other apparatus.

In this way when offered his choice of a life pursuit he elected to go through the course of study at the Royal School of Mines in London. After putting in two years study in inorganic chemistry in the lecture room and laboratory, he continued through the remaining two years curriculum, which included the theoretical and practical study of mineralogy, mechanical drawing, applied mechanics, physics, geology, metallurgy and assaying. Having passed the examinations in all these subjects, necessary to obtain his degree of Associate of the Royal School of Mines, he put in another year's study attending the lectures of Prof. Huxley on biology, and of W. Warrington Smythe on mining, in which latter subject he also obtained a certificate. His father being a life member of the Royal Institution and also of the London Institution, he had the benefit of frequently attending lectures at these places, and thus hearing Tyndall, Huxley, Abel, and the leading men of science of England on a wide variety of subjects.

On leaving the Royal School of Mines he spent some time in the mining districts of Cornwall and Wales, familiarizing himself with mineral deposits and the practice of mining. In 1879 a short digression was made into the realms of electricity, when he joined the electrical staff of the Edison Telephone Company in London, during which period he was entrusted by the company, amongst other similar tasks, with the demonstration of the use of that, then quite a novel instrument, for underground communication, which was probably the first experiment of this kind.

On the amalgamation of the rival Edison and Bell Telephone companies, he determined to return to his proper field of action in mining and metallurgy, with the hope also that his wish for travel might be gratified. Shortly after he was offered the direction of an exploration of some mining property in Canada and proceeded to Lake Superior in the spring of 1880. Arriving at Michipicotan Island on the opening of navigation, he got his first glimpse of Canadian geology in the copper-bearing Keweenawan rocks constituting that island. Having organized his party, he proceeded across the lake to his destination at Cape Mamainse, where similar rocks constitute the shores of the lake. The summer was spent examining the extensive property held by his clients, and directing the making of the preliminary tests of the mineral veins thus located.

On the completion of his engagement he returned to England, but on the formation of a company to further test and work the property, he accepted an engagement as manager, proceeding to Canada in the spring of 1881, and fulfilled the duties of that position till the fall of 1882, when, finding the carrying out of a policy with which he was not fully in sympathy both irksome and wearing, he resigned the management. The following summer of 1883 was spent in Wyoming Territory, studying its copper deposits and reporting on the same for London capitalists.

After his return from this work, he received an offer of a position on the Canadian Geological Survey from its director, Dr. A. R. C. Selwyn. His strong scientific sympathies led him to accept this offer, and after a lengthened visit of study to the Pennsylvania coal mining regions, and some private reporting on Canadian mining properties, his connection with the Survey began in July, 1884, and has since that date been continuous, first as Mining Geologist, and latterly as Mining Engineer in charge of the Division of Mineral Statistics and Mines.

From the commencement his duties have been connected with the study of the economic minerals and mines of the Dominion, special studies having been made of the silver-bearing veins of the Thunder Bay District, and of mineral developments around the Canadian shores of Lake Superior, their history, extent and results. Several summer seasons were also spent on a special study of the mode of occurrence of the apatite deposits of the Laurentian rocks of Ottawa County, Quebec.

Since November, 1889, in performing the functions of the office he at present holds, his duties have lain chiefly in the superintendence of the Mining Division in its work of collecting technical and statistical data relating to the economic minerals of the country, and their utilization through the mining operations carried on, which is accomplished in part through direct investigations by the staff of the Division in the field and supplemented by information gathered by the other field officers of the Survey, and through other reliable channels, all which is edited and compiled to form the annually issued report of the Division.

Through the visits and study of mining districts thus necessitated, and by his past career, his attention has thus been continuously directed towards economic geology, mining, and its allied subjects.

CORRESPONDENCE.

Mining in British Columbia.

To the Editor of the Review:

SIR,—Having visited British Columbia during the mining season for the last three years, and having lately returned from four months' residence there, I respond to your polite request to give your readers a sketch of my observations and a report of the prospects for mining in the southern districts of the Province.

Throughout the Province, from the Rocky Mountains to the Pacific, south of the Canadian Pacific Railway, the traveller comes upon a succession of mining districts, each of which has its special wealth of silver, gold, lead, copper, coal, limestone and other mineral products; and every man met with has his pocket specimen of "the richest ore yet found." Others have stories of new placer ground, where the gold is to be picked up in great nuggets, and the exhibition of one mounted as a scarf pin is a convincing proof of the truth of the representations. The perplexity of the investor is, not to find something good to buy, but to know which of the innumerable offers of unlimited wealth to accept. An old man is encountered washing gravel in a creek to test it for gold. He takes the measure of his inquisitor, and spotting him in his mind as a tenderfoot capitalist, he addresses him as follows: "I have been mining for 40 years, and have been in every camp from Alaska to Mexico, but I am satisfied that West Kootenay is the richest mining district on this continent. I have explored this country pretty carefully, and I've made up my mind that Toad Mountain is the best spot in it, and if you'll come up the mountain with me, I'll show you the most valuable claim that's been discovered on it. I'm hard up or I wouldn't sell it at any price; but as things are, I'll let it go cheap."

Here one learns that he has come to the place where America's wealth has been concentrated, but he hesitates even to pay the moderate sum asked for its possession,—so much has his confidence in the veracity of prospectors been weakened.

On Toad Mountain is one great property, the Silver King, rich in copper and silver, which first gave fame to the district. It's discoverers had to give away half of it to defend themselves against claim jumpers; then after refusing several good offers, they finally floated it in England, receiving only about $30,000 in cash, but getting a large block of shares, which ought to prove valuable, as the mine is undoubtedly a good one. It has been further developed this summer with a force of about 50 men, and preparations are being made to put in machinery and a tramway, and make it a good working mine. The town of Nelson will be greatly benefitted by its operation, and its success will lead to the opening up of other properties. Not only are there ledges of similar ore near by, but within a radius of twenty miles there are many claims located for gold, both in quartz veins and placer ground.

The great smelter at Pilot Bay, about twenty miles east, is being completed at a cost of over a quarter of a million dollars, and the mines at Ainsworth are being opened up with good prospects of success. With some advance in the price of silver, it looks as though the Kootenoy Lake would be the scene of lively operations in the coming year.

But it is in the Slocan District that one reaches the seat of the mining fever that has agitated the country. Here are numerous veins of silver galena, some of remarkable size, and most of them giving an average of value above that of any other mining district, while a few show ore that is phenomenal in its assays, sometimes making shipments that average from 300 to 500 ounces silver to the ton, with occasional selections going up into the thousands. The great bulk of the ore that has been taken out so far can be relied on to give a value of $100 and $150 per ton. A few enterprising and persevering men have worked on for two years developing claims amid great hardships and tremendous obstacles, until now the railway has reached them and it will be possible to mine and ship ore with an assurance of profit, and with some degree of ease. A concentrator is being erected and substantial mine operators are coming into the country from the United States, and acquiring property, attracted, not only by the mineral wealth but by the more stable conditions of labor that prevail on the Canadian side of the line.

The history of the development of this region gives one of the romances of mining. First, an advance prospector comes in with ore that assays ahead of anything known. Then a thousand men start into the country. With packs weighing 50 to 75 pounds on their backs, they walk 20 miles over the narrow mountain trails, and then through almost impenetrable timber and underbrush, they force their weary way up the seven thousand feet mountains, till at last one comes to a gulley where a snow slide has bored the rocks and shown large streaks of galena. He stakes off the ground. Others come along and see the rich show. In the hope of finding some flaw in the title they also put up stakes, or as it is called "jump the claim." They measure the first stakes to see if they are not less than four inches square. They copy all the inscriptions, look up all the records, and watch to catch the locator tripping in some lack of compliance with the many legal formalities. In one case they even bribed a sub-official to forge later dates in Government record books and destroy the original notices, so that the later location would become valid.

But the prospector wins a victory by careful observance of the mining laws, and opening up the ground improves its appearance so that he is able to sell it to a syndicate for what, to him, in his humble mode of life, is a fortune. Next, the syndicate develop the property, ship some ore that yields a high return, get a report from a noted expert and float a company with a million dollars capital. Now it becomes a mine, vast sums of money are sunk in it, and at last great dividends may float to the surface.

In this, as in all new mining districts, the hazards of claim jumping have to be reckoned with, as well as the uncertainties of mineral deposits. A brief sketch of the history of the Bon Ton mine will illustrate the difficulties that one must be prepared for. A rich deposit of galena was found on this property. The first assay gave 1,257 oz. of silver to the ton, and subsequent assays went as high as 1,800 oz. The owners opened up the ledge and left it when the snow came. Returning the next spring to work the mine, they found that the owners of an adjoining claim called the Big Bertha, that had no ore in sight, had annexed the Bon Ton, and on the strength of its "shows" had bonded the properties under the name of Big Bertha for a large sum of money. A tunnel had been run in 100 feet and ore was being shipped away. Then followed injunctions, seizures and surveys, and finally the Bon Ton owners recovered the property, though the season for work was over. In the meantime, three more jumps had been placed upon the property, and one of the jumpers discovered that the Mining Recorder had written S. E. instead of N. E. in copying a notice. Reference to the original showed this to be a clerical error, but still it was made the pretext for an adverse claim. A third interest was offered to a lawyer to take uy the case. He declined it, but there are always shysters around a mining camp ready for such work, and a suit was entered and the property hung up for nearly a year. The plaintiffs were nonsuited with costs, but being penniless and non-residents the owners could recover nothing of their expenses. Nothing daunted, the jumpers proceeded to the property and went to work again, running a new tunnel 75 feet and commencing to ship away ore when the leader was arrested and sent up for trial. The Attorney-General, however, dismissed the case, and said it ought never to have been brought, and one of the instigators of the jumpers was appointed Mining Recorder of the district. But at last the Gold Commissioner signed the Certificate of Improvements, upon which the Crown Patent is granted, and the owners are wondering whether the Queen's title will be proof against the wiles of Montana claim jumpers.

A good way to prove the value of a property is to locate it and then talk loudly, and widely and wildly about its riches. The professional claim jumpers at once start for it, search all the records and examine every point in the location, and if any fancied flaw is found they put up their stakes, or even if no flaw is found, they locate a claim over it for the purpose of blackmail, thinking the owner will buy them off rather than fight. But if no jump is put on the property the owner may as well abandon his claim as worthless, for these fellows are good prospectors, and if they do not think a property is worth staking it is pretty good proof that the surface showing gives no indication of value.

In the Slocan district ore is now being produced in such quantities that it is estimated that 10,000 tons will be shipped out this winter, and that even at the present low prices of silver and lead there will be a profit of $70 per ton, making a net income to the district of $700,000.

This summer the forest fires swept through the country destroying everything in their path. One man lost $20,000 in buildings and plant, but the clearing of the ground led to the discovery on his property of a galena ledge twelve feet in width, and he says he could stand such a fire as that every week. In spite of the revival of interest in silver mining that is surely coming, capitalists will be timid for a while in tackling the low grade properties, but the average value of the Slocan ores is so much higher than those of any other available locality, that it seems certain that this region is to be the scene of a tremendous development that will make it the largest silver producer on this continent. Those who have good properties there need have no dread of the alms-house.

But western profits are made not only in mines. Town sites are often a greater source of wealth, and the shrewd man who forecasts the location of a future city ensures the speedy acquisition of a fortune. In March, 1892, Kaslo, on Kootenay Lake, had two houses, and town lots were selling for $100. In a year from that time 3,000 people were on the spot and lots were changing hands at $2,000. Then came the silver slump; fire, flood and tempest devastated the town; superior enterprise built a railroad from the mines in a direction opposite from Kaslo, and last summer a few hundred people lingered bewilderingly, and a lot that was once in negotiation for $4,000 was sold at $50 for taxes. Widespread ruin was everywhere, and one man, who was asked for a document, replied that not only was his business extinct, but his books, house and lot had been washed away. Kaslo has a wonderfully delightful location, facing a beautiful lake and surrounded by vast mountain peaks, and it also has a promising business situation. The railway to the mines will yet be built, and a good share of the Slocan traffic is bound to flow that way.

Attracted by the possibility of a quick fortune in these suddenly growing mining regions, a syndicate of Montreal and Boston capitalists acquired a property in the Boundary Creek and Kettle River mining district, situated at the junction of two rivers, the meeting place of two projected railways, on the direct route of the only pass through the mountains for a hundred miles, and at the foot of the hills containing vast bodies of ore carrying copper, gold and silver, and with coal mines on either side. The town of Midway was started a year ago with its fence on the International boundary line, and only one log house in sight, and this month the County Court is holding its sessions there in a thriving village, located in one of the most beautiful valleys of British Columbia. Soon the boom in town lots will come and rapid fortunes will be realized. Twelve miles west of here gold is being taken from the banks of Rock Creek; further on the stamp mill at Camp McKinney is night and day crushing rock that is yielding constant rich returns, and still further west at Fairview the stamp mill of the Strathyre Mining Co., largely composed of Montreal capitalists, is making a thorough test of large reefs of quartz carrying a considerable quantity of gold. Ten miles south of this, on the Osoyoos mountains, Montreal enterprise has opened large ledges of gold bearing rock, and the Divide mine bids fair to make a name for itself. Again to the west, on the Tulameen and Similkameen rivers, Montreal capital is represented in gold and platinum placer mines, and the latest report comes of copper deposits, said by an enthusiast to be 800 feet wide and 4,000 feet long. To the north the rivers are being ploughed, dredged and pumped for gold, and even the sea coast is being attacked. In the Cariboo district, where so much gold was taken out by simple processes years ago, modern methods are coming in to wash down the rich banks of former rivers by means of hydraulic monitors. Last winter ten miles of 24 inch steel pipe were hauled in 150 miles, and ditches have been dug at the cost of hundreds of thousands of dollars, but now the clean up of gold is said to mean an average of over $1,000 a day. Many reproaches have been made against Canadians for lack of enterprise in developing the mineral resources of their own country, but one is surprised to find out how many of our cautious citizens who would not for the world be suspected of such rash conduct as investing in mines (or gambling with God, as it is often termed), yet have quietly risked a little stake in ventures which, though sometimes "wild cats," often prove to be bonanzas.

It surprises one who hears so much of the mineral wealth of British Columbia, to learn that at present, apart from the coal industry, there is not in the whole province what in the United States would be called, a "working mine." The prospecting and developing stage has not yet been passed, owing largely to the lack of facilities for transportation; but it is evident that the time is close at hand when what can fairly be called *mines* will be operated.

It astounds one also to learn that the population of this vast territory, surpassing in area all the habitable portion of eastern Canada, possesses only a population of 100,000, of which only 65,000 are whites. Yet million dollar parliament buildings are being erected and there are no more important officials anywhere. They are largely "old timers," worthy, hearty, British gentlemen, who are loyal to the Queen and to the Canadian Pacific Railway, and who keep to the left when they drive.

The past summer has been a trying one for the traveller. The floods were rushing over the railway tracks, and a construction train had to go ahead and prop up the road bed for the passenger train to get over. Transfers over washouts had to be made on hand cars or in boats. As the train slowly crawled on the narrow shelves along the sides of sandy mountains, the rocks could be seen rolling down from above between the wheels of the train while the gravel slid out from beneath the sleepers below. At last railway tracks and bridges all disappeared in the swollen rivers, and no resource was left but to mount the bucking cayeuse and ride over the mountain trails. A day in the saddle, fording rapid rivers, climbing along the ledges of precipices, jumping huge fallen timber and scratching through underbrush, so overcomes the tenderfoot, that although at dusk a big black bear crosses his path, and he hears the warning of a rattlesnake, he dismounts, and rolled in the saddle blankets, sleeps upon the ground in the deep forests, and only dreams of the wealth that is surely coming as the reward of his toil.

Some of our hardy phosphate miners, whose business was depressed, started out for British Columbia, and by their energy and close observation, discovered valuable properties in regions where many skilled prospectors were disappointed. Sturdy men who can find no work in the east might get some rich relations or friends to grub stake them, that is, put up the bare money for their expenses and go halves in the discoveries. Many a disheartened toiler might thus secure a fortune, or at any rate be braced up by the invigorating labor of exploring amid the grand scenery of the Selkirk mountains, and in camping in the deep forests by the snow-cooled streams that flow down the mountain gorges.

British Columbia possesses vast treasures of mineral wealth, which when capital becomes more confident, transportation more available, and trade restrictions less severe, will make it a region of great prosperity.

ROBERT C. ADAMS.

MONTREAL, 21st October, 1894.

MICA MINING NOTES.

The main shaft of the mica mine of Messrs. Wallingford & Co., in the eighth range, Township of Templeton, has attained a depth of 90 ft. The vein, which has been followed to that depth, measures ten ft. in width and contains for the greater part large sized crystals, and is continuing regularly in a north-west direction. A drift has laid bare the vein for a length of 60 feet. It is the intention of the operators to sink the shaft farther into the vein and to open up the same in lower levels by drifts. The amount of mica taken out daily is between 4 and 6 tons, cutting for the greater part 2 x 5 in. and upwards. Eighteen men are steadily at work. Some new buildings and hoisting machinery have been added to the plant with a view to increased capacity. Taking into consideration the vast amount of mica crystals as laid bare by the drifts and shafts it is safe to say that this mine can be considered at present the most valuable mica deposit in the Township of Templeton.

The Lake Girard Mica System is working the Stevenson property, lot 15, in the eighth range, of Templeton. The main shaft, which was worked some years ago for phosphate, is at present about 35 ft. deep, yielding a considerable quantity of apatite intermixed with well defined mica crystals. Some 150 tons of apatite have been taken out this season. On the western slope of the property a vein of well defined mica crystals was discovered this month. The crystals on the surface are of a perfect nature and of regular shape, some cutting 4 x 6 in. clear. This vein has been laid bare for 25 ft. in length, and shows regularity in occurrence. It is intended to work same at once with a large force of men.

The so-called Goldering mine, one of the oldest phosphate mines in the Township of Templeton, situated on lot 17, in the ninth range, has been leased to Mr. A. McLaurin, from the Bank of Hochelaga, for six months. Operations were commenced on the 10th of this month, and a great deal of mica crystals are reported to be in the main shaft. Eight men are employed.

About thirty men are working over the dumps of the Blackburn mine for Mr. P. McLaurin. The mica is being cut for a New York concern.

Work on the Cascades Mine in the 15th Range, Township of Hull, was resumed this month by W. A. Jamieson, et al.

Mr. W. F. Powell, of Messrs. Powell & Clemow, Ottawa, is now in New York disposing of the product of their properties, of which about 250 tons rough culled mica are on hand.

Parties wanting cheap jewellery in exchange for mica lands can be accommodated by applying to the representatives in Canada of a so-called English syndicate.

The White Mica Mine on Lac Pieds-des-Monts, Murray Bay, belonging to Mr. F. B. Hayes, Ottawa, has been sold to the Canadian Mica Co., represented by Baumgarten & Starke, the consideration being $8,500, almost wholly in shares of the company. A good force of men is already employed and it is reported to bethe intention to put up a steam plant very soon.

The Beaver Lake Mine in Bergeron county and the Perkins property in Hull, have been acquired by the same people. The consideration for the latter was, we understand, simply stock.

PHOSPHATES.

Mr. David T. Boyd, Glasgow, writing in the last number of the *American Fertilizer* on European and American phosphates, says: "The expansion of the phosphate business in Europe goes on uninterruptedly, and one would be rash to predict that the end of the century will not find us nearly abreast of supply, if it do not overlap it. Besides the gregarious follow-my-leader element in the increase of the use of new fertilizers, it has been wonderfully stimulated by the abnormally low prices of rock which have now ruled for some time. The experience of the past 25 years is likely to hold good again—every cycle of low prices is succeeded by a stronger reflex current, which affects a much larger area, and does its best to make the ends of supply and demand meet but not overlap. Such confidence in the future may appear a little extravagant, in view of the enormous amount of rock now being mined on both sides of the Atlantic, but "enormous" is really a relative quantity, and the chances are that, while that word may be correct for to-day, it will have a totally different meaning when viewed from the standpoint of 1900. So long as money is abundant and cheap, so long will the enterprises representing lasting industries find favor, even if these for a time tax the patience of investors for adequate returns."

Recent newspaper and magazine articles have supplied much information about the phosphates of Algiers and Tunis and much stress has been laid on their quantity and quality and the cheapness with which it can be transported to foreign ports. The fact is, however, that notwithstanding the vast extent of the phosphate territory of Algiers it has failed to furnish any considerable quantity of the rock consumed by manufacturers. In 1892 the shipments amounted to 450 tons, in 1893 to 1,200 tons and up to date of the present year from 6,000 to 7,000 tons. There is talk that the output in 1895 will be very large. This has been the phantom which has annoyed South Carolina and Florida during the past year, but it is not much more than a phantom, if the reports in French papers be only partly true. There is much dissention among those who applied to the Government for concessions and claim that they got them as low as from 30 to 50 centimes per ton, equivalent to from 6 to 10 cents American money; but, all the same, the Government is now exacting from 2 francs to 2 francs 50 centimes per ton, which is fully as much as the royalty required by the State of South Carolina or Florida. We are not willing to under estimate the product of any country, but it will be difficult to obtain Algerian rock until the existing differences are adjusted, and this is a matter for the future. The Scotch, English and French firms who got concessions in Gafsa, Tebessa, Djebel, Dyr, Djebel and Konif, Constantine, Deckma, Sarja, Onedrio, Kora and Rio Salada have made demands upon the Government which have so far been disallowed. In one case 2,000,000 francs have been asked and 6,000,000 in another. Even if these demands be granted, however, more serious questions confront the miners. Does the rock exist in the territory they have secured, which is doubted in many well informed quarters, and if it does exist in quantity, is it of merchantable quality, varying from 45 to 80 per cent. and much of it so soft as to prevent its being mined? Can it stand the sharp competition it will meet in France and Germany? It is admitted that it carries an excess of carbonate of lime, many say it lacks uniformity, others that it contains objectionable quantities of iron and alumina, and some shipments have given trouble on account of excessive carbonate of lime.

The only mine at present worked in the Ottawa district, is the High Rock, where the Phosphate of Lime Co. has about twenty-five men employed.

Some 500 tons were shipped this season from the North Star mine to the fertilizing works of the Nichols Chemical Co., at Capelton, Que. The various grades of fertilizers made by the Nichols people are finding a steadily increasing sale among Canadian farmers, and the business is likely to grow in importance.

The grinding mill at Bassin-du-Lievres has been fairly busy all season, grinding low grade phosphates in which a good deal of shipping has been done by Mr. T. S. Higginson, to the United States.

GOLD MINING IN NOVA SCOTIA

The Minneapolis property recently sold at Sheriff's sale to F. B. Wade, Q. C., has been transferred to Miner T. Foster of Halifax.

Whiteburn—It is understood that Mr. G. J. Partington, who has been working a small force of men here during the summer, has accepted the management of the Oxford Gold Mining Co., at Chezzetcook.

Chezzetcook—Mr. J. M. Reid, owing to failing health, has resigned his position as manager of the Oxford Company and will spend the winter in a warmer climate.

The property owned by Mr. John H. Anderson is showing well, the lode increasing in size and in richness. 170 ozs. were recently returned from a short mill run. The exhibit from this property at the Halifax Exhibition was exceptionally fine.

Molega—Little is doing in this camp beyond the operations conducted by Mr. Turnbull upon the property formerly owned by the Boston Gold Mining Co.

The Fiske block, held under an option for $10.000,00, is opening up in a small way, and some desultory prospecting is doing elsewhere.

South Uniacke—Reports from the Golden Lode Co. announce that the shaft has passed the 400 ft. mark. A fine stamp mill has been ordered from the Windsor Foundry Co., and is now in course of erection. It is contemplated to equip the property with an air drill plant at a near date.

The shaft in the Thompson-Quirk property is now 350 feet in depth and is still sinking to reach a lower pay chute.

Caribou—The consolidation of the various properties in this district mentioned in our August issue is hanging fire—a delay in making payments is reported, and rumor has it that other difficulties have been encountered.

The equipment of the Lake Lode under the management of Mr. W. A. Sanders is progressing rapidly. A new ten stamp mill is building, the mortar of which will be cast by I. Matheson & Co., of New Glasgow, and the tappets, cams, shoes, etc (which will be of cast steel) will be furnished by the Pittsburgh Steel Castings Co. of Pittsburgh, Pennsylvania.

Lower Country Harbour—An agreement to sell $\frac{9}{10}$ of the Mason-Hudson property for $20,000, has been made, payments to run over two years. This is the "new-find" about six miles from Johnson's Brook. Messrs. Mason & Hudson retain a one-tenth interest.

Cochrane Hill—The twenty stamp mill is rapidly approaching completion. A considerable quantity of mill rock has been accumulated, and the results of the first clean-up will be anxiously looked for by some doubting shareholders.

Wine Harbour—The return of the Eureka Company is reported as 51 ozs. for the month. Work on the Eames patent process for extracting gold has been carried forward slowly.

Montagu—The Salisbury Co. has passed into new hands, under the management of Mr. Price. The "*Nissen*" mill, of newspaper fame, has been unceremoniously removed to the scrap heap and a new mill with new foundations has been commenced. It is reported that a good site has been made in the mine.

Goldenville—A difficulty in meeting payments is reported as the cause of suspension of work on the Springfield property, under management of Mr. MacNaughton.

GOLD MINING IN BRITISH COLUMBIA.

The Nelson Hydraulic Co., organized this year, has stopped work for the season on Forty-Nine creek, and cleaned up $500 in gold. The barren earth has been removed and next summer they will work on the rich gravel.

Since the inception of the placer fever on Cariboo Creek, prospectors have been scouring the neighboring hills, seeking to discover the quartz lead from whence come the coarse tailings found in the bed of the stream. That their efforts have been successful is amply attested by the official records here, and, for the time being, the placer fever has given place to the quartz craze. So far the discoveries are centered round Cariboo Creek and its tributories, and the ledges range in width from a few inches to several feet. In many, small streaks of galena appear, with an abundance of copper stains and white iron. The first claim staked out was the Golden Eagle, by George Hardie. This is located on the Government trail, on the west side of Cariboo Creek, one and a half miles above Mineral Creek. The ledge in this is well defined, several feet in width, and of white quartz. An assay on this went as high as $481 in gold, and 6 oz. in silver per ton. Since then nineteen other claims have been recorded, quite a number coming in this week.

B. J. Cornish, says the *Miner*, one of the directors of the Cariboo and Kootenay Mining Co., has been here for the past ten days examining the St. George placer camp and having a test made. The ground washed averaged $2 a yard. The men who have this claim in hand are of the right sort and are getting things in shape for work all through.

The Enterprise Mining Company, which has diverted the course of the south fork of the Lardeau river for 1,000 feet, netted $45 per hour during their first run.

Some new placer ground about twenty-five miles above the mouth of the Pend d'Oreille is causing some excitement. Messrs. Lobot & King, of Spokane, are putting in an hydraulic plant. Mr. Litchfield is prospecting his property with the same intention if results are satisfactory. The claims are on the American side and are one-half mile each in length.

We hear that the $5 shares in the Caribou Hydraulic Mining Co. are quoted as high as $25.

A large dredging plant is being built at the British Columbia Iron Works, Vancouver, for the Fraser River Mining and Dredging Co. The plant consists of a screw 130 x 33 with a "clam shell" dredger, having a lifting power of eight tons at a distance of 40 feet from its center, which will deliver sand and boulders alike (and gold too it is hoped) into the sluice-boxes, to which water is supplied by two eight inch centrifugal pumps. A new arrangement is the "water guard" or screen, shaped like an enormous snow plough, which, being placed ahead of the dredger divides the current and permits work to be carried on in comparatively calm water. Power is supplied by no less than five separate engines of which the largest is 125 h.p. There are also two horizontal engines aggregating 40 h.p., while two others, with 15 inch cylinders and 6 feet stroke, drive the stern wheel. Steam is supplied from a 24 h.p. boiler. The working of the new dredge will be anxiously watched.

The Le Roi Co. is shipping 8 tons daily, and ore is being continually blocked out for future shipment. The shaft is over 300 feet deep, and four levels run about 150 feet each way on the vein. The hoisting capacity of the plant is about 30 tons a day, and it will be run to its full capacity this winter. The stopes could furnish 100 tons a day if it could be taken away, and the best of it is, the greatest depth shows the richest ore. The large boiler is in place and the air compressor of eight drill capacity will be in working order within six weeks. The company has shipped ore from four other places on the mine, the ore being as rich from all four as that from the shaft, and at three places the ore bodies are fully as large.

The Canadian Pacific Mining and Milling Co., of Minneapolis, of which Mr. Westby is vice-president and manager, is preparing for active work on its gold property on Woodberry Creek, three miles north of Ainsworth. A contract will be let for about 300 feet of tunnel, seven feet by nine feet. In the meantime the necessary machinery will be erected and steam drills will be introduced for the continuance of the work.

Placer work on the Columbia River has received an impetus owing to the vast alterations in the bed of the river, made by last summer's flood. In many places bars that have been worked for many years are stripped ready for new works, and at Troy, 20 miles north of Wenatchee, some rich ground has been struck. Two men took out, according to a telegram, $15 in half a day. The gold is very fine and is difficult to save.

SILVER LEAD MINING IN BRITISH COLUMBIA.

About thirty-three claims will work and ship ore in the Slocan this winter. Times promise to be more prosperous there than in any other mining section of the North-West. The output will probably reach 17,000 tons by next spring.

The first stage in the litigation between the owners of the Lanark mine and the owner of the Maple Leaf mine, in Illecillewaet district, has resulted in favor of the former. The owner of the Maple Leaf claimed that the greater part of the ore extracted from the Lanark was from the Maple Leaf ground.

The parties who have the bond on the Fisher Maiden mine, on Four-mile Creek, Slocan district, have contracted with Lane Gilliam to pack 100 tons of ore to Silverton, a distance of eight miles. The Fisher Maiden is reported as one of the best showings for a mine in Slocan district. The ore is 'dry.'

A survey was made a few days ago of the ore in sight on the Slocan Star. The mineral was computed at the astounding figure of 232,000 tons, and that, too, without further drifting. Reckon that at the low value of $100 a ton and some idea of the richness of the property may be obtained.

The Silver King is sending down eight tons a day, of shipping ore, to Nelson, and it is understood this output will be kept up indefinitely. A. R. McPhee secured the contract for building the mile and three-quarter flume that will bring a water supply to the power house at the mine.

Although the Slocan Star is said to have 232,000 tons of ore in sight, the Idaho is now considered the "biggest thing" in the Slocan country. The great strike in the mine was made about two months ago, and already $30,000 worth of ore is sacked ready for shipment.

The President group of claims, in Goat River district, which were owned by Messrs. Fitch, Fritch and O'Neil, has been sold to a Wisconsin company, and part of the purchase money paid. Work, it is said, will be commenced at once.

On October 8th, 1891, John Sandon and Bruce White located in Slocan district a mineral claim that has been made a mine. The location was named Slocan Star, and that winter it was bonded to Byron N. White, who early in the spring began developing it. A little work went to prove the property a good one. The bond was taken up and a company was incorporated to take over the mine. The company was organized in Milwaukee, and incorporated under the laws of the State of Wisconsin, Angus Smith, a well-known Milwaukee capitalist, accepting the presidency, Byron N. White being chosen vice-president and general manager. All through the summer and fall of 1893, when other mining operators were jumping sideways in their efforts to raise money to take up bonds and keep development work going, the "Byron N. White Company of Milwaukee, Wisconsin," had a regular pay day, and paid as regularly as the day arrived. During the winter of 1893-94, although other mines shipped ore, none was shipped from the Slocan Star. Over 800 tons were, however, hauled from the mine and stored at Three Forks, there to remain until it could be hauled by rail to the smelter. Last week, says the *Tribune*, that ore was sold in Spokane, and the sum realized will more than repay the company for every dollar it has expended on the mine for development work. The ore was purchased by the Omaha-Grant smelter of Omaha, and the contract for hauling it to the smelter was secured by the Canadian Pacific Railway. A further contract was entered into between the mining company nd the railway for the shipment of 1000 tons in addition to the 800 tons now at Three Forks, the 1800 tons to be delivered to the railway company at Three Forks, by the 1st of January, 1895. The money realized from the sale of the 1800 tons will more than place the mine "on velvet," and from this time on the Slocan Star will be a dividend payer.

The contract for freighting and smelting the 800 tons of Slocan Star ore now lying in the ore shed at Three Forks, has been secured by the Omaha and Grant smelter. Tenders for this contract were opened in Spokane this month. There were five bids, from the following firms: Omaha and Grant, represented by E. F. Matthews; Selby Co., of San Francisco, by Herbert Lang; United Smelting Company of Montana, by Charles G. Griffiths; the Everett Smelter, by Louis Verdin; and the Colorado Smelter at Butte, by O. Bergstrom. The ore will go out via Nakusp as soon as the railway reaches Three Forks and will be handled as far as St. Paul by the C.P.R.

The report again reaches us from Victoria that the Hall mines are about to build a smelter near Nelson large enough to take custom work besides treating their own ores. There is no doubt that such a proceeding has been talked of by the company and probably it will be carried out by and by. But we regret to have to deny the rumour as for as it relates to any immediate action. It has been found impossible to keep the pipes that supply water to the diamond drill on the Kootenai Bonanza free from ice. It will be remembered that this supply is forced through 1,700 feet of piping from the engine house on the Silver King. Lately, in spite of a continual stream being kept up day and night, the frost could not be avoided and several lengths of pipe have burst. The drill is now shifted to the end of the 900 feet tunnel where it will drive straight ahead, exploring the rock through which the tunnel would pass is prolonged. Including the men working at the flume there are now about 70 men employed by the Hall mines.

About 15,000 tons of ore, from the present indications, will be shipped from the Slocan, between now and next spring.

The Sunrise is showing up well. Between 50 and 100 tons will be shipped.

On the Carbonates, located at the head of Spring Creek, and bonded to J. A. Finch, the miners have uncovered three feet of ore that assays 300 ounces of silver to the ton. Selected specimens assayed 2,000 ounces to the ton.

A full force of men is now at work on the Reco; ore averages 180 ounces of silver per ton, and as a large amount will be shipped this fall and winter, it means a large amount of money for the camp.

At least four important strikes have been made on the Kaslo side of the divide this season, viz: The big strike of the McDonald Bros. on the Eureka, Finch's find of three feet of rich ore on Spring Creek, Otto's Bunker Hill on the west branch of Kaslo Creek and Price's Silver Eagle at the head of the same stream. There are better days ahead for Kaslo, and they are not a long way off.

GOLD MINING IN ONTARIO.

A ten stamp mill is being put in on the property of Ward Bros. *et al* in the Rainy River district. the vein is reported unusually rich and the development work has given satisfaction to the owners. The mine is located on an island just east of the Little American Mine.

A Duluth despatch says: The Beaver Mining company, which owns the Little American gold mine on Rainy Lake, signed a lease of the property to George A. St Clair for twenty years. St. Clair is at the head of a syndicate which will immediately take steps towards developing the property in good shape. The lease requires that two shafts shall be sunk to a depth of 200 feet at a distance of 500 feet apart, and a tunnel cut between the two. Hoisting machinery of approved pattern must be stationed at each shaft. The new deal contemplates an outlay of $25,000, including a much larger stamp mill, which will not, however, be needed until the shafts have been sunk. Payments are to be made monthly in the shape of a royalty, a certain minimum being guaranteed. The original investors will receive at least between 15 and 20 per cent. interest on their money and later 25 per cent. or more.

A new company has been incorporated lately under title of the Syndicate Mining Co., to open mining properties on Rainy Lake. This company has already sunk a 25-foot shaft on their island a mile and a half east of the town, and have let a contract for an additional 25 feet. Their purpose is to put in a stamp mill during the winter. Mr. Dent will personally direct the operations of the company for the present.

The International Mining and Milling Co. will shortly commence active mining upon the Grey Eagle and Wild Rose locations near Rossland, Lake of the Woods district. It is also reported upon good authority that two other promising gold prospects in the Rossland neighborhood will soon be open by live United States men. These lots have recently been examined by and for the owners.

NEW COMPANIES.

The Dominion Gold Dredging and Placer Mining Co. Ltd.—Application for charter of Incorporation under Dominion Statutes is made by this company with the object of carrying on mining in the Province of British Columbia, and in the North West Territory. Head Office: Toronto. Authorised capital $40,000 in $100 shares. Directors: James Amess, John Perkins and Alex. Leslie, all of Toronto.

Stellarton Gold Mining Co. Ltd.—This company with headquarters at New Glasgow, N. S. has applied for incorporation under Nova Scotia Statutes for the purpose of mining in the Sherbrooke district and elsewhere in that province. Authorised capital $20,000, in shares of $10. The Directors are: John McQuarrie, Guysboro; W. L. Ormond, Thorbourn; John McQuarry, Stellarton; Duncan McGregor, Westville; and James Keith, New Glasgow.

The Syndicate Mining Co. Ltd.—This company with an authorised capital of $300,000 has been incorporated with headquarters at Rainy Lake, Ontario, to operate gold mining properties, in that district. The officers are B. C. Dent, Duluth, President; H. M. Miles, Duluth, Vice-President; H. H. Phelps, Duluth, Secretary-Treasurer. Work has been commenced.

Nickel Steel in Shipbuilding.—The American liner Paris has had constructed for her a spare length of shafting of nickel steel. We believe this is about the first application of this alloy in a merchant steamer, notwithstanding that it is five years since Mr. Riley of the Steel Company of Scotland, first demonstrated in that country its greater elasticity and tensile strength. The Paris's new shaft has tensile strength of about 90,000 lbs., probably 25,000 lbs. more than any British or German steel shaft. It has been established by tests that nickel steel has a higher elasticity than ordinary steel to the extent of 31 per cent., and that the tensile strength is 20 per cent. greater. Moreover, ductility is not adversely affected. Although, therefore, the size and weight of the Paris's shaft might have been reduced with maintenance of strength, it has been kept the same as those first fitted at Clydebank. The original objections against the alloy, notably the influence of cold weather, have been removed by similar demonstrations to those made by Mr. Riley, and by proof of fact that it is incorrodible and can be advantageously made on the basic open hearth furnace. The idea of using it in the construction of steamships and their boilers and engines is being discussed, since there would be a reduction of nearly one fourth in weight for the same power, which weight, added to the size of the machinery to augment power, would greatly increase speed without adding to the dimensions of the vessels. For instance with 4·7 per cent. of nickel in the composition of the steel, the elastic limit has been increased from 16 to 28 tons per square inch, and the breakage strain from 30 to 40 tons. Its adoption for armour is proof of its efficiency, but it is just possible that the conservatism dominant at the Board of Trade may allow Messrs. Cramp to step in with a nickel-steel ship and machinery, and thus carry off the laurels from the Clyde. The North American continent production of nickel ore increases, and prices are decreasing.

Trees in a Coal Vein—A short time ago, it is stated, pieces of resin and wood were found in the coal vein at Newcastle, Washington, 2,000 feet under ground, and now the miners are at work getting out a tree, for there is a perfectly formed fir log lying embedded in rock and coal over one-third of a mile under the surface of the earth. The bark is probably 6 or 7 inches thick, and the peculiar characteristic marks of fir bark show very plainly. The specimens of the wood are even more clearly marked by the annual layers and wood fibres, and, though of solid rock, look so natural that they appear as if they would readily yield to a pin stuck against them. In the coal crevasses near by are found great quantities of resin, as beautifully clear and amber colored as if it had been picked from a standing tree. There is no telling how long that log of rock is, but its diameter shows that it must have been 24 inches through the wood, and must therefore have been originally 150 feet in height. It is probable that a piece not larger than a ton or two will be raised to the surface, but the miners are at work getting out as large a piece as possible. The log in places is coated with a white incrustation of limestone.—*Exchange.*

Jordan's Tipping Coal Screen.

—

By Mr. Robert Jordan,

(South Wales Institute of Engineers.)

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The objects aimed at by this screen are the following:—

1. Efficient screening, or separation of the large coal from the small.

2. Facilities for cleaning the coal and for picking out the dirt before the coal is pped into the truck.

3. Minimizing the amount of small coal produced by screening and transferring e coal from the pit-tram, or tub, to the railway truck.

The arrangement consists of the following:—

1. A specially designed tram tippler.

2. A tipping, curved and self-balanced screen, with the usual "Billy Fair-play," r ascertaining the weight of the small coal, attached thereto.

3. A coal cleaning platform.

4. A truck trimming platform.

1—Tram Tippler.

The tram tippler is a tipping platform and short screen combined. This screen ojects about three feet beyond the front of the tram placed for tipping upon the tipler. It is also raised above the rail level of the tippler, as close as possible to the derside of the tram, so that when the coal leaves the tram it shall only have a few ches to fall upon the screen. At the end next to the tram this screen is about 3 ft. in. wide, expanding to about five feet wide at the other end. The object of this pansion is to allow the coal to spread out as it leaves the tram, so as to cover as uch as possible of the surface of the main screen, in order that it may be well reened, and also that by being well spread out it may be the more easy to pick the rt from the coal.

Two curved uprights, fixed to the sides of the tippler, carry a horizontal bar, from hich a swinging plate hangs in front of the tram of coal. The object of this is to event the coal from being pitched violently forward from the top of the tram when e tram is tipped. A short chain attached to one of the lower corners of the plate nd hooked to one of the uprights prevents the plate from swinging out too far when e tram is tipped, and by this means the coal is made to drop upon the projecting hort screen, close to the end of the tram; should the coal become jammed between e plate and the tram, the chain is unhooked and the coal immediately released.

The object of this projecting screen is to receive any coal that may fall from the am while it is being tipped and before the tippler has touched the main screen, so to convey the coal as easily as possible to the main screen from the tram. It also mmences the screening the instant the coal leaves the tram.

After being tipped the tippler is brought back by a counterbalance weight susnded beneath it. A self-acting catch holds it in position to receive another tram, nd prevent its tipping when the full tram is on it until required. The same catch olds the tippler down, when tipped, until all the coal is out of the tram. The catch withdrawn by a treadle.

2—Tipping Curved and Self-balanced Screen.

This is what may be called a self-contained tipping shoot, with screen bars at the pper end, a plated platform at the lower end, and with plated sides, the whole being pported by T iron ribs or binders.

It is fixed upon a shaft resting in plummer blocks upon the coal cleaning platrm. This forms the fulcrum upon which it is balanced, and the fulcrum is so placed at the weight of the upper end of the shoot, or screen, preponderates over the lower nd sufficiently, when the screen is empty, to bring it back promptly, but not too pidly, from the tipped position into position for receiving another tram load of coal. articular care is necessary in fixing the fulcrum shaft on to the shoot to ensure the tter being properly balanced; and due attention to this and other details is fully rearded by the satisfactory working of the arrangement afterwards.

When the shoot or screen, is in position to receive coal from the tram, the upper nd rests upon suitable supports, and the lower end is supported by self-acting catches, xed to the beams of the coal cleaning platform. In this position the fall of the screen 4½ inches in a foot at the upper end, and 1½ inch in a foot at the lower end; the hange from one gradient to the other being effected by an easy curve, so as not to lock or interrupt the descent of the coal. The object of the flattened gradient is to ring the large coal to a state of rest upon the screen without abrupt shock, for the urpose of cleaning it before it is tipped into the truck. Upon the fulcrum-shaft a rake rim is fixed, which for additional strength is also bolted to the side of the screen; pon this rim a brake acts and controls the movement of the screen.

The bars of the screen are arranged in about 4 feet lengths, and the ends of the rs of one length are inserted between the bars of the adjoining lengths; so that inead of the bars being in one continuous length from end to end of the screen, as is sually the case, each length of about 4 feet, is succeeded by an intervening space of bout 4 feet, into which any small coal that may have ridden down the bar will drop, stead of being carried forward with the large coal, thus securing efficient screening.

To prevent the screen, when it is tipped, from descending upon and damaging e basket or "hopper" of the "Billy Fair-play," a plank-on-edge is fixed in brackets n the middle row of columns supporting the coal-cleaning platform, on which the reen descends. In this position the screen clears the "Billy" basket, and also just lears the side of the truck, into which the snout of the screen descends. As the coal iles up in the truck it becomes necessary to arrest the descent of the screen at a highr point than the plank-on-edge to allow the free discharge of the coal from the snout f the screen. This is done by stops or stop-blocks fixed above the plank-on-edge, hich are brought into use when required. By the brake, also, the descent of the creen may be arrested at any other point.

By the facilities thus afforded for depressing the snout of the screen well into the ruck at the commencement of the loading, and afterwards of regulating the depression o any other point, the minimum amount of fall from the snout of the screen into the ruck is attained.

Besides this, as the coal upon the screen is in a state of rest near the lower end of he screen prior to its being tipped, it acquires but very little velocity in descending to the truck when the screen is tipped. And it is found in practice that none of the oal leaves the screen until the screen has reached the desired point of depression, ven when that is the lowest point upon the plank-on-edge, so that the coal is deited in the truck with comparatively little violence. Thus, and by aforementioned eans, the amount of small coal produced in transferring the coal from the tram to he truck is minimised.

Where more than one is required the screens are arranged in pairs, the breadth ver each pair being 13 feet, which is less than the length of an ordinary 8-ton coal ruck, so that two screens may be discharging coal simultaneously into the same truck; nsequently, once a truck is placed in postion under the screens it has not to again be moved until it is full; whereas, with ordinary single screens, one end of the truck is first put under the screen and filled, then the truck moved and the other end is filled, thus involving extra labour in handling the trucks.

3.—Coal-cleaning Platform.

Upon this platform the screen (or screens) is fixed. It extends in front and on each side of the screens, and is about level with the lower end of the screens when the latter are in position to receive coal from the pit-tram, thus providing the necessary convenience for handling the screens and cleaning the coal. A man and a boy are employed at each screen for this purpose. Both take part in the cleaning, after which the man attends to the tipping of the screen, and the boy weighs the dirt. A record of the weight is kept against each tram separately, thus affording means of checking the sending out of dirty coal. Until all the dirt amongst the large coal has been picked out the screen is not to be tipped. By these means, with ordinary care and attention, the coal can be efficiently cleaned.

4.—Coal-trimming Platform.

This is a narrow platform fixed to the front row of columns which support the coal-cleaning platform. It is on a level with the top of an ordinary coal truck.

Standing upon this platform the man employed for the purpose pulls the lumps of coal into position in the truck as they leave the screen by a light rabble or rake. By this means the most of the trimming can be done without clambering over the coal, the object being to avoid as far as possible everything that tends to bruise the coal, and by this means to lessen the amount of small coal sent away with the large.

Comparison with other Screens and Modes of Cleaning and loading Coal.

1.—*The Old-fashoned ordinary Screen.*

This, as everybody knows, is a straight shoot, placed at various and sometimes haphazard angles of inclination, without regard to the minimum angle at which the coal would slide down the same so as to avoid unnecessary and injurious velocity. The screen bars are continuous in length throughout a portion (sometimes the entire length) of the shoot. A balanced flap or door at the lower end of the screen is sometimes used to check the velocity of the descent of the coal into the trucks; and sometimes a plank-on-edge, placed higher up the screen and hinged to the side thereof, and moved by a rope or chain fixed to the other end of the plank, is used to check the descent, and to afford opportunity to pick out dirt. But the best of these are defective, as on account of the slanting position of the screen it is not possible to stand upon it to pick the dirt out thoroughly, and very much of it is carried with the coal into the truck, whence it cannot be picked out (except but a little) through its falling in between the lumps and being out of reach and out of sight. In addition, as the lower end of the screen must be placed high enough to admit of the coal being loaded above the side of the truck, and as this is a fixed point, the coal has a considerable height to fall into the truck, especially at the commencement of the loading, in consequence of which many of the lumps are broken and small coal is produced. This is especially the case where the coal goes down the screen with unchecked velocity into the truck.

2.—*The Newberry Balance Screen.*

This is a well-known screen, being in use at several collieries in Glamorganshire and Monmouthshire. It was designed to obviate the defect of excessive velocity common to fixed screens, which to some extent it is, no doubt, capable of doing. But as the whole of the tram-load of coal is deposited in a heap at the upper end of the screen, whence it travels from a state of rest with increasing velocity down the screen into the truck when the balanced end of the screen is lowered for the purpose, there is still room for improvement in this respect. Then, with regard to the cleaning of the coal—as it is deposited all of a heap upon the screen, much of the dirt may be covered up and out of sight until the coal begins to slide down the screen, when it cannot be arrested, but falls with the coal into the truck, whence some of it may be picked out, but not as much as is desirable.

3.—*Belt Arrangement.*

This is, no doubt, excellent, and with sufficient hands to pick out the dirt as the belt travels forward the coal can be efficiently cleaned. But it does not afford the facility provided by the curved-balanced screen for ascertaining the exact amount of dirt sent out in each tram separately, by means of which the offender may be properly dealt with.

Conclusion.

There are 33 of these screens now in Monmouthshire—28 at Ebbw Vale and branches, 2 at Llanhilleth, 2 at Glyn Pits, Pontypool, and 1 at Abersychan.

The first was erected at Waen Lwyd Colliery, Ebbw Vale, about sixteen years ago, where they are still at work.

They were designed by the writer, in which he was ably assisted by his late highly-respected friend, Mr. George Golightly, Mechanical Engineer, and by his very clever son, Mr. George Golightly, now of Newport, Mon.

The Canadian Iron Industry—The Canadian correspondent to the *Iron Age*, New York, writes: The pig iron consumed in Canada now comes from two sources almost exclusively—that is, from our own furnaces and from those of the United States. Great Britain furnishes very little of it. It hardly pays to carry British iron into the interior, and it no longer finds a large market in the maritime parts of the country. There, in fact, as soon as it is landed, it meets the great smelting works of the country, for our largest furnaces are in Nova Scotia. The Nova Scotia iron sells as far inland as Toronto and Hamilton, having pushed its way against both British and United States irons. The latter makes have the advantage west of Montreal, however. Even in Montreal, American iron has found a good reception this year, several carloads of No. 2 Niagara pig having been sold there last month at 12.50 dols., in bond on track there. This is equal to 17 dols. duty paid net cash 30 days. Some southern iron costing 12.25 dols. in bond on track, equal to Middlesbrough brands, was also disposed of in Montreal, but is not as suitable for the wants of foundries. New Brunswick is to become an iron producing province. A project is on foot to build two furnaces at St. John, with a capacity of 250 tons a day. Ore, limestone, and coal are easily assembled at that point, and freight facilities for shipping into the interior provinces are favorable.

AUTUMN MEETING

OF THE

General Mining Association of the Province of Quebec.

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The Autumn Meeting of this Association was held in the Magog House, Sherbrooke, on Wednesday and Thursday evenings, 26th and 27th ulto. There was a large attendance. Mr. John Blue, C. and M.E., President, in the chair. Among those present we noticed: Mr. James Mitchell, (Beaver Asbestos Co.), Sherbrooke; Mr. J. Obalski, M.E., Inspector of Mines, Quebec; Mr. George E. Drummond, (Canada Iron Furnace Co.), Montreal; Mr. H. J. Williams, (Beaver Asbestos Co.), Thetford Mines; Capt. John J. Williams, Sherbrooke; Mr. F. S. Spafford, (Nichols Chemical Co.), Capelton; Mr. S. W. Jenckes, (Jenckes Machine Co.), Sherbrooke; Mr. E. B. Haycock, (Star Gold Mines), Jersey Mills; Mr. L. A. Klein, (American Asbestos Co.), Black Lake; Mr. John J. Penhale, (United Asbestos Co.), Black Lake; Mr. George R. Smith, (Bell's Asbestos Co.) Thetford Mines; Dr. James Reed, Reedsdale, Que.; Mr. A. Sangster, (Canadian Rand Drill Co.), Sherbrooke; Mr. F. P. Buck, (Dominion Lime and Marble Co.), Sherbrooke; Mr. Daniel Smith, (Hamilton Powder Co.), Brownsburg; Mr. John Jenckes, (Jenckes Machine Co.), Sherbrooke; Mr. Frank Grundy, General Manager, Quebec Central Railway, Sherbrooke; Mr. T. J. Tuck, (Dominion Lime Co.) Sherbrooke; Mr. A. W. Elkins, (Nichols Chemical Co.), Capelton; Mr. B. Rising, (Moulton Hill and Howard mines), Sherbrooke; Mr. Andrew Sangster, Sr., Sherbrooke; Mr. B. Marcusé, (Jeffrey Asbestos Mine), Danville; Captain F. Bennetts, Sherbrooke; Mr. Walter Adams, B.A. Sc., Montreal; Col. King, Sherbrooke; Mr. H. D. Lawrence, Sherbrooke; Mr. Steel, (Quebec Central Ry.), Sherbrooke; Mr. J. F. Patten, Black Lake; Mr. T. S. Somers, Sherbrooke; Mr. E. O. Grundy, Sherbrooke; Mr. John Falls, Sherbrooke; Mr. P. Jobodin, Black Lake; Mr. J. W. Woodside, Sherbrooke; Mr. C. Gordon Rogers, Ottawa; Mr. B. T. A. Bell, Ottawa, Secretary, and others.

The Secretary read the minutes of the meeting of the Association held on 6th and 9th July, which were confirmed; also a letter from the Treasurer, Mr. A. W. Stevenson, C. A., Montreal, expressing regret at being unable to be present and forwarding financial statement for the three months as follows:

Treasurer's Statement to 26th Sept., 1894.

1894			
Jan.—By Balance from 1893			$ 136 87
" Receipts for copies Volume of Reports:			
Government Pro. of Quebec	$125 00		
Dominion Government	96 00		
Members	136 00		
		357 00	
By Subscriptions to date		520 00	
			$1,013 87
To Paid—B. T. A. Bell Sec'y as per vote at Annual Meeting	$150 00		
" " Windsor Hotel balance dinner	32 40		
" " Stenographer January Meeting	20 00		
" " Mortimer Co., Acct. preparing Vol. Reports	548 00		
" " Sec'y Acct. to 26th September, 1894	165 15		
" " Stenographer Sydney Meeting	15 00		
" " Sundry Postages	11 80		
" " Circulars and Receipt Book	2 75		
" " Sundry Expenses, Com., Collections, Bank Com., Telegrams, &c., &c.	24 82		
			$969 92
Balance			$ 43 95

Memo. LIABILITIES.

Balance due on Mortimer Note	$52 00	
Mortimer & Co., Account	58 50	
McLaughlin & Co., Account	41 00	
		$151 50

ASSETS.

Balance on hand as above	$ 43 95	
" due by Quebec Gov'mt for Vol. Reports	125 00	
		$168 95
Also unpaid subscriptions to the value of		$220 00

(Signed) A. W. Stevenson,
Treasurer.

Montreal, 26 Sept., 1894.

Election of New Members.

The following new members were elected:—

R. H. Martin, New York,
B. Marcusé, Danville,
H. D. Lawrence, Sherbrooke,
T. J. Tuck, Sherbrooke,
Wm. Mitchell, Drummondville,
Col. Chas. King, Sherbrooke,
Dr. James Reed, Reedsdale,
Andrew Sangster, Sr., Sherbrooke,
J. Boas, St. Hyacinthe.

Election of a Vice-President.

The next item was the election of a vice-president in place of the late Col. Lucke, Sherbrooke. Mr. George R. Smith moved that the nomination of Mr. W. A. Allan, (Little Rapids Mining Co.), Ottawa, made at the last meeting of the Association be ratified. The motion was carried unanimously.

Federation Committee Appointed.

The subject of a federation of existing Canadian mining organizations was next discussed.

The Secretary read the minutes of the joint meeting with the Mining Society of Nova Scotia, held at Sydney, in July, and presented the report of the Committee of the Nova Scotia Society upon a scheme. It had been resolved to appoint a committee of four from each organization to draw up a basis of federation. The Ontario Mining Institute had endorsed the proposition and appointed its committee. After discussion, the report of the Mining Society being taken up clause by clause, the following committee to confer with the other organizations was appointed: Mr. John Blue, President, Mr. F. A. Halsey, Mr. L. A. Klein and Mr. B. T. A. Bell, Secretary.

The President of the Privy Council elected an Honorary Member.

Mr. James Mitchell, Sherbrooke, seconded by Mr. John J. Penhale, proposed the election of the Hon. W. B. Ives, Q.C., M.P., as an Honorary member.

The motion was carried unanimously.

The Cape Breton Meeting.

On motion of the President, the Secretary was instructed to convey a very cordial vote of thanks to Mr. David McKeen, M.P., Mr. W. Blakemore, M.E., Messrs. Kingman, Brown & Co., Mr. R. H. Brown, M.E., the President and members of the Mining Society, Capt. Isaac P. Gragg, Col. Granger and the President and members of the Sydney Club, for courtesies extended during the visit of members to Cape Breton in July.

The President then called for the first paper for consideration.

Slate: Its Formation, Extraction and Uses.

Mr. H. J. Williams—The growing importance of the slate industry in Canada demands a consideration of the utility and value of the mineral, its occurrence and distributions, especially in the province of Quebec, and the method of extraction and usage.

The subject is so comprehensive that adequate justice cannot be given to it in a short paper of this kind.

I find nothing written upon the subject except the meagre references made in the Geological Reports of Sir Wm. Logan and others. Therefore, as no thorough examination has been made of the slate formations of this province, our knowledge of the same must be limited.

No clay slate of any value is found in the Laurentian range nor anywhere in the Province of Ontario. In coming east through the Province of Quebec, we find the first slate formation near Stanbridge, and this appears to be a continuation of a similar slate found in an island in Lake Champlain, and also in Hatch Hill, south of Whitehall, in New York State. No work has been done on this vein except on the island above mentioned. Then farther east we strike purple and green slate in Missisquoi County and at Granby, where some small openings have been made. This formation continues to the N.E. to Actonvale, where a quarry was opened and operated by Mr. Rankin of Montreal. Then we come to the Kingsy formation, which is a very wide purple and green belt. A quarry was opened on this vein at Trenholmville, but the slate that was produced was of poor quality. This formation is different from all the others, it being a laminated formation, the bedding about ¼ inch and more apart, and not capable of being split between the beddings. A slate of similar character and texture is found in Birds-Eye Mountain near Castleton, Vt., which possibly is a continuation of the same formation. East of this are the Melbourne veins upon which several openings have been made, to wit, Melbourne quarry, the New Rockland quarry, which is now being worked, the Steele quarry in Cleveland and the Danville quarry in Shipton. Slate of excellent quality is being produced from this vein.

The next formation east of this is found near Windsor Mills. It is an extensive deposit, but owing to its ribbony character, the ribbons in it being hard and occurring at intervals of only a few inches, renders it unworkable and of no value.

Next we come to the Brompton formation upon which two openings were made near Key Brook, about 34 or 35 years ago, but this also is full of ribbons, which unfit it for the production of roofing slate. Slabs for sidewalks and cellar bottoms have been taken out of it at several places which at a greater depth would be good for that purpose. This formation is very extensive, being about a mile in width at Brompton. It is identical with the beds at Montpelier, North Johnsbury, and also Guilford south of Brattleboro, Vt. Quarries have been opened in each of these places and were wrought for many years, the Brattleboro or Guilford quarries being undoubtedly the oldest on this continent. They were worked as far back as 1812. This vein runs south of Guilford for about ten miles when it is pinched out by the granite.

Then we come to the formations at East Angus and Garthby and several veins of different colors in Beauce County.

From the number and variety of the slate deposits of Quebec, it would appear that many remunerative quarries might be opened.

The main ingredients in the composition of slate are silica and alumina, which show it to have been at one time ordinary clay. Blue (of different shades), purple, red and green, are the ordinary colors met with. The blue color is derived from the presence of protoxide of iron, or iron and oxygen mixed in the proportion of one part of the former to two of the latter. The red and purple varieties take their color from iron in the form of peroxide, two parts of iron combined with two of oxygen. Into slate of a green color, which is the best common variety, iron less largely enters, and in combination with magnesia, gives them a greenish hue.

The clay beds were deposited in ages long past, in the bottom of the sea, and in process of time they have been hardened into stone, and lifted up so as to form dry land. That these beds were originally deposited in the sea, geological authorities mention among other reasons the fact that they contain abundantly the remains of former sea life, which lie along the planes of the bedding, such as zoophytes, mallusca and crustacea. The fossils of these strata may be studied from Sedgwick and McCoy's "Palaeozoic Rock and Fossils" and other works. The presence of soda and potash in the slate deposits, being the record of the saltness of those ancient seas, is an additional proof of the beds of clay in the sea. It can be well imagined how when this deposition was made that it went through a process of sorting. The heavy, coarser material would be deposited first near to the shore; the finer matter would be carried farther to the sea, and the lighest portions of all would be held longest in solution and would reach the farthest from the shore line. We can well understand then that the variations we find in the quality, color, consistency and thkness of the strata, etc., are all due to the disturbance of the water, caused by oanic and tidal currents, as well as by storms, which then as now occurred periodicy. As a result of these storms we might naturally expect to find, even in the fist deposits, layers of coarser material.

From these simple statements relative to its formation it will readily be seen that in slate bed which extends over miles of country, a great variation in consistency al color will be found. The deposition of the coarser or finer portions will deterne the former, while the latter is dependent on the presence in the water, of the derent oxides of iron in combination with carbon, when vegetable growth has occred, magnesia and other elements. It will be seen also that it is fallacious to spose, that because a vein has been proved good or bad in a certain portion, that it nst necessarily continue the same throughout its entire course. Each particular portn must speak for itself only.

In all slate veins, lines, or bands, sometimes wavy, but oftener straight, will be sn crossing it. These are the lines of bedding and it does not follow that the lines cleavage will coincide with them, as it can only be supposed that the phenomenon cleavage resulted from an action which occurred long subsequent to the deposition the muddy layers in beds. There is some difference of opinion among those who ve given attention to the subject as to the manner in which this slaty cleavage was pduced. It is explained by some to be the result of a crystallizing action; by others oe due to magnetic currents, while others, again, claim it to be the effect of meanical forces that compressed the sediment at right angles to the direction of cleavage. it one or the other or a combination of forces, we find the line of cleavage always right angles to the dip of the vein.

The occurrence of joints such as floor or foot joints, face or side joints is accounted by the mass slowly hardening and consolidating by pressure as well as heat. fted out of the water it cracked and split in various directions in drying, and, inenced by the laws of crystallization, it assumed definite shapes, being split into ugh and homboidal masses. Had our original deposition been homogeneous d subsequent action constant and uniform our present slate veins would all have en practically perfect. As such, however, was not the case we find we have to cond against many conditions which determine its possibility of being worked to advane. The presence of dykes, posts, wavy cleavage, impure beds, etc., we find in all ate formations, and it is only after a careful and intelligent study of the conditions at we are enabled to know of its value.

We will now proceed to the methods of working a slate quarry which are the me the world over, differing only in the manner of laying them out, which is depenent entirely on the locality of the opening, the condition of the formation, and its sition relative to the surrounding rocks. It may be: 1st. An open quarry. 2nd. chambered quarry worked underground by means of levels or adits. 3rd. An underround quarry worked by shafts. I will confine myself to a brief description of the rst only, as with one exception all the quarries on this continent are open quarries.

Slate rock being of a soft clayey nature is affected by the elements more, perhaps, an any other rock. In the slate quarries now opened in Canada, the top or rock hus affected is from 30 to 40 feet in depth, all of which has to be removed before ound slate can be made. An opening is made along the face and another across the ein. This portion is quarried back, another bench or gallery started in the same vay, and so on until the opening is laid out in a succession of galleries. The first peration is the quarrying of blocks, and it is here that the most intelligence is necesary. It is imperative that the block shall be quarried without shattering, and the kill of the quarryman is tested by his ability to take advantage of the slips, joints, loors, to make each hole do the work properly. In some cases wedges are used, plitting and slowly forcing a certain portion from its position, but it is usually done by means of blasting. A hole is put into the face and at right angles to it until a split or bed plane is notched. The hole properly charged is filled with powder to the mouth and as little tamping as will hold the powder in is used. In this way the pressure caused by the explosive being uniformly distributed along the entire width of the porion to be moved, the block is cut its entire length between floor joints and is thus moved without shattering. Had our hole been filled only half full and the balance amped, all that portion of the block from the powder to the mouth of the hole would be shattered and rendered useless for slate. Ordinary blasting powder is used exclusively in this work as the force wanted is a dull heaving one, which will heave and displace the rock without breaking it. The sudden force of explosion in the higher explosives such as dualin or nitroglycerine acts too quickly and before our rock has time to be cut it is entirely shattered and distroyed by the rapid action.

Our large block has now to be cut up, and, here, again, much skill and judgment is requisite. And I might say here, that there is no mining in which such intelligence, skill and judgment are required on the part of the labor employed as in the quarrying and working of slate. With a small steel gauge and light single hand hammer, a small ditch or trench is cut across the end of our block. Then with a steel chisel whose point is from 1½ to 2 in. long, the workman follows along this ditch making its bottom even and straight—a similar chisel though a dull one is then used. And by heavy blows on this chisel following along the ditch, the fine grains of slate are driven into the end of our blocks, and a cut is started along the grain which if nursed properly will continue straight throughout its entire length. These separate portions are then split into convenient sizes for hoisting and tramming, and are laid down along the sides of the shanties to be further worked into slate. Here, again, skilled labor is required and our "slatemakers," so-called, who usually work in pairs, study their block that they may make the most slate therefrom. As most blocks will contain impurities and disfigurement he must consider how in cutting it up he can bring these to the end of his slate that they may be cut off in dressing with as little waste as possible. His block is cut length-wise into two or more widths in the same manner as that employed by the quarryman discribed before. He then splits them into blocks or slabs of about 2 in. thickness and breaks them cross-wise by striking on the edge with a large heavy wooden buth, having previously weakened the opposite edge by making a gap or cut into it. The small blocks are then carried into shanties to be split and trimmed or dressed into the different sizes of slate used in roofing. The splitting is done by means of a flat, broad, thin-edged chisel and a wooden mallet, for the blows of wood are better adapted for the splitting of slate than those from steel. Splitting is one of the most skilful and particular processes of slate making. A fresh end or side to split from is necessary and the splitter carefully guards this end or side from bruises, and keeps them damp in dry weather as the split easily runs out the side when the blocks get dry. Again, a block being in a frozen condition will work up readily while frozen, but it is almost impossible to split them when they are thawed out, in which case they are usually left until frozen again. The dresser takes the pieces from the splitter and after trimming as little as possible from one end and one side at right angles to each other, the remaining end and side are trimmed to make the largest size possible from the piece. There are usually about 18 sizes varying from 12 x 6 in. to 24 x 14. The sizes being regulated by means of a gauge attached to side of machine thus ensuring a uniform length and width to all sizes. The slates are carried to the stock piles, inspected by a competent man, and counted into 100 piece lots, allowing from 2 to 5 per cent. breakage. From here they are shipped without further treatment, except in case of transhipment from rail to water, when they are usually boxed.

In the process of school slate manufacturing, the method is entirely similar to that described for roofing slate up to the dressing or trimming stage. In this case the slates are trimmed to size by means of a small saw with few teeth revolving very rapidly. In this way a very little splintering on the under side results. The surfacing is done principally by means of emery wheels or rollers revolving in water and the slate forced under the wheels or through the rollers. The hand process of surfacing, however, is much used, and consists of drawing an ordinary drawshave across the surface exactly as one would shave a piece ot board. The edges are bevelled to admit of entering tightly in the grooves of the frame. The latter are made entirely by machinery. Boys insert the slate, close and glue the frame, which is then planed and finished by means of machinery. They are packed and shipped in boxes and are sold to the market by the dozen or gross.

Another very large and growing branch of the industry is the milling of slate. There is no rock which so much resembles wood in its method of being worked as does slate. Blocks being brought from the quarry to the mill are sawed by circular saws, and planed by passing under a planer knife, a chisel some 6 or 8 inches long. From the planer the slabs go to the rubbing bed which is a large, heavy, revolving cast-iron plate, where by means of sand and water the surface is ground down smooth and even, to any required thickness. From here it will go to the jig or band-saw, the boring machine or the groove as the case may require. From here it may go through the marbleizing process, by which it is made to resemble any kind of stone or wood and thus used for ornamental purposes. It may be used for tanks or washtubs, or other vessels for holding liquids, in which case it is taken from the machines, put together by means of grooved joints with cement, and bolted or screwed.

The most general use for slate is for roofing. For this purpose it is unexcelled, except, perhaps, by copper, but the relative expense taking into consideration the utility of the two, is entirely in favor of slate. We have records of roofs laid in Wales in the time of King Henry VIII., which are in a good state of preservation to-day. The average cost per square which means enough slate to cover 100 square feet of roofing and which corresponds to 1000 feet of shingles is about $4, F.O.B. cars at shipping point of quarry. The laying, including nails, etc., will cost from $2 to $2.50 per square.

We have already mentioned its use as manufactured into school slate, which branch of the industry has been checked somewhat by the introduction of cheap paper tablets.

The uses to which milled slate is put are very numerous and varied. Among others the following are the most important: Billiard beds, blackboards, mantles for fireplaces, beautifully polished, marbleized and richly ornamented by hand painting, monuments, washtubs, tanks for water, oils or acids, urinals, closets and all sanitary purposes generally in public institutions and buildings, tiles, steps, and all kinds of flooring. It is also becoming more and more extensively used for electrical purposes such as switch boards, instrument stands, etc.

I will mention one other use, which promises to become a very important branch of the industry. I refer to the grinding of the slate rock into dust from which is made a brick whose compactness and strength and wearing qualities are not excelled by any other brick made. Tiles of any color, both plain and glazed, are another product of this dust.

The industry in the Province of Quebec is at present confined to the workings of but two quarries. One operated by the New Rockland Slate Co., at New Rockland, and the other by the Danville Slate Co., near Danville. Both these quarries are located on what is known as the Melbourne vein previously mentioned. The former is the most extensively worked of any that has been opened in Canada. Here the rock stands nearly straight having a dip of 80° to the south-east. The slate is of excellent quality, being hard, tough and strong, and blue-black in color, which is unfading. It is of compact and close grain, admitting of no soakage of water, making it very durable.

The first workings were opened about 1865, on what is known as the west bed, lying in the serpentine rock. Operations were entirely confined to this bed until the year 1881, when a cutting was made through a hard bed, and a body of slate found which was equal in quality to that of the other vein. Operations have continued in this new vein up to the present time. This vein is very regular in formation, not being intersected by any foreign rocks, but parts of it are very subject to chicks, or an unsoundness, known as slants by quarrymen, which chicks, running at an angle with the cleavage renders it unworkable for roofing slate or slab work.

A very extensive quarrying and milling plant is in use. The Salmon River here affords a very excellent water power, which is conveyed to the hoisting engines and mills, by means of wire rope transmission. Cable derricks of the Blondin system are extensively used. A large mill 100 x 60 feet, thoroughly equipped with all modern milling machinery, produces slab work of all descriptions. A narrow gauge railroad, about five miles in length, connects this quarry with the Grand Trunk Railway, at a point about five miles east of Richmond.

At the Danville quarry the vein is intersected by a series of hard ribbons, which, however, are at a sufficient distance apart to enable slate to be made from between them. The equipment here, though on a much smaller scale, is similar to that at New Rockland, except, that the power used is steam. In addition to their roofing slate and slab work, school slates are manufactured.

Owing to the private character of the companies operating, I am not able to give satisfactory statistics of the iudustry. The trade, however, has grown to be a very important one. This has been due principally to the efforts made by these companies to introduce slate, by the opening up of the country with railroads and by the protection which the Government has seen fit to bestow upon it. So rapidly has the trade grown of late that the demand is far in excess of the production, and with the extensive deposits of slate that we have in this country, there is every inducement for a thorough examination of the various veins, which I do not doubt would lead to the opening up and working of several remunerative quarries. And I look forward to the time, in the near future, when slate quarrying shall have become one of the principal industries of the province.

Vote of Thanks to Mr. Grundy.

Mr. F. P. BUCK—Mr. Grundy, the General Manager of the Quebec Centra Railway, has very kindly placed a special train at the disposal of the Association for the excursion on Monday (applause), and I would move that we tender him a hearty vote of thanks for his kindness. The motion carried unanimously.

Invitation from the Hon. W. B. Ives, Q.C.

The Chairman announced that the Hon. W. B. Ives, Q.C., M.P., had invited the members to dine at his house on Friday evening the 28th. (Applause.)

The meeting adjourned at 11 p.m.

The members re-assembled on Thursday evening, at eight o'clock, the President in the chair.

The Magnetic Needle.

Mr. A. W. ELKINS—A slender bar of steel, charged with some of that mysterious, imponderable fluid or influence, called magnetism, generally about five inches long and about one-sixteenth of an inch thick, pointed or wedge-shaped at the ends, and provided at its centre with a cup-shaped piece of very hard metal, or precious stone, so arranged that the bar may freely turn upon a pivot, is essentially the simple little instrument known to-day the world over as the Magnetic Needle, which possesses the wonderful property of remaining in a direction, (or of turning upon its centre, until it assumes a direction), nearly north and south, and this provides data from which the direction of the geographic poles of the earth can be inferred with a fair degree of accuracy.

Such is the essential part of the instrument, which, for at least seven centuries, has been the greatest boon to navigators, and of inestimable service to explorers of unknown territory.

The early history of this simple but invaluable contrivance is lost in antiquity. It is thought that the Chinese were its inventors; and one authority states that the Emperor, Ho-Ang-Ti, marching with his army against the enemy, finding himself embarrassed by fog, constructed a chariot which indicated the south. This was in the year 2634 B.C., and it is supposed that the magnetic needle was referred to; but the first time that it was explicitly mentioned was in a Chinese dictionary, finished A.D. 121. However, its use to navigators was probably not generally known till the middle of the twelfth century.

In order to bring forcibly before you some of the wonderful properties of the instrument, I will arrange a needle so that its extremities will turn towards the poles.

I have here a common knitting needle about seven inches long, to which I have imparted some of that subtile, imponderable fluid or influence, generally described as magnetism. Attached to the centre of this bar of steel is a fine silk thread by which I suspend the bar. It will be noted that one end immediately turns towards the north and the other towards the south. That end towards the north is called the north pole of the needle, or more properly speaking, the north seeking pole, for I will show you that the kind of magnetism that is at the north seeking end of the needle, is different from the magnetism which attracts it towards the magnetic north pole of the earth.

I have here another needle, similar to the one suspended before you; this one has also the properties exhibited by the suspended one, that is, it is magnetised.

Now, upon bringing the north seeking pole of this needle towards the north seeking pole of that one which can turn freely, it is seen that the one I hold in my hand *repels* the other, and the south end of one also repels the south end of the other; but the north end of *either* attracts the south end of the other. Therefore, the magnetism of the so-called north end of the needle is not the same as the magnetism of the north pole of the earth.

An ordinary magnetic needle costs about two dollars, but there are circumstances under which it may, and often has suddenly risen from this trifling value, to the enormous sum of three or four millions of dollars. For instance, in the case of one of our costly modern ships of war. Imagine one of these giants of the ocean cruising in a storm on a dangerous coast, the sun, moon and stars obscured by clouds and rain; her commander unable to find anchorage, must depend entirely upon that tiny bar of steel for guidance, to save his ship and the lives of all on board.

Insignificant though the needle seems to be, there is no known substitute for it, under conditions such as I have named.

Though the value of the magnetic needle cannot be overestimated, it is subject to changes, or influences, which are not perfectly understood, and which, at times, cannot be successfully guarded against. It is, therefore, necessary to use it, or to follow it, very cautiously, otherwise serious consequences might result.

The magnetic poles of the earth are not identical with its geographic poles, and this difference, which is indicated by the angle, contained by the astronomic and magnetic meridians, is called the declination of the needle; which difference is not everywhere the same.

In this eastern part of America the direction of magnetic north is about sixteen degrees *west* of true north, whereas in British Columbia, it is about twenty degrees *east* of north; and this declination is continually changing, to the extent of about five minutes in a year, the north end of the needle now gradually moving towards the west in this eastern part of America. It is, therefore, of primary importance that, before using it in any section of the country, its direction be ascertained by astronomic observation.

It is likewise subject to another change, known as the diurnal variation, which deflects it from its usual course about twelve minutes in twenty-four hours, and must be taken into consideration in using it, the maximum variation occurring about two p.m., after which it slowly returns to its former position.

In these northern latitudes the north end of the needle is drawn downwards, the extent of the inclination varying in different locations even in the same latitude.

It has been ascertained that the north magnetic pole is situated in about latitude seventy degrees north and longitude ninety-six degrees forty-six minutes west, which is a little north-west of Hudson's Bay, and not far from Chesterfield Inlet.

The magnetic equator does not correspond at all points with the earth's equator, but it is a curved line, in places a number of degrees from the equator proper. On the magnetic equator the needle remains in a horizontal position; but in southern magnetic latitudes the south end is drawn downwards in the same way that the north end inclines in northern magnetic latitude. In order to counteract this dipping, and to keep the needle in a horizontal position, a sliding counterpoise is placed upon most needles. Sliding, because, as the instrument, from long use or any other circumstance, loses its magnetism, the north end dips less.

I have spoken of the changes that take place with a greater or lesser degree of regularity; there are others, sometimes very material, that cannot be accounted for and which require the constant watchfulness of the observer to detect. The greatest change of this unaccountable character that has come under my personal observation, was a deflection of about forty-four minutes in eight or ten minutes of time. This was probably due to an electrical storm, which could not otherwise have been noticed.

The glass cover of the compass sometimes becomes charged with electricity, which causes the needle to apparently stick to the glass. This is of rather frequent occurrence. Wetting the glass immediately dispels the electricity.

Any state of the atmosphere in which electricity is an element, greatly affects the needle, electricity and magnetism being, it would seem, almost the same; the power of an electrical motor, for mechanical purposes, being dependent on the magnetic force induced in iron by an electric coil surrounding it.

In many places a purely local attraction causes the needle to swerve from its general course from five minutes to fourteen degrees, as noticed by myself during the twelve years I was actively engaged in surveying, and instances have been recorded where this local swerving exceeded twenty-five degrees.

These considerable deflections of the magnetic needle in certain localities are doubtless due to large deposits of magnetic substances. In the vicinity of Thetford and Coleraine the iron ore, that is disseminated through the serpentine and so-called asbestos, attracts the needle very sensibly.

Navigators have to contend with another perplexing source of error in compass reading, which is not easily overcome, particularly in these days when iron enters so largely into the construction of ships, and that iron so used sometimes affects the needle to a serious extent, and from causes that are not always apparent.

It is a well known fact that iron, remaining long in one position, sometimes becomes magnetic, and it has been found that portions of iron ships become magnetic. Now, the action of unmagnetized iron upon the needle is inversely as the square of the distance between the iron and the needle; but if a piece of unmagnetized iron, which at the beginning of a voyage would attract the north end of the needle, should become magnetic, it would repel the north end under certain obvious conditions.

I believe it was recently discovered that the needle was influenced to a dangerous extent on a man-of-war by the side arms of a sentry who passed near the compass and whose bayonet had become magnetized by having been stored near the ship's dynamo.

All of these irregularities of the needle may be successfully guarded against in fair weather, by frequent astronomic observations, but such observations require special instruments, which are not always obtainable.

In the absence of astronomic observations, the correctness of the work in hand depends upon the skill of the observer and his knowledge of the capricious pranks, so to speak, of this little instrument, which, with all its faults, is so marvelously useful.

With a view to increase the accuracy of compass surveys, I, several years ago, invented and obtained a patent in the United States upon a little instrument which I called an "Improvement on Transit Compasses," and it obtained considerable favor among surveyors; in fact, some of my confreres were kind enough to say that they thought that my instrument would supersede the plain sight compass.

The instrument consists mainly of a compass, rigidly attached to the upper side of a telescope turning upon trunnions in a bifurcated holder. It possesses many of the advantages of the heavy and expensive transit instrument, with the lightness and inexpensiveness of the compass, and it is therefore particularly desirable for surveys in places not easily accessible.

In ordinary so-called "line running" the surveyor would only use the needle at starting, after which required points in the great circle would be accurately determined by the use of the telescope, indicated in the cut of the instrument.

DISCUSSION.

Mr. GEO. R. SMITH—Is the compass of any value in underground workings, such as Mr. Blue's, to determine the true north—in long drifts, for instance?

Mr. ELKINS—You could not depend upon it. Its principal use in underground surveying is checking deflecting angles. Sometimes in deflecting from that line a mistake might be made. By leaving the bearing of that needle it would act as a check upon the work of the surveyor.

Mr. BLUE—I beg to differ with Mr. Elkins. I was engaged in mine surveying many years, and we used altogether the compass for all our mine surveys. There (in Scotland) mine owners are compelled by law to have accurate surveys of all their main workings taken every six months and accurate plans kept. To take a survey with transit in one of those large mines would require a week. I have kept plans of very many collieries in the Old Country, had charge of work where we were approaching boundaries, and have done work with the compass that was perfectly correct, and proved to be so by subsequent workings from the other side. I ran a line by compass from the bottom of two shafts about a mile and a half apart, and brought them close together in coal workings.

Mr. ELKINS—Were those workings checked by Rittenhaus' method? This method calculates altitudes and departures, and proves where workings come together. That is the only way of determining exactitude.

Mr. BLUE—For quick work there is nothing like the compass.

Capt. BENNETTS—I have done correct work with a compass for several years.

Mr. ELKINS—For a short distance and for rapid work there is nothing to excel the compass or take its place; but for absolutely accurate work you should never depend on it.

Mr. LAWRENCE—It seems to me, as one without any experience, after hearing what has been said, that both gentlemen might be entirely correct. In the workings Mr. Blue spoke of, in coal bearing strata, there might not be any local cases of variation to interfere with the compass; but in many localities it is utterly impossible to make any correct survey without the transit instrument. I do not see why in many cases the rapid work of the compass should not be as correct, and would be cheaper; but it must be a fact that in many localities the compass would be entirely valueless.

Mr. BLUE—I agree that in such cases the compass is of no value whatever. But I must say that in a great many places the compass is of more value than the transit.

Mr. E. B. HAYCOCK—I think that if I had to do work and was allowed to use the instrument I considered would do the best work, I should take the transit. Some years ago I made a survey on Lake Erie, and my chief instructed me to take the compass and make the survey, as being quicker and cheaper. I had a run of fourteen miles and ran it with the compass, and I can assure you that that compass line was as crooked as a lame dog could have made it. I then took the transit and ran the same trip, and came within an inch and a-half of a perfectly straight line. I also that summer did some short line work with the compass, and found that the best way I could use that compass was to start the line and use the piekets.

Mr. BLUE—In surveying a coal mine where the workings were stoped would entail as many as five hundred bearings, and you could only get the bearings of the length of your rooms, twenty to forty feet. Anyone who has used the compass or transit can just imagine the difference of time in taking those five hundred measurements. Can you see any reason why one should be more accurate than the other? You are plotting little bits of short distance to a small scale. The width of your pencil line would amount to several degrees.

Mr. ELKINS—I would compute the total altitudes by Rittenhaus' method and then lay off those total departures, which would insure practically absolute accuracy.

Mr. KLEIN—I had a little experience with compass surveying, and the question was settled ouly lately in court, and our company was about one hundred acres out—against the compass. I may say that lately a survey was made of a town line and through the compass quite a deposit of chromic iron was discovered. This line had been previously run by compass, and on the three different occasions produced three different lines, which varied about half a mile. If I had a survey to make I would in every case use the transit for the first time.

Mr. ELKINS—Does chromic iron attract the needle?

Mr. OBALSKI—I do not think so. I have never found magnetic chromic iron in this country.

Chromic Iron: Its Properties, Mode of Occurrence and Uses.

Mr. J. T. DONALD, (Montreal)—It has long been known that chromic iron occurs in this province in the Cambrian serpentines that stretch from the Vermont boundary to Gaspé, and in the past, at various times, small quantities of the ore have been mined and shipped, but the total output from the time of the discovery of these deposits to the present year is perfectly insignificant.

There are at present, however, indications that the raising of chromic iron may become an important industry in this district. The writer has examined the deposits that are now being worked at Black Lake, and has studied the occurrence of this ore in California during a professional visit to that State in June and July of the present year. The object of this paper is to clearly set forth the characters of the ore, its mode of occurrence and uses, with a view to enabling the prospector and the miner to avoid those snares that have befallen other Canadian mining industries in their infancy. Take our phosphate for example. It is well known that in one or more cases tons of pyroxene were, by mistake, mined for phosphate. And again shipments of valuable ore were sold at a loss simply because they did not come up to the required grade, and this simply because of a lack of care in dressing or in sampling the lot. It is to be feared that unless care is exercised similar costly mistakes will be made in connection with chromic iron. I repeat that the object of this paper is to furnish information that will enable those interested in this ore to avoid such costly mistakes.

Chromic iron or chromite is a compound of chromic oxide and ferrous oxide together with variable propertions of magnesia, alumina and silica. It is the only important ore of the metal chromium, and its value depends of course upon the quantity of chromic oxide it contains. Chromite as usually found is a massive compact mineral, possessing a granular or sometimes a slaty structure. Its color is iron-black or brown black, and its streak or powder is decidedly brown. Chromite is *sometimes* magnetic, but my experience with Canadian ores is that the high grade ores are not magnetic. Chromite has a hardness of 5.5, and a specific gravity of 4.4, that is, it is about twice as heavy as ordinary serpentine.

Our ore may be distinguished from magnetic iron, which is the only common mineral it resembles by the fact that its powder is brown whilst that of magnetite is black, and also by the fact that the chrome ore gives, with borax, a beautiful emerald green gloss.

Chromite occurs usually in serpentine, not in beds or veins, but in detached pockets, but sometimes these pockets seem to have been deposited along certain definite lines. This is the case in the Lambley and Robichon properties at Black Lake. The ore pockets vary greatly in size, some being exhausted by a single shot, whilst others yield hundreds of tons. Mr. Lambley has taken nearly 500 tons from one pocket which is not yet exhausted. As a rule, however, the pockets do not persist to any great depth, and in California it has been found that the ore does not improve with depth, but rather contrariwise.

The principal uses of chromite ore is the manufacture of the chromates and bichromates of potash and soda, and the preparation of chrome steel, an alloy of iron and chrome very valuable for special purposes on account of its great hardness.

But not all chromic iron is acceptable to these users of the ore. Ore containing less than 50 per cent. of chromic oxide is not desired, although, I believe, in certain cases, 48 per cent. is accepted. There are only two important manufacturers of chromates in America, viz: the Tyson Co., in Baltimore, and the Kalion Co., of Philadelphia, and these companies pay at present about $26 per long ton for 50 per cent ore delivered at their works, which is equivalent to about $20 per long ton at Black Lake.

Now whilst deposits of chromite are by no means rare, it happens, unfortunately, that but few, very few, of them are capable of producing ore of 50 per cent. chromic oxide. I have analysed a number of samples from various parts of this province, and only those from the Black Lake district have been up to the mark, the others ranging from 35 per cent. to 46 per cent. Selected specimens from Black Lake have analysed as high as 56 per cent., and Mr. Lambley informs me that the only shipment for which he had received returns averaged 51 per cent.

The question arises: Are chrome ores of less than 50 per cent. valueless? The answer must be: in their natural condition they are practically valueless at present. Recently, in California, attempts have been made to concentrate or work up the low grade ores to the market standard. Certain low grade ores are intimate mixtures of chromite and serpentine, the latter being much lighter than the chromite. It is on this fact that the system of concentration is based. It consists in crushing the ores to a fine powder and passing them over vanners or concentrators. Certain ores lend themselves readily to this system of concentration; for instance, a crude ore of only 24 per cent. has been dressed up to 50 per cent., whilst on the other hand some ore of 40 per cent. could not be dressed to grade over 42 per cent. The success of the operation depends upon the nature of the foreign matter associated with the chromite.

In conclusion, permit me to note two points on which special emphasis should be laid by those who are interested in this mineral, or may contemplate engaging in mining it: First make sure that your ore is up to the standard, that is, that it contains 50 per cent. chrome oxide. Secondly, remember that although a hand specimen may test over 50 per cent., it does not follow that the ore in shipping quantity will test as high. It is almost certain to test notably lower; indeed it will be found that very careful dressing or cobbing is necessary in order that large quantities, say car loads of the ore, do not test lower than 50 per cent. If selected hand specimens test not over 51 per cent. any miner knows that his ore as a whole will test considerably lower. And finally, if I may venture on a third point, permit me to say that no single fragment can possibly represent a pile of ore, and in taking a sample take a large number of small pieces chipped from all parts of the pile, from rich and poor masses alike, indeed, I would say, let your sample whether it be sent for analysis or to a buyer, be rather under than over the average of the pile. In the end the results will be none the less satisfactory.

MR. J. OBALSKI (Quebec)—The occurrence of chromic iron, or chromite, in the serpentine rocks of the Eastern Townships, has been known for many years, and it is mentioned by the late Sir William Logan, in the Geology of Canada, for 1863, eleven tons of over 50 per cent. having been then shipped to Glasgow at a price of $52 per ton. Ten years ago a few tons were extracted from Lot II, Range 24, of Wolfestown, and in 1887, Dr. James Reed made a shipment of from 4 to 5 tons, low grade, ore from Lot IV., in the 16th Range of Thetford, and 40 tons of 52 per cent. from Lot X, in the 1st Range of Leeds. At the same time specimens sent to the Antwerp Exhibition attracted much attention and a demand for the mineral was created; but owing to the small size of the deposits then known nothing eventuated. In April last (1894) a good surface show was discovered at Black Lake Station, on the Quebec Central Railway, and specimens having been forwarded to Baltimore, it was established that owing to the fair price offered and the facilities for working and shipping it would become a profitable businessr With such encouragement prospectors took the field. Other discoveries were made and a little excitement followed.

Chromic ore is found in irregular pockets and only in the serpentine rock. I will recall then that the main belt of serpentine which runs through our province and contains the well known asbestos mines starts from the south of the V. and VI. Range of Bolton, forms partly the mountains of Orford, passes east of Brompton Lake, and in the Ranges V. and VI. of Melbourne, XIV. and XV. of Cleveland, appears in Shipton (Jeffrey's Mine), Tingwick Lot XI. 21, Ham, north and south near the Nicolet Lakes Garthby, and takes a large development in the south-east part of Wolfestown, forms the mountains of Ireland and Coleraine by Black Lake and Caribou Lake with a branch to the little lake St. Francis and Adstock mountains. It comprises the important asbestos mines of Black Lake and Thetford, passes in Thetford and Brompton and is met on the rivers des Plantes and Echemin. No more serpentine is then noticed except in Gaspesia forming a large mass at the head of St. Anne River and at least on the Darmouth River. On the course of that formation chromic ore has been noticed especially near the lake Memphremagog, in Bolton VI. 27, VII. 13, 23½ W.; Melbourne, VI. 22½ N.E.; South Ham I. 27, II. 4, 20; Garthby I. A. B. I.; Island of Breches Lake V. 35, 36; Wolfestown II. 24½ N.W., VII. 23, 24, 25.; Coleraine Block near Black Lake Station X. 19, XII. 8, XIII. S. 7, 8, IV. 25, III. 25, II. 26, B. 3, 6, and on the Mount Albert in Gaspesia. All those deposits are of variable importance and in some places like Memphremagog Lake and Mount Albert only loose rocks detect them. As a rule the chromic ore appears at the surface of the serpentine as a form of black sponge which some times is only superficial or penetrates in on a width of few inches which can increase as far as several feet. Some time too the ore appears at the surface in its largest dimensions. Loose rocks in the earth are also considered as an indication of a deposit in the vicinity. This ore is in pockets of variable sizes and forms very irregular and disappears suddenly without any trace for further investigation. I have not remarked any kind of walls except the ordinary slides in the serpentine rock.

I will give some details on a few of those deposits. 1st. Several shows exist in the part of Block A of Coleraine, situated between the Q. C. R. and Lot 10, 19, and near this one. The most noticable and first discovered has been developed by M. Nadeau & Co., and latter by Mr. M. Lambly & Co. The ore appears there but little mixed with serpentine on an area 10 x 30 feet, with same indication at a distance of 200 feet N.E. At a depth of a few feet the pocket was exhausted having produced about 500 tons of which a shipment of 250 tons sent to Baltimore yielded 50.3 of sesquioxide of chrome.

Another pocket on an adjoining property at about 400 feet N.E. shows also some good indications, but has been but very little worked. On the same block near the Black Lake some valuable deposits have also been found.

Lot 19½ N.W., in the X. Range, belongs to Dr. J. Reed, and at a little distance from the above deposits, several shows are opened by small parties of miners, the most important being the one of Mr. J. Lemelin & Co., who works in from different places, one of them showing a width of 4 feet. 150 tons have been taken out of which 1 car (18 tons) has been shipped to Philadelphia and 4 to Pittsburgh. At some distance N.E. another good show is developed by M. Frechette & Co. from which 30 tons have been extracted.

Lot II. 26 has been hought recently from the government by M. M. Leonard, Morin and Labreque, who will develop it on a large scale. This deposit is very remarkable showing solid chromic ore 60 by 150 feet with important indications connected with the main body at 50' N.E. and 100' S.W. From a small opening 5 feet deep, more than 100 tons of good ore have been extracted by only a few shots. So far it is impossible to appreciate its depth, but the ore has been found at a difference of level of 20 feet. In admitting the depth corresponding to the other dimensions we find that we have there a considerable quantity ore, which will be ot great value if it only reaches the standard. This mine is 6 miles distant from the Q. C. R. between the stations of Black Lake and Coleraine, and the Company is just building a road for getting it. The above described deposits are all in the Township of Coleraine. The quantity of ore extracted represents about 850 tons of which 270 have already been shipped to Baltimore, 55 to Philadelphia, and 70 to Pittsburgh.

Distinctives Characters.—The chromite has a specific gravity of 4.5 representing about 7 cubic feet per ton in situ. Its hardness is 5.5. It gives a brown strike and dust of the same color. Some mineralogists pretend that it is magnetic, but I have not remarked this fact in our province, although I have found specimens of magnetite yielding some chrome.

Its composition is of sesquioxide of chrome and protoxide of iron, nevertheless, the elements chrome and iron are often partly replaced by alumina and magnesia, which lessen the percentage beside the mixed serpentine easily discerned. Theoretically it would contain 68 per cent. of sesquioxide but it scarcely yields over 56 or 57 in picked specimens and 53 to 54 in cargoes. The commercial grade is 50 per cent., but 49 and some times 48 is accepted. Below this it is considered as low grade ore and not used for chemical purposes. The Black Lake ore gives 49.8 and 50.3 on cargoes (analysis of Baltimore chrome works), and 54 and 56.02 on picked specimens (analysis of Donald).

Uses.—Chromite is mainly used for manufacturing bitchromate of potash which is employed for calico printing, for making pigments called chrome yellow, orange and green, in the construction of electric batteries and in chemistry. Chrome in alloy with other metals communicate to them its hardness, elasticity and unalterability, and now it is quite extensively used as ferro chrome for manufacturing steel armor plates, special hard tools, stamp shoes and dies, safes, etc. It is proposed too for hardening alumina.

Sources.—Chromite is always found in connection with serpentine, and the main producing countries are, or have been, Syria, (Asia Minor), New Zealand, New Caledonia, which produced high grade ore. Some chromite is also obtained from Austria, Greece, Norway, Russia and Australia is reported as containing important deposits, but of difficult access. There is some too in Newfoundland. In the United States, Pennsylvania and Maryland, have been as far as 1880 and for many years, large producers of this ore, while California contains important deposits, but of low grade ore (38 to 47%), and of difficult access. Nevertheless, they can be concentrated there and sent after in a granulated form with a percentage of 50 per cent. and over.

Market.—In the United States there are two Companies manufacturing bi-chromite: the Baltimore Chrome Works (Jesse Tyson & Son), Baltimore, the Kalion Chemical Co., (Harrison Bros., Philadelphia. The following Companies are using chrome for metallurgical purposes: Brooklyn Steel Chrome Company, Brooklyn; Bethlehem Steel Company, Bethlehem; Carnegie Steel Works, Pittsburgh.

In Europe there are several manufacturers in England, France, Norway, Russia, but we have no information regarding them. Glasgow (Scotland) seems to be the most important place for chrome manufacturing, and I will mention as purchasers: John Nelson Cuthbertson, Stevenson and Carlyle, J. & L. White. It is worthy of mention that for metallurgical purposes the low grade ore can be used, it is said as low as 40 per cent.

For the United States the manufacturers of Baltimore and Philadelphia give $26 per gross ton (2240 lbs) delivered for 50 per cent. and over. For a few years there was a duty of 15 per cent. *ad valorem* representing $2.90 per ton, hut with the Wilson Bill this duty has been removed and chrome ore is now on the free list. The freight is $5.50 from Black Lake to Baltimore and $5 to Philadelphia. The cost of carting from the mine to the railroad ranges from 25 cents to $2 per ton, and mining and hoisting vary from $1 to $8 leaving then a good margin for profit.

I am not well informed about the European market, but I understand that in Glasgow they pay $22.50 per ton delivered, the freight amounting to $4.50.

According to the "Mineral Industry" the price in Europe would be £5.10 per ton of 50 per cent., with a rise of 5s. per unit. In the United States the price paid for Turkish ore would be: for 48 per cent. $26, 50 per cent. $27.50, 52 per cent. $31.80, 54 per cent. $34.50. The production of the United States in 1893 would have been 1,620 tons, and the importation 6,354 tons, total, 7,974 tons. The manufacturers of bichromite requiring from 5 to 6000 tons.

I don't know what the consumption in Europe is, but from what is said above, the market and the demand for chrome ore appear to be favorable, our deposits being in the best condition for working and shipping. At date, the annual consumption of chrome ore for commercial purposes, is from 10 to 12,000 tons.

The present paper has been prepared at the request of the President of the G.M.A., after only a few days of notice, which explains and may excuse its elementary form. For better information on the subject, I refer to a very good article of the "Mineral Industry for 1893," in which I have found a good deal of facts. I must mention too the information I have obtained from Dr. J. Reed, one of the first exporters of Canadian chrome ore, and from Mr. W. Gleen, of the Baltimore Chrome Works.

As a conclusion, I will recall the irregularity of those deposits which make their exploitation a investment favorable only under certain conditions.

DISCUSSION.

Mr. BLUE—What is the difference in the specific gravity between chromic iron and gangue?

Mr. OBALSKI—Between 3.20 and 4.50.

Dr. REED—The papers just read are very exhaustive and cover the whole ground. People have an idea that chromic iron is generally found in small pockets. I believe that to be a fallacy. I have been told by parties who have mined in California and the States that they found very deep pockets, five hundred feet, and chromic iron there. You can find pockets in a certain strike in the rock; you go along a mountain and find five or six pockets all in one stretch. You go off that stretch thirty or forty yards north or south and will not find it. Large portions of this ore will be found in veins. If that can be found correct, we will be able to mine chromic iron as we do other minerals. You will find at Coleraine the pockets nearly touch each other. The most important thing to miners is the acid. We sent to Baltimore a carload of chromic iron. They say: this is forty-eight per cent—and you must take their word for it. Now, that is a bad position to be in. You notify them to come and examine what you have and say what it is worth. They say: you must send it to us, and I take whatever we will give you. See how much better it would be to send it to Glasgow. In Glasgow they have an official analyst who examines not only chrome but other minerals, and his assays are binding on both buyer and seller. Why should not our Government be able to furnish correct assays for our people, so that when we who have a large quantity of ore to send away the certificate of our Government would give the quality of our ore? I would suggest that our Secretary correspond with the Government upon that subject that we may have a proper chemist who will certify as to the quality of our ore, not only chrome, but other ores, so that we will not be at the mercy of the buyers, and that we may be in the same position in regard to ores as in regard to timber. We sent a carload down to Philadelphia. They wrote back that the ore was only forty-eight per cent. We had to take their word and reduce the price so much a ton; and the same thing occurred in regard to our Baltimore shipments. I believe ores as low as forty per cent. can be sold to mix with iron and steel.

Mr. OBALSKI—I noticed at St. Francis a very large pocket. I do not suppose that chromic iron is found in regular veins. Sometimes some inside pockets can be found, which could be tested by a diamond drill. I agree with Dr. Reed as to having an analyst appointed by the Government, and I think we should have a Bureau for this purpose, and a certificate could be issued by the Government.

Mr. B. T. A. BELL—I have argued for a long time that our Mining Bureaus should give more attention to the commercial aspect of our mining industries.

Mr. GEORGE DRUMMOND—My friends, Dr. Reed and Mr. Bell, have made a good point with reference to the appointment by the Government of an analyst, but I cannot see how that is going to bind the American buyer. The latter will be bound, not by the Canadian chemist, but by his own chemist. I think it would be well for those gentlemen if each had his own chemist, and then a sample could be sent to some independent or neutral chemist in the United States, as a safeguard against the courts later on, so that his certificate would be just as good as the certificate of the buyer. Buyers in the United States are more competent than gentlemen mining in Canada to tell the correct percentage of ores. We have got to meet our customers and admit that they are honest until we find them otherwise. There are only a few buyers in the United States, and they are not likely to defraud wilfully. I think Mr. Donald and Mr. Obalski have pointed out a few facts we ought to look at squarely. There is a tendency which almost every miner, particularly those who own property which they desire to sell to some unfortunate speculator or financial men—there is a tendency to go down and pick out the best specimen and say: There! that is a fair sample of my mine! With regard to Black Lake, I had a gentleman call on me the other day with a very fine specimen, and he said he had "mountains of it!" Dr. Reed says you have very large pockets, but he has not said as much as the gentleman I have just referred to. I think the concensus of opinion is that in the majority of cases chromic iron occurs in pockets, and although it is a good thing to push our mines to development, I think it would be wisest for those going into these mines to go very cautiously. They should be very careful in the selection of their ores and in the amount of money put into these mines until it is proved that there is a large supply.

Mr. B. T. A. BELL—It is a lamentable fact that to-day we have absolutely no data respecting the economic geology of many promising mining districts in Canada, while at the same time, officers of our Geological Survey are exploring and reporting on distant sections of our great country. How many years, I should like to know, will it be before the resources of Chesterfield Inlet and Labrador will be economically available? In the County of Hastings, and in other sections of Ontario, where gold and other minerals have been found, and where capitalists are seeking investment, no official reports that would be helpful to the development of the industry are available. Has any officer of the Geological Survey visited this field since these important discoveries of chrome iron were developed.

Mr. KLEIN—Mr. Willimott is, I believe, there now.

Mr. BELL—Is he investigating the nature and occurrence of the deposits, or simply collecting specimens? (Laughter.)

Mr. JOHN J. PENHALE—Mr. Obalski mentioned the cost of carting chrome as 25 cents to $1 per ton, and the cost of mining from $1 to $8 per ton. I would like to know how that is arrived at.

Mr. OBALSKI—I mentioned the case of Lake St. Francis, lot 26. I was there myself and saw the place. After making inquiry, I estimated that it would not cost more than one dollar for carting. Eight dollars would also be the maximum for mining.

Mr. JOHN J. PENHALE—Would that be a fair statement to put before the public? Is it fair to suppose that the miner is mining at as high a cost as he ever will mine it? If he has to pay a royalty, and the cost of mining is eight dollars, and the freight five dollars and fifty cents, and there is a duty of 15%, he would be left a very narrow margin.

Mr. BELL—The duty has been taken off.

Capt. BENNETTS I went out to examine these chrome mines, and the first question I considered was the geological question. Was it serpentine? And if so, is that serpentine congenial to the deposition of chrome iron? I found it was. These ores are in pockets. The quantity of ore raised has been considerable, considering the amount of work done—between nine hundred and one thousand tons—and by the returns of the United States they raise there twelve hundred, so that gives me the idea that these ores are worth not only recognition but searching after. So far, they appear to be of great value. The occurrence of the mineral covers a wide area, extending from Black Lake into Coleraine. I should like to ask Mr. Obalski if he noticed any other minerals that might be of value to the prospector in connection with serpentine.

Mr. OBALSKI—In Bolton there is a great deal of magnetite.

Mr. BLUE—I hardly agree with Dr. Reed in his suggestion of a Government analyst for determining the value of chrome iron and other ores. If a man has an article to sell, and another wants to buy it, they ought between themselves to establish a value. As to finding the proportion of valuable metal in ores—say, the amount of iron in these minerals—there is no difficulty whatever in taking a sample and having a public analyst, of whom there are plenty in Canada and the United States, make a complete analysis. I do not see what the Government has got to do between the private transactions of two persons. In our copper business we do not have the least bit of trouble, and I do not see any difference between selling copper and chrome iron. We sometimes have a little argument; but no trouble in having it ultimately settled. If the assayer of the buyer does not agree with the assayer of the seller, a third party can be called in. In regard to low grade ores, it is claimed that ores under 50% are not of much value, and Mr. Obalski says the specific gravity of the chrome iron is 4.50 and of the rock about 3. This being the case, it would not be difficult to establish a system of concentration that would bring up low grade ores to the required standard.

Mr. GEO. DRUMMOND—In selling chrome, as a safeguard, why not sell it so much per unit? You will have to determine the unit by having your own chemist and a corresponding chemist in the United States. I ship goods to a man and he says he receives only 990. Who will settle the difference? You must fight that man in the courts. These differences will arise, and no government can help you out. A great many young men come out of our college every year as trained chemists——some of them members of this Association—are you going to shut them out because you want to appoint a government official? If you find that a man in the United States has been acting badly and been trying to cheat you, why, find another buyer. You will find buyers in Scotland; and if we sell in the best markets we can always guard ourselves commercially, and that will he done by using the unit.

Dr. REED—The laws of England are pretty good laws, and based upon justice, and if it is right and proper for the British Government to appoint Dr. Clark to assay ores and weigh them, why should it not be right for our Government to appoint one here?

Mr. DRUMMOND—Dr. Clark will not be bound by any Government chemist appointed here.

Dr. REED—I know of a case of an American who took Dr. Clark's decision as final.

The meeting adjourned at 11 o'clock p.m.

Repairing Rock Drills.

Mr. A. SANGSTER (Sherbrooke)—It is to the interest of every drill user to keep the repair bill as small as possible. The Canadian Rand Drill Co. believe it to be their interest also to have their drills require few repairs, and in the following suggestions the writer would endeavour to show how a drill can be made to last longer and do more work. The repairs will refer more especially to those for which it is necessary to send a machine, or part, to the shop.

In nearly every case of a drill coming in for repairs, we find the cylinder worn in the bore from $\frac{1}{16}$ to $\frac{1}{8}$ of an inch (mostly on the bottom side, from using the drill in a horizontal position) so that it will require to be bored $\frac{1}{8}$ to $\frac{1}{4}$ of an inch larger.

The rings are generally worn out.

The split bushing for the lower head, and the stuffer, are generally worn $\frac{1}{8}$ or more, ond the piston (barring accidents) usually in good condition; in fact it is a common occurrence to get a piston that has been in use for years, not worn more than $\frac{1}{16}$ inch in diameter, running in a cylinder $\frac{1}{8}$ inch larger.

The drill is often accompanied by an order to re-bore cylinder and put in new rings, or larger rings; but the lower head is considered good enough.

As the cylinder is one of the most expensive parts of the drill, we should consider how to prevent this excessive wear. It is the opinion of the writer that it could be prevented by putting in a new split bushing in the lower head when that part wears out. It is very evident that when the bushing is worn so loose it no longer forms a guide for the rod, and all the wear caused by the drill bits being out of truth, or by the drill moving on the mounting, comes on the piston and cylinder, and the cylinder being the softer suffers most.

Some drill repairers recognize and try to prevent this wear, and keep a guide on the rod by putting in a new stuffer, but it is designed only to tighten up the packing, and will not take the place of the bushing, which is a steel casting and has a bearing surface nearly four inches long, while the stuffer is of malleable iron and has a bearing only 2 inches long.

The bushing is held in place as solid as the cylinder itself, by a projection into the cylinder, a large shoulder on the cylinder, and firmly clamped in the lower head, which is pulled up tight with the side rods; while the stuffer is only held in place by being pinched on the threads, a bearing of about one inch. This soon wears itself loose (and the threads in the lower head as well) when this extra duty is imposed upon it.

We supply at least ten stuffers to one lower head bushing, and as many cylinders as bushings, yet if the bushing was renewed in time a new stuffer would be unnecessary, and the cylinder would last much longer; and this bushing might be renewed five times for the price of a cylinder.

We will now consider how to repair a cylinder already worn out as described.

When the piston or cylinder of your pumps, hoists, or compressors, is worn too loose, you have the cylinder re-bored and a new piston made to fit, at a comparatively small expense; but in a rock drill, where the piston with the rod and chuck are all one piece and the most expensive part of the drill, the case is quite different.

To re-bore the cylinder $\frac{1}{8}$ inch larger requires a collar on the ratchet box and on the lower head bushing, to fit necessarily enlarged counterbores. If this is done and only larger piston rings put in, it is not worth the doing, as we have then only $\frac{3}{4}$ in. bearing at each end of piston, that is the width of the rings, which will wear out and be as bad as ever with a few days' use.

If a new piston is made for the re-bored cylinder, it is the most expensive and troublesome way to repair the drill, as the part saved (the cylinder) is the cheaper of the two. This also requires the collars in counterbores. Then, in the Little Giant Drill the piston is too close to the rocker pin hole, by one half the amount bored out. This necessitates reducing the rocker on the face, and as it is tempered it is a difficult job, and could not be done nicely outside of a machine shop without considerable time and trouble. This difficulty is not confined to the Little Giant Drill, but occurs in any drill in which the valve is moved by mechanism in contact with the piston.

It would be better and cheaper to put in a new cylinder. If necessary the piston can be trued up, and the new cylinder made a little smaller to fit.

The only way an old cylinder can be economically repaired, and a way which is made a regular practice in some of the American mines, is to bush the cylinder with a brass tube. These can be obtained drawn the standard size of the cylinder, and if the piston is not worn much, a good fit can be made, with all parts standard size, which is a matter of great convenience at the mines when it is desired to exchange parts from one drill to another.

The cost of boring and lining the cylinder the first time would be less than half that of a new cylinder, while to renew the lining would be less than one third.

Of course it cannot be expected that the brass lining will last as long as a new cylinder, but it can be renewed as often as desired.

A point in the Little Giant drills where much loss of power can be prevented, is in the rocker. With the wear on both points of contact with the piston, the ball of the rocker, the hole in the slide valve, and the dropping away of the piston itself there is sometimes in an old drill, a very small port opening. This can be remedied by swagging out the rocker, as well, and even better, than with a new rocker, as it can be drawn a little more to allow for the wear in the other parts. But it is a fine job, and could not be done by every drill sharpener; but in the hands of a good mechanic it is one of the best ways to liven up an old drill. We usually swag the rocker on every drill that comes in for repairs, and have had old rockers sent in to be swagged.

We use, in repairing an old drill or in setting up a new one, a skeleton valve, which is simply an ordinary slide valve, with the port cut right through so as to show it working on the seat.

By leaving the steam chest off, and moving the piston backward and forward by hand, we can see exactly what port opening the drill has, and in swagging the rocker can see where to draw it so as to give full and equal port opening at both ends of the stroke.

I would recommend that every repairer have a skeleton valve, and examine the drills with it when they come out of the mine, and not wait till the drill gets weakened in its action.

At some mines, after the slide valve and seat have been used as long as they will work, they are thrown aside, and new ones put in.

This is unnecessary, as a valve seat can be planed up as good as new several times. The same with the slide valve; but as it can be dressed as cheaply with a file as on a planer, it can be done at the mines. The recess or steam passage must be looked to and dressed out to its original depth, otherwise the steam or air would be throttled at this point.

A customary way in which the drills are abused is by pounding on the piston rod or chuck with a hammer or bar when for any reason the drill gets stuck in the hole. With our hexagonal chuck there seems to be no excuse for this undue punishment of the piston. And the fact that some pistons which have been out for years, even without the hexagonal chuck come in with very few marks upon them, plainly shows that it is not necessary.

About a year ago we repaired several chucks which had been pounded out of all shape, some of them right through to the bushing, and all of them allowing the bushing to project from an ⅛ in. to ¼ in.

These are repaired by turning up the end as large as possible, and shrinking and pinning a steel collar on about 1 in. or 1¼ in. wide. The collar was bored to fit the bushing at one end, thus lengthening out the hole for the bushnig. They were held in place by two large pins screwed and riveted in parallel with the rod, and several put in diametrically. Upon inquiry last week it was learned that they were giving good satisfaction.

The annoyance of nuts working loose can be prevented by using lock washers which we now put under each nut on all drills. They also make practicable the use of a paul stud, which many prefer to the stud we regularly put in: it has a long taper head fitting in a reamed hole in the ratchet box, and passes right through the cover, and has two nuts with a lock washer between them. The first nut is to make a close joint about the hole; the washer and second nut to keep it from slacking back. These, or the regular studs can be put in any old ratchet box, no matter how large the hole may have become, by plugging it and making a fresh hole for the stud.

In the progress which has been made in the construction of rock drills better material is being used, parts which were once made of cast iron have for several years been made of malleable; amongst them the steam chest and ratchet box, making the breakage of those parts a rarity. In fact the cylinder and valve seat are the only parts of the Little Giant Drill which are made of cast iron.

Great care should be taken to see that the drill is oiled regularly with a good quality of lubricating oil. From the rough nature of the work for which this class of machinery is used, this important point is often overlooked and by using an inferior oil, through misrepresentation or from a sense of economy, a plant which has been laid out with expert engineering advice and the best machinery put in, is often seriously crippled.

DISCUSSION.

MR. GEORGE R. SMITH—In expressing an opinion upon Mr. Sangster's paper I should exercise great care, for it is entirely, I presume, based upon his acquaintance with the Rand machine; and, as you all know, my ideas are founded upon experience with the Ingersoll make. The valve motion of the Rand is entirely different from the Ingersoll, there being no tappet. The bushing of the cylinder is a new idea to me. Is his idea that the company who furnish the drill furnish the bushings?

MR. SANGSTER—Yes.

MR. GEORGE R. SMITH—The trouble is, I think, that the bottom side of the cylinder is usually worn more than the top side. The latter would either have to be bored out a little to take the bushing, or the bushing would have to be tapered to be put in. How can we use this bushing without re-boring the cylinder or getting a taper brass lining? Would not the cylinder have to be re-bored to take the brass lining?

MR. SANGSTER—The cylinder would have to be re-bored the first time. Afterwards the bushings would be renewed without reboring.

MR. GEORGE R. SMITH—Of course, the only point is that you could use the old cylinder; but I think the idea a new one and a good one.

MR. BLUE—How is the bushing kept in place?

MR. SANGSTER—It has such a long fit in the cylinder that the danger of moving would be very slight. It could not move sideways, as the heads and two pins screwed in and rivetted over would prevent its turning round.

MR. BLUE—Would it not be possible when a cylinder was in the shop to bore it out a certain size and get several bushings, all fitted for that size, and when sending the drill back to the mine owners send several bushings at the same time.

MR. SANGSTER—Yes; the bushings would all be the same size, and a cylinder once re-bored a bushing could be exchanged.

MR. L. A. KLEIN—The economical part of the question has not been referred to. Have you, Mr. Sangster, made any practical test of your theory? How long will such a brass bushing stand?

MR. SANGSTER—A practical test has been made at some of the American mines. I have only had experience in bushing one cylinder. I never heard anything against its use.

MR. KLEIN—Would it not pay better to have a new cylinder instead of putting in four or five bushings? How would that compare?

MR. SANGSTER—The cost would be less than one-half to bush it the first time, and less than one-third to renew the bushing. Many mine owners are averse to putting in new cylinders. They wish to use out the old parts.

MR. KLEIN—Wrong tactics!

MR. SANGSTER—No doubt a new cylinder is the best method. But how many are there who will do that?

MR. F. P. BUCK—We would all do it if we knew it to be cheaper.

MR. L. A. KLEIN—Is it not better to have a new cylinder than new bushings, and be obliged to renew these brass bushings so often?

MR. SANGSTER—My argument is that the old cylinder can be used economically.

MR. S. L. SPAFFORD—My experience is that after a drill gets to a certain stage, when the cylinder is worn and the piston is worn, and the general repairs would be heavy, it is better to get a new machine than try and patch the old one up. Such a policy is a saving in your fuel, and I do not believe in bushing old machines. It is possible that bushing a cylinder is a good idea; but I think that if the cost of bushings were taken into consideration, and the time of repairing the machines, it would be found that it did not pay. Brass bushings wear out rapidly.

MR. BLUE—I think if the manufacturers of drills would be content with a moderate profit, on the manufacture of drills, say if they would give us a drill for something like 25 or 50 per cent. on the cost, it would be the wisest plan for all users of steam drills to throw them away after the first six months' work and get new drills. I have always found the first six or eight months' work of drills the best work, and not very satisfactory after that time.

MR. GEORGE R. SMITH—We all ought to feel very grateful to Mr. Sangster for having introduced such a subject. If there is a sore point among mining men it is that of repairing drills and drill parts.

MR. BLUE—The use of better oil is a good suggestion by Mr. Sangster. A drill is the worst used piece of machinery on the face of the earth.

CAPT. BENNETTS—I have been using these drills some two hundred miles from a machine shop; and in such a case as that, many points of Mr. Sangster's paper would come in usefully.

MR. A. SANGSTER, SR.—I think there is not enough care exercised in the choice of oil. Agents will come along sometimes and offer you an oil at a cheap rate, telling you it is of the same grade and quality as the best. But instead of this cheap oil keeping the machinery lubricated, the machinery begins to cut, more especially in the case of cast iron. We always try to get the best oil; and when we once get a good grade of oil, we keep to it, no matter what agent comes along. I think there is a great deal in the oiling of machinery to keep it running longer than it ordinarily does. I am not acquainted with any kind of drills, but simply with the running of machinery so far as oil is concerned. That one point has been very well taken by Mr. Sangster.

MR. SPAFFORD—What do you consider, Mr. Sangster, the usual cost of repairs per month?

MR. SANGSTER, JR.—I refer you to Mr. Jenckes, and to those who use drills, on that question.

MR. L. A. KLEIN—We have had a few American and Canadian machines. Our repairs in the first year, on five machines, did not amount to more than $42, using them all the time, two of them underground and three at open work. But in the interests of drill manufacturers, I do not like to mention what they cost afterwards.

MR. BLUE—That bears me out.

MR. GEORGE R. SMITH—Mr. Spafford's question is a hard one to answer. With us a drill will last longer than in the Copper mines. Our rock is solid. A seamy rock seems to break the drills up much quicker than a good straight stratified rock. Another great point is the operator. You can give a new drill each to two men. One man's drill will be in just as good condition at the end of six months as at the beginning; while the other man's drill may have cost in that time six or eight, or sixty or eighty dollars, according to the manner he used it. It depends on the rock and the man who was running the machine.

MR. KLEIN—The difference in cost of repairs between machines run by compressed air and machines run by steam is very considerable. With steam, you break a machine in about half the time that you do one with compressed air. I have been using both on the same ground, with the same men and conditions, and the steam does not stand half the time. There are certain parts which seem to break away, and at certain points.

MR. S. W. JENCKES—I never heard of any difference in working between steam and air, unless there was greater pressure used by steam than air.

MR. KLEIN—We carry eighty and ninety pounds, steam and air.

MR. S. W. JENCKES—Would your pressure be the same?

MR. KLEIN—Not exactly the same, on account of the difference in length of pipe line. 1,800 feet of pipe line, used in the case of air, naturally reduced the pressure ultimately on the machine, while the steam gets nearly the full benefit of the ninety pounds. I know Mr. Halsey fully admitted the repairs to be considerably higher in the use of steam; and his explanation was that it was due to the heating of the drill.

MR. SANGSTER, JR.—Certainly, repairs are greater in the use of steam.

MR. KLEIN—It is not more expensive at the same time to run with steam, though the repairs on a drill are higher. For the ultimate cost of a foot drilling where there is a possibility of running with steam in open works, is considerably lower than using compressed air. We can well afford to repair drills and use steam just the same.

MR. B. T. A. BELL moved the adjournment of the discussion, which was carried.

Excursion to the Copper, Chrome and Asbestos Mines.

Favored with the best of weather, the members drove to Capelton on Thursday and spent a thoroughly enjoyable day as the guests of President and Mrs. Blue. A considerable portion of the time was spent in a profitable inspection of the surface plant of the Eustis mine, and in examining the extensive underground works for which it is famous. (For a full description of the operations carried on here see our issue of July, 1893.) A *recherché* luncheon, given by Mr. and Mrs. Blue, was served in the

Club House. The adjacent mines of the Nichols Chemical Co., with which are connected extensive works for the manufacture of sulphuric acid and super-phosphate, were not thrown open to the inspection of the Association, for business reasons, but as the character of the ore and the conditions of its occurrence are the same as at the Eustis mine, both properties being located on what is regarded as the same vein, the real object of the visit was obtained. Too much cannot be said of the geniality of the hosts of the day, who were untiring in their efforts to make everything thoroughly pleasant, and it is needless to say, judging from the delighted remarks of the party, they succeeded admirably. The drive home over the fine roads and through a delightful stretch of picturesque scenery was greatly appreciated by all, Sherbrooke being reached in time for supper.

Delightful warmth and glorious sunshine favored the members for their excursion to the mining districts, on the line of the Quebec Central Railway, on Friday. Mr. Frank Grundy, the genial manager of the line, courteously placed a special train at the disposal of the members, a token of his good will to the mining fraternity, which was heartily appreciated. A start was made at nine o'clock, the first stop being made to permit an inspection of the important pulp and paper making industries at East Angus. Then a pleasant run through the charming scenery of the St. Francis Valley brought the members to the quarry and works of the Dominion Lime Co., Ltd., at Dudswell. About 100 persons are employed here. There are 10 kilns, and the output when running full time is about 150 tons. The face of the quarry is about 150 ft. in height. The lime is celebrated for its great purity, and is surpassed by that of no other lime works in Canada or the adjoining States, the amount of foreign matter being not more than one per cent. The train was soon again in motion for a run to Black Lake, and in order to lose no more time, a lunch, embracing everything that could be desired, was served on the way, the fresh air and exercise, and the universal feeling of good fellowship causing everyone to appreciate the good things provided to the fullest extent. Choice bits of scenery abounded, and the run to the chrome workings—they can hardly yet be called mines—which were reached about one o'clock, was enjoyable in the extreme. The members, under the guidance of Dr. Reed, Mr. Lambley and Mr. Robichon, were soon scattered about the various pits and trenches that have been opened recently on the hillside in close proximity to the railway, and from which several hundred tons of chromic iron of excellent quality have been mined. The nature and occurrence of these deposits are fully described in the papers by Mr. Obalski and Mr. Donald, reproduced elsewhere in this issue. A stop was made at Black Lake to visit some of the important asbestos mines, but the main body continued to run to Thetford mines, the headquarters of the industry, where the remainder of the day was spent with profit examining the important works of the Bell's, Beaver, King Bros. and Johnson mines. The return trip was a fast one, Sherbrooke being reached shortly after six o'clock, in time to dress for the second part of the day's entertainment.

Dined by the Hon. W. B. Ives, Q. C., M. P.

On Friday evening the members assembled at the residence of the Hon. W. B. Ives, Q. C., M. P., President of H. M. Privy Council, where they were entertained to dinner. Mr. Rufus H. Pope M. P. occupied the vice-chair. After a royal repast, and cigars were lit,

The Hon. Mr. Ives rising to propose the health of President Blue said :—Your President came over here when a young man ; and by virtue of sterling ability, perseverance and industry has attained to a very important and responsible position. He has done very well for himself—as Scotchmen generally do—and he is doing a great deal of good to the country. He is a man of integrity, a man of substance, a man of stability ; and he is a man whom we would like to see multiplied. (Applause.)

Mr. John Blue, responding to the toast and the iterated vocal assertion that he was all right and a jolly good fellow, said : I was told this afternoon by one whom I supposed to be an authority, that there were to be no speeches on this occasion ; and I rejoiced thereat exceedingly. Nevertheless, I have to thank you as best I can for the toast. But you are all too kind and flattering. Quite a number here know that at last winter's meeting of the Association, in Montreal, I accepted with a great deal of reluctance and hesitation the position which is responsible for my being on my feet at the present moment—the position of President of this Association, which I have the honor of holding. I had a great many scruples as to my ability to fill the position and that fact, taken in connection with the position itself, reminds me of a little story.

A certain great iron master in the North of Scotland had risen right from the pit, and come to a high position in the manufacturing world. He was noted for his good deeds and works and beneficence to educational institutions and the church ; and in recognition of these qualities, the church to which he belonged decided to confer upon him the honor of making him an elder. The object of this attention had serious scruples about accepting the eldership ; but he did not see how he could decently refuse, and so was compelled to submit to his fate. Shortly afterwards, a neighbor called in and asked him to come to the bedside of a dying parishoner ; and in the exercise of his duty as an elder of the church, he went, though somewhat taken aback by this unexpected call to arms.

"My friend," he said to the dying man, "a very great mistake has been made in calling me here. I am only a sort of business or managing elder of the congregation. I am not a praying elder. If you want spiritual discourse, you will have to get somebody else." (Laughter)

And so, gentlemen, you can apply this little story to my own particular case. I am not a talking machine for the Association. But none the less, I trust you will understand how I appreciate—an appreciation I cannot express—the manner in which you have responded to the too flattering manner in which my health has been proposed.

Mr. B. T. A. Bell, in proposing the health of the Hon. gentlemen whose guests they were said : It would be presumption on my part to attempt to express what we all think of our host, and the delightful hospitality which he has extended to us during this meeting. He is an old and valued friend to every mine operator in the Eastern Townships. He is known to every one of us, as a statesman of sterling worth and ability, whose first interest is the welfare of this constituency which he so ably represents. This merry evening under his hospitable roof is the crowning feature of what has been unquestionably one of the most successful gatherings since our Association was formed. (Applause.)

Hon. Mr. Ives, in responding, to the remarkably uniform manner in which the glasses were emptied to his health, and the vociferous singing of a popular refrain of which he was the objective point, said : I am exceedingly obliged to you, Mr Bell and gentlemen, for the very kind manner in which my health has been proposed and received. I can assure Mr. Bell that in the Townships we are a very happy family, and a fairly united family : and it gives me great pleasure to meet gentlemen from other parts of the Dominion, who come here to meet them as on this occasion ; and nothing can give us greater pleasure than to take part in the celebration and enjoyment which follow these meetings. I feel assured that the General Mining Association of the Province of Quebec is an association that has done and is doing and is likely to do a very great good. I am certain from what I hear that Mr. Bell in the journal which he publishes and edits and in his other efforts is doing a very good work—a work that is very useful to the Dominion and very highly appreciated by the practical miners of the Eastern Townships. As for our President, we have a very kindly feeling for him indeed in the Eastern Townships. He is one of our *boys*, and has been identified for a great many years with us, and he has made a success of an enterprise whose success was doubtful when he took hold of it. He has made money for his company, and I trust he is making a fairly good competence for himself. We like to see him succeed ; and he has the best wishes for himself and the mining interests of the Eastern Townships of us all ! If you look at the exports of the Eastern Townships, you will find that the mineral exports are among the most important, if not the most important of all. We feel proud when we go outside to say that our resources are so varied as they are. Mineral, agricultural, lumbering and others—we have them all, not depending upon one string to our bow. For we have very many strings ! After travelling over the Dominion from West to East, you will find that there is no portion of our country endowed with so many natural advantages and at the present moment so solidly prosperous as the Eastern Townships. Our agriculture is prospering, our mining industries are prospering. There may be an ebb and flow to this or that industry ; but in the main all are prosperous.

When I was in London, not very long ago, I was in company with two or three others from Montreal, and we occasionally went around among the barmaids. One day a conundrum was propounded to us by one of these barmaids. She said : When is a virgin not a virgin ? We all gave it up, and the answer she gave us was : In nine cases out of ten ! (Laughter.)

When you find an Eastern Townships man who is not thoroughly proud of the Eastern Townships he is the one case in ten. We are all proud of the Eastern Townships. It is a country large enough to receive all, and employ all, to say nothing of giving a competency and prosperity to all.

I have to thank you all again for the manner in which you have received the toast of my health. I am the unworthy representative (No ! no !) in the Cabinet of the Eastern Townships. I feel strong in the support your strength and support gives me. I feel when I go to Ottawa that I have behind me the pulsation of the Eastern Townships, and I hope I shall be true to the Eastern Townships. I try to be ; and if my common sense does not fail me, I shall be so always. And you may be sure of this : that I shall thoroughly, and truly and honestly represent the interests, and wishes and aspirations of the Eastern Townships.

The genial host called upon his guests to fill their glasses to the brim and drink to the health and prosperity of one who was an important factor of the Association, and of the Association's success, the Secretary.

Mr. B. T. A. Bell, in responding to the toast and the enthusiastic manner in which it had been received, briefly returned thanks.

Between the speeches, and later when the party adjourned to the spacious hallway, where an impromptu but highly successful concert was gaily held, songs and recitations of a pathetic and sentimental, and tragic and comic order were given by Mr. Geo. R. Smith, Mr. B. Marcusé, Mr. Gordon Rogers and Mr. H. J. Williams, while Mr. F. Grundy, Jr., proved himself a skilled and incomparable accompanist. It was 1 a.m. when a very happy lot of gentlemen shook hands with their kind host and drove back merrily under the glittering stars to Sherbrooke and bed.

Sherbrooke and Thereabouts, with the Q. M. A.

By the Junior Reporter.

The Gog and Magog Hotel, Sherbrooke, does not cover as many arable townships in its area as its name would imply ; but there is a great deal of room about it—for improvement. Still, the morning pilgrim who comes in on the Shivering Express at 5 a.m., and tries to register his name in Egyptian italics with his numbed fingers, will always find a nice new Early Rose potato for him to wipe his pen in, curled up with the ink and the blotting paper, calling cards and the matches, looking like a cross between a porcupine and a target in the time of Robin Hood, with its stucco of dismembered pen nibs and forgotten toothpicks.

There are two balconies running around the hotel three quarters of the way, like a short belt that wont buckle around a fat man. The upper one is for flirtation, and serves its purpose well ; and the lower one is for business, and pleasure of a less romantic turn. The ground floor balcony is a nice retreat for a flat-chested man, provided he sits up close to the wall. He can sit there and see the Postmaster wake up to hand out a letter in the Post Office opposite ; and he can hearken to the waterfall below the bridge, and the clinking of the "ryes" in the bar behind him, while his feet stray off into the road and paralyze traffic.

Sweet little Lennoxville—the neatest village on the continent ! Shall we ever forget the drive on that matchless morning through the rich and beautiful country about delightful Sherbrooke, over that piece of perfect road that lies between the picturesque town and the village that has been made famous by its college ? Sweet little Lennoxville ! indeed, with its broad clean street, its fine buildings of fresh-looking brick, its wholesome, healthy atmosphere, its beautiful entrances of perfect roadway bordered by great willows, and its background of lovely hills and slopes and charming farms and valleys !

We drove through a land indescribably delightful and smiling—even in the autumn time of sadness that is in itself most sweet ; through the country of the St. Francis and the Magog, the Massawippi and the Coaticooke rivers. Such a tangle of tree-girt, willow-bound, shadowy streams, that seemed to run into each other and lie in one another's bed, as it were, and then straighten out and loiter on as before.

"Mine? Yes, a mine! *Copper* mine!"

When you stand in the gravelled roadway by the office of the Manager of the Eustis Copper Mines at Capelton, and look about you, your eye rests and feasts upon a veritable land of promise—but a land of promise that has given much already and promises much more. Before you stretches a broad valley, green and glorious, that rises as if leisurely until it terminates as if exultantly in a stretch of wooded hillside. And across the valley, and up and over the hill, passes a white line of road, like a path running out from Arcadia to the world !

Then, beyond you, rises abruptly a great hill—a hill that is a mountain, rugged and most repellant in the hardness of its features. But it is a kindly old hill, after all ; for deep down beneath the rough surface of its breast, that has been pierced by shafts nearly two thousand feet deep, there is a treasure house of countless tons of pyrites, from which this old hill has been giving and from which it will give for many years.

The J. R. didn't go down this trip. But he sat on the verandah of the Club House, where there were a good many sweet little things of different sorts (soda scones and nips of scotch), and watched the procession pass by with its blue underclothes and cheap-sale assortment of last year's stock of headgear. When they came back, there was a sort of fagged, ragged, jagged, bagged-at-the-knees, curled-up-at-the-ankles look bout them; but it seemed that a little nip of something or other, taken quickly with ie eyes shut, was a good cure for this.

We sat down to as fine and variegated and wholesome and merry a luncheon as ver graced a table with four sound legs; and one of the many best parts of it was at there were no speeches. Every eligible jaw-wiggler had known in advance that is would be the case, and as a consequence no naturally fine appetites were impaired y worrying over the smart things to be said, and everyone eat as he had never eaten efore, and thought between bites how good Mrs. Blue had been. Poor Mrs. Blue's ars must have been burning an awful lot about that time! It was one of the bluest ays, in the best sense of the word, we ever put in—blue sky, blue clothes, blue every-here; and Ge—rge R-r-r-r-rg-l-s S——th, in his cerulean jeans and roundabout, lew in frequently to have something, bless him!

Long live John Blue! So say we all of us!

There is a high school at Capelton that looks like something between a sun-burnt ghthouse and a north pole observatory. You see the kids come scampering out of ie port holes that are on the ground floor like the fire escapes of an Esquimaux alace; and the solid, stolid, red-faced, telescopic old egg shell of education seems ositively to smile down upon the youngsters in its grim way.

When a boy in this institution passes out of the part-first, ground-floor class, he ses higher—to the next floor—and keeps on rising and graduating until he slides up to the tenth or twelfth story and passes out on to the roof in all the glory of degrees nd diplomas and scholarships and heart failure. And then he takes wings and spreads em out and flies away.

The genial little gentleman who bosses the running of the trains of the Q.C.R.R. ad placed a special train at our disposal, and we ran out in it on Friday, a jolly party, n a bright morning that promised an even brighter day.

A stop at East Angus allowed us to see the works of the Royal Pulp and Paper ompany—works so extensive that they require two townships to locate in, as there is n extensive paper mill operated by the same company on the other side of the stream. aper! paper! paper! of all sorts and conditions and sizes—paper in embryo, paper n its infancy, paper in its prime! The mills of the R. P. & P. Co. don't grind slowly, ut they grind exceeding fine paper. Paper, sir? Well, rather!

Then we branched off for about five miles to Dudswell, and inspected the great uarry of the Dominion Lime and Marble Company. This quarry of limestone is a ght to see. It is a great excavation, two or three hundred feet across either way, nd one hundred and fifty feet deep. The perpendicular gray white wall would make ie Sunlight soap advertising agent take to drink out of sheer envy; while down below, ie workmen, quarrying, look like pigmies. The stone is loaded down there upon all cars, that come gliding up the incline to the tops of the kilns. At the base of ie latter you can look in upon a glowing mass—and wish that you had in your yard t home just half the hardwood they fire in there in a day. Then you can see the me drawn out from another doorway, irregularly shaped blocks—and there you are! here is one ton of lime for every ton of stone dumped upon the hot summit of the iln.

When near Black Lake we made another stop and trudged away up a mountain—ie highest in Canada, I think—and saw the chromic iron deposits; and if the pro-rietor's pockets are ever half so full of finances, on the head of his shipments, as those re pockets were of dumps, he can go out of the business.

Acres upon acres of serpentine, stretching far away, greeted our eyes at Thetford. t's a case of mine, counter-mine, here, too; but you want about four hands to count hem all on; and your feet have to be mates when you are walking around there. his is the great asbestos region; and Mr. H. J. Williams—the only Harry—toted us bout and showed us how it is all taken up out of the great big quarries, and smashed nd pulverized until it is all so soft and silky, you could turn a handspring on it with-ut hurting anything but your feelings. Then, over the way, Mr. William King—long fe to him—coralled us all in his snug house and set 'em up in a fashion that I hope ill always be in style.

I don't know how it was. None of us *should* have been very hungry after the xcellent luncheon we had fought to a finish on the train, on the way to Thetford. ut all the same, we proved to the Honorable W. B. Ives that we *were*, when we sat own to the admirable dinner on Friday evening, he had bidden us to.

But all good things must have an ending—this article included—the dinner had, nd so too had the variety show in which the inimitable G——e R-r-r-g-l-s S——h istinguished himself and brought down the house with applause and laughter. And t last we shook hands cordially with our incomparable host, and drove back under he clear stars of a fine autumn night, and an impression that we had never had a etter time before—even in our boyhood.

An Improved Rock Drill.

Messrs. R. G. Ross & Son, of Glasgow, Scotland, have patented an improved ock drill. The drill is mounted on a tripod and fitted with the latest patent pneumatic utomatic feed, whereby the screw feed is entirely dispensed with. The piston works n the cylinder of the drill proper to which the flexible tube is connected.

The tool is attached by a plunger to the pneumatic feed cylinder which is clamped o a bracket connected to the tripod.

The tool is ready to start work when air is admitted to the cylinder by the thumb ock, the piston at once gets into rapid motion and simultaneously the air finds its way y a small channel to the outer end of the plunger in the feed cylinder, thereby press-ng the drill up to its work with a steady and unvarying pressure. All the attendant as to do is to turn the hand wheel steadily and somewhat quickly. When the drill as penetrated 18 in. or so, the plunger has travelled out that distance; the attendant hen slackens the clamp a little, pushes forward the feed cylinder till its outer end is ear the clamp, fixes it by a turn of the nut and the tool is ready for another 18 in. of ravel. It will thus be seen that holes 3 ft. deep can be bored by this tool with one ength of drill.

The tool is clamped to the upright stretcher bar by a simple bolt. One turn of he bolt enables the workman to raise or lower the tool, or to swivel it in any direction; ndeed, the arrangement of clamps form a perfect universal joint. The principle of he tool, we are informed, frees it from much of the tear and wear inseparable from he rock drills hitherto in use and thus enables them to be made lighter and more rtable. This secures greater economy in working, as one man can shift a complete ool and set it up at any new place without assistance. The tool is also made to work y hand and is, we understand, very effective in rock of a soft nature; but in hard ock it is desirable to use either stretcher bar or tripod, as may be found most nvenient.

An Incident of Forty Years Ago. to have occurred

follow to suppose

The following is clipped from *The Sporting Times* of London, and portrays an actual incident. The incident, ~~however, did not occur near New Denver, as some who have read it believe, or near Denver, Colorado, but~~, in the early 50's, near a little town in Shasta County, California, named Muletown, where for awhile gold was as easy to get out of the ground as whisky is to get from over a bar at New Denver now. The roads leading from Muletown down through the valley of Sacramento river were then, as they are yet, probably the dustiest in California, and to follow behind a freight "outfit" for any considerable distance would certainly be a great punishment. Although the incident occurred forty years ago, men of the mining camps are just as foolish to-day as they were then.

"WALK."

Up the dusty road from Denver town,
To where the mines their treasures hide,
The road is long, and many miles
The golden store and town divide.
Along this road one summer day
There toiled a tired man,
Begrimed with dust, the weary way
He cussed, as some folks can.
The stranger hailed a passing team
That slowly dragged its load along,
His hail raised up the teamster old,
And checked his merry song.
"Say, stranger. Wal, who-o-ap,
Ken I walk behind your load
A spell on this yer road?"
"Wal, no, yer can't walk, but git
Up on this seat and ride. Git up har."
"No-op, that ain't what I want;
Fur its in yer dust, that's like a smudge
I want to trudge, for I desarve it."
"Wal, pard, I ain't no hog, and I don't
Own this road afore nor 'hind,
So just git right in the dust and walk,
If that's the way yer 'clined.
Gee up! ger 'lang," the driver said,
The creaking wain moved on amain,
The teamster heard the stranger talk,
As if two trudged behind his van;
Yet looking back could only spy
A single lonely man.
Yet heard the teamster words like these
Come from the dust as from a cloud,
For the weary traveller spoke his mind,
His thoughts he uttered loud.
And this the burden of his talk:
"Walk, now yer damn fool, walk,
Not the way yer went to Denver,
Walk ——, —— yer, walk.
Went to the mines and made yer stake,
'Nuff to take yer back to the state
Whar yer was born.
Whar in hell's yer corn?
Wal, walk, —— yer walk.
Dust in yer eyes, dust in yer nose,
Dust down yer throat, and thick
On yer clothes. Can't hardly talk,
I know it, but walk, —— yer walk.
What did yer do with all yer tin?
Y-e-s, blew every cent of it in!
Got drunk—got sober—got drunk agin?
Wal, walk, —— yer, just walk.
What did yer do? What didn't yer do?
Why when you war thar yer gold dust flew.
Yer thought it war fine to keep opening wine,
Now walk, 'you son of a biscuit!' walk.
Stop ter drink! What!! Water!!!
Why, the water with you warn't anywhar',
It was wine—extra dry—oh! you flew high,
Now walk, ——, ——, yer walk!
Chokes yer this dust? Wal, that 'aint the wust,
When yer git back to whar the diggings are,
No pick, no shovel, no pan. Wal, you're a healthy man,
So walk, —— yer—just walk."
"The fools don't all go to Denver town,
Nor do they all to the mines come down;
Most of us all have in our day,
In some sort of shape, some kind of way,
Painted the town with the old stuff,
Dipped in stocks, made some bluff,
Mixed wines old and new,
Got caught in wedlock by a shrew,
Stayed out all night, tight,
Rolled home in the morning light,
With crumpled tie and torn clawhammer,
And woke up next morn with a 'katzenjammer,'
And walked, yes, —— us, how we walked?
Now don't try to yank every bun,
Don't try to have all the fun,
Don't think you know it all,
Don't think real estate won't fall,
Don't try to bluff on an ace,
Don't get stuck on a pretty face,
Don't believe every 'jay's' talk,
For if you do—
You can bet your sweet life you'll walk."

MISCELLANEOUS NOTES.

The mining lands, plant and equipment, and other property of the Drury Nickel Co. (Ltd.), in liquidation, will be sold in the White House, Sudbury, Ont., on Wednesday, 5th December next.

The shipments of coal from the Old Sydney colliery, Cape Breton, N.S., operated by the General Mining Association (Ltd.), are greatly in excess of last year. For the year ending 30th Sept., 1893, the total output was 217,000 tons; daily average 852 tons, or 1,265 tubs; while for the same period this year the total output has been 246,000 tons; daily average 946 tons, or 1,408 tubs, an increase of 29,000 tons. Mr. Robert Robertson, for many years underground manager, is we believe, likely to sever his connection with the colliery at an early date.

The H. H. Vivian Company, owners of the Murray mine, near Sudbury, is opening up a new location about a mile south of the present works. Mr. H. Merry has arrived from Swansea in connection with alterations to smelting plant.

The Crystal Gold Mining Co., lately incorporated, has started work with a strong force under Mr. McConnell, on their property at Lake Wahnapitae, Ont.

We take the following from the report of the British Columbia Board of Trade for 1894: The West Kootenay district has given further evidence of its richness, principally in silver bearing ores. During 1893, 1,337 mining claims were recorded and 1,167 transfers were made. Between December 12th, 1893, and May 31st, 1894, 5,374 tons of ore were exported (chiefly from Slocan mines), to Swansea and United States, the declared average value for customs purposes being $120 per ton. All the Slocan mines have been discovered since 1891, and, with few exceptions, every mine located there has improved as it has been developed, the veins becoming stronger as they went deeper. In 1893 the mines gave employment to 225 men.

The Jeffrey asbestos mine, at present operated by the Messrs. Boas of St. Hyacinthe, Que., has a force of 150 men working under the superintendence of Mr. B. Marcusé, and a large output is being made.

The Danville Slate Co. has about 100 men employed at its Danville quarry.

Clarence H. Dimock, of the Wentworth Gypsum Co., Windsor, N. S. and J. B. King, of the firm of J. B. King & Co., manufacturers of plaster, New York, visited the new plaster quarries, owned hy Mr. Dimock, at Demoiselle Creek, this month. The plaster from these quarries has been tested and proved a superior quality. A new wharf has been built at Gray's Island, Hillsboro', affording ample shipping facilities. It is rumored that Mr. Dimock will build a plaster mill at the quarries next summer. A branch line from the Salisbury & Harvey railway is now being built to the quarries.

The New Glasgow Iron, Coal and Railway Co. (Ltd.), has, we understand, acquired from the Government of Newfoundland a 99 years' lease of a fine red hematite deposit on Great Bell Island, Conception Bay. The ore body is extensive and gives on analyses 55% of iron and 0.08 silica. Work has been commenced, and tenders have been asked for the construction of an overhead tramway from the quarry to shipping pier, a distance of about three-quarters of a mile. The ore will make a fine mixture with the others from the company's mines in Pictou County.

The test well for oil that is being drilled by the Dominion Government at Athabaska Landing, 90 miles from Fort Edmonton, is down 700 feet. No oil has yet been struck, though gas is very plentiful, a second flow having just been tapped.

A prospector from Fort Edmonton, N.W.T., reports that 200 men are placer mining within about 20 miles of that town, but with poor success, most of them averaging only $1 per day. On the Peace river no gold at all is being taken out. On the Mackenzie river, 1,000 miles north of Edmonton, 15 men are averaging $10 a day. Flour is 25c. a pound, sugar 50c., tobacco $1 a plug, and other articles equally as high.

The coal shipments from the province of British Columbia for the month of September were:—

	Tons.
New Vancouver Coal Mining and Land Co	20,275
Wellington Coal Co	21,062
Union Colliery Co	19,960
Total	61,297

This shows an increase over the two previous months, the total for August being 54,009 tons, and for July 52,261 tons. The shipments from the collieries of the New Vancouver Coal Co. remain practically the same as in August, the difference being only 30 tons. Wellington's shipments show an increase of over 4,000 tons, and Union's of about 2,500.

A new seam of coal exceeding 9 ft. is reported to have been found at Anthracite, N.W.T., on the mining property worked by the H. W. McNeill Co. (Ltd.) The Winnipeg *Free Press* is our authority for the statement that about 8,000 tons of this company's coal is now banked in Winnipeg, and that it will be retailed all winter for $8.50 a ton, quite a drop from $10.50, last winter's price.

"Not many months ago," says a B. C. exchange, "there arrived at Nelson a man who knew absolutely nothing of prospecting or mining, having worked for years as a railway mail clerk. For awhile he worked at mining on Toad mountain, then he tried prospecting in the Slocan. He returned to Nelson this week a prospective millionaire, having struck a claim on which is eight inches of solid gray copper and antimonial silver ore, that runs over 1,200 ounces of silver to the ton. The discovery was made on the 1st of September, and it is situate about a mile south-west of the Dardanelles. The claim is named "Nil Desperandum," and the name of the locator is D. R. McLean."

Dr. Heintzzerling, of Frankfort, Germany, has been sent out in the interests of European capitalists, to examine and report on the well known Jeffrey asbestos mine, at Danville, Que.

The exports of minerals from the Ottawa Consular district for the eight months ended 31st August last, were: Phosphates, $8,830; mica, $9,414.89; nickel, $161.75. It should, however, be pointed out that mica is shipped in considerable quantities, of which the Consular agent has no record, inasmuch as where the value of the shipment is less than $100, it is not necessary to secure a certified invoice.

A new discovery of free gold in the Township of Addington, Ont., is being rapidly opened up by Ottawa capitalists, but before any machinery is put in, it has been wisely determined to have a thorongh mill test, and a carload will, we believe, be shipped shortly to the Oldham Gold Co., Oldham, N.S., for this purpose. The samples shown the REVIEW were rich in free gold.

We understand that the shipments of chromic iron from Black Lake have given entire satisfaction to the American purchasers, who have increased their orders for further supplies. A report reaches us that a German concern will take 3,000 tons at a fair figure.

The Price of Silver.—The recent advance in silver, though not very great, is very welcome to all classes of the community. There seems to be no doubt that it is connected with a war loan to China which is being negotiated in London. The demand is entirely from that quarter and it is reasonable to think that there will be more needed after a little as the China-Japan war is likely to be a long one. This, with returning confidence in business circles and an improvement in the volume of general trade, will give an impetus to the mining industry which it has long needed.

The Harvey Hill Copper Mines Sold—Dr. James Reid, Reedsdale, has purchased from the Bank of Montreal, the well-known Harvey Hill copper mines, Broughton, Que, the property of the Leeds Copper Co. Ltd., in liquidation. The purchase consideration was $10,500 cash. The estate comprises 2,801 acres, freehold, 1,300 acres of mining rights, together with the plant, machinery, buildings, ore on hand, etc. For many years, under various owners, this property has been worked, extensively developed, and a large quantity of high grade copper ore taken out, but owing to excessive capitalization and other causes, the mine has never been a success. Dr. Reed hopes, by careful and economic exploitation, to make the property a remunerative investment. He certainly bought the property cheap enough.

The Spanish River Talc and Nickel Mining Co.—A new company under this designation is seeking incorporation under Ontario Statutes, for the purpose of carrying on mining operations in the Township of May and elsewhere within the district of Algoma. Head office: North Bay. Authorized capital, $96,000, in shares of $100. The directors are: G. J. Bury, F. J. Lee, Henry Dreany, D. H. Barr, H. Troop, D. Cameron, all of North Bay, and A. Sharp, Sault Ste. Marie.

American Development Co. (Ltd.) has been registered at Victoria, B.C., with an authorized capital of $100,000, in shares of $100, and headquarters in the city of Chicago, to carry on mining operations in British Columbia.

Mica Mining in the United States.*

BY E. W. PARKER.

North Carolina—During the latter part of November, 1893, the writer visited the mica regions of North Carolina for the purpose of studying the methods employed in mining the mica in that locality and the facilities afforded for placing it upon the market. The time selected for the trip was unfortunate, for the region had just been visited by heavy rains, and the mountain roads, bad at the best seasons, were in many places almost impassable. With a good pair of horses, capable of making 10 miles an hour on a good road, and in a light buckboard, with no other burden than the writer and driver, two full days were occupied in travelling from Asheville to Bakersville, a distance barely exceeding 50 miles. A number of places which it was desirable to visit could not be reached on account of the condition of the road, it being necessary to keep to the county roads. Notwithstanding these disappointments, considerable information was obtained, and the writer is indebted to Mr. G. D. Ray of Burnsville, and Mr. G. L. Rorison, of Bakersville, for valuable assistance and various courtesies extended. Mr. Ray owns one of the largest mines in the vicinity of Burnsville, besides doing considerable business in buying and shipping mica, when business justifies it, but owing to low prices prevailing during 1893, his mine remained idle and he did no other trading in mica. Mr. Rorison handles most of the mica shipped from Bakersville. He attributes the unsatisfactory condition of the mica mining industry in that locality principally to the crude methods employed. There has been an entire absence of enterprise in the way of adopting modern mining appliances, and this, he claims, accounts for the limited product. In addition to this, there is the lack of transportaiion facilities. The region is very mountainous and without railroads, while the waggon roads for many months of the year are all but impassable. The streams are without bridges and the larger ones much of the time past fording. The beds of the smaller streams frequently form a part of the county road, especially in ascending and descending the heavy mountain grades. These portions of the "road" are naturally rough and very hard, both on the horses and vehicles. The nearest railroad point from Bakersville is at Marion, distant about 40 miles. For a heavy team the time necessary for this journey is nearly four days, in fairly good seasons. With these disadvantages it is not surprising that more capital has not been invested in modern machinery, and that the crude methods of mining with which the industry started still obtain. There is, however, some prospect of the extension of the Charleston, Cincinnati and Chicago railroad from Marion to Johnson City, Tennessee, following the grade of the North Toe river. This road, if constructed as at present contemplated, will pass within about two miles of Bakersville, and within five or six miles of Burnsville. The lack of railroad transportation will then be supplied, and it would be an easy matter to induce capital to invest in the necessary machinery to properly develop the mica properties.

The Mica Industry of New Hampshire—Mr. D. L. Stran, of Grafton Center, reports the following in regard to the mica industry of New Hampshire:—

"Mica deposits exist and mica has been mined in the towns of Acworth, Alstead, and Springfield, in Sullivan county; Wilmot and Danbury, Merrimack county; and in Alexandria, Grafton, Orange, Dorchester, Groton and Wentworth, Grafton county. These towns are located on a belt that runs in a northeast and southwest direction. On this belt at various places, for a distance of 50 miles, are found veins of quartz, feldspar and mica, interspersed with beryl, tourmaline, garnets, quartz, crystals, and many other minerals. In the above-named towns no mica was produced in 1893, except in the towns of Alexandria and Groton. In Alexandria work was commenced in April, and continued until September at the deposit formerly owned by the Alexandria Mica Company.

"This work was under the management of the American Mica Company, of Boston, Massachusetts. Large quantities of mica are here found, but a large percent-

*Mineral Resources of the United States 1893.

age is of a poor quality. In the town of Groton the several companies were in operation and producing mica during the year 1893. The largest producer has been the Old Ruggles deposit, located in the town of Grafton. It was at this place that the first mica was mined for commercial purposes in the United States, as far back as the commencement of the present century.

"At first and for many years the work was carried on in a desultory way. About the period of 1840 there was an increased demand for this mineral, and more extensive operations were carried on. About the year of 1860 there was a greatly increased demand, and from that time down to 1885, this deposit was in the full tide of prosperity. This property being owned by private parties, with their headquarters in Boston, and they for many years having a monopoly of the mica business, but little could be ascertained of the output or its value. The large piles of waste mica that can be seen at this deposit show the production to have been immense. Other openings have been made at various places in this town by different parties, and some have been very productive.

"The discovery of mica in North Carolina about the year 1867, and the large production that followed caused a decline in prices, more especially for small and medium sizes, and this finally closed most of the deposits for several years. When the deposits of North Carolina began to decrease in their production, the mica business of the United States found its level, and the industry gradually revived in New Hampshire, and for several years good deposits carried on a remunerative business. About 1885 mica began to be imported from India, duty free, and later from the Dominion of Canada. This tended to reduce prices, and production was again curtailed. The large importation of 1892, before the McKinley tariff took effect (which placed an ad valorem duty of 35 per cent. on mica), probably furnished this country with that article for quite a period in advance of the consumption. During the early part of 1893, quite extensive plans were under consideration for mining mica in this State, but the widespread business demoralization that followed, paralyzed the industry, and the present outlook is not very encouraging for mining mica in this vicinity.

"The hills of this mica belt are fast being cleared of their forests, and in many instances these denuded tracts are burned over, thus bringing into view new deposits, some of which look very promising. When the business of the country assumes a brighter aspect, with the increasing demand for mica it is expected that this section will again come to the front with large productions."

Mr. S. A. Mitchell, of Alstead, New Hampshire, states that the first mica mining in that State was carried on by a Mr. Ruggles at Grafton, in Grafton county, but the date of his operations is uncertain. Later, (about 1830 to 1835), Mr. James Bowers commenced working mica deposits at Ackworth, Sullivan county, and Alstead, Cheshire county. These parties supplied the trade of the United States for a number of years. Mr. Bowers was succeeded by his son, who continued the business until his death, working deposits in Alstead, Acworth and Orange, New Hampshire, and in North Carolina. He was in his turn succeeded by his son, who worked the North Carolina mines, and by Mr. Mitchell, who worked the New Hampshire properties. Meanwhile other parties were working other mines in New Hampshire at different periods and with varying success. Mr. Mitchell states that the mica-bearing belt extends from Cheshire county in a north-easterly direction through Sullivan and Grafton counties. The deposits are overlain with micaceous slate or schist, sometimes approaching hornblende slate. This has been ruptured, and seams of granite, sometimes rich in mica, occur in the overlying rock. Tourmalines, beryl, and other crystals are associated with the mica. According to Mr. Mitchell, the sheets of mica are more numerous in the New Hampshire veins than in the North Carolina deposits, but are not as perfect. He attributes this difference in quality to more violent disturbances, which not only affected the crystals directly by pressure and distortion, but opened seams in the rock which exposed the deposits to the action of water and changes of temperature.

Alabama—Mr. J. B. Merrill, of Edwardsville, Alabama, reports a production of $1,000 worth of rough mica in that State during 1893. Mr. Merrill states that it is only very recently that the mica deposits of Alabama have been receiving proper attention, or that efforts made to develop them gave promise of successful results. He claims that the mica is of excellent quality, and that the lands are being taken up by parties interested in obtaining good merchantable mica. A writer in the Chattanooga *Tradesman* gives the following account of the mica deposits in Alabama:—

"The occurrence of mica in Alabama, in crystals large enough to make merchantable sheets, was discovered and considerable prospect work done several years since. Attention was first attracted to the occurrence of mica by some prehistoric workings, considerable in extent, and very ancient, large oak trees from 15 to 18 inches through having grown on the dumps and in the pits since they were abandoned.

"The location of these granite veins bearing mica is in the extreme southern portion of Cleburn county, east of the Tallapoosa river, and also in the extreme northern portion of Randolph county. The district from which merchantable mica can be mined, covers about fifteen or sixteen square miles, being about five miles in length from northeast to southwest and three in width. On one property there appear as many as 11 distinct veins carrying mica, which outcrop parallel with each other at irregular intervals for half a mile, and a shaft sunk 80 feet cross-cut four of these, the narrowest of which was four feet. The strike of the veins is in a course slightly east of north to south of west, and the outcrop can be easily traced across 600 acres, showing great continuity in length. The dip is irregular, at an angle of about 20° to 25° towards the southeast. Each vein is distinct and separated from the next in rotation by strata of decomposed feldspar and kaolin clay.

"A few years ago considerable activity was manifested in the mica mines, and the prospect work previously mentioned was then performed; but the imported Indian mica was placed on the Eastern market at so low a price for the better grade used in stoves and furnaces that, although slightly inferior in transparency to the North Carolina, and the best of the Alabama mica, the miners in both of those States became discouraged, and all the Alabama mines, as well as some in North Carolina, were shut down, and remained idle until quite recently. In North Carolina, as well as Alabama, the mica mines are remote from railroad transportation, and the work has been crudely done, but the transparency of the mica and the sizes in which it can be cut, promises to bring it into demand in the future, and with an increased demand and steady market, the one great drawback of distance will, it is believed, be overcome.

The production of North Carolina in 1884, from only a few mines, reached $180,000 in value, and demonstrates what the possibilities are in the future for the Southern mines with an increased demand and steady market for the product. The work in Alabama has only been shallow, up to the present time, but crystals which produced 7 per cent. of first grade sheets of cut mica have been mined. As depth is attained the rust, stains, and flaws in the sheets become scarcer and the transparency consequently improves, so that in the near future it is possible that Alabama mica will be in as great demand as any on the market. The superficial area of the district being limited to the size before mentioned, is an incentive to the owners of property to develop it in a systematic and thorough manner, instead of following the crude system of a few years since. When this is done the value of the Alabama mines will be demonstrated more fully than to-day, and it will be possible to estimate with some degree of accuracy the quantity of mica in sight and the probable yield of the district. But this will always be somewhat speculative, because all the mines are pockety; in other words, although the veins are regular in their occurrence and dip, yet the mica crystals are found in irregular bunches in the veins, especially where a vein swells and in offshoots.

"On all the mica properties there is a large quantity of refuse on the dumps which would be of value for electrical purposes, but which, because of the lack of railroad transportation is not at present utilized, although pronounced by experts superior to the Canadian mica.

"There is a good prospect, though, as soon as the present panicky conditions pass away, that a railroad, and maybe two, will be built into this section of Alabama. One of these is projected and partially graded from Tallapoosa, Georgia, southward to connect Roanoke, in the southern portion of Randolph county, with the East Alabama railroad, and the other is projected from Anniston, Alabama, southeastward to Brunswick Georgia, or, rather, to be more particular, from Sheffield, at deep water on the Tennessee river, to Lagrange, Georgia, and thence to Brunswick."

Connecticut—Mr. S. L. Wilson, of New Milford, Connecticut, was the only producer of mica in that State during 1893. His production amounted to two tons of rough mica, which was sold to an electrical company, by whom it was cut and split for market. The mine is not worked for mica alone, but also for feldspar, golden beryl, aquamarine, and garnets.

Nevada—During 1893, 300 pounds of uncut mica were shipped from the Czarina mine, near Rioville, Nevada. All of this was sent to Hamburg, Germany, to be cut. In February, 1894, 200 pounds were shipped to Hamburg and 300 pounds to Syracuse, New York. In April, 1894, 1,000 pounds were shipped to Syracuse. All of this was cleaned of waste, so far as practicable, and was supposed to cut from two by three inches to eight by ten inches, a good portion of it being estimated to cut about three by five inches. No returns had been received by the shipper, Mr. Daniel Bouelli, up to the time of making his report. In addition to the Czarina mine, Mr. Bouelli has other claims, chief among which are the Pioneer and Princess mines. In his report to the Survey, Mr. Bouelli, says:

"The mica mines, of which the Pioneer and Princess are among the best, (there being someother smaller deposits) were discovered by me about twenty years ago. They are situated in the Virgin range in the St. Thomas mining district, Lincoln county, Nevada. The Pioneer is about fifteen miles slightly north of east from Rioville, which is at the head of steam navigation on the Colorado river, at its confluence with the Rio Virgin. The Princess is about 1 mile northeast from the Pioneer. The Pioneer group is at an altitude of 5,000 feet, near springs and accessible to waggons. About $600 has been expended in development work, and the probability is that $1,000 worth of work is needed to strike the mica below the influence of surface dislocations. The mica occurs in hard, glassy quartz rock, of which there is an outcrop 200 feet wide and 600 feet long. The surrounding rocks are systematic gneiss and granular schists.

"The Princess is a smaller reef of white quartz, with solid mica, better laminated, surrounded by dark-colored tourmaline bearing rocks, gneissoid graduating into syenite. Hornblende and biotite abound and pyrite and other associations of tin are at hand. These claims have been worked very little of late years.

"The Czarina was discovered and located in May, 1891. On this claim there is now a shaft on an incline following the dip of the mica 27 feet. This was found unsafe and another shaft of 35 feet is now directly over the point towards which the dip of the mica seam leads, and will be sunk vertically until the surface crush of the inclosing rocks is penetrated and the crystals show no breaks. Here also the mica occurs in and along the side of a heavy outcrop of white quartz in a country rock of gneiss, carrying various characteristic minerals. The muscovite or white mica seems to follow the division plane of the stratification, along the line or axis of the uplift or rock fold. This line runs north and south, slightly east of north of the main trend of the range, thus running into Arizona a few miles north of Rioville. In fact, the mica belt forms the boundary line between Nevada and Arizona for about 50 miles. The mica, mostly small, is abundant, but marketable sizes are rare and not to be had without a good deal of hard work."

Imports—In October, 1890, mica was placed on the dutiable list by tho new tariff, with a duty of 35 per cent. ad valorem. It had previously been imported free. The imports for the year, especially before the law went into effect, were exceptionally heavy—more than double the value of the imports in any previous year. This undoubtedly provided for an accumulation of stock beyond immediate needs.

Engineering Instruments and their Calibration.*

By Prof. D. S. Capper, M.A., King's College, London.

The value of laboratory training to an engineer is now everywhere recognized. It gives him facility in designing and making accurate scientific experiments, and, above all, it trains his judgment, and that faculty most essential to an engineer, his common sense, so that he may soundly interpret his results. Many valuable engineering data are lost, or vitiated by false assumptions as to the accuracy of the observations upon which they depend. One frequent source of such error is a too ready reliance upon the accuracy of the instruments employed.

There are two sorts of experiment which enter very laegely into engineering work of all kinds, and which specially exemplify the advantages of laboratory experience, viz: Testing engines and motors, and the strength of materials. In testing materials there are two instruments whose accuracy limits the accuracy of the resulting observations—the testing machine, which applies and records the load, and (where elastic extensions are required) some form of extensometer for measuring the resulting strain. Ordinary specification tests involve the accuracy of the machine alone, and may be relied on with any first rate machine to 0·5 per cent., wbich is sufficient for all practical purposes where the ordinary factors of safety are employed. But where determinations of the resilience or modulus of a material are wanted, some more exact knowledge of the limits within which the machine may be trusted are required. The more important possible sources of error are three in number: First, errors due to leverage; second, errors produced by friction; and third, errors in reading the position of the jockey weight. The actual value of these errors varies with different machines, as does the ease with which they can be determined.

With regard to testing machines, it will generally be sufficient for practical purposes if an accuracy of 1 per cent. is insured in the limit of elasticity and breaking load values. If the modulus is required, the second significant figure is of importance. Beyond that figure it is unnecessary to go for practical work, as two pieces of the same material may differ by a greater amount than that in the value of their "moduli," and it would, therefore, be unsafe to rely upon a greater uniformity for constructive purposes. For purposes of calibration, machines divide themselves into two classes, vertical and horizontal.

*Abstract of a paper read before the British Association, Oxford.

Horizontal machines require more knife edges than vertical, and the weight of grip and connections between the last knife edge and the specimen must be borne on rollers or other "frictionless" bearings. The calibration is rendered difficult by the fact that to apply dead loads (the only satisfactory method) a bellcrank lever must be interposed between the load and machine. Friction, on this lever, therefore vitiates calibration to some small extent. The maximum error will, however, be obtained in this manner.

Vertical machines have usually but one knife edge between steelyard and specimen, and a dead load can be applied direct with but little trouble, for at all events an appreciable portion of the total range.

The accuracy of load reading will depend largely upon the proportions of the machine and upon the size of the jockey weight. In English vertical machines the load is usually measured by a 1 or 2 ton jockey weight. In horizontal machines of the Kirkaldy type a variable jockey weight is universal. In the former case, the error due to reading is probably the largest error in the load measurements. In the latter, the accuracy with which the load can be read exceeds the accuracy of the machine. With a 100 ton vertical machine with a 100 inch steel yard, and a jockey weight of 1 ton, 0·01 inch error in the placing or adjustment of the jockey index will cause an error of 22½lb in the reading, and a possible error of 45lb over a range. With a variable jockey weight this source of error can be made as small as you please.

Vertical machines have been calibrated, but, as far as the author can discover, no published results exist of the accuracy actually obtained. Horizontal machines have also been calibrated for some portion of their range. The author has recently calibrated his own machine (50,000lb) at King's College, up to the point where the stress relieved the weight on the bearings of the grips, and so reduced the friction to that upon the knife edges alone. The apparatus used, as being ready to hand, consisted of the torsion wheels belonging to the machine, to which ball bearings and a knife edge were fitted for the purpose. This was found to answer very well for low, although, of course, unsuitable for heavy loads. Dead loads were attached to the rim of these wheels, and then balanced on the steelyard of the machine. Varying jockey weights were employed, so that measurements were taken at intervals along the whole length of the steelyard. Up to the point where the ball bearings failed there was an error, whose maximum value, including friction in the wheel bearings, was 24lb. There was no noticeable upward tendency of this error, but fluctuations were observed between 8 and 18lb.

To test the sensitiveness of the machine at higher loads, a test bar was inserted, and loads varying in value up to 20,000lb total load applied. The extra load required to move the steelyard from its central position was then measured by placing weights of 0·1lb each on its outer end. The amounts required to produce the first visible drop were as follows:—

At 5,000lb	total load, 6lb	additional load.
At 10,000lb	" 7lb	" "
At 15,000lb	" 7·5lb	" "
At 20,000lb	" 8·5lb	" "

To test sensitiveness at starting, when all the friction due to the weight of the jaws, etc., was present, a silk thread was attached to the grips, and it was found that a thread which broke under a load of 7·78lb sufficed to move the steelyard from its zero position against the stops. If we remember, therefore, that when taken over a range this error will, in many cases, disappear, and always be reduced, and that with a variable jockey weight (even if it is not less than 50lb in weight) the load can be accurately read to 1lb, we are fairly entitled to assume that in such a horizontal machine the maximum error is below 25lb.

On a 10 inch steel bar, ¾ inch in diameter, 25lb total load would produce an extension of under $\frac{1}{80000}$ inch, which would only affect the modulus in the third figure. A similar cast iron specimen would extend $\frac{1}{22000}$ inch under this load. In the vertical machine, with a maximum possible error of reading of 45lb over a range and similar steel test bar, an error in the extension of $\frac{1}{34000}$ inch, and on a cast iron $\frac{1}{12000}$ inch, would result. This would still leave the second figure accurate in the modulus if the average of a sufficient number of ranges were taken. To get an accuracy equal to that from a variable jockey weight, a test bar with larger area of section is needed. To ensure certainty in the second significant figure in the modulus, measurements of extension must be true to $\frac{1}{10000}$ inch, so that either of the above cases is well beyond this limit. Extensometres must be accurate, therefore, to this amount, and in order to insure this must be supported entirely independently of the machine—must, in fact, be self-contained on the test bar.

The instrument designed by Professor Kennedy is true to $\frac{1}{10000}$ inch, and if properly adjusted is entirely free from backlash. It can be readily calibrated by direct application to a micrometer, and is specially designed for ordinary laboratory use. The beautiful extensometers designed by Professor Bauschinger and Professor Unwin, will be read to $\frac{1}{50000}$ inch, and are, therefore, more adapted for scientific work where special precautions can be takeu. Professor Ewing has also lately designed a beautifully simple apparatus which will read accurately to $\frac{1}{50000}$ inch, and supplies its own means of calibration against a micrometer screw. He has kindly consented to exhibit it, to those who are interested in its construction, at the end of this paper.

With these latter instruments, if the necessary precautions have been taken, the testing machine previously calibrated, or the jockey weight or sectional area of test bar adjusted so as to render its errors negligible, it is possible to approximate closely to the third figure of the modulus. No uniform calibration of these instruments has, however, ever been attempted, and it is at least possible that the want of consistency in published values of moduli, etc., by different observers may, in some part, be due to such absence of uniform standard calibration. In bending experiments a possible error, such as above indicated in the testing machine, has a more serious effect.

The length between supports of the beam, or its sectional area, requires to be proportioned to the known error of the machine. For example, an error in the load of 45lb would, on a beam 20 inches between supports, and 2 inches by 3 inches sectional area, cause an extension of $\frac{1}{18000}$ inch on a steel beam at the outer fibre, and on a cast iron beam of $\frac{1}{8000}$ inch. It is possible that neglect of this fact may have caused some of the discrepancies which have occurred in published beam experiments. It is advisable, where small sections or long beams are to be tested, to use a separate and more sensitive machine.

When we turn to engine trials the possible sources of error are more numerous. In making up a heat balance for an engine, we have, on the one side of the account, fuel used. The measurement of fuel, being a weight measurement, can be extremely accurately made except for the fact that a certain amount of difference may occur between the state of the fires at the beginning and end of the trial. This error can readily be reduced to less than ½ per cent. by suitably lengthening the duration of the trial. The calorific value and heat constant can be determined with equal precision. On the other side of the account are quantities of heat expended in power, and, second, quantities of heat rejected in exhaust and up the chimney. In a condensing engine, these last (heat rejected) can be measured very closely, also, as they depend upon weight and temperature measurements. If the thermometers are corrected by a single Gay-Lussac correction, the exhaust rejection can be determined to less than ½ per cent. It is now possible to measure flue temperatures by a Callendar pyrometer to the $\frac{1}{10}$th of a degree, and, by taking sufficient samples of blue gases and subjecting them to chemical analysis, the heat rejected can be measured to about ½ to 1 per cent. Radiation losses are generally determined by the method of differences, but can be found very exactly by special experiment. As their total value should not exceed a small percentage of the heat expenditure, a very approximate determination will suffice to render the final result true to ½ per cent.

The power measurement is usually made by means of indicators, the original steam pressure being made by means of gauges. A well made gauge may be and remain accurate to 1lb for a long period, but errors of 3lb to 8lb are not infrequent, and it is probable that considerable alterations take place after undue heating or subjection to shocks. Periodical calibration of gauges is therefore advisable. The types of indicator in general use are so well known that any description of them will be unnecessary. It will suffice to point out that the essential principle upon which they all depend is multiplication by some form of linkwork of the extensions and compressions of a spiral spring under variations of pressure. All engineers know that such an instrument cannot give absolutely accurate indications of pressure when used under varying conditions of temperature, etc. The more important sources of error are as follows: 1. The scale of the spring is sensibly different when hot and cold. Upon this point some interesting experiments were made recently in the laboratories of Sibley College, America, and the results embodied in a paper read before the American Society of Mechanical Engineers last December, by Messrs. Carpenter, Marks and Barraclough. They found that the average difference between hot and cold tests of the same spring was about 3·6 per cent. 2. The effects of pencil and piston friction, inertia of cord, etc., have been investigated by Professor Osborne Reynolds. 3. The errors due to inaccuracy in length of levers, etc., all of which may occur, and tend to vitiate the indicator readings.

Many of these errors do not affect the mean pressure readings to more than ½ per cent.; most of them may be corrected by suitably adjusting the spring scale. This scale error frequently reaches 4 to 5 per cent. of the total indicated power, and, as there seems little possibility of avoiding it altogether by improved manufacture, it is of great importance that, where closer accuracy is required, the indicators should be calibrated and a suitable correction introduced.

With the object of investigating how far such calibration and correction is practically possible, the author has recently devised and erected an apparatus in his laboratory at King's College for directly testing indicators and gauges under steam against a column of mercury. By this means pressures up to 180lb per square inch can be measured with an accuracy of ⅛ inch of mercury. With this apparatus he has made a large number of experiments on different indicators, and has found the following practical points clearly demonstrated:—

1. Tests to be of value must be made at the same temperature at which the diagram is taken. In other words, the error of the indicator can only be determined at any pressure by heating the indicator to the same temperature that it would be subjected to at that pressure in actual use. For this purpose the most convenient method is to test the indicator under steam, and the conditions must then be closely identical with those it would be under when used in a steam engine. For indicators for use on gas and oil engines this condition is more difficult to attain. It is certain that in very many cases the temperature to which the spring is subjected, when attached to a gas engine cylinder, is very far below the temperature of explosion. It is probable that the indicator cylinder is filled with a cushion of combustion products, and that the flame never actually enters it. Under these conditions it is not easy to determine what is the correct temperature at which it should be tested. It is at any rate more accurate to correct under steam than cold; it would be still better to test under heated compressed air, in the manner advocated by Prof. Witz, of Lille.

2. A second condition is that spring and indicator must be tested together. This will be obvious. A small difference in the adjustment of the same spring to two indicator pistons will make a considerable alteration in the piston friction and resulting error.

3. A third point is that many springs which will give closely accurate results if used over a small range of pressure will have very large errors over a wider range. As the result of these experiments, the author has found that most springs cannot safely be used over the full range usually assigned to them. It is better to limit the height of the diagram in all cases to less than 2 inches. The actual range which each indicator and spring will accurately cover can only be determined by individual experiment. Many will little exceed a diagram 1¼ inch high without serious errors.

4. Blacklash or lag exists to a greater or less extent in most indicators. It is wellnigh impossible to avoid it, even with the very perfect appliances now used in their manufacture. It is due to a variety of causes. Many indicators, which show little or none up to 1 inch height of diagram, have a very appreciable amount above that point. This is probably due to side thrusts from the springs, and consequent friction upon piston and rod. Undue pressure upon the pencil naturally magnifies this source of error. In general, the fewer and more rigid the links, the less will be the tendency to backlash, other things being equal. Where much backlash occurs, it will

(To be continued.)

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OF

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A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.

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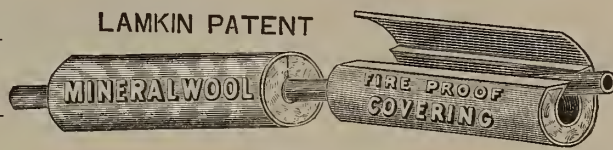

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Original discoverer of ore or mineral on claim entitled to stake out a second claim.

Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

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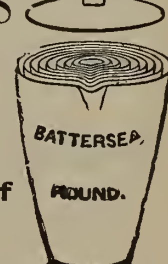

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MINING REGULATIONS

TO GOVERN THE DISPOSAL OF

Dominion Lands Containing Minerals other than Coal.

THESE REGULATIONS shall be applicable to all Dominion Lands, excepting those situated in the Province of British Columbia, containing gold, silver cinnabar, lead, tin, copper, petroleum, iron or other mineral deposits of economic value, with the exception of coal.

Any person may explore vacant Dominion Lands, not appropriated or reserved by Government for other purposes, and may search therein either by surface or subterranean prospecting for mineral deposits, with a view to obtaining under the Regulations a mining location for the same, but no mining location or mining claim shall be granted until the discovery of the vein, lode or deposit of mineral or metal within the limits of the location or claim.

QUARTZ MINING.

A location for mining, except for iron, on veins, lodes or ledges of quartz or other rock in place, shall not exceed 1,500 feet in length and 600 feet in breadth. Its surface boundary shall be four straight lines, the opposite sides of which shall be parallel, except where prior locations would prevent, in which case it may be of such a shape as may be approved of by the Superintendent of Mining.

Any person having discovered a mineral deposit may obtain a mining location therefor, in the manner set forth in the Regulations which provides for the character of the survey and the marks necessary to designate the location on the ground.

When the location has been marked conformably to the requirements of the Regulations, the claimant shall within sixty days thereafter, file with the local agent in the Dominion Land Office for the district in which the location is situated, a declaration or oath setting forth the circumstances of his discovery, and describing, as nearly as may be, the locality and dimensions of the claim marked out by him as aforesaid; and shall, along with such declaration, pay to the said agent an entry fee of FIVE DOLLARS. The agent's receipt for such fee will be the claimant's authority to enter into possession of the location applied for.

At any time before the expiration of FIVE years from the date of his obtaining the agent's receipt it shall be open to the claimant to purchase the location on filing with the local agent proof that he has expended not less than FIVE HUNDRED DOLLARS in actual mining operations on the same; but the claimant is required, before the expiration of each of the five years, to prove that he has performed not less than ONE HUNDRED DOLLARS' worth of labour during the year in the actual development of his claim, and at the same time obtain a renewal of his location receipt, for which he is required to pay a fee of FIVE DOLLARS.

The price to be paid for a mining location shall be at the rate of FIVE DOLLARS PER ACRE, cash, and the sum of FIFTY DOLLARS extra for the survey of the same.

No more than one mining location shall be granted to any individual claimant upon the same lode or vein.

IRON.

The Minister of the Interior may grant a location for the mining of iron not exceeding 160 acres in area which shall be bounded by north and south and east and west lines astronomically, and its breadth shall equal it in length. Provided that should any person making an application purporting to be for the purpose of mining iron thus obtain, whether in good faith or fradulently, possession of a valuable mineral deposit other than iron, his right in such deposit shall be restricted to the area prescribed by the Regulations for other minerals, and the rest of the location shall revert to the Crown for such disposition as the Minister may direct.

The Regulations also provide for the manner in which stone quarries may be acquired.

PLACER MINING.

The Regulations laid down in respect to quartz mining shall be applicable to placer mining as far as they relate to entries, entry fees, assignments, marking of localities, agents' receipts, and generally where they can be applied.

The nature and size of placer mining claims are provided for in the Regulations, including bar, dry, bench creek or hill diggings, and the RIGHTS AND DUTIES OF MINERS are fully set forth.

The Regulations apply also to

BED-ROCK FLUMES, DRAINAGE OF MINES AND DITCHES.

The GENERAL PROVISIONS of the Regulations include the interpretation of expressions used therein; how disputes shall be heard and adjudicated upon; under what circumstances miners shall be entitled to absent themselves from their locations or diggings, etc., etc.

THE SCHEDULE OF MINING REGULATIONS

Contains the *forms* to be observed in the drawing up of all documents such as: "Application and affidavit of discoverer of quartz mine." "Receipt for fee paid by applicant for mining location." "Receipt for fee on extension of time for purchase of a mining location." "Patent of a mining location." "Certificate of the assignment of a mining location.' "Application for grant for placer mining and affidavit of applicant." "Grant for placer mining." "Certificate of the assignment of a placer mining claim." "Grant to a bed rock flume company." "Grant for drainage." "Grant of right to divert water and construct ditches."

Since the publication, in 1884, of the Mining Regulations to govern the disposal of Dominion Mineral Lands the same have been carefully and thoroughly revised with a view to ensure ample protection to the public interests, and at the same time to encourage the prospector and miner in order that the mineral resources may be made valuable by development.

COPIES OF THE REGULATIONS MAY BE OBTAINED UPON APPLICATION TO THE DEPARTMENT OF INTERIOR.

A. M. BURGESS,
Deputy Minister of the Interior.

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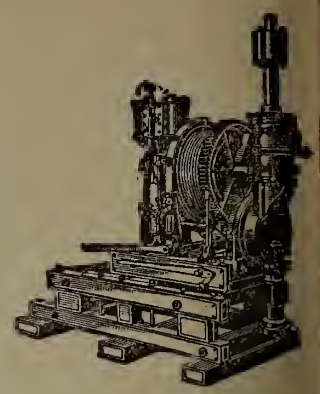

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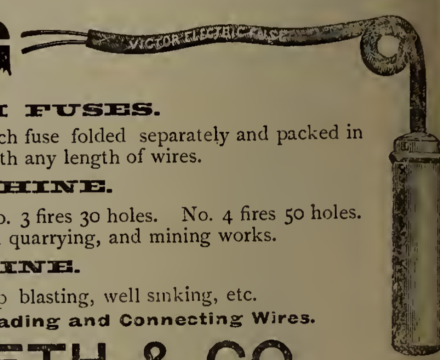

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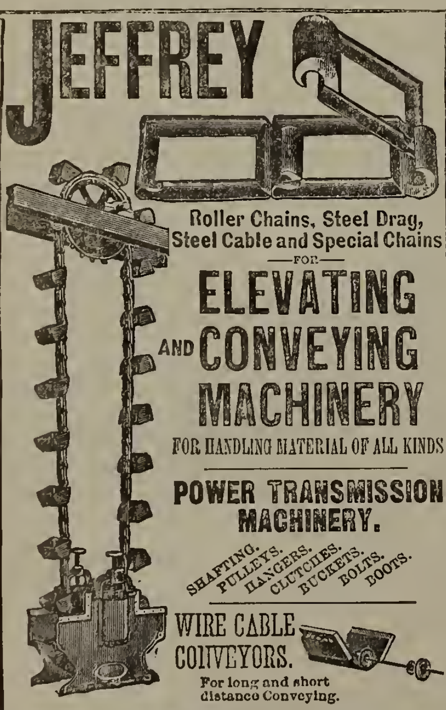

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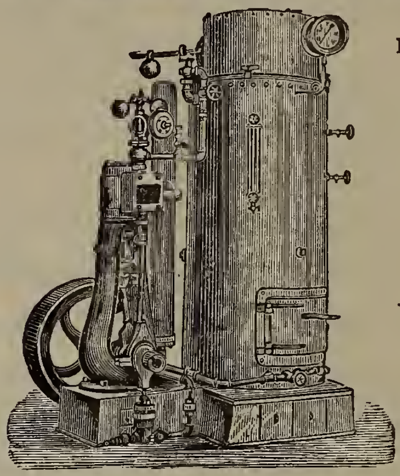

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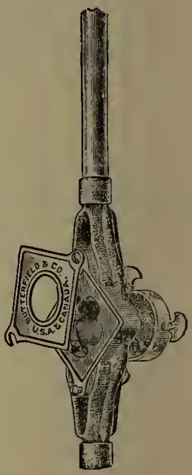

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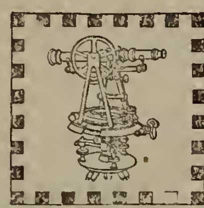

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The Canadian Mining Review

Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Victoria Chambers, Ottawa.

VOL. XIII., No. 11 NOVEMBER, 1894. VOL. XIII,, No. 11

Federation.

The Mining Society of Nova Scotia held its regular meeting in Halifax on the 6th instant. The principal business of the day session was the consideration of a scheme for federation reported by committees of the Ontario Mining Institute and the General Mining Association of the Province of Quebec. As will be seen from the detailed account of the meeting published on another page, the report was much amended, and in some of its most vital and characteristic points. It remains to be seen whether Quebec and Ontario will approve of the views held by their brethren of Nova Scotia.

The limitation of the action of the Council in Dominion matters is of no importance, and the enlargement of the Council to a body of nine or ten instead of six is a good point. But the insistance on a uniform annual fee strikes us as not only in very bad taste, but as likely to be a permanent stumbling block. A representation based on the annual income of each Society will have an objection in Ontario, where the annual dues are but $2.00 per year, as against $10.00 per year each for Quebec and Nova Scotia.

Likewise, a per capita contribution of $3.00 towards the publishing fund is impossible in Ontario.

Our friends in Nova Scotia evidently believe in working for love, as they have made the onerous position of Editor and Secretary-Treasurer an honorary one *without salary*. They may do work without pay in Nova Scotia, but we have never seen anything of that sort in our peregrinations in that Province. The idea is farcical, and simply means that a clerk or other competent person must be employed by the Council or Secretary-Treasurer.

We do not care to express any opinion as to how the proposed constitution will be received by the Ontario and Quebec associations, which each have a meeting in January, but that important changes will be made goes without saying. It seems to the REVIEW that this idea of Federation is capable of great good for Canada if appreciated and understood correctly, and if carried out in a broad and comprehensive sense. Its inception may properly be due to an idea of economy in getting out the transactions of the various societies, but its enlargement into a body that would be representative of the mineral interests of the whole Dominion, and which would be regarded and honored as such, would make of it an instrument for the advancement of mining throughout the Dominion. The scheme as reported on by the Society is as follows :—

NAME.

The organization shall be named THE MINING INSTITUTE OF CANADA.

CONSTITUTION.

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

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

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

MEMBERSHIP.

The original founders are as follows, viz.:

The Mining Society of Nova Scotia.
The General Mining Association of the Province of Quebec.
The Ontario Mining Institute.

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

GOVERNING BOARD.

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

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

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

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

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

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

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

SUBSCRIPTIONS.

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

MEETINGS.

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

PUBLICATIONS.

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

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

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

"Progressite" the New Non-Nitro-Glycerine Explosive.—For some time past it has been rumored that a countermove by those interested in the nitro-glycerine explosives was contemplated against that class of explosives termed "safety." The new explosive, "Progressite," it is said, is shortly to be introduced into the country by one of the firms connected with the Dynamite Trust Company. It contains two constituents, namely nitrate of ammonia and hydrochloride of analine, the proportions being 94 per cent. of the first and 6 per cent. of the second. The proeess of manufacture is described as extremely simple and cheap, the two ingredients being combined chemically by water. The manufactured explosive is, we understand, perfectly homogeneous, and may contain a considerable percentage of water without the nitrate being physically affected thereby. This constitutes an important advance in the class of explosive under consideration. Another improvement claimed is that it is less hygroscopic than others of its class.

January Meetings.

Arrangements for the next quarterly meeting of the Ontario Mining Institute are rapidly nearing completion. So far, we are able to announce papers by Dr. A. P. Coleman, Prof. Nichol, Prof. Goodwin, Mr. Peter McKellar, F.G.S.A., and others. The meetings will be held in the Lecture room of the new School of Mining, Kingston, in the first week of the new year.

The General Mining Association of the Province of Quebec will inaugurate its fourth year with a series of meetings in Montreal in the second week in January. Contributions have been promised by Capt. R. C. Adams, Mr. J. Burley Smith, M.E., Dr. R. W. Ells, Mr. Dwight Brainerd, Mr. John Hardman, S.B., Mr. R. G. McConnell, Ba. Sc., Mr. John J. Penhale, and others. Hopes are also entertained that Sir William Dawson, the venerable ex-Principal of McGill, will be able to deliver an address on the occasion.

Nova Scotia Gold Output.

The returns of the gold yield of Nova Scotia for the year ended 30th Sept. 1894, which we publish below, are instructive reading. The totals are hardly to be compared with those of last year, owing to the change of the departmental fiscal year, which now ends Sept. 30th instead of December 31st as formerly. Last year the Government blue book contained the returns for only nine months, this year it will contain twelve. The only comparison that can be made is with the totals of years previous to 1893, and from this point the returns show a marked falling off. It is, however, but fair to say that the returns, as supplied the REVIEW by courtesy of the Mines office, are incomplete. Of the 39 mills reporting, only 9 have reports for each of the twelve months, the period covered by the remaining reports varying from eleven months down to one. It is therefore possible that the aggregate may be increased by from 500 to 700 ozs.

There are only three mines reporting yields above 1,000 ozs.; these are the Antigonish Gold Mining Company, of Stormont, with 2,111 oz., 10 dwts.; the West Waverley Gold Co., Ltd., with 1,860 ozs., and the Richardson Gold Mining Co., with 1,564 ozs. It is noteworthy in this connection that each of these companies is working low grade ore, the average of the Antigonish Co. being 6.7 dwts., of the West Waverley 4 dwts., of the Richardson 5.2 dwts. Of the total number of tons milled (47,330), West Waverley milled 9,312, or 20 per cent. of the whole; these three companies milled 21,575 tons, or 45½ per cent. of the whole, and produced 5,535 ozs., or 32½ per cent., practically one-third of the whole production of gold. The average value of the rock milled by these companies was 5.14 dwts., and the width of vein extracted varied from 12 inches at the West Waverley mine to 9 feet at the Antigonish and nearly 20 feet at the Richardson. These figures are certainly instructive, and bear out the words of the Inspector of Mines, Dr. Gilpin, at the united meeting of the Canadian mining societies in July last, as follows:—"The prospect of an increased output from the small, rich "leads is not encouraging, In the future the greatest returns must be "sought for in the mining and milling of low grade ores." The figures quoted certainly confirm Dr. Gilpin's views, as the average of the 47,330 tons milled is but 7 dwts.

The prospects for the coming year are, however, very encouraging. The Richardson Company have completed extensive improvements in their plant, enabling them to handle much larger quantities of ore, and are also opening a large vein 1,500 feet west of their workings. New mills of large capacity are being erected at Caribou and Mooseland upon large deposits of quartz that mills from $4 to $8 per ton. The continuation of the rich pay chute of the Thompson-Quick property has been cut by the Golden Lode Co. at South Uniacke and is now being vigorously worked, returns showing that the high grade character af the roll (from 6 to 10 ozs. per ton) is well maintained. A large mill has been erected at Cochrane Hill, but has not yet been started. The once famous Salmon River mine shows a return of 271 oz. for eight months. The Oldham mine, which had a production of over 3,000 ozs. in 1893, shows only 536 ozs., having been practically idle since February, 1894. The small, fabulously rich lode discovered in Sherbrooke has brought that district up somewhat. Guysboro' County, this year as last, shows the largest production.

OFFICIAL RETURNS FURNISHED "REVIEW" FOR THE TWELVE MONTHS ENDED 30TH SEPTEMBER.

Name of Company or Mine.	District or Address of Mine.	Rock Crushed.		Gold Milled.		
		Tons.	Cwt.	Ozs.	Dwt.	Grs.
Oldham Gold Co......	*For 12 Months:* Oldham.........	918	2	536	18	10
West Waverley Gold Co	Waverley......	9312	16	1860	1	0
Damas Touquoy.......	Moose R, Caribou	4131	—	342	12	17
Moose River G. M'g Co	" "	2501	9	551	6	21
Oxford Mill...........	Lake Catcha.....	1643	15	944	18	0
John H. Anderson.....	"	661	15	642	4	0
Richardson G. M'g Co..	Stormont........	5963	4	1564	11	10
Antigonish G. M'g Co.	Stormont........	6299	—	2111	10	—
N. Scotia G. Mines Ltd	Montagu........	1484	10	814	1	0
Herbert Dixon........	*For 7 Months:* Caribou.........	673	—	972	—	—
C.P.F. Mining Ass'n...	*For 11 Months:* Uniacke........	1311	—	237	7	0
Symon Kaye Syn. Ltd.	Montagu......	334	—	336	—	—
Neptune Mill.........	Gold River......	299	5	196	12	18
W. A. Sanders........	*For 10 Months:* Caribou.........	2297	—	618	14	—
Mooseland G. M'g Co..	Mooseland......	1355	—	434	1	0
Goldenville Mill.......	*For 9 Months:* Sherbrooke.....	407	—	163	16	—
Thompson & Quirke....	South Uniacke...	129	10	790	3	2
James A. Macdonald...	Stormont...... ..	686	—	472	9	—
Pictou Dev. Co.....	Renfrew.........	889	—	683	5	—
Dufferin G. M'g Co....	*For 8 Months:* Salmon River....	1467	—	271	5	—
Eureka Mill..........	Ecum Secum.....	108	—	51	—	16
Kempt " ..	Kemptville......	188	—	187	14	—
Miners Mill...........	*For 6 Months:* Sherbrooke......	194	—	89	8	—
Old Provin'l G. M'g Co	Killag........	199	11	119	16	7
Columbia Milling and Reducing Co......	*For 5 Months:* Oldham.........	74	—	10	19	6
A. C. Cogswell........	Lake Catcha.....	90	10	172	8	—
K. F. Crocker........	Whiteburn.......	478	—	236	16	—
New Egerton G. M'g Co	*For 4 Months:* 15 Mile Stream..	613	—	193	—	—
Stanley "	*For 3 Months:* 15 Mile Stream..	560	—	359	—	—
Country Harbour "	Stormont........	1025	—	420	—	—
S. R. Giffen........	"	131	—	79	11	12
Cochrane Hill G. M'g Co	*For 2 Months:* Sherbrooke......	136	—	69	17	12
Wentworth Mine......	"	3	2	226	—	—
Phœnix Land & Dev. Co	Uniacke...... ...	50	—	10	19	9
McNaughton's Mill....	Wine Harbor....	71	—	83	15	—
Central Rawdon M'g Co	Central Rawdon..	85	—	44	10	—
J. J. Withrow *et al*....	Uniacke........	54	6	32	7	12
Truro Gold Mining Co.	*For 1 Month:* Caribou.........	60	—	8	16	4
Boston " "	Malaga.........	456	6	92	—	—

J. M. REID,

Oxford Gold Mining Co., Musquodoboit Harbour, N. S.

EN PASSANT.

Although an extra issue of two thousand copies were printed, our August number has been completely sold out. September and October issues are also out of print.

Our next issue will contain a complete review of the features of this year's Nova Scotia coal trade.

Mr. J. S. Drew, of the Royal Engineers, has, we learn, invented and patented an ingenious and promising device in connection with safety mechanism for mining cages, lifts, elevators and like appliances. Seeing the number of serious accidents which annually occur through overwinding or the breaking of the hoisting ropes used with such apparatus, we hope that Mr. Drew's invention may be speedily introduced. The contrivance in question is simplicity itself, and can be readily applied to existing cages or lifts with but little structural alteration or expense. It consists in the employment of powerful spring bolts, which are liberated on the travelling structure should the rope become ruptured and whereupon the bolts are instantly caused to engage with the vertical or inclined controlling guides and thus arrest the descent of cage or car.

We are authorized by Mr. John F. Caldwell, Winnipeg, the owner of the Sultana gold mine, Lake of the Woods, to say that the reported sale of the mine to an English syndicate is not confirmed.

A new method of raising water from deep borings has been devised by Mr. Thomas Matthews, Manchester, Eng., and has been put in operation at the breweries belonging to Messrs. Gartsides, Ashton-under-Lyne. At these breweries, it is stated, there was already a bore-hole about 300 feet deep, and in it was a pump driven by strong wheels, cranks, and levers, the full capacity of which was about 3,000 gallons per hour. Mr. Matthews undertook to double this quantity without altering the bores in any way. After taking out the old pump, Mr. Matthews applied his patented system, and in place of the old cranks wheels, levers, &c., put down a neat but strong steam engine, working at thirty-six strokes per minute, driving up to a height of over 200 feet from the bucket a column of water equal to 7,000 gallons per hour, and this without shock, noise, or trouble of any kind. The work done by the engine is very considerable when we take into consideration that 7,000 gallons per hour equals 14,000,000 foot-lb. per hour, or upwards of 30 tons of water, 200 feet in one hour. The manager of the brewery, who has had an opportunity of inspecting the pump put down by Mr. Matthews, states that, with the new management and with no increased cost as regards fuel or steam power, they could now raise in six hours quite as much water as the old set of pumps could do in twenty-four hours, and whereas previously they had been subjected to scarcity of supplies of water from the well they had now ample supplies without running the pumps at full pressure.

In his report recently presented the Ohio Inspector of Mines gives the following statistics relative to coal mining by machinery in that state. He says that 2,553,074 tons were produced by this method, an increase of 313,994 tons as compared with the preceding year and the largest by the above amount of any year of which a record has been kept by the department. The returns indicate that during the year, machine mining has been confined to 10 of the coal producing counties of the State as compared with 8 during 1892 and 11 during 1891. Part of this variation was caused by Guernsey county, which dropped from the list in 1892, but entered again in 1893.

"The largest production returned was from Hocking county, followed by Athens and Perry. These 3 counties embrace the Hocking Valley region, in which the returns indicate that the production from this source amounted to 2,429,512 tons, which equals 95⅙ per cent. of the year's production of machine mined coal as compared with 93 4-10 per cent. during 1892; of this Hocking county produced 55 1-10 per cent. There were 379 hands employed in operating the mining machines, which indicates a gain of 35 as compared with the year of 1892. In preparing the coal for market, after it has been undermined by the machines, another set of men called followers, drill the holes, blast it down and load it into mine cars. Of this class the returns show that there were 2,587, which is a gain of 286 as compared with the preceding year. In the time worked the greatest was in Jackson county, the least in Guernsey, while the average in the nine counties was 32 weeks, a gain of 3 weeks, as compared with the average time worked in the mines throughout the state."

In the 10 counties referred to 379 machine operatives and 2,587 day hands were employed 30 weeks. The output of lump coal was 2,263,362 tons; nut coal, 156,331 tons, and 133,381 tons of pea and slack.

Natural gas pumped from under the Detroit river is to be supplied to Detroit consumers from the Canadian wells at Kingsville, Ont.

ST. LAWRENCE COAL DELIVERIES, 1893-94.

As customary, on the close of St. Lawrence navigation, we are able, by courtesy of the Customs' officers and agents of the companies, to provide our readers with an authentic comparative statement of the coal deliveries for the past season. The total quantity received is the largest in the history of the trade, the figures for previous years, since 1885, being: 1885, 360,000 tons; 1886, 377,500 tons; 1887, 482,103 tons; 1888, 517,539 tons; 1889, 467,525 tons; 1890, 543,656 tons; 1891, 602,323 tons; 1892, 626,087 tons; 1893, 737,891 tons, and in 1894, 796,282 tons. In comparing the returns of the companies we find the Dominion Coal Co., Ltd., with an increase over last year of 54,839 tons, while the General Mining Association and the Intercolonial Coal Co. show a decrease of 02,056 tons and 2,928 tons respectively.

Company.	Montreal.		Sorel.		Three Rivers.		Quebec.		Totals.	
	1893	1894	1893	1894	1893	1894	1893	1894	1893	1894
General Mining Association, Ltd........	75,195	74,359	11,494	8,485	9,218	3,952	33,500	22,555	129,407	109,351
Dominion Coal Co., Ltd	466,005	512,269	5,191	3,151	....	5,529	18,087	23,173	489,283	544,122
Intercolonial Coal Co., Ltd......	72,079	69,151	....	....	....	....	....	....	72,079	60,151
Scotch, English, Welsh and American bituminous	36,074	55,849	1,528	1,932	....	....	9,520	15,877	47,122	73,658
	649,353	711,628	18,213	13,568	9,218	9,481	61,107	61,605	737,891	796,282

The wells belong to the Ontario Natural Gas Company. It is said this company has an output of 50,000 feet of gas a day at present, and can easily supply Detroit without assistance from the Ohio fields. An 8-inch pipe is to be laid under the river at an estimated cost of $50,000.

"A steel cable one and a half inch in diameter, travelling at the rate of 12 miles per hour, can transmit nearly 2,000-horse power," says the *Electrical Age*. "But by taking a copper wire one square inch in section and applying to it a potential equal to that which is in use to-day in at least one place in this country, viz, 10,000 volts at 1,000 amperes per square inch, we find we are transmitting in an invisible form over that wire more than 13,000 horse power, which is enough to rupture instantly six such cables as are ordinarily used in operating a cable railway."

An American journal describes a shot-firing appliance, which can be attached to any form of safety lamp, and is known as the "Roberts Shot-firing Lamp." The following are the essential features of this apparatus:—A brass tube 5-16in. in diameter is inserted through the oil cistern and its top is terminated in a brass box covered with gauze. A hole is made in the tube opposite the flame, and is normally closed by a "sleeve" pushed up by a spring. The lower end of the tube is also closed by a plate pushed over it by a spring. A blow-pipe also passes through the oil cistern, and is closed like the lower end of the tube. To fire the fuse it is pushed through the tube, and the sleeve being drawn down, the flame directed on to the end by the blow-pipe. When it is certain that sparks will not be thrown from the end of the fuse it may be withdrawn from the tube.

A new kind of elevator for use in mines is mentioned by the English mining journals. It is constructed so that one side exactly balances the other. On one side is a large cage on which a loaded car is run, to be hoisted to the top of the mill, and on the other is a huge iron tank capable of holding sufficient water to raise the car, load and carman to the top. The carman, from his station at the bottom, pulls a rope which opens a stop cock and fills the tank with water, at which the tank descends, and the cage, containing car, carman and all, rises to the top of the bin, when the car is dumped. The carman then pulls another rope, which opens a valve at the bottom of the tank and lets the water out; thus the cage and car, now being the heaviest, descends, its movement, of course, being always under the control of the operator or carman. The cage is provided with strong brakes, capable of holding it and the contents stationery at any point, either in going up or coming down, and the whole is hung on an 8-foot wheel by a 1½-inch wire rope of great holding capacity.

Not long since at Springbank colliery, Airdrie, Scotland, a trial took place of a Rigg and Meiklejohn coal cutting machine. The machine was one of the usual size, 7¾-inch diameter cylinders, and was worked by compressed air at a pressure of 40 pounds per square inch. It was worked by 4 men, 1 to attend to the machine, 2 laying rails and setting props, and another followed the machine clearing out the cut to let the coal drop. The cut was 3 feet under in a seam of coal 2 feet 8 inches thick, and the wall to be cut was 70 yards long. This whole length was cut in 1 hour and 30 minutes, which at this rate would mean a cut of considerably over 300 yards per shift of 8 hours. The whole was done in a very satisfactory manner. Mr. William Cassels, the manager, says: "We can cut easily 300 yards per shift. The machine is 7 feet 10 inches long over all, 2 feet 10 inches wide, exclusive of cutter, and 1 foot 10 inches high on the rails, and the air pressure at the machine is 35 to 40 pounds, and this is quite enough. The grip cut by this machine is only 2¾ inches to 3 inches deep, and this results in a large saving of hand coal as against hand labor."

As we go to press we are advised that in the suit against the Dominion Coal Co., referred to elsewhere in this issue, the Supreme Court of Nova Scotia, on the 24th inst., reversed the decision of Judge Townshend and ordered a new trial.

Is there anything new under the sun? asks the *Railway Review*, and here adds: Soloman was right. The more the past is explored the more evident this becomes. A pre-historic blast furnace is the latest discovery. Professor E. Petrie, in 1890, convinced himself that in a remarkable mound called Tel-el-Hesy, in South Palestine, would be found the remains of what was one of the strongest places in the country down to the invasions of Sennacherib and Nebuchadnezzar. The explorations, said Mr. Bliss at the recent Palestine exploration fund meeting, have fully verified this forecast. Amid all the evidence discovered by Mr. Bliss of the civilization of that remote age—wine presses, treacle presses, alkali burnings and innumerable others—by far the most curious is the disclosure of an iron blast furnace, arranged to give strong evidence of being intended to heat, in its descent, a blast of outside air forced through passages before entering the chamber at the level where tuyeres are usually fouud. "If this theory be correct," says Mr. Bliss, "we find 1,400 years before Christ, the use of the hot air blast instead of cold air, which is called a modern improvement in iron manufacture due to Neilson, and patented in 1828."

A small light "pocket" blasting battery has been brought out by the Nassau Electrical Company, of New York. The battery is made up of chloride of silver cells, each being securely and hermetically sealed; these cells have an E. M. F. of 1.10 volts, with a maximum current of 2.00 amperes, weigh less than 1 oz., are less than 2¾ in. long, and under ¾ in. in diameter.

At the last meeting of the North Staffordshire Institute of Mining Engineers, Mr. J. J. Priest contributed a paper on "Colliery Cost Sheets," which he illustrated by drawings. He observed that there were greater difficulties in carrying out an elaborate system of cost keeping in North Staffordshire than in almost any other district, owing to some extent, to the mode of working, and partly owing to the fact that in many instances ironstone and coal were drawn not only from the same shaft but from the same seam. It would generally be admitted that some system of ascertaining in detail the cost of labor per ton of minerals produced or paid for was of the first importance to a manager, and unless these accounts were carefully and minutely kept, the management of any mining enterprise was not likely to be economical or successful, as would otherwise be the case. Labor costs were very generally based on the tons produced or paid for at the pit, and were therefore only useful as a means of comparison with the labor cost of previous pays. It was a common custom in some districts a few years ago for the subordinate heads of departments to make out their own wages and cost sheets. This system had the advantage of impressing on the memory of those officials the cost per ton of each class of labor working under their immediate authority, but that system in late years had become more or less obsolete. The services of such persons were generally thought to be better utilized in the active superintendence of their particular departments, while the work of making out the wage sheets and cost sheets was now generally performed by clerks. The cost sheet would in all probability be made out on the "tons accounted for," otherwise "disposed of," and these would in nearly all cases show a greater or less—generally less—quantity than the tons paid for at the pit, the discrepancy arising from refuse and dirt picked out of coal, allowance to customers, variation in the tare weight of trucks, &c., all adding to the probability that less tons would be "accounted for" than the colliers were paid for "getting." In some instances the cost was worked out on the production—that was the coal paid for at the pit—but he maintained that the most accurate plan was to work out the statement entirely on the "tons accounted for," all fuel consumed on the works being charged for as materials, at market prices, while coal put to stock on the ground was valued at much less than current market prices, on account of the deterioration which naturally took place; coal in wagons or on the pit bank might or might not be taken into consideration in the "general cost sheet," his experience being adverse to its inclusion, as the quantity of coal paid for and not yet accounted for in this direction usually balanced itself month by month. He made suggestions respecting dealing with rents, rates and taxes, and spoke of the advantage of the slide system.

Coal Outcrops.

This was the subject of a paper read by Sir William Dawson before the Society of Students of Mining Engineering of McGill University, at the opening of the session of the Society on the 26th ulto.

A typical coal-bed was defined to be a fossil bog or swamp, with an underclay or ancient soil beneath, full of carbonized roots, and a roof of shale or sandstone above, often containing fossil leaves or trunks of trees. Some of the latter are occasionally found to stand erect as they grew; and being replaced by stony matter, they form what have been called "coal-pipes," which when the coal beneath has been removed by mining, sometimes fall into the workings, causing accidents to the miners. The coal itself is shown by the microscope to consist of layers of compressed and carbonized vegetable matter. In some exceptional beds, chiefly of cannel coal, there is no true underclay, and the coal in this case seems to have been produced by the bursting or discharge of bogs pouring vegetable debris over submerged flats. By continuous or intermittent subsidence and renewed deposition, it usually happens that several beds of coal are found to occur, separated by intervening shales and sandstones, in the same locality.

The coal-bed formed in either of these ways is at first horizontal and covered up with earthy beds of greater or less thickness, deposited upon it, and whose pressure has contributed to its condensation and preservation. It has thus no outcrop except where it has been cut across by the channels of streams, or by the action of the sea on coasts, when the edge of the bed may appear in the banks of ravines or canyons or on coast cliffs. Coals of cretaceous and tertiary age in a horizontal or nearly horizontal attitude crop out in the banks of rivers in many places in the Canadian North-west, and may be mined by levels run iu from the river valleys. Even coals of the true carboniferous period sometimes retain their horizontality, as in parts of the Ohio coal-field Usually, however, the movements of the earth's crust have thrown the beds into synclinal valleys and anticlinal ridges, and when the crowns of the anticlinals have been removed by denudation the edges of the beds appear at the surface or covered only by soil and loose material, and the outcrops of the several beds of the same series run in lines more or less parallel to each other. In this case the beds may be seen to dip in different directions and at different angles with the surface. Such an outcrop when exposed and examined, enables the explorer to ascertain the thickness and quality of the bed, the character of its floor and roof, its horizontal course or strike, its direction and angle of dip; and in connection with these facts, the directions along the surface in which it can be traced, the depth at which it can be reached at any given point, and the area under which it can be profitably mined. All these facts and inferences can be learned from a very small opening, provided it exposes the whole breadth of the outcrop. Additional information may be obtained from the outcrops of the beds associated with the coal, wherever these are exposed.

But since the beds of coal are not unlimited in extent, and since the crowns of anticlinals and the bottoms of synclinals are not always parallel to the surface, we may expect the reverse dips on the opposite sides of synclinals not to run parallel to each other, but to curve round and join each other at the ends of the troughs or basins. We must also make allowance for the manner in which the outcrops bend backwards in crossing transverse ridges or forwards in crossing transverse valleys. These points were illustrated by the arrangement of coal-beds in Eastern Cape Breton, which have been said to run up on the land like a series of stranded boats. These outcrops also show the manner in which anticlinals bringing up hard rocks sometimes form ridges, and when they bring up softer rocks which have been denuded away, appear as hollows. The various appearances presented in this way were shown by a map, and also the curving and widening out of the series of outcrops when the angle of dip of the measures diminishes.

The effects of faults were then explained and illustrated, and the manner in which they may repeat the outcrops of beds of coal, or may render them discontinuous. Special illustrations were given of these disturbances from the great faults in the Pictou coal-field, which were at one time so perplexing to explorers.

Cape Breton was then taken as an example of the submergence and erosion by the sea of the outcrops of coal-seams. Limited portions of the outcrops of coal-seams dipping more or less toward the sea appear in many places around the older rocks which form the nucleus of Cape Breton. Only a small part of many of these coal areas remains on the land, while there is reason to believe that they extend widely over the sea bottom both east and west, and that they are continuous under the sea with the coal-fields of Nova Scotia proper and Newfoundland. Thus a large part of the mineral fuel of Cape Breton as well as of Nova Scotia lies under the sea, and it was shown to what extent these submerged coal districts may be made available. It was also shown that the amount of accessible coal not yet mined is enormous, and that the mining of coal in the maritime provinces of the Dominion admits of a great expansion, if a profitable market can be found either in Canada or elsewhere.

COMPANIES.

New Glasgow Iron, Coal and Railway Co., Ltd.—The following is an excerpt from the Directors' Report submitted to the shareholders at the last annual meeting:—"Your Directors are pleased to advise the continuous operation of the furnace during the entire year, resulting in an increased production of iron. The various services of the Company have been well maintained throughout the year. A good deal of difficulty was experienced and some expense incurred in keeping the railway and other outdoor operations going during the excessive cold of the past winter. A subsidy was voted by Parliament at its last session for the extension of the railway five miles, but your Directors have decided that under existing circumstances it would not be prudent to proceed with the work at present. As all are aware, the year has been one of great depression in all lines of trade, but possibly none have felt it so keenly as the iron business in its every department. That we have been able to do even as well as we have, is, in the opinion of your Directors, a matter for congratulation. The amount of the profits after two years' operations have been $110,814.59."

Nova Scotia Steel and Forge Co., Ltd.—Owing to extreme commercial stagnation, covering a large portion of the year, neither the volume of business nor the prices realized by this company were as large as the previous year. Notwithstanding the earnings of the company have been fairly satisfactory. The profits of the year (ended 30th June, '94) were $61,281.52, to which is added the balance at credit of profit and loss carried forward from last statement, $2,943.68; or a total profit of $64,225.20. On recommendation the amount was distributed as follows:—Reserve for insurance against bad debts, $4,000; reserve for depreciation of plant, $11,500; 8 per cent. dividend on preference stock, payable 5th Sept., $18,174.45; 8 per cent. on ordinary stock, payable on 10th October, $26,664.00; leaving balance forward of $3,886.75.

Drury Nickel Co., Ltd.—A special meeting of the stockholders was held at the office of the Company in the Township of Drury, Ont., on 26th instant, for the following purposes:—

1st. To authorize the proper officers of the Company to place a mortgage on all of the Company's property for the purpose of paying the debts of the Company.

2nd. To authorize a sale or transfer of all the property of the Company for the purpose of paying the debts of the Company.

3rd. To authorize an order to wind up the affairs of the Company.

4th. To do any and all things necessary to a proper transfer of all of the property of the Company, for the purpose of paying the debts of the Company.

5th. To transact any other business that may legally come before the meeting.

Broad Cove Coal Co., Ltd.—The officers of this Company, incorporated at the last session of the Legislature of Nova Scotia, are:—John M. Raymond, *President;* Alpheus P. Alger, *Vice-President;* William Penn Hussey, *Treasurer and General Manager;* Edgar S. Buffum, *Secretary;* Warren D. King, Electrical Engineer; Directors, Wm. H. Munroe, of Martha's Vineyard; George W. Gale, Boston; John Y. Pazant, Halifax; Hon. John M. Raymond, Salem; Warren D. King, Peabody; Hon. Alpheus B. Alger, Cambridge; Edgar S. Buffum, Salem; J. R. Naegeli, Zurich, Switzerland; William Penn Hussey, Danversport. The American Loan and Trust Company, of Boston, of which S. Endicott Peabody, of Salem, is president, is trustee of the company, holding a deed of trust for $1,000,000 as a guarantee of payment of principal and interest of bonds. The areas controlled by the company cover two square miles, and are located in Inverness County, Cape Breton. The company is preparing to build a shipping pier off McIsaac's Lake, tenders for the dredging of which have been given out.

Nova Scotia Steel Co., Ltd.—The proposed amalgamation of the New Glasgow Iron, Coal and Railway Co., Ltd., and the Nova Scotia Steel and Forge Company, Ltd., will be discussed by the shareholders at a meeting to be held in New Glasgow on 12th proximo.

The Maud Hydraulic Mining Co., Ltd., has been registered at Victoria, B.C., to acquire the placer mining claims, leases and property held by J. M. Buxton on Four-Mile Creek, near Quesnelle River, in the Province of British Columbia. Authorized capital, $25,000, in shares of $5. Directors: J. M. Browning, J. M. Buxton and Charles Wilson. The head office is at Vancouver, B.C.

Alberta Railway and Coal Co., Ltd.—Subjoined is an excerpt from the report of the directors submitted to the shareholders on 31st ultimo:—"The accounts show a profit on working of the railway and colliery of £17,969, while house rents and water privileges brought in £844, making a total of £18,813; on the other side managerial expenses, insurance, and taxes absorbed £6,391, and interest on debentures and loans, if paid in full, would have required £62,591, leaving a deficit for the year of £50,168, and increasing the debit balance to profit and loss to £101,316. Interest on first mortgage debentures, however, requiring in full £53,400, was only paid to a small extent in cash. Sundry creditors in Canada and London, and bills payable, totalled on June 30th last £212,429, of which £188,203 was secured on mortgage; and there were in addition sundry creditors for debenture interest for £75,687, and the cash balance amounted to £3,462:—

The balance-sheet and accounts for the twelve months ending June 30th, 1894, are herewith submitted. In judging the result of the working for that period, the shareholders will bear in mind that the condition of business generally in Canada and in the United States was very unsatisfactory. In face of the severe commercial depression, however, it is gratifying to observe that the quantity of coal which the Company disposed of was 139,308 tons, against 133,924 tons in the previous year, or an increase of 5,384 tons. The shareholders are aware that during the year 1893 the Lethbridge-Dunmore Railway was widened to the standard gauge under arrangement with the Canadian Pacific Railway Company. The work was complated on November 28th, 1893, and since that date the railway has been operated by that Company with a result, it is believed, alike satisfactory to both Companies."

Canada Coals and Railway Co. Ltd.—The shareholders of the Canada Coals and Railway Company, of Joggins, N.S., held their annual meeting in Montreal on 20th instant. The following board of directors was elected:—Messrs. S. Finley, R. L. Gault, A. F. Gault, S. H. Ewing, E. Hanson, E. W. Wilson and R. Wilson Smith. At a subsequent meeting of the board Mr. S. Finley was re-elected president; Mr. A. F. Gault, vice-president, and Mr. A. G. Watson, secretary-treasurer.

The Canadian Anthracite and Coal Co., Ltd.—The annual general meeting of the shareholders was held at Ottawa on 14th inst. There was a large attendance. The output from the colliery (at present operated by the H. W. McNeill Co., Ltd., under lease), for the month of October was the smallest for some months, being 6,000 tons. It is intended to largely increase the output in 1895. The C. P. R. are taking large quantities of the coal, which is giving great satisfaction, and an increasing market is being found for it in Manitoba, notably at Winnipeg, where it is gradually superseding Pennsylvania anthracite. The officers of the Company are:—Hon. J. G. Thorpe, Cambridge, Mass., President; O. H. Ingram, Eau Claire, Wis., Treasurer; W. K. Coffin, Eau Claire, Assistant Treasurer; L. Crannell, Ottawa, Secretary. The quantity, quality and value of the coal is now assured beyond any doubt, and great credit is due to the lessee, Mr. H. W. McNeill, for the vigorous and successful manner he has prosecuted the development of the trade of the colliery.

Creighton Gold Mining Co.—Several experts have reported on this Company's property and the works have been closed down. Mr. J. Burley Smith, M.E., has, we believe, taken a contract to do some prospecting with the diamond drill, and this work is proceeding.

The Eureka Oil Developing Co., of Lambton.—This Company seeks incorporation with the object of taking over the petroleum and power producing business at present carried on by James E. Austin, of Enniskillen, in the County of Lambton, including real estate, oil wells, machinery, buildings, pipe lines, tanks and all the plant connected with said wells and business, and to carry on and extend the same. Head office: Petrolia, Ont. Authorized capital, $5,000. Directors: J. E. Austin, London; R. M. Morgan and J. W. Morgan, of the town of Adelaide; David Barr, Petrolia, and George Burness, London.

Compagnie Francaise des Phosphates du Canada.—The lands of this Company, in liquidation, will be sold by public auction at Bordeaux, France, on 4th proximo. The property is in the Townships of Portland East and West, and Templeton, Ottawa County, Que. The upset price is 10,000 francs, and the purchaser will have to pay over and above a sum of 5,800 francs for government costs in France and the costs of liquidation. The price is payable five months after sale.

Nelson Hydraulic Mining Co., Ltd.—The first annual meeting of the Nelson Hydraulic Mining Co. was held last month. The directors presented a report of the progress of the company, which has been so frequently noted in our colxmns that there is no necessity to repeat it. Mr. John Elliot was elected a director in the place of Mr. J. F. Hume, resigned, and the other members of the board were all re-elected. Some important alterations of the by-laws were discussed and left to the board to carry out.

Rapid Tunnel Work.—The record for fast tunnel driving is believed to be held by the East River Gas company in the construction of its tunnel under the East river, New York. In one week the day shift made 48 feet 6 inches—a total of 101 feet. The heading is 10 feet 6 inches by 8 feet 6 inches and was advanced in full section. The rock is very hard hornblende gneiss. This is very remarkable work, considering the peculiarly difficult conditions of the locality; and is claimed to be the quickest tunnel-driving of the kind. Four three-and-one-half-inch drills were used in the heading, mounted on tunnel columns with arms, two drills on each column. About fifteen holes, nine to ten feet deep, were drilled by each shift, consisting of five machine runners and their helpers.

GOLD MINING.

Nova Scotia.

Caribou.—Messrs. Dixon & Co. have completed the transfer of their property to the Caribou Gold Mining Co., Ltd.

The work of unwatering and retimbering the shaft on the Macdonald property has been completed, and levels started from the shaft. Capt. Mackintosh reports good ore showing in the faces.

Mr. Damas Tonquay continues to work steadily his Moose River surface gravel. Last year he crushed 4,131 tons, which gave an average of $1\frac{6}{10}$ dwts., making this the lowest grade ore worked in Nova Scotia.

Gold River.—Negotiations are afoot for the transfer of the Victor Co's property to New York people.

An expert has also visited the property of the Lincoln Mining and Milling Co., and is making a mill test of the ore from the "Picayune" and "Captain" lodes.

Mr. T. N. Baker has opened a second lode upon his property, 200 feet south of the large lode. It is small in size, from two to nine inches, but the ton and a half in the dump is valued at 10 ozs. to the ton.

Killag.—This district is practically deserted, and no returns have been made for some time.

Stormont.—The October return of the Richardson mine was 300 ozs. from about 900 tons. The new plant is now running smoothly and the faces in the mine workings are showing a higher grade of ore. The "McMillan" lode has been cut on the western end of the property and is about 18 inches wide, showing gold freely.

The Country Harbor (or Saint John) Co., at Johnson's Brook, have cut the streak worked on the adjoining Antigonish property and are now in good ore. October's yield is reported at 175 ozs.

Uniacke.—The C. P. F. Mining Association are successfully working a 3 to 4 dwt. ore here. The mining is done by open cut or quarry, a Miller cable hoist being in use for hoisting and conveying from the pit. This system is likely to find favor in other portions of the Province where large belts of auriferous material occur.

South Uniacke.—The new mill of the Golden Lode Co. is reported ready for running. The quartz taken out of the roll cut by the shaft has been milled at the Thompson-Quirk mill and yielded a brick of 272 ozs., an average of over 7 ozs. to the ton. This property will be a very large producer in 1895.

Renfrew.—The mill of the Pictou Development Co., which has been several months idle from lack of water, has started up and is now crushing the large accumulation of quartz mined during the summer months. The lode is reported as looking fully as well as hitherto.

Ontario.

The Sultana Gold Mine has not been sold to English capitalists as reported.

The Ophir Gold Mine is being worked by a strong force. The 30-stamp mill is also running double and a respectable brick is reported periodically. Mr. F. D. Taylor, M.E., is superintendent.

During the month, Sheriff Carpenter, Rat Portage, sold all the moveable property of the Black Jack Mining Co, and the Gold and Silver Reduction Co. under executions in his hands. The whole cost originally $6,000 or $7,000, and was bought by Mr. W. G. Motley for $1,050 and will be moved to White Fish Bay for the purpose of operating the Regina mining location recently purchased by an English syndicate.

The Rainy Lake *Journal* states that Capt. Dent, of the Syndicate Mining Co., reports that his Company is working night and day on the Luella property, and as the shaft goes down on the mine the ore becomes richer and the vein is getting wider. In fact the ore is so rich that a 20-stamp mill has been ordered and the work of construction of the building is to begin inside of two weeks, or as soon as the necessary plans and specifications can be secured from Duluth.

Last Monday morning Mr. Wm. Caldwell and a gang of men went out to the Regina mine with an outfit to erect camps, shaft house, and other necessary buildings to accommodate a mining staff of twenty men for the winter to carry on the development of the property. A 20-stamp mill will be put on the property as soon as the state of development will warrant it.—*Rat Portage Herald.*

British Columbia.

The Cariboo Mining Company, Camp McKinney, are considering the idea of putting twenty additional stamps onto the Cariboo in the spring and working their mill by water power by bringing the water in pipes from Rice creek from a distance of a mile and a half. In this case some of the stamps—ten or fifteen—could be utilized for custom work. There is no doubt that a custom mill at either McKinney or Fairview would be kept busy the year round and pay a handsome dividend.

The negotiations which have been under way for some time past for the purchase of the Victoria Hydraulic company's claims on the North and South Forks of Quesnelle river, have been closed, and the property transferred to the new syndicate. This is composed of Messrs. Geo. A. Cox, president of the Canadian Bank of Commerce, and Wm. McKenzie, president of the Street Railway, Toronto, D. D. Mann and T. G. Holt, contractors of Montreal, also representing other eastern capitalists, and F. S. Barnard, M.P., of Victoria, the original owners also retaining a considerable interest. The amount paid to the latter in cash and paid up stock is understood to be in the neighborhood of $70,000. The purchasers, to whom the proposition was introduced by Mr. Barnard, secured the services of Mr. Ross Brown, a well known mining engineer of California, on the properties. Mr. Ross Brown was not only well satisfied with the prospects for developing a profitable mine, but also expressed himself very favorably of the whole of that section of the province, believing that there are numerous auriferous channels of ancient rivers, which will pay largely by hydraulicing.

About 40 men are placer mining at Rock creek, South Okanagan, and 30 of these will stay in all winter. The average is $6 per day.

In all 22 car loads of machinery have been shipped to Lytton for the new pumping and dredging plant.

Prospects for Trail creek are very good. The Le Roi is expected to turn out 30 tons of ore a day, averaging $40 a ton.

The gold output of Kootenay will this year approximate a total of $200,000, made up as follows:—

Mining Division.	*Gravel.*	*Quartz.*
Trail Creek		$150,000
Nelson	$ 8,000	20,000
Trout Lake	2,000	
Revelstoke	10,000	
Fort Steele	10,000	
Total	$30,000	$170,000

The O. K. stamp mill is running on ore that has been culled over three times and yet is found very profitable working.

On December 6th, 1890, Charles Hussey, who owned a five-eighths interest in the Poorman mine and mill, six miles west of Nelson, mortgaged his interest to the Spokane National Bank for $14,000. The bank shortly afterwards suspended and was placed in charge of a receiver. The mortgage was one of the assets the receiver hoped to realize enough on to enable him to pay off the bank's indebtedness in full. Last month A. L. Davenport, who owned the other three-eighths of the mine and mill, bought the mortgage and the transfer is now on record in the record office at Nelson. By this deal Mr. Davenport secures title to the Poorman mine and mill, and he is now in a position to work the property to the best advantage. At present the mill is running day and night, the water supply being ample. The ore worked is so soft that from twenty to twenty-four tons are crushed daily. About 1,000 tons have been run through this year, the returns being satisfactory. The stoping ground, however, is pretty well worked out, for if the drifts were continued much farther they would both come out on the surface, owing to the incline from which the drifts run starting in a ridge or hogback. It is more than likely that a hoist, to be run by a Pelton wheel, will be put on the mine in the spring. If this is done, the mill will be run continuously, as it is the intention to sink on the ore body.—*Tribune.*

The Golden Era Mining Co. is hydraulicing with good results on the North Thompson. The machinery is very simple and comprises two wheels 14 ft. in diam. and of 9 ft. face, driven by the current of the river and set upon either end of a scow. These drive the pump for hydraulicing. It is proposed to build a larger scow than the one at present in use, and employ a single wheel, say 16 feet diameter by 18 feet wide, instead of the two smaller sized ones now used, and this single wheel will give them sufficient hydrauiic power for any purpose whatever. The power from the river is so great that one pump will put in 400 miners' inches at an elevation of 150 feet.

Work has been begun on the claims on Granite Creek in the Similkameen district owned by the Stevenson Gold and Platinum Hydraulic Mining Co. Tests on these upper benches have run as high as $1.50 to the cubic yard, and the whole bank is estimated to average 25 to 35 cents. The gold is coarse. Platinum has also been found and is expected to yield about one-third as much in value as the gold.

The Victoria Placer Mining Co., represented by J. D. Sherwood and J. F. Warner, will spend $55,000 on developing its claims on the left bank of the Pend d'Orielle. Water will be brought from four miles up the Salmon River in a flume, which will be carried across the Pend d' Orielle on a cable.

A recent dispatch says: " Up to this year British Columbia has owed its reputation as a mining country to the gold output of the Cariboo district; but this year will prove that Kootenay is not only the silver and lead-producing district in British Columbia, but is the greatest gold-producing district of the province as well. The gold output of Cariboo comes from gravel mines, while the Kootenay output is from the quartz mines, and these only meagerly developed. Quartz necessarily gives employment to a large number of men and the industry is a lasting one. The gold output of Kootenay this year will aggregate $200,000.

The War Eagle is now working about 20 men, sinking two shafts and running a tunnel. The owners will began ore on 4th instant. The ore yields $600 in gold and 12½ per cent. copper. Steam power will be obtained from the Le Roi mine and Burleigh drills put in next week. The new shaft will join the tunnel and will be completed in about a week when the bond on the property will be taken up. On the north side the ledge is opening well and is now 6 feet 10 inches wide. The ore chute is 900 feet long by 9 feet broad and all in sight is ore. Once stoping is started 100 tons a day can be taken out as easily as one ton, and when opened out another 200 feet she will put out 250 tons a day. This property gives every promise of becoming a mine sooner than any other in camp. Everything is being done in a miner-like manner to develop the property to the best and fullest advantage. Mr. Kingsbury, part owner of this property and also of the Poorman mine in the Cour d' Alene, states that he prefers this camp to any other in this province.

A personal visit to the O. K. says the *Miner*, shows the work to be in active progress. The tunnel is in 300 feet and the qnartz vein matter cuts it in several places and shows up well at the end of the tunnel. A five stamp mill is in full swing and gives concentrates worth $500 per ton. The tailings also will be rehandled as considerable gold passes out with them. A jigging machine with copper table has just been put in and will start work next week.

In the I. X. L., adjoining the O. K., stoping is going on in two or three places and ore of the same quality as the O. K. is being taken out, but no plant has yet been put in. The recent survey of these claims by Mr. F. Ritchie throws the line of the I. X. L. over on to the O. K., covering the tunnel for some 40 feet; the two mines are therefore using the same tunnel and the I. X. L. is taking out ore which was thought to have been located by the O. K. people.

At the Le Roi is still going on in the 300 foot level and the ore comes up richer than ever. Burleigh drills will be put in at once and they will ship some 30 tons a day as they have a clear face of 300 to 400 feet of ore to work on and will probably put out between 3,000 and 4,000 tons this winter. It is understood that all this shipment will be made from Trail landing.

Mr. Chas. F. Law, late Commissioner to the World's Fair, contributes the following to that excellently gotten up provincial magazine *The Province*:

"The development now in progress in the district of Cariboo promises to open up a new field for placer miners in the old river channels which are now buried beneath the enormous masses of lava which cover the upper country for many miles. These channels are usually at a much higher elevation than the beds of the modern streams, and whenever cut into and worked have served to supply the present river beds with their auriferous deposits. In many instances the older channels are so completely obscured that it has not been possible to discover their location. Mr. Ross T. Browne, who recently exploited the Victoria Hydraulic properties at Quesnolle Forks, Carihoo district, has developed a system in California for tracing these old channels, which is known as the Forest Hill Divide System, because of the principle first having been successfully applied to the opening of that great property. A late report of the state mining bureau of California refers in detail to the work inaugurated by Mr. Browne as a very remarkable piece of engineering skill, and explains the means by which he was enabled to trace the bed of a phocene river between two mines, five miles apart, and where the veins of the channel were 8,000 feet distant from each other. The earlier drift mining on the great blue leads of California was attended by many costly mistakes which modern engineering science has shown us a way to void; and it is to the accumulated knowledge and ripe experience of such authorities as Mr. Browne and others, that we are enabled to reap all the advantages of such experience in opening up ground in Cariboo district of like character and conditions. It is apparent from observations made in the field during the last season, that we are about to enter on an era of drift mining which will carry us into localities hitherto unexplored. There is a vast district lying west of the Fraser, opposite the mouth of Quesnelle, which is covered by basalt for 100 miles square; and it is to this particular field that I wish to call attention with a view to investigation. The old system of drainage of the Quesnelle river country appears to have crossed the Fraser where the two now meet, and proceeded in a westerly direction towards the coast. It is possible that at that time the upper Fraser river did not then exist, and proof of this appears to have been furnished by the discovery of a great auriferous channel passing to the westward under a cap of basalt 100 feet thick, at an elevation of several hundred feet above the present Fraser system, and crossing the latter at right angles. This channel was found by Dr. Selwyn, director of the Geological Survey many years ago; and the conditions being exactly the same as in California add Australia, he has always been of the opinion that it should be investigated. Mr. Hobson, the well known hydraulic engineer, has exploited much of the ground about Quesnelle, and his California experience has forced him to conclusions which bear out the theory of a westerly drainage of the Quesnelle river system. If it should be proven that this channel continues westward and does not return again to the Fraser river, we will have proved the important fact that the vast broken plains between the Fraser river and the sea coast, which are now covered with lava, have at one time been traversed by a river system containing auriferous gravels, but now hidden from view. The opening up of such a field may lead to prodigious results, as the lateral branches of the greater streams may extend over an immense area. The methods employed in California to trace out these channels and their tributaries can be directly applied to this new field; and it is possible that we may be able to prove a new gold field of greater value than old Cariboo. It will be possible in many instances to trace the older auriferous deposits to quartz veins of a permanent character, and thereby place the mining of gold quartz on a solid bases. When it is considered that the Witwatersrand district in South Africa is only 12 miles in length and is producing thirty millions sterling of gold per annum, it is not unreasonable to assume that our gold oelds will prove equally as rich in an area so extensive as that which we posses. The righest gold fields in Australia and California were proven to exist in old channels buried under basalt and other debris, and we may expect similar results from like conditions in this country."

SILVER LEAD MINING IN BRITISH COLUMBIA.

An extraordinary showing of clean ore is to be seen in one of the stopes in the Slocan Star. Byron White measured eight feet across of clean high-grade galena, without a trace of country rock or zinc or other base metal in it. It is not anywhere near the surface, either.

Since the railway reached Three Forks, the Slocan Star has been shipping ore at the rate of 50 tons per day and this record will be kept up for fully two weeks to come. The ore, like all previous shipments from here is consigned to the Grant-Omaha smelter at Omaha. There are 800 tons to come down from the store-house, with 1,000 tons more from the mine during the winter. At the end of the week the Mountain Chief will resume its 500 ton shipment. Other properties are preparing to ship, including the Alamo, Idaho, Noble Five, Cumberland and Surprise. About 250 tons in all have been forwarded from here during the week, valued at $25,000. Besides this the Trail creek mines shipped—Le Roi, 30 tons to Everett; Josie, 14 tons to Tacoma; and the Gold Hill 5½ tons, also to Tacoma. These latter shipments were valued at $2,475. The approximate value of the ores of the district shipped during October was in the neighborhood of $48,000. The local list stands thus:

Sept. 13,	from the Alpha mine	120,000 lbs.,	valued at $6,000
Sept. 17,	" "	180,000	" 9,000
Sept. 19,	" "	220,000	" 11,000
Sept. 20,	" "	78,130	" 3,900
Sept. 21,	" "	178,375	" 9,000
Sept. 24,	" "	181,000	" 9,100
Sept. 26,	" "	180,000	" 9,000
Oct. 1,	" "	90,000	" 4,500
Oct. 9,	" "	150,000	" 7,500
Oct. 15,	" "	75,000	" 3,750
Oct. 25,	Mountain Chief	122,450	" 6,150
Nov. 3,	Slocan Star	200,000	" 10,000
Nov. 5,	" "	40,000	" 2,000
Nov. 7,	" "	260,000	" 13,000

The value is reckoned on the basis of the release manifest of $100 per ton, but this will be found to be below rather than above the actual worth of the ore.

There are four mines in the Slocan to-day putting out ore that goes over 1,000 ounces to the ton. They are the Antoine, the Nonpareil, the Goodenough and the Reucau. On the Antoine, Jack Thompson and two men have been at work for eight weeks putting out 1,000 ounce ore, and they reckon that they have $15,000 to $20,000 worth on the bank. From the Nonpareil thirty sacks of ore, about one ton in all have been brought down to Kaslo for shipment. The ore assayed over four thousand ounces to the ton. —*Continued on page 229.*

CORRESPONDENCE.

(With Pleasure.)

The Editor :—

Your personal note concerning me in the October REVIEW contains a grain of truth, but several measures of error.

As you are well aware I have all along been connected in a dual capacity with both the American and Canadian Rand Drill Cos. My duties in connection with the American company have of late largely increased, while the business here has reached a stage of development where it does not require my personal attention to the extent that it formerly did. Under these circumstances I expect to make New York my headquarters for the future, but I have no intention of severing my connection with the Canadian Rand Drill Co. On the contrary I expect to continue as engineer of that company and direct its operations as heretofore. I hope to continue to meet my Canadian friends on their own soil in both a business and social capacity, and beg to say to them that when in New York they will always find the latch-string out at 23 Park Place.

Yours faithfully,

F. A. HALSEY.

SHERBROOKE, Que., 12th Nov., 1894.

Mining in British Columbia.

The Editor :—

One of the best evidences of the inexhaustible richness of the mines of this province is that much of the world's experience is gravitating here and settling down to the work of steady and systematic development. And not only is this experience amongst the arrivals, but the numbers and the capital are coming to make their stand in the gulches and on those mountain tops on which nature has bestowed her richest mineral treasures. The days of placer mining, though limited, have not yet passed away in this country of mountain ranges, deep gulches and golden sands ; but modern methods have begun to deal with refractory ore and with the rocks which nature in her convulsions has burned and made obdurate.

The pan has been superseded by the rocker, and the wooden aqueduct has given way to the hydraulic pipe, and the machinery of our boyhood has been superseded by the stamp mill with its great power to pulverize the hardest quartz and thus release the golden treasure from its rock-bound bed. One effect of the superabundance of rich mineral ore is that it sooner or later attracts capital, and this becomes a staying power in the production of wealth. The old complaint that the miners are mere prospectors and do not represent fixed or systematic effort is rapidly disappearing before the steady influx of miners and capitalists who have come to stay, but the work of the prospector has by no means ceased. The field here is yet a large one and the encouragement, compared with that offered by other countries, is by no means small or variable.

After many years of labor in the field Dr. Dawson has concluded this year's work with the deepest conviction that the mineral prospects in the province are very encouraging. As an authority on British Columbia mining matters he is, perhaps, one of the select, because he has given the province most careful attention. He is not given to superlatives, but the summary of his report of the year's work does not admit of any other conclusion than the one that the mining industry of the province has already marked an activity not exceeded in previous years, and that the production, especially of silver, is going to add millions to the wealth of the Dominion.

The ordinary reader is very apt to put down what he hears of mineral development now-a-days to be the dream of an enthusiast, who, tired of the oppression, is inclined to draw fancy pictures in order to encourage the desponding.

He is, however, assured on authority which men have everywhere learned to respect, that the mining activity of the province is by no means a vision of the dreamer, but a reality, and that the recent shutting down of the Kootenay mines has only been a pause for breath, during which smelter and concentrating works have been erected for reducing the ore on the spot.

One of the pleasing features in this respect is to note the way in which Canadians themselves are taking hold. In the past the Canadian yielded too readily to others. He gave way to the Englishman or the American, as though these always possessed more experience than himself. He has since learned to use better judgment, to give way only when fairly over-matched.

I have in memory a picture that was presented to me a short time ago by a man who was working a rocker on the Fraser near Yale. Said he : "Do you see those pieces of plant lying around loose on the banks of the Fraser ? They are the remains of a plant sent out by an English company. The plant cost about $40,000. There was an Englishman in charge and he was so important a person that he stood all day with an umbrella over his head and superintended the locating, or rather the *dis*locating of this plant. He would listen to no one. A suggestion from a practical man was out of the question. Even when offered by an old timer with a fund of experience on the Fraser, and given with the best of intentions, it was unheeded and went the wrong way, because it was gratuitous and well meant. The result may be seen any day, and the uninformed traveler wonders what kind of water works came to grief when this plant was distributed promiscuously along the river banks."

It is a feature in New Zealand mining that English capital is best conducted under Scotch management, though it is by no means to be inferred that all English management of gold mines is capricious and extravagant. The inference to be drawn is rather that Canadians are finding that they have been more or less underrated in the mining field.

The advance which Ottawa has made in this western province indicates the potent and progressive power of the Dominion Government. In the explorations which have been found necessary to secure the introduction of capital and also to secure development, the educated gentlemen of the Geological Survey have done very much to make the resources of the country known.

They have also exercised a beneficial influence in lighting the way for the accomplishment of two great measures which will, doubtless, be sooner or later adopted by the Dominion Government, viz :—the sub-division of freshet-occuring streams and a general system of irrigating dry lands.

So far it has been deemed advisable to begin this series with a brief introductory article. In those that follow the attention of the reader will be called to certain facts which bear intimately on the mining resources as they present themselves in a general way to the observer.

It is not a little astonishing to find that numerous misconceptions prevailed in the early days with regard to the mineral resources of this province. The limit at one time embraced only gold and coal. The rich silver deposits of Kootenay were then unknown, as also were the iron and copper deposits which are now found to exist in large quantities. In the race for gold the prospector has laid bare other treasures which are both rich and inexhaustible and new areas are constantly entering the domain of his mineral treasure.

It is this constant prospect of new areas which adds interest and value to the mining industries and gives additional interest to the province.

There is an expectation in mining circles which is commensurate with the mining possibilities of the province. It is the reasonableness of these possibilities which gives life, strength and hope to the mining industries of the country. The grazing lands of the province may possess some extent—the agricultural lands may be limited, but the mineral areas are constantly expanding, and as the case is in Cariboo there is a decided tendency to revive a one time activity.

The Canadian geologist regards the province as a great exception from the general rule. He is astonished but not confounded. The prospector camped in the gulch will hail you as you pass, invite you to partake of his grub, hand you some specimens of the latest find and then tell you that, at one time, Nature has furiously kicked up her heels and fairly howled. There never was, he will tell you, before or since, such a fine old jumble as when these mountains "bucked" forth and then stood perfectly still.

Camped, not far from North Bend I met, some weeks ago, a man who was an old timer. He was an Englishman named Louis Johnson. Like most of his countrymen in this country he is warm hearted and would share his last piece of bread with the hungry traveler. After partaking of his frugal fare this veteran handed me some specimens of gold-bearing quartz which he found in the mountains adjacent to North Bend. These specimens were exceedingly rich, but the depth and extent of the lead was yet to be determined. This prospector who has been 25 years in the business in the province was quite sanguine. A great deal of confidence is really necessary if the prospector must succeed. He is undoubtedly a fortune seeker and it does not square with his calling to give way to gloomy reflections even though he never found bed rock or made the "riffle."

To the omnipresent gold, silver and coal in the province, must be added gypsum and mica as articles of commerce possessing considerable commercial value.

In the early days of the maritime provinces during the existence of the Reciprocity Treaty, gypsum from the provinces found a ready market in Portland, Boston and New York. Not a few farmers realized handsomely from this gypsum trade. Its reduction by burning to expel the water and thus make plaster of paris was an easy process. The American people import not a little of our gypsum now-a-days but its demand in the Dominion is constantly increasing—something close to a hundred thousand dollars being the quantity used in Canada. But of this gypsum more particulars will be given hereafter.

Of mica there are known to be four promising mines, two near the Tete Jeune Cache and two on the Canoe River. These mines are the property of Mr. Louis Victor Bennett, of Kamloops. Mr. Bennett, though quite a young man possesses much of the ability, enterprise and perseverance which are so necessary to achieve success in the mining world. This gentleman has already expended a large amount of money in holding the fort. As mica comes within the mining regulations the duties which have to be performed on its possession in the mines place it beyond the reach of the ordinary speculator.

The property on Canoe River is known as white mica. It is founed in gneiss rock. It is also found in diminutive quantities in quartz about ten miles west of Canoe River.

It is found in no less then ten distinct veins heavily laden with the mica. The veins are parallel and they run in a south-easterly to a north-westerly course with a dip to the south at an angle of about 55° and covering a distance of from one mile to one mile and a half in width visible in a north-westerly direction until they again seek refuge in the cragged glacier mountains to the west, a distance of about one mile and a half. The veins measure from 7 to 16 feet in thickness. Writing of this mine on Oct. 22, 1894, Mr. Jno. F. Smith, who has the mine in charge says : That all the work that had been done was centered on this vein which is about 12 feet thick where it is opened, but immediately below a shale of rock of about 12 feet in thickness is another vein 10 feet in thickness, but I think these will be found to be the same vein on further development. "Nevertheless we continued operations in the open cut previously started from which we took out some fine blocks of mica. As I judge the formation of mica in large blocks is little understood I brought out several pieces of especial interest showing how the mica is formed in the quartz and the class of rock in which mica is found. In our operations, continues Mr. Smith, we found a small piece of very hard and brittle bluish-white stone which may prove to be beryl, some formation of which is precious stone. A few days later a large piece was found. I broke this in two with the intention of bringing it out, but unfortunately I laid it down on a stone and came out forgetting it. Nevertheless I have the small piece first found which will cut glass as easily as a glazier's diamond. We also picked out small pieces of fluor spar blue in caste. Several deposits of black mica were found, all of which can be seen by anyone who may desire.

"Mica is found in as well defined a ledge set in quartz as any other mineral but in wedge shaped blocks from four to ten inches thick at one end, squaring various dimensions. Mr. Smith says each block of the mica found will weigh from 15 to 20 pounds. There are several distinct veins running parallel in these mountains which are strictly the Cariboo range of mountains. These deposits can be traced for several miles in length and about a mile and a half in breadth. There is, he says, equally as much mica here as there is at the Tete Jeune Cache. It does not show so well because there has not been so much work done. We started in the centre location and ran a drift 14 feet from which we unearthed considerable mica of a little different quality, not quite so clear as that from Tete Jeune Cache, but a little rougher and more flexible."

Passing gold, coal and iron mines, Mr. Smith has directed his practical attention to a neglected field.

The demand for mica is constantly increasing and as we have no reason to doubt that our protective policy will give way to a suicidal one of handing over the natural productions of the country to strangers, the interest of Canadian capitalists must center more than ever in the natural resources of the country, especially in this portion of the Dominion. Canadians have been too ready to hand over their mineral treasures to outside capitalists who have often been in no better circumstances than themselves. Mistakes like these will not be made in the future, though the inference is not to be drawn that in these pages any attempt is made to create a prejudice against outside capital. This capital is very much needed, but it is not to be preferred to the home-made article which it has been the practice in mining circles to regard as inferior to the importation.

The constantly widening demand for mica in this conntry is an incentive to the development of this mineral, and as the proof of the richness of a place may be best determined by the actual field, so the readers of the journal may best realize what the value of this mica is by a sample which will be shortly sent to the REVIEW office.

H. J. E.

KAMLOOPS, B. C., 21st Nov., 1894.

The Coleraine Mining Co.

To the Editor :—

For the benefit of investors whose attention may be directed to the chromic iron industry of this section, a few lines respecting the remarkable business methods of this company may be of interest. The Coleraine Mining Co., in which Lieut.-Governor Chapleau and Senators Desjardins and Lacoste are directors, owns a large block of land in the township of Coleraine, Que., and on the discovery of deposits of chromic iron upon its property, the Secretary, Mr. Papineau, granted working leases of areas to a number of operators. These leases, it is worthy of remark, were signed only by Mr. Papineau as Secretary of the Company, and were accepted in good faith as a *bona fide* and binding agreement with the Company. A considerable amount of development followed and large quantities of chromic iron, commanding a good market, were raised. But the Company, finding the value of its land greatly enhanced by these operations, cooly repudiates the leases of its Secretary, and claims that they are invalid, inasmuch as they have not been ratified by the Company. A nice state of things this for the unfortunate operator who has been allowed to spend considerable money on his area and who seeks a recompense from the sale of his ore. And now, forsooth, he is compelled to accept new terms or lose his all. The new agreement provides for the lease of small areas, some twenty-eight acres in extent, at *a royalty of one-half the selling p ice of the ore.* Out ofthe remainder (say nine dollars), he has to provide his working expenses and costs and recoup himself as best he may. This sharp practice will not commend itself as worthy of the eminent and Honourable gentlemen who preside over the affairs of the Company, neither will it conduce to the speedy development of their lands, which they so earnestly desire. The goose will lay one golden egg and then die. I may say that Dr. Reed, who owns probably the best chromic iron property in this section, is quite content with five dollars per ton, a royalty, by the way, in itself high enough in all conscience.

Thanking you for the space.

R. S.

BLACK LAKE, 22nd Nov., 1894.

Prospecting on the Rainy River.

The Editor :

A few notes respecting a prospecting trip to the Rainy River country may be of interest to your readers. We arrived at Rat Portage on 19th June and purchased our pro- provisions and camp outfit. It had been our purpose to go direct to Rainy Lake, but on hearing of the discoveries of gold in the vicinity, we determined to spend a few days in and around Rat Portage. We examined a great many islands and found many promising leads, but on learning of the rich finds being made on Rainy Lake, we left for this point on 25th June, and arrived at Fort Francis three days later. Fort Francis is an old Hudson Bay fort at the head of Rainy River, about 190 miles from Rat Portage. Between these points there is a very fair steamer service, the boat making the round trip once a week. Leaving Fort Francis on the 29th with two canoes we went to the North-West Bay, about 26 miles away, and here our party divided—my brother and a hrlf-breed going farther north-east, while I went south-east, or towards the Seine river. On reaching Shoal Lake, some 42 miles from Fort Francis, I found the surrounding country promising enough to warrant the establishment of a permanent camp. We discovered some very promising leads, some of them showing free gold and all panning very well. About this time a great many prospectors were coming into this region from the Manitou district. By the 15th October we had taken up about 1,000 acres of promising country. All the land round Shoal Lake has been taken up by the numerous parties in the field and development is being rapidly pushed ahead. Five stamp mills of various sizes have been contracted for to be in running order by the 1st of June next year, and altogether the outlook for practical results next season is very promising. The only thing necessary to make this a great gold producing region is confidence, capital and enterprise, as there is no doubt of the existence of gold in paying quantity.

Yours etc.

BUSH WINNING.

PLANTAGANET, Ont., 21st Nov., 1894.

Drilling for Oil at Gaspe Que.

The Editor :—

Can you give any particulars respecting the operations of a company reported to be drilling for oil in the Province of Quebec? If any such work is being done what results are being obtained? Any information you can give through the medium of your columns will be esteemed.

J. T. PLATT.

New York, 21st. Nov., 1894.

[An English syndicate named the Petroleum Oil Trust, Ltd. has, we believe, a large force at work near Gaspe. A number of wells, each equipped with an expensive plant, have been drilled, some of them to a considerable depth, and oil found in very small quantities. The head office of the company is at 22 Henrietta Street, London. The authorized capital is £430,000 sterling, in ordinary shares of £1., and £100,000 in preference shares of £10. Of the ordinary capital £345,940 has been allotted and paid, £314,988 having been issued to the vendors, and of the preference capital £39,490 has been subscribed and called up. The outlay on the equipment and drilling of the wells must have been very large and the prospects of finding oil in any quantity are generally regarded to be visionary by those geologists who have visited the field. Althogether the concern is regarded as a very doubtful enterprise—EDITOR.]

LEGAL.

Tobin vs. The New Glasgow Iron, Coal and Railway Co. Ltd.—This is an action to recover $5,000 damages for the death of an employee named Peter Tobin. The deceased, whose duties were to attend the ore washing machinery, was found dead, jammed in the machine, the first night he was on duty. No one saw the accident nor can it be explained. It is claimed that the ore when washed came out through spouts projecting from the front of an iron tank filled with lumps of ore and water in which ponderous cylinders revolved. The size of these spouts was 9 x 11 inches. The lumps of ore were sometimes larger than the opening, and consequently would not pass through. If the spouts clogged the tank would soon fill with ore and the cylinders in their turn would clog, and if not cleared out some part of the machinery would break. Among other things it was Tobin's duty to keep these spouts clear. The only platform was the one above the tank, but this platform was on a higher level than the spouts, being 3 feet 9 inches above them. When a lump of ore was forced down by the revolving cylinders to the front end of the iron tank too large to pass through the spouts, it had to be lifted by hand out of the mouth of the spout and over the front of the iron tank which projected above the spouts, by a person standing on the upper platform. This could not be done by a straight iron bar 3 to 4 feet long, the only tool provided by the company to do the work. The spouts could not be reached by hand from the upper platform. The only st nding place from which Tobin could reach the spouts was the end of a beam which formed part of the trestle work. This beam extended out from the end of the frame work or butment on which the ore washer rested 2 feet 2 inches, and projected over a pit ten feet deep. This beam was near enough to the cylinders to be covered with mud from the washer and was slippery. Standing on this projecting end of a beam Tobin could only reach the mouth of the nearest spout by bending over a revolving shaft connected at that particular place by a coupling with bolts. A line drawn from the beam on which his feet rested up over the revolving shaft and down to the spout would be over four feet in length. The revolving shaft with the coupling bolts was uncovered. The work was carried on at night. There was no building over washer, simply a trestle work erected, no railing around it, no light in front where the spouts were; only one dim light above on the platform. No means of signalling the engineer who was on duty at his engine; was fifty feet away in the engine house and on a lower level, and could not be seen or heard from the place where Tobin stood. No one saw Tobin at the time he was killed, but it is conceded from the position in which his body was found, "his head jammed between the coupling on the shaft and the screen, his coat wound round the coupling and his legs hanging down below the shaft," that he was standing on the projecting beam endeavoring to clean out the spouts, and by losing his footing on the slippery beam his clothing was caught in the machinery. The defendants deny that the ways, works, machinery and plant were negligently constructed, defective or dangerous, or that they were operated in a negligent or dangerous manner. They also claim contributory negligence on the part of the deceased. The case was first tried before Mr. Justice Ritchie and a jury and dismissed, but this judgment was reversed and a new trial ordered by the Supreme Court *in banco*. On appeal to the Supreme Court of Canada this verdict was confirmed a few days ago and a new trial ordered in the court below.

George W. Stuart vs. Charles F. Mott—Stuart, who is a well known gold miner in Nova Scotia, brought a suit for the performance of an alleged verbal agreement by Mott to give him one-eighth of an interest of Mott's interest in the Dufferin gold mine, but failed to recover, as the court held the alleged agreement to be within the Statute of Frauds. On the hearing Mott swore that he had agreed to give Stuart one-eighth of the proceeds of the mine when sold, and after the sale Stuart brought another action for payment of such share of the proceeds. In an appeal to the Supreme Court of Canada judgment has been given in favor of Stuart, with costs, reversing the decision of the Supreme Court of Nova Scotia. In rendering judgment Mr. Justice Gywnne said: I am of opinion that this appeal should be allowed with costs, and that the judgment of the court of first instance in favor of plaintiff be restored. The only real defence to the action urged before us was that the plaintiff's cause of action was estopped and barred by a judgment rendered in favor of the defendant in a former action at suit of the plaintiff which, as was intended, operated as *res judicata* upon the matter of the present action; but concurring herein with the learned judge of first instance, I am of opinion that there is nothing in the former action which operates as a bar or estoppel in the present.

Tilley vs. Walker—Several years ago Mr. W. H. Walker, Ottawa, induced plaintiff to invest in his plumbago mine at Graphite City, near Buckingham, and there was an agreement by which Tilley was to furnish more capital if necessary. The plaintiff believing that he would be throwing his money away did not complete his engagement and Walker sued him. This suit was settled by Tilley forfeiting the greater portion of what he had put in and abandoning his claim against Walker. Walker on the other hand entered into an agreement whereby he acknowledged himself indebted to Tilley to the extent of $5,500, which he promised to pay in five years with interest at six per cent., giving Tilley a mortgage upon his mine, which, however, had been previously mortgaged to the extent of over $50,000. This was on the 12th January, 1892. In May last, having received nothing on account, although there was two year's interest overdue, Tilley entered the present action for $752.50, the amount of interest due at that time and also for $5,500 of principal, which was not due, but alleging that Walker was insolvent and the security worthless by reason of the prior mortgages, and that on this account the principal was now exigible. Walker contests the suit and claims that he has spent a great deal of money on the mine recently and that it is worth $300,000. The suit will be tried in Hull on or about the 20th inst.

The Bank of Ottawa (plaintiff in court below), appellant, and **A. Lomer** (defendent in court below), respondent in the Court of Queens Bench in appeal.

The appeal is from a judgment of the Court of Review which reversed a judgment of the Superior court. The judgment of the Superior court condemned the respondent to pay the bank appellant the sum of $911.56 being the amount of two sterling bills of exchange drawn by respondent upon the Kingston Phosphate company, and accepted by that company. The judgment of the Court of Review reversed this judgment and dismissed the appellant's action. The Bank of Ottawa, appellant, sued the respondent on two bills of exchange drawn by Lomer, Rohr & Co., on the Kingston Phosphate company. Appended to the signature of the drawers were the words "Mg. Agts." The appellant alleged in its declaration that the abreviation "Mg. Agts." stood for mining agents, and that the respondent bound himself personally as drawer of the bills. The contention of the respondent was that the abreviation "Mg. Agts" did not stand for "mining agents," but for "managing agents" viz., managing agents of the Kingston Phosphate company, on which the bills were drawn and by which they were accepted. The respondent pleaded that he did not sign the bills of exchange in his individual capacity and never intended to become personally liable upon them, but that he drew the bills in his representative capacity of managing agent of the Kingston Phosphate company, which alone was liable on the bills. The Court of Review, reversing the judgment of the Superior court, held that appellant was well aware of the meaning of the words "Mg. Agts." underneath the signature of the firm of Lomer Rohr & Co., and that it discounted the bills with full knowlege that the firm was only binding itself as agent of the company on which the bills were drawn.

Judgment was reserved.

Lauchlin Mclean vs. Dominion Coal Co., (Ltd.) Appeal to the Supreme Court of Nova Scotia. Plaintiff, a farmer, claims $2,014 damages for value of property destroyed or damaged by a forest fire, which, it is claimed, originated on the defendant company's railway. At the trial in the court below the jury returned a verdict for the plaintiff, but the judge, (Townsend) ordered judgment to be entered in favor of the company, for the reason that the burning of the brushwood that occasioned the fire, was done by a contractor of the company, whom he considered liable. A similar appeal by another farmer named John McDonald, who sustained loss on the same occasion is also down for hearing in the same court.

Phosphate Milling Co. vs Montreal Warehousing Co.—At the Superior court, Montreal the defendants moved for leave to re-open their enquete. The court was of opinion that they had not shown proper diligence; the enquete had previously been re-opened by their request and closed. Motion dismissed.

The Canadian Copper Co's Suits—J. B. McMullen and G. B. McMullen, vs. S. J. Ritchie. Judgment in this celebrated case has been given in the United States Circuit Court as follows:

"In January, 1886, Samuel J. Ritchie contracted to purchase from James B. McMullen and George W. McMullen, the plaintiffs, 210 first mortgage bonds of the Central Ontario Railway Co. Ritchie was to pay them $210,000 cash and $40,000 in stock of the Canadian Copper Co. The delivery of the bonds and coupons and the payment of the consideration were to be simultaneous. Ritchie failed to make such payment and was sued in the Canadian Court for breach of contract. Judgment was rendered against him in February, 1888, for the sum of $238,000. Afterwards suit was brought on the judgment in the United States court in the northern district of Ohio. in September, 1888. The result was that judgment was rendered at the November term, 1890, upon the Canadian judgment for $265,370. The case was taken upon a writ of error to the supreme court of the United States where it is still pending. Execution was issued from this court. The failure of Ritchie to set up the defence which he now by an amended cross bill seeks to arrest is fatal to his application. He seeks to attack the judgment, but shows no reason why he did not earlier acquire the same information upon which the attack is based. Mr. Ritchie was himself president of the railroad company at the time the bonds were issued and at the time the contract of 1886 was made and has continued to be president to a very late date. The McMullens had jointly with Ritchie been the owners of the road. It was his right to have examined those bonds and coupons and it is impossible for him to escape the charge of very gross negligence in this matter." The decree goes on at length into the debts of Ritchie to Judge Burke, Senator Payne and the Cornell estate. For the amounts due Judge Burke a decree was given. "There is a controversy as to the debt claimed to be due the Cornell estate on a note for $8,000," continues the decree. "The only controversy as to the indebtedness claimed by Senator Payne against Ritchie is as to a note for $6,000, dated in 1887, payable in three months after date. The note was worthless at the time it was executed, as the railway company had no means of payment and there was no practical way of coercing payment. Ritchie is entitled to have this note sold or collected and the proceeds applied to the payment of Senator Payne's debt. The other debts or claims of Senator Payne are allowed. The aggregate amount of compensation claimed by Mr. Ritchie for services of one kind or another for the running of one or both companies, exceeds $1,000,000." Judge Lurton held that when Ritchie was engaged in the matter for which he claims compensation he was officially connected with the companies and that neither company had by any resolution provided for any salary or compensation to any president or director. He says: "His services have been voluntarily rendered without expectation on his part that he would be paid for them. Lands were bought by Ritchie some times in his own name, and others in either of the copper companies. He gave his services with no expectation of compensation other than as the stocks owned by him would increase in value. He was a man of great ability, energy, and a towering ambition for great enterprises. As a promotor or boomer he seems to be unrivaled. His ambition was to make millions. He believed that these mines were of fabulous wealth. Difficulties did not seem to deter him, nor danger affright him. The company's caution in his judgment was timidity and cowardice. He appears to have been an overbearing and imperious man, and the court is not particularly impressed with the scrupulousness of his methods or reliability as to details of fact. The conservatism of Messrs. Payne, Cornell and Burke was never a barrier to his exertions or an obstacle to his plans. To those ends he devoted himself with the zeal of a crusader. He had most exaggerated ideas as to the value of these properties."

The document then devotes some space to the discussion to Mrs. Ritchie's stock, the judge holding that a decree will be drawn, directing that the collaterals held by Mr. Cornell's executors, other than those belonging to Mr. Ritchie, be first sold and then the coupons levied upon by the McMullens to pay any further sum be next sold and if any surplus remains after satisfying the Cornell debt the McMullens will be entitled to such surplus, and if there be a deficiency enough of Mr. Ritchie's securities will be sold to make good such deficiency.

Summing up, Judge Lurton said that the McMullens will deliver the bonds and coupons sold to Ritchie and for which they have obtained judgment to Clerk Belford, who is oppointed special commissioner, and take his receipt. Each of the defendants will do the same. The commissioner will, after advertising, sell at public sale each lot of collaterals. The sales will in each case be for cash unless the council for all parties agree upon a different mode of sale. The sale is not to be made earlier than ninety days from date to give Ritchie an opportunity to pay off the several amounts due to complaintants Burke, Payne and Cornell and all the costs of the cause.

The claims of the different parties to the suit are set off by the court as follows: H. B. Payne, $600,000; Judge Burke, $230,000; Cornell estate, $200,000; McMullens, $270,000.

The Coolgardie Gold Fields—Rich, Perhaps, but Costly.

(From the Investors Review.)

Coolgardie! Who has not heard the name? Its praises have been sung incessantly of late, and by all the members of the band, from the Agent-General down to promoters, punters, and touts. The song has been ever the same—gold, gold, until the whole city is sick to death with the thing. It is impossible to take up a paper without one's eyes falling on further marvellous gold discoveries at Coolgardie, or at the Murchison or Yilgarn fields. Crowds are rushing here, crowds are rushing there; two or three men in as many days simply by a hand machine have obtained so many hundred ounces of gold; water has been found in plenty, and so forth. We quite expected all this, for preparations have been for some time in progress to introduce to the London market companies to work the gold fields of Western Australia, even down to the Agent-General hiring a shop window in Gracechurch street in order to display some samples of the metal. Gold has long been known to exist in Westralia, as it is now the fashion to call the colony, and since 1885 various fields have been "proclaimed;" but former attempts to "boom" the place were not successful, mining operations being too heavily handicapped by difficulties and cost of transit and the lack of water. Since that time the Government of Western Australia has expended some money on roads and railways and in making experiments for the storage of water. It also adopted the pretty sure way of getting the country developed by selling immense tracts of land to enterprising speculators for very little money, in spite of the known or suspected riches. We have no desire to disparage gold mining in Western Australia; but the public must be told the truth. Gold is there in large quantities, at and near the surface. Whether it takes the form of proper and well defined lodes which continue to any depth, has yet to be proved; but the extraordinary richness of the finds suggests that the lodes are "pockety," and not permanent. The country is little better than an arid desert, whereas timber will be largely wanted if any real mining is to be done. Railways are being slowly constructed, but are still many miles from the seat of operations. Of water there is none, beyond the sea water, between 100 and 200 miles away, though this, of course, can be condensed at considerable trouble and expense. Even the optimistic Agent-General admits that the lack of water is a very urgent question. "There is," he says, "a skeleton in every cupboard, and with them it is the question of water." The Government have spent a fair amount in water conservation, but the average yearly rainfall does not exceed twelve inches, and is immediately sucked in by the parched soil. Artesian wells are spoken of, but good authorities think little of the idea. The drawback to the industry is therefore plain enough—the great cost of working, and unfortunately it is "writ large." It is almost a repetition of the Queensland "boom" of some seven or eight years ago, when over two dozen companies were formed with an approximate capital of about 5 millions, of which four-fifths were taken by vendors and promoters. How many of these companies are still at work? All but very few have been wound up and the money lost. So it will be with these latest creations, and the public will have to use great caution in having anything to do with such traps. If the remaining companies to be brought out—and we understand that a great number of ventures are waiting to be issued—are not started upon a more solid basis, Coolgardie will stand no chance whatever. If it had ever stood much chance it would have been developed years ago. Shareholders are face to face with their usual privileges—reconstruction and calls, or the swift death of all their hopes.

The Status of the Nickel Industry.

(From the Engineering Magazine.)

The large increase in the production of nickel during the past few years is mainly due to the introduction of the metal into material designed for war purposes, the toughness of nickel-steel having been found of considerable value in the manufacture of objects which are to be subjected to sudden and excessive stresses. It has been found that steel alloyed with a small percentage of nickel (3 to 4 per cent.) possesses great tensile strength with a corresponding elastic limit. The percentage of nickel used in the alloy has a marked effect upon its physical characteristics, the advantage of steels containing a low percentage of nickel not being found in richer mixtures. For instance, a gun manufactured of steel carrying 27 per cent. nickel did not give satisfactory results, treatment after forging reducing its physical qualities below simple steel.

Up to the present time nickel-steel has met with an extended use only on the part of national governments, such being the inertia of custom that it has not been introduced openly into the arts and manufactures. This is partially due to expense attending its manufacture, partly to a conservative spirit which hesitates to employ a new material, engineers not caring to call for it in their specifications and manufacturers hesitating to advocate its introduction. It is very important for the nickel industry that this nickeliferous iron alloy should meet with a general introduction because in that case nickel would find a ready and ever increasing market. That such a desideratum can be reasonably looked forward to is foreshadowed in the opinion recently expressed by one of our best authorities on steel subjects who stated in a letter to the writer that the qualities of nickel-steel are simply marvellous and if properly pushed it should have a great future. On this account the future of the metal seems closely bound up with that of nickel-steel and the limited extent to which this material has already been employed has given the nickel industry a considerable stimulus, the remarkable results obtained from physical tests of this material affording much hope for its ultimate extended use. Although the results obtained in the cases of certain Harveyized plates recently submitted to the Government for testing purposes caused some doubts to be cast upon their effectiveness, still the many tests of a similar nature which preceded the ones referred to and which turned out successfully, and others which have subsequently been made, render it more than likely that in these particular cases failure cannot be charged up against the alloy. As is the case with every new industry, perfection has not been attained at once, and some failures must naturally be expected; but it has not been by any means demonstrated that the disasters which overtook the particular plates mentioned are to be ascribed to any inherent weakness in the nickel-steel itself. An accumulation of evidence obtained at Krupp's works in Germany, at the Ochata trials in Russia and at the many tests made at Indian Head and other places in this country and in France has been obtained, which goes to show conclusively that nickel-steel plates, when placed side by side with those of ordinary steel, and subjected to severe tests, are capable of withstanding greater punishment than the latter. As stated, this fact has been established upon American and foreign proving grounds again and again so as not to admit of any reasonable doubt remaining upon the subject. However our naval authorities were not satisfied with the resisting powers of nickel-steel plates but wished to carry the matter still further, and to provide for the new war vessels building a material of great surface hardness in addition to toughness so that the projectiles should be broken up on their surfaces, they still possessing the quality of not cracking. If in thus attempting to produce in ideal plate, one possessing the toughness of nickel-steel at the same time with an extremely hard outward surface, it has been found that further experience in the methods of manipulation is necessary before attaining perfection, it is hardly logical to ascribe a casual failure to any inherent weakness in the nickel-steel itself. When it is considered that the presence of 0·1 per cent. of carbon, more or less, in a plate constitutes the difference between a material which will resist cracking, or one which will fly to pieces under the impact of projectiles, the extreme caution necessary in proportioning the ingredients is apparent. Furthermore, the effects upon steel of the various processes of annealing, tempering, etc., are factors which demand serious consideration, especially in the case of heavy armor plate subjected to severe test shortly after manufacture.

Apart from the mechanical and chemical processes to which the plates are subjected, the incorporation of the nickel into the alloy during the process of manufacturing the steel may also have a considerable bearing upon the results produced. In France, which was the birth-place of nickel-steel, the method of incorporating the nickel into the bath was for a time through the medium of ferro-nickel. The material, which corresponds in a measure to the compound of iron and manganese known as ferro-manganese used extensively in the manufacture of steel, was prepared from ores of the two metals and subsequently introduced into the steel bath. This process of manufacturing nickel-steel is explained at length in the patent specifications of both Schneider and Marbeau, and has much to recommend it. It is only rational to assume that where two metals, iron and nickel, are already alloyed in the ferro-nickel, the latter will become very evenly diffused through the steel bath when the ferro-nickel is introduced into it. At present the French manufacturers appear to have substituted metallic nickel in the place of ferro-nickel in manufacturing their nickel-steel; but in either case the nickel is introduced into the steel bath in the metallic form. In this country a different method has been employed by our nickel-steel makers—one which, when the object to be obtained is considered, does not commend itself either upon chemical or mechanical grounds. The nickel is introduced into the steel in the form of what is known as "commercial oxide," and the incorporation of a small amount (between 3 and 4 per cent.) of nickel, in the form of oxide, into a bath of steel so as to form a homogeneous alloy under the condition named is hardly to be expected. It is difficult to understand how the nickel can become evenly distributed throughout the bath, and if by chance the oxide should not be thoroughly reduced the cohesion of the whole mass is naturally weakened. A priori it would appear as though the European practice of incorporating the nickel in the metallic form were the one most likely to lead to uniform results, and the practice of using nickel in the form of oxide may account in some cases for the uneven results obtained over here. The production of alloy is not always an easy operation; but there are other metals forming component parts of alloys in common use, which possess essential characteristics so widely differing from each other that they are much more difficult to alloy than is the case with nickel and iron; yet practice and experience have overcome the difficulties at first encountered. Similarly happy results may be confidently expected in the case of nickel-steel when the manufacturers have gained the requisite experience, and probably occasion to refer to blow-holes or uneven distribution of the nickel will not then rise so often.

One point clearly established by experience with nickel-steel up to the present ime is, that as far as applied to large castings the alloy has unquestionably come to stay, but to what extent it can be utilized for smaller articles remains yet to be proved. There appears to be no good reason why it should not eventually find general introduction wherever a tough steel of great tensile strength is required.

The non-corrodibility of nickel would seem to fit it especially for culinary utensils, and these have been placed upon the market for some time, manufactured both from solid nickel as well as combined iron and nickel plate, manufactured in the manner already mentioned. The method of welding nickel to iron and then rolling them both to plate, gives us a material possessing most of the desirable qualities of nickel without its excessive cost. Iron "plated" in this manner does not readily part with its nickel coating, as is so generally the case when it is plated by galvanic action.

Solid nickel coins have recently been issued by some of the European governments, and alloys of nickel and copper, the so-called "nickels" in common use, have long been in circulation in this country and elsewhere; but the uses to which metallic nickel is put to-day are comparatively few, and will probably remain so until improvements are introduced for reducing the metal out of its ores.

Engineering Instruments and their Calibration.—*Continued.*

generally be found that successive observations taken at the same pressures will not repeat themselves exactly. The lines will wander round about a mean position. If readings be taken first with rising, and then falling pressures, it will often be found that one of these will remain constant for successive repetitions, while the other varies owing to slight alterations in friction. Oftener, however, both will be found to vary together.

5. The atmospheric or zero line alters with alteration of temperature, and should therefore always be taken immediately after the diagram, time only being allowed for the complete escape of steam from the underside of the piston. This is naturally only important for measuring the absolute pressure of steam at any point of the diagram, and will not affect the mean pressure. If the atmospheric line be taken previously, the pressures above the atmosphere will all be too high. It is probable that this error is not so great in actual practice, where the spring has not so much time to fully acquire the temperature of the steam as in static calibration, where the steam is steadily applied for an appreciably longer time.

The author finds that, for purposes of correction, all the foregoing errors may be summed up under two heads, viz., scale errors and backlash errors.

With regard to the former, the combined effect of rise of temperature and unavoidable inaccuracies in both spring and linkwork, is to alter the scale of the diagram so that the spring becomes of higher or lower scale than its nominal value. By plotting the errors of several cards taken at each of a number of successive pressures, an error curve may be drawn with a base line representing the successive pressures, and vertical ordinates representing errors. It can then be seen at a glance what the general character of the inaccuracies is. The curve generally approximates to a straight line, with larger or smaller undulations; and if a straight line be drawn through the mean values, it will usually be found to differ by less than 1 per cent. of the total pressure from any individual observation for a large portion of the range. In general, the actual observed errors will leave this line after a certain point, which will define the range beyond which the spring should not be taken. A spring which deviates widely from such a mean line should not be used where errors less than these deviations are important. A spring and indicator which show a less mean combined error than 2 to 3 per cent. is unusual. Many indicators, if taken beyond a 1½ inch range of diagram, exceed 10 per cent. errors from their true reading. These occur in both a positive and a negative direction. By the means of this correction line the true scale of spring in the given indicator can be determined. If observations be taken on both rising and falling pressures, two sets of readings will be obtained, one up, the other down. A second mean line will then have to be drawn, and the difference between the two will represent backlash errors.

In all such calibration, pistons, linkwork, and all moving parts must be oiled at frequent intervals, as would be done in practical use. Dryness or foulness of piston, etc., will, of course, largely modify the backlash. Under static tests, or with the steady and slow rise and fall of pressure which are necessary for the accurate determination of the pressure, it is probable that the maximum difference between the rising and falling position of the piston will be shown. In actual use, with the rapid alternations of pressure and quickly moving pistons and parts which then take place, it is probable that backlash may, to some extent, be reduced. On the other hand, any undue pressure upon the pencil point would very largely increase this effect. In some experiments made on this point, the author found that with engines running at a constant speed and doing constant work, by modifying the pressure on the pencil the diagram was altered in precisely the direction one would anticipate. The effect of backlash upon an indicator diagram would be to make too low an admission line too high an expansion curve and too high an exhaust line, as long as it remains straight or drops. If any drop in the admission line, or rise in the exhaust line, occurs, this effect would be reversed. This is precisely what the author found in the cases referred to. With straight admission and exhaust lines, increase of pressure on the pencil produced lower admission line, higher expansion line, and slightly higher exhaust. This indicates a method by which backlash can be approximately corrected for. Under the above conditions it will generally only be necessary to correct the admission line, as the expansion and exhaust lines erring in the same direction, the mean distance between them will be practically unaltered by backlash. Where the admission line falls, or the exhaust line rises, instead of being straight, it is the exhaust line which will require correction. This correction, of course, involves some trouble where a large number of cards have to be measured, and if backlash could only be avoided, or reduced to negligible dimensions, the simple correction for scale would alone be required.

An indicator has recently been introduced in this country which seems to promise great possibilities in this direction. It has a rotary in place of a reciprocating piston, and there being no linkwork of any kind between pencil point and spring, there is little opportunity for backlash. The friction between piston and cylinder has been reduced to a minimum. If the spring is initially adjusted out of the centre line, side pressure, and therefore friction, is caused upon the journals, increasing as the pressure rises, and there is some backlash. With the springs properly adjusted, however, the backlash is remarkably small. In the Crosby and Tabor instruments the springs are attached to the pistons by ball and socket joints, so as to allow them to adjust themselves if any slight deviation of the spring pressure should occur. But the danger of vertical play prevents sufficient slackness in this joint to render it always effectual.

It is curious that one of the indicators which the author tested, and which gave the most consistent results, had a spring from which the ball had accidentally become unfixed, though fitting it perfectly and sliding upon it without perceptible play. This seems to indicate that if this ball and socket joint could be made effectual, some of the irregularities due to piston friction would disappear. The backlash due to the linkwork was still present, however.

In conclusion, the author hopes that, in pointing out the possible values of indicator errors, he may in no sense be deemed to depreciate their value. A clear idea of what these errors are, and how they can be avoided and allowed for, must only tend to increased confidence in the indicator as a scientific instrument. If in any degree this paper has helped to attain that result, it will have accomplished the object the author had in view.

THE MINING SOCIETY OF NOVA SCOTIA 1892

AUTUMN MEETING

OF THE

Mining Society of Nova Scotia.

Federation endorsed provisionally after a long and lively debate. The July papers discussed.

The Autumn meeting of the Mining Society of Nova Scotia was held at Halifax on Tuesday 6th instant. The attendance was not large but the proceedings were lively. There were present:

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

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

NEW MEMBERS.

Mr. A. N. Whitman. Mr. J. G. Leckie. Mr. J. D. Sword.

FEDERATION.

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

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

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

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

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

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

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

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

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

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

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

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

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

On motion the report was recieved and adopted.

THE CHAIRMAN—The next step is to read what action has been taken by the other associations. Ontario and Quebec have each appointed a committee, which committees have drawn up two schemes practically identical. The first is from the Ontario Mining Institute and is endorsed by their full committee. (Scheme as outlined read.) The second one is from the General Mining Association of Quebec and is signed by three of the four members of the committee, the fourth member while endorsing it as a whole has forwarded a letter which, perhaps, will be better read after the schemes have come before the meeting. The scheme is substantially as follows: (Scheme as outlined read.) I think these reports sent by the Ontario and Quebec Societies are properly before the meeting for discussion.

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

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

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

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

(Sec. 6, par. 5.) I am not in favor of this method of representation in Council, as it places all the larger and more important societies in a disadvantage, being eventually out-voted by smaller organizations and such that have become members *after* federation. I would much more favor a "de capita" representation, but knowing there is a vast difference in the subscription fees (and therefore quite possible to acquire a large membership with a small fee) I would wish to have the representat on in council based on the annual subscription list of each society *pro rata*. The idea may strike you strange, but we will have to deal with this subscription list anyhow in some measure or another, viz. (Par. 6, Sec. 12) re annual subscription of each society, which could not possibly be the same amount in each and every case. I would suggest that the council should consist of the Presidents (which would give a representation of any society in any case) and one member "*for every*, say $250 or $300, *Annual Subscription*," to be elected annually by each such society. The subscription list of the previous years to be governing.

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

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

MR THOMAS—I take it that the object of the amalgamation is to publish the proceedings at a cheaper rate. Therefore I was surprised that there should be outside members at all.

THE CHAIRMAN—I think Mr. Thomas' idea is the one most of us have. The men who might wish to come in as outside members are persons not directly interested in mining in any of our provinces but are interested in it as a whole.

MR. THOMAS—If a lot of such men were to come in they might have a representation on the Council and thus injure our standing as a society.

MR. STUART—I think we should insist that the men who would join this Institute should join it as members of one of the original societies.

MR. THOMAS—In our Committee's first report something was said about electing the Council according to the numerical standing of the Societies. Now we have one member from each. I understood that the Ontario Institute had not been formed when we were in Sydney.

THE CHAIRMAN—The Ontario Mining Institute was formed in April and is a thoroughly representative organization of the mining interests of that Province; its annual subscription is I believe two dollars. The General Mining Association of Quebec is composed almost entirely of owners or men engaged in the management of mines and the fee is $10.00, the same as ours.

MR. WILLIS—It looks as if all this business will be done by one man, the Secretary elected by the six members of the Council. There might be a man whom the members of the other two Societies might wish to elect who would be offensive to the people down here. We would have only two members to their four. If it ever came to a vote they would always combine against us. They have a much larger membership.

THE CHAIRMAN—There are always chances to make combines.

MR. WILLIS—I think the Secretary of this Federation should be elected by a vote of the different Societies.

MR. GUE—The same majority would be against you with the larger number. I am in favor of the original scheme, federation for the purpose of publication of transactions.

THE CHAIRMAN—The scheme before the meeting is the very one you mention.

MR. WILLIS—My objection is to the manner of electing the Secretary. I object to that part which says that the Secretary shall be elected by the Council.

MR. GUE—Why do we want a Council and Secretary for the editing of the joint report?

THE CHAIRMAN—The object of this scheme is economy. It costs us about $500.00 to publish our proceedings. The scheme is, that by the payment of one-third of that amount we get the same thing and in addition the papers published by the other two Societies. This programme is open for amendment. We can reject it, or we can send them a substitute, or we can reject it altogether and stand on our own footing.

MR. ARCHIBALD—I think the simplest way out would be to give us the simple object of this federation. There seems to be a suspicion that this Council can do us an injury in some way or other, or call upon us to pay more money. If the object of the Society is simply as you specified, to have the reports issued cheaper than before, I do not see that I have any objection to it.

MR. THOMAS—I don't see that it is necessary to have a Council in this affair at all.

THE CHAIRMAN—I think a few figures will show the reason. This Society with a membership of eighty or ninety purchases two hundred volumes of its transactions. Five hundred copies of the transactions would cost little more than the same amount. Putting the membership of the Quebec Society at one hundred and twenty and Ontario at one hundred there would be about three hundred altogether.

THE SECRETARY—Our printing has been done at Ottawa. The printing here is slightly cheaper, but we have to have the plates done in Montreal and Toronto.

MR. FERGIE—I would suggest that the representation for Council be one for every forty members, following the precedent of the English Federation. I move this as an amendment.

MR. POOLE—I second it.

MR. THOMAS—The words "affairs and business" should be better defined. Why not make the Secretary responsible to the Council of each Society.

THE CHAIRMAN—You would find that more difficult than to make him responsible to one body.

MR. HAYWARD—I fail to see why it is necessary to appoint a Council to transact a matter of one hundred and fifty dollars a year.

THE CHAIRMAN—The Council will have the control of more than four hundred and fifty dollars a year. There is another object in view also. The Royal Society of Canada, as I am informed, gets a grant from the Dominion Government of about $10,000 a year, which sum is almost entirely devoted to the publishing of their transactions. If our federation goes through we shall apply to get a grant from the Dominion Government which will help to pay for the publication of our proceedings.

MR. THOMAS—Why not say what the object of the federation is?

MR. POOLE—Let us first have it established that it is the desire of this body to form a Federated Institute and then consider the details of the organization section by section. We will make better progress in that way.

THE CHAIRMAN—I would like to point out that at the united meeting in Cape Breton it was passed unanimously that we do federate. Mr. Wylde made the motion.

MR. WYLDE—When that motion mas made, the question of federation simply for the sake of economy in publishing the transactions, was under discussion. Any objects other than this have been brought up since that resolution was passed.

THE CHAIRMAN—At the suggestion of our Past President, unless there is objection, having agreed to federate, we will proceed to discuss this scheme paragraph by paragraph. The two schemes of the Quebec and Ontario Associations are practically the same, where they differ I will read each.

MR. HAYWARD—I move that the proceedings taken in Cape Breton be reconsidered.

THE CHAIRMAN—I cannot entertain that, as that was a united meeting and we cannot deal with what was done there.

(Mr. Hayward appealed to the meeting, but the Chairman was sustained.)

MR. PEARSON—I must confess to considerable ignorance on the subject. As it appears to me, a decision was arrived at by the united meeting at Cape Breton to amalgamate, the object being the joint publication of the proceenings of the Societies. If that was defined distinctly then it is only a question of the machinery necessary to carry that out. Is there any clause of the constitution by which the object is limited to that particular thing. I would say it would seem to be a pity that the object should be limited.

THE CHAIRMAN—Mr. Pearson has stated the facts as they are. It does define the objects, viz:—

(*a*) The publication in one volume of the papers and proceedings of the several organizatians in the federation.

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

These objects can be extended with advantage.

As to the first paragraph, the name. Ontario suggests "Mining Institute of Canada," Quebec, "Canadian Mining Institute."

MR. PEARSON—I would move that this Society approve of the name "Mining Institute of Canada."

MR. POOLE—I second that, because we will use the expression "The Mining Institute" in conversation.

The motion passed.

Paragraph 2 was then read and the first part down to "(*b*)" adopted.

MR. WILLIS—I move that sub-section (*b*) "Action upon all matters affecting o relating to the mineral industries of Canada" be struck out.

MR. HAYWARD—I second the motion.

MR. POOLE, seconded by Mr. Fergie, moved that it be retained.

MR. WILLIS—The report of the first committee limited the object of this federation to the publication of the reports. Now this is added on to that, I am not in favor of federation for any other purpose.

MR. POOLE—It is desirable that there should be some organization with a Dominion character. I would not like to see the Mining Society of Nova Scotia become of secondary importance, and I do not see how it can under this new formation. I think giving it a Dominiun character would add dignity to it in the eyes of the public. We have allowed the mining business to be run by the politicians alone; now we all want to have a say in mining matters.

MR. PEARSON—As I understand it the proposition is to create a council and clothe it with powers to do something as representative of all the Societies of Canada. It commends itself to my mind that that council should have some functions besides editing minutes, functions by which it could talk in the name of the Mining Societies of Canada. Limit them entirely to the mining interests in Dominion matters. The Dominion Government control the duties on coal coming into Canada. They may negotiate reciprocity treaties. The societies at the two ends of the country should have some central institution which could speak for them. The jurisdiction should, however, be limited to matters of general Canadian interest. I would move that that clause be not passed upon now, but that it be sent to a committee to consider what limitations be put in it. It seems to me that it is very desirable to have an additional clause to the one passed, but it might be well to limit the jurisdiction of the council to some class of subjects distinctly Canadian.

MR. THOMAS—I second that motion.

Messrs. Willis and Poole withdraw their motions.

THE CHAIRMAN—Mr Perrson's motion is as follows "Resolved that section (b) be not now considered, but that the same be referred to a committee to report at once whether any limitations are desirable to said clause, and if so, what."

The motion passed and the following gentlemen were appointed the committee: Messrs Pearson, Dick, Archibald, Gilpin and Willis.

The committee withdrew to draw up a report.

Paragraph 3, comprising sections 3 and 4 was then passed.

THE CHAIRMAN—The next paragraph relates to ordinary members and is as follows: "Any gentleman interested in the Canadian mining industry who may not be a member of the societies in the federation is eligible for election as an ordinary member.

Ordinary members shall be elected by council and will pay an annual subscription of ten dollars."

MR. STUART—I should decidedly object to that clause. Any member should be required to obtain his membership through one or the other of the existing societies. I move that it be struck out.

MR. WYLDE—I second the motion.

MR. MORROW—There might be mining men in New Brunswick who would like to obtain the Journal, and it might not be convenient for them to join either one of the societies.

MR. WYLDE—They are eligible to ours now, and it would not cost them more, and they would get greater privileges.

The motion was then put and passed.

THE CHAIRMAN—Paragraph 5 is as follows: "The affairs and business of the Institute shall be managed and controlled by a Council consisting of the Presidents of the socities in the Federation and one member to be elected annually by each society. The Council shall elect a Chairmrn and a Secretary-Treasurer each year."

MR. POOLE—I move that the different societies have one representative for every forty of its members in addition to the President of the society.

MR. FERGIE—I second the motion.

MR. GUE—I fail to see why we should care whether they have the control or not. If the object is merely to publish the reports in combined form, we need not care whether they have four thousand members.

THE CHAIRMAN—As a matter of fact the Society is not committed yet to federation. We say we are willing to federate if the scheme commends itself to us in its details. In connection with representation, the Ontario society is not on the same par with Quebec. The members of the Ontario society only pay two dollars per year. Mr. Klein proposes, therefore, that the representation be based on so much annual subscription. On the basis of per capita representation they would have two members and a half. On the basis of money representation they would only have one member.

MR. POOLE—The vote could be to some extent controlled by providing that all members having votes respecting the constitution and by-laws should pay an equal fee.

THE CHAIRMAN—Mr. Chas. Archibald the chairman of the committee appointed to revise sub-section (b) of the second paragraph, presents the following report:

"Your committee having considered the construction of clause (b) beg to report that the same be adopted with the following proviso added thereto, viz—'Provided that nothing in this clause shall be cosntrued as conferring jurisdiction of power to act with reference to any matter or thing affecting the said mineral industries or any of them unless thereto requested by a majority of the members of one or more of the societies associated in such federation."

The report was on motion adopted.

THE CHAIRMAN—(reading paragraph 5 section 6.) There is a motion to amend that so that it will read—"The Presidents and one member for every forty members of each society."

MR. POOLE—It was found necessary when the federation was made in England that there should be some uniform lines in order to put members on an equal footing, and the fees were made identical. Ontario should raise the membership fee to $10.00

MR. WILLIS—How would it be if there were ninety or one hnudred members. Would there be one representative for the members over the eighty?

THE CHAIRMAN—I would suggest this view might be met by altering the amendment to "every forty members and fraction thereof."

MR. AUSTEN—The thought has struck me when I heard Mr. Poole suggesting that the Ontario society should be asked to raise their fees to $10.00 that they could say to us "We find that two dollars is full and sufficient to pay all the bills we propse to contract". I dont know whether it is correct for one society to ask another to raise its fee to $10.00 because it finds a $10.00 fee to be just sufficient. I would suggest that the President and one from each society be the Council and do whatever little business is to be done, then the Nova Scotia Society would have equal representation with any other. I think the paragraph reads fairly at present.

MR. WILLIS—I will incorporate my motion with that of Mr. Poole.

THE CHAIBMAN—The following is the amendment proposed by Mr. Poole, seconded by Mr. Fergie "and one member for every forty full members of each federated society and fraction thereof."

"The qualification for full membership as specified above shall be an annual fee of ten dollars."

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

THE CHAIRMAN—The next parograph reads "The Council shall elect a Chairman and a Secretary Treasurer each year."

MR. WILLIS—I beg to move the following in amendment:—

That the Council elect a Chairman each year, and that the office of Secretary-Treasurer shall be an honorary one, and that this officer shall be elected by the individual votes of the members of each of the Societies in the Federation. This was seconded by Mr. Hayward and carried.

MR. POOLE—I move that the following words in Section 8 "shall be appointed by, and his salary if any, shall be determined by the Council" be struck out, and the rest of the clause retained.

This was seconded by Mr. Andrews and passed.

Sections 9 and 10 were then, on motion, passed.

THE CHAIRMAN—Section 11 reads as follows: "The accounts of the Treasurer and the financial statement for the year shall be audited by two members of the Institute. The auditors shall be elected at the Annual General Meeting."

MR. STUART—I would suggest that the auditors be one from each Society.

THE CHAIRMAN—I take it that the accounts shall be audited at the annual general meeting, and the auditors would be elected then.

The clause passed.

THE CHAIRMAN—The next section, 12, provides for an annual subscription not to exceed $150.00.

MR. POOLE—I don't like the last part. If the papers are illustrated they could not be got out for that. I prefer a per capita tax. I move that that clause be amended to read "not to exceed $3.00 per capita" in lieu of $150.00.

This motion was seconded by Mr. Stuart and passed.

Section 13 was struck out as the subject matter was embraced in a previous amendment.

THE CHAIRMAN—The next section provides for the Annual General Meeting to be held each year in the month of July at such time and place as the Council may determine.

The clause passed.

Paragraph 8, respecting publications was then read.

MR. POOLE—I would not allow the Council the privilege of distributing free copies. I would allow a certain number also to the authors.

MR. DICK—There is no provision for exchanges. I move that one copy be allowed to each member, twenty to the authors, and that the balance be sold by the Council.

This motion was seconded by Mr. Austen and passed.

MR. MATHESON—In regard to exchanges I move that the following be incorporated with the 15th section,—"That copies of the Transactions sent for exchange shall be accompanied with a request for a copy of such exchange for each Society in the Federation." Seconded by Mr. Fergie, and passed.

Section 16 was also approved.

THE CHAIRMAN—The last section reads:—"The Council may accept communications from persons who are not members of the Institute and allow them to be published." We may desire to have papers from members of the Geological Survey, or from members of McGill and other Universities. It is simply a permissory clause. The clause passed.

MR. POOLE—I move that the scheme as amended be forwarded by the Secretary to the two other Societies as the basis upon which the Mining Society of Nova Scotia will enter the federation.

MR. WILSON—I second the motion. Passed.

COMMITTEE ON MINING LEGISLATION.

MR. B. C. WILSON—seconded by Mr. Willis moved the following:—

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

The Chairman thereupon nominated the following committee:—Messrs. Poole, Drysdale, Stuart, Pearson and B. C. Wilson.

(To be Continued.)

Gold Milling—The Vibration of Stamp-Stems.*

Philip Argall, Denver, Col. (communication to the Secretary): Dr Raymond claims (*Trans.* xxiii., 560), that my statement (p, 559) regarding the crystallization of iron "is beyond question incorrect." He says: "It is not even settled that vibation will crystallize iron under any conditions." While admitting that authorities differ on the possibility of cold crystallization of iron, I believe it is a settled and undisputed fact that vibration in the presence of heat will crystallize iron. Bloxam and Hunttington say: (1) "Vibration assists in converting fibrous material (iron) back into a crystalline state when heated, a lower temperature sufficing than in the absence of vibration." Mr. A. F. Hill, (2) summing up a very exhaustive review upon the crystallization of iron and steel, pronounces against crystallization, but only at temperature below 900° F. Mr. Howe, (3) discussing the breakage of a 20-foot porter bar with a crystalline fracture, suggests that it was attributable to heat, jointly with the jar. We see, then, that vibration of heated iron bars will induce crystallization and consequent change of structure.

Referring to my statement, I wish to point out, that I was discussing the vibration of stamps and should have said, "vibration under all *such* conditions," etc. That is, vibration attended with sharp blows, such as a stamp-stem is subjected to, will crystallize iron; yet I believe that intense vibration under any condition will eventually crystallize iron. It is only a function of time, a very long time, perhaps, when the vibration is unaccompanied by shocks or blows.

I an not aware that any law of modern physics, or of the molecular theory of matter, would be violated by the assumed rearrangements of molecules in a viscous solid, such as iron, at ordinary temperatures. We must admit that the molecules are in motion, and that any force capable of increasing the amplitude of their vibrations may induce a change of structure. What is electrolysis but the direction, by means of an electric current, of the movement of molecules in the electrolyte to form new bodies? We have seen that vibration of hot iron bars induces crystallization at temperatures far below plasticity; so that it can be understood, that at ordinary temperatures, where the molecular motion is comparatively slow, the vibration must either be intense or long continued, in order to cause crystallization. Dr. Barus (4) has shown that "the chemical equilibrium of a solid changes with each change of strain." Osmond (5) claims that strain more or less completely converts cold metals from one definite molecular condition to another. Warbug and Ewing (5) have proved that hysteresis is not only associated with mechanical stress but may also be induced by magnetic stress, while the experiments of Rowland and Bell (5) prove that magnetic iron is more electronegative than unmagnetic iron. From which Barus infers that this pheonmenon is to be interpreted as directly evidencing "a chemical difference between magnetic and unmagnetic iron."

It has also been proven by Dr. Barus (6) that, "even at temperatures slightly above mean atmospheric, the molecular configuration of glass-hard steel is always in a state of incipient change." He says:

"During the last three years I have been making experiments on the secular annealing of cold hard steel. The results are very striking, and show that mean atmospheric temperature acting on freshly quenched steel for a period of years produces a diminution of hardness nearly equal to that of 100° C. actin for a period of hours. I examined some twenty rods, the specific resistence of which, within thirty-seven months, has fallen from 46.5 to 42.5 in the case of thin rods (diameter 0.08 c.m.) and from 43.7 to 35.4 in the case of thicker rods (diameter 0.13 c.m.)."

It is true that these quotations do not support a crystallization theory for iron but they do prove that the molecular structure of iron can and does change under different physical conditions and at atmospheric temperatures. This conceded, the possibility of cold crystallization of iron becomes apparent, the "current fable" and the "myth" to the contrary notwithstanding.

Apart from the abstract theory, however, we have practical experience on the one hand and two sets of theorists on the other, from which conclusions may be drawn.

The cold crystallization of iron is a subject that has long been agitated and never satisfactorily settled. It is true, some eminent authorities have at various times settled the matter to their own satisfaction, but godd, fibrous iron will continue to break with

* A continuation of the discussion arising in connection with Mr. Rickard's paper on "The Limitations of the Gold Stamp-Mill," Trans. American Institute of Mining Engineers, Bridgeport meeting, October, 1894.

a crystalline structure, in stamp-stems, for instance; and practical men cannot accept the dogmatic assertions of the theorist as evidence against their own observation and daily experience.

In 1866, Kirkaldy (7) settled the matter to his satisfaction, and published his sixty-six conclusions on iron. Of these, No. 18 bears more directly on crystallization. Said Kirkaldy:

"Iron, when fractured suddenly, presents invariably a crystalline appearance; when fractured slowly, its appearance is invariably fibrous."

The crystalline appearance here referred to is very different from that of iron crystallized by the vibration and sharp shocks to which a stamp-stem finally succumbs. In the first case the fibres are not given time to stretch, but are broken off at right angles to their longer axis, whence the apparent fine crystallization; while, in the latter case, actual crystals are developed in the iron, some reaching as much as 0.25 inches in diameter. It is with this latter phenomenon we have to deal in stamp-mills.

Fairbairn (8) has said: "We know that in some cases wrought-iron, subjected to continuous vibration, assumes a crystalline structure." Greenwood (9) tells us that "continued hammering of iron in the cold state induces hardness and brittleness, with a more or less crystalline structure in the iron."

It must be admitted that stamp-stems invariably break with such a structure. Again, it is generally admitted that railway axles are, on the whole, inclined to break with a crystalline fracture. The fracrure of the 5-inch connecting-bar of the Washington Navy Yard testing-machine was considered by Beardslee "an unmistakable instance of crystallization."

Rankin (10) sums up his conclusions as follows: "It is certain, at all events, that iron ought to be as little as possible exposed to sharp blows and rattling vibrations."

R. W. Raymond, New York City: The subject of Mr. Argall's reply to my former remarks is so important as to justify the most extended discussion. And I would not deny that, as a part of such discussion, the citation of authorities is pertinent and valuable, although the mere heaping up of contradictory statements and opinions is not likely to determine the truth, without such further sifting and weighing of the evidence as will show what may be taken as thus far reasonably proved.

I may be permitted to recall that the remark of Mr. Argall originally criticized by me was, that "vibration, under all conditions, will crystallize iron."(11) This I declared to be "beyond question, incorrect," adding, that "it is not even settled that vibration will crystallize iron under *any* conditions."(12) In the same connection, I observed that Mr. Rickard and Mr. Argall had "adopted a current fable, which may or may not have a basis in occasional and exceptional experience, but which owes its vitality chiefly to its availability as an excuse to shield manufacturers from the blame deserved for bad work."

Mr. Austin (13) presented, in opposition to my view, some considerations to which I have already replied. I wish to recall here only the fact that I disclaimed any narrow sense of the term "crystallize," and accepted, as the subject really under discussion, the question, whether there is really a molecular change produced by vibration in iron or steel.

Mr. Argall now restates his original proposition so as to confine it to such vibration as takes place in the stem of a stamp. I accept this modification also, although I may be permitted to point out that it greatly narrows the field of inquiry originally suggested by him, and excludes most of his evidence and reasoning, as well as some of mine. It is now quite possible for him to say, that an experiment, in which prolonged vibration had no effect upon a piece of iron, is not conclusive, because the vibration was not like that of a stamp-stem in a battery. But I conceive, on the other hand, that it devolves upon him to show the difference, or else to abandon the argument from theory and analogy, and to confine himself to experimental proofs drawn from stamp-stems exclusively.

But Mr. Argall cannot be permitted to state this question as one with regard to which practical men are arrayed on his side and theorists on the other. That is a ludicrous reversal of the situation. The wildest theorists are notoriously so-called "practical" men, when they once let themselves loose in the field of speculation; and in this case the so-called "practical" men are the only ones who have set up any theory at all. The fracture of a stamp-stem is a fact; the notion that it is due to a molecular change caused by vibration is a theory. Nobody denies that this is conceivably a true theory; but a good many observers have been led to doubt it, because there is not a single clear experimental proof of it, and because attempts to prove it by careful experiment have proved the contrary, so far as they have had any definite result whatever. It is quite out of place for the defenders of the theory to characterize as dogmatic theorists those who have no theory at all, but are simply asking for the facts.

Dr. John Percy said in 1864: (14)

"Another point remains to be considered, namely, whether vibration caused by impact, or otherwise, may induce a crystalline arrangement which did not previously exist, or was only imperfectly developed. I have not met with any evidence to justify an answer in the affirmative."

This is not abstract theory but practical common sense, as is also the observation which follows:

"Neglect in observing the essential connection betwen the character of the fracture and the particular mode in which it has been effected, has led to the conclusion that the crystallization of iron has originated from mechanical treatment, when, in reality, crystalline structure pre-existed, and was only rendered easily manifest by fracture consequent on induced brittleness." (15)

This declaration of Percy's represents correctly, I think, the conclusion to which any competent observer, critically examining the evidence accessible in 1864, would have been led. That the situation has not been changed in favor of the vibration-theory by any subsequent evidence, will appear in the following passage, translated from the hand book of Prof. A. Ledebur, (16) who may fairly be called the highest, as well as the latest, authority on iron and steel:

"The observation has been often reported, particularly in former times, that iron exposed to continuous shocks, as in railway-axles, crane-chains, etc., suffered a loss of strength and toughness as the result of a change in its structure; especially, that fibrous tough iron was in this way gradually altered to granular brittle iron and that in this process could be found the cause of the occurrence of fracture in pieces which had served their purpose for decades without breaking. According to this view, continued shocks (*anhaltende Erschutterungen*) would produce the same effect as ......heating wrought-iron nearly to melting-point and gradually cooling it.

"This supposed observation received a seeming confirmation from the law announced by Wohler, in 1870 (17) as the result of thorough experiments, according to which the fracture of a body might be brought about by numerous repeated strains, no one of which reached the breaking limit. Later experiments (18) have shown that fracture is not induced, even by an unlimited number of strains, if a certain limit of strain is not exceeded.

"But the opinion that a fracture caused by repeated strains is the result of a change in structure, and particularly that fibrous wrought-iron is transformed into granular under continuous shocks, has proved to be entirely erroneous (*vollständig irrig*). On page 642 the circumstance has been pointed out that the appearance of the fracture of fibrous iron is dependent upon the manner of the breaking, and that fibrous iron shows a complete coarsely-granular fracture when suddenly broken by a heavy blow. Such a shock is usually the cause of the fractures in which it has been believed that the transformation of fibrous into granular iron was observed.

"Bauschinger, in 1878, took links from a chain bridge erected in 1829 at Hamburg, and subjected in service to continual shocks (*Erschutterungen*), and compared them with similar links of the same material, which had remained in stock unused. (Here follows a table of tests.) The fracture of the broken pieces showed no change due to use; the pieces which had been in service showed to a large extent fibrous structure. (19)

"The wrought-iron bolts of a wooden railway-bridge on the Allgau road, having been tested for strength before use, showed, when tested again by Bauschinger after twenty-five years, no diminution in strength. (Here follow the figures.)

"Again, a comparative test made by Belelubsky, in 1888, between the links of the Kiew chain-bridge, which had been forty years in service, and the links of the same material which had remained in stock, indicated no change in these properties. All the test-pieces showed fibrous structure. (20)

"Numerous experiments instituted by Bauschinger in the mechanico-technical laboratory of the *Technische Hochschule*, at Munich, in which bars of iron and steel were submitted to repeated shocks, led him to the conclusion that 'strains of iron and steel repeated frequently, millions of times, bring about no change of structure.'"

The word *Erschutterungen*, which I have translated "shocks" in the foregoing extract, is a stronger term than *Schwingungen* (vibrations). It includes both shock and vibration, and exactly represents Mr. Argall's definition, "vibration attended with sharp blows." Prof. Ledebur's conclusions are, therefore, directly contradictory of Mr. Argall's view.

Mr. Argall replies to my statement that "it is not even settled that vibration will crystallize iron under any conditions," by asserting his belief that "it is a settled and undisputed fact that vibration in the presence of heat will crystallize iron." He is, of course, aware that I was speaking of cold metal only; and I do not care to be drawn away from the issue which he has himself taken pains to confine to the conditions obtaining in stamp-mills. Nevertheless I may venture to say that the authorities he cites do not warrant his sweeping conclusion: "We see, then, that vibration of heated bars will induce crystallization and consequent change of structure." The really "settled and undisputed fact" is that heat-treatment alone, without any vibration, will produce the change referred to, as Prof. Ledebur, in the passage I have quoted, incidently points out. All that has been suggested as to vibration is that it facilitates the work of heat. The essential agent must still be the heat, for the simple reason that heat alone will do the work, whereas vibration alone, so far as we can find out experimentally, will not. At the very best Mr. Argall's assertion that *heat and vibration* will produce a certain result, is no contradiction of my assertion that it is not settled that *vibration* will do it.

Moreover, there is no argument to be drawn by anology from the behavior of iron under special heat-treatment to its behavior at ordinary temperature and after complete solidification. The very term vibration means different things in the two cases. Shock is differently transmitted in a heated bar, and structure is unquestionably under incipient obliteration. Mr. Argall's statement, "We have seen that vibration of hot iron bars induces crystallization at temperatures far below plasticity," is not warranted, even in its vagueness. The only temperature he specifies is 900° F. (482° C), which is not "far below plasticity." This temperature is, in fact, almost exactly the point at which iron exhibits a remarkable and sudden change in physcal qualities, indicative of a weakening of structure. The tensile strength and elongation, as determined by Kollman (21) for the temperatures below and near this point are as follows:

Deg. C.	Tensile strength kilo. per sq. mm.	Elongation. per cent.
310	33.5	33.0
340	32.1	35.0
410	27.0	45.0
510	11.1	37.0

It will be seen that, between 410 and 510 degrees, the strength has diminished more than one-half, and the elongation has passed its maximum. In a word, what I suppose Mr. Argall means by "plasticity" has clearly set in.

Mr. Argall says that he is not aware that any law of physics or of the molecular theory of matter would be violated by the assumed rearrangement of molecules in a viscous solid, such as iron, at ordinary temperatures. For my part, I am not aware of such a fact either. If there were any known law thus violated, the assumption would, of course, have to give way to the law. But the arguments and citations by which Mr. Argall seeks (as I suppose, for I cannot conceive on what other ground he considers them pertinent) to render his assumption theoretically probable, fall far short of that effect; while the effect itself, if achieved, would amount to nothing. For Mr. Argall and his molecular argument are confronted by practical men, not theorists; and when he says, "Why should not this be possible?" they may reply, "We don't know; all we know is, that the thing, possible or not, has not been proved to occur. Mr. Argall seems to dislike my term "fable" and Mr. Howe's term "myth," as applied to his theory. If he prefers Prof. Ledebur's term "entirely erroneous" he is welcome to that. I beg to observe, however, that a fable, as I understand the term, is not necessarily an impossible, but simply an untrue story—in this case, a product of the "scientific imagination."

But what does the theoretical argument of Mr. Argall really prove?

1. Barus, he says, has shown that "the chemical equilibrium of the solid changes with each change of strain." Dr. Barus, in the paragraph quoted, refers not to vibration at all, but to steady pressure; and not to molecular or physical equilibrium, but to chemical equilibrium. And his conception of chemical equilibrium is measured simply by electrical resistance. Moreover, his experimental basis was a non-fibrous solid, namely, glass.

2. Mr. Argall's second quotation from Barus asserts a change in the molecular configuration of cold glass-hard steel, produced by time alone. This change is in hardness—not necessarily in structure. But here also it will be observed, we have a non-fibrous material, and one which is already under intense internal strains. All that Dr. Barus has proved is, that these strains, existing between molecule and molecule, readjust themselves at ordinary temperatures, in the course of years, almost as much as they would do at 100° C. in the course of a few hours. There is no tangible necessity here for a change in "molecular configuration," even; but, besides that, I do not understand that Dr. Barus means by "molecular configuration" molecular arrangement, or what we call structure.

3. Mr. Argall quotes from Dr. Barus the statement that Osmond claims, "that strain more or less completely converts cold metals from one definite molecular condition into another." I may be permitted to quote, in addition, the remark of Dr. Burus, which immediately follows:

"I have been unable to find, however, that Osmond has any direct evidence to support his assertion, and I have already pointed out some of the difficulties which Osmond must surmount before his view can gain general credence."

This shows pretty plainly where Dr. Barus stands on the question here under discussion. It is evident that he does not draw from his own experiments on glass and glass-hard steel inferences favorable to Mr. Argall's theory of stamp-stem crystallization. But M. Osmond is an observer of recognized acuteness and authority :if he has really asserted the general proposition, apparently attributed to him by Dr. Barus, his assertion of it has weight, whether Dr. Barus agrees with it or not ; and that weight bears unquestionably in favor of Mr. Argall's theory, though the term "strain" may or may not designate the particular kind of strain to which Mr. Argall ascribes a particular kind of molecular change.

I have, therefore, examined with care the statement of M. Osmond ; and I find that he speaks exclusively of the two varieties of iron (*alpha* and *beta* iron) which he considers as two "molecular conditions"—not two different arrangements of the molecules—and of which he says : (22)

"The *alpha* variety (malleable) predominates in steels slowly cooled from red heat, and the more exclusively, as these metals approach more nearly pure iron.

"The *beta* variety (hard and brittle) is formed :

"*a.* Artificially, by the action of any mechanical pressure applied below very dark red heat and producing permanent deformation.

"*b.* Spontaneously, at a certain critical temperature not yet determined."

Clearly enough M. Osmond is announcing no general law, but explaining (upon his own *alpha beta* theory, not by any means universally accepted as yet) the familiar effects of cold-rolling and hammering upon iron and steel. He carefully excludes strains which do not produce permanent deformation, and thus implicitly contradicts Mr. Argall's hypothesis.

4. The researches upon "hysteresis," concerning which Mr. Argall quotes Dr. Barus's reference to Warburg, Ewing, Rowland and Bell, are too abstruse and too little pertinent to repay special analysis and discussion here. If they proved anything for his purpose, they would prove too much. The kind of molecular change which these writers call "hysteresis" is something which they can produce by magnetism as well as by mechanical force ; it is evidenced by electrical resistance, wholly or chiefly ; it is not shown or asserted or believed to produce a granular structure out of a fibrous one ; and it is only called a molecular change, because, on the molecular theory of matter, the molecules must be somehow concerned in it. Pure and simple, it is a change in electrical resistance, which is inferred to involve a change in "chemical equilibrium," which is again inferred to be a change in molecular condition.

I can easily understand Mr. Argall's frank admission that his citations "do not support a crystallization-theory for iron ;" but I will leave others to decide whether they prove "that the molecular structure of iron can change and does change under physical conditions and at atmospheric temperatures."

With regard to Mr. Argall's question, "What is electrolysis, but the direction, by means of an electric current, of the movement of molecules in electrolyte, to form new bodies?" I beg to say that I do not pretend to know exactly what electrolysis is, but I strongly suspect, that whatever it is, it is not *that*. I cannot conceive, however, the remotest connection between this question and the one under discussion ; and will therefore abstain from introducing a purely outside and wholly theoretical issue.

But a little investigation of Mr. Argall's theory itself may not be out of place. It is, if I comprehend it :

A. That the iron of new stamp-stems has a fibrous structure.

B. That this structure is changed during use, by the effect of repeated blows and vibrations, which cause the molecules previously arranged in fibres to separate and rearrange themselves in crystals.

C. That the result of this process is shown by the granular fracture when the stamp-stem breaks.

It seems to me that any stamp-stem thus fractured in service would break at the beginning, rather than the end, of such a process. The molecules can not be expected to rearrange themselves without separating ; and how they are to retain cohesion when they have once separated, so as to resist the breaking-effect of shock until they have got comfortably crystallized, is not clear. The beginnings of separation are incipient fracture ; and the experiments of Wohler and others, cited above, show that shocks producing such slight separation of particles may, by repetition, go on increasing the fracture thus begun; so that at last, the peace breaks by the dissolution of its original, not of a secondary, structure. This conception involves no molecular theory whatever. It rests on the established fact that iron is made up of joined and cemented particles, which can be pulled apart ; and that, when they are sufficiently pulled apart, the iron breaks. Such a conception explains all the phenomena thus far adduced, and it is scarcely necessary to set up an auxiliary and imaginary theory that the particles first separate, then reunite, and then break apart again, under strains which tended to fracture all the time.

The whole question of the fibrous structure of wrought-iron and its supposed relation to strength, has received much new light within recent years, especially in connection with the attempt at Avesta to produce fibrous soft steel in the Little-Bessemer process, by casting some slag with the steel. The peculiar lamination caused in puddled iron by the presence of intermingled cinder was thus reproduced in steel for the benefit of prejudiced consumers ; but it was not shown that this structure gave increased strength. However, I will not now pursue that part of the subject.

Let us now examine the testimony of practical experience, adduced by Mr. Argall "apart from abstract theory."

The opinion quoted from Commander L. A. Beardslee, U.S.N., that the fracture of the 5-inch connecting-bar of the Washington Navy Yard testing-machine was "an unmistakable instance of crystallization," might be construed as an assertion that this crystallization was unmistakably due to repeated shocks. Since the statement quoted is part of the report of a committee of which Commander Beardslee was chairman, and was apparently concurred in by the other members, namely, Gen. Q. A. Gillmore, A. L. Holley, William Sooy Smith and David Smith (all experts of recognized ability), the precise language employed is worthy of careful consideration. It will be found in the *Report of the United States Board for Testing Iron and Steel*, Part I., Washington, 1878, pp. 181, 182 :

"The question as to whether crystallization can be produced in iron by stress, or by repetition of stress with alternation of rest, or by vibration, has been very much discussed, and very opposite views are entertained by experts ; therefore it was considered that any data which might be gathered during our tests, bearing upon this point, would possess a value.

"We have met with but one unmistakable instance of crystallization which was probably produced by alternations of severe stress, recoils and rest.

"The connecting-rod of the chain-prover was 5 inches in diameter, had been in use for forty years, and had, during this period, been frequently subjected to stress up to 250.000 pounds, with recoils produced by rupture of test-pieces.

"It was carefully made in the anchor shop, being hammered from the best quality of wrought-iron scrap ; it is not probable that any section of it, if broken when first made, would have displayed crystalline structure, but while we were testing, it parted one day at less than 200,000 pounds stress, and the surface of the fractured ends showed well-defined crystallization, the facets being large and bright as mica ; the ends having become injured by rust, the bar was again broken by impact, at a point distant over a foot from the first fracture, and the same appearance was found, which is shown in the illustration, Plate V., Fig. 1, the original of which is now in the cabinet of the Stevens Institute."

The illustration here mentioned is a heliotype, reproducing a direct photograph of full natural size ; and, while I have not had the opportunity to examine the actual piece said to be at the Stevens Institute, I feel sure that the appearance of the fresh fracture is better shown in the illustration than it could possibly be shown by the piece itself after the lapse of sixteen years. At the same time, the broken piece might still yield, under proper microscopic and other examination, some important further information, although, as I shall point out, its pedigree is not good enough to justify precise conclusions.

The photographic illustration plainly shows, I think, the laminated structure due to rolling. Whatever crystallization there is, is clearly subordinate to that general structure, and therefore may have existed always, as it existed at the time of fracture, together with the lamination.

The statement of the committee is, that this is "an unmistakable instance of crystallization," but the opinion as to its cause is much more cautiously stated as merely "probable." And the degree of this probability is carefully indicated by a statement of all the data upon which the committee's opinion is based. The facts personally known to the committee, or verifiable by it beyond reasonable doubt, are, that the piece had been in service for forty years ; that it had been frequently under stress up to 250,000 pounds ; and that it broke under less than 200,000 pounds. A fact presumably less certainly established, is that it was carefully made, about 1838, by hammering from the best wrought-iron scrap. The committee infers that "it is not probable that any section of it, if broken when first made, would have displayed crystalline structure." And this is the only reason for supposing that such a structure has been since induced.

In weighing the force of this conclusion, it must be remembered, first, that wrought-iron has a crystalline structure to begin with, and that this structure can be made clearly visible by cold fracture produced in a certain way ; so that, in fact, what the committee means is, that it is not probable that the piece of iron in question, if broken by continued increasing tension, when it was first made, would have failed to show the fibrous fracture due to the elongation of the crystals under such tension. Such an elongation in mass implies that the adhesions of the individual grains in mass is sufficient to resist, for a time, their separation in mass. That a sudden shock or strain might produce separation with little or no elongation is to be expected according to familiar mechanical principles.

Again, the illustration given by the committee represents a fracture *under impact*, which would have been likely to be crystalline in any event. But, considering the character of the observers, we may safely accept their assurance that this fracture presented the same appearance as that produced by tension. The committee's statement, then, is substantially that, after forty years of service, a piece of iron, broken by tensile strain smaller than that which it had previously endured without breaking, showed a tension-fracture exactly like its impact-fracture, whereas, if broken when first made, the tension-fracture would *probably* have been more fibrous.

Even this *probably* is open to somewhat damaging inquiry. For the committee does not say, and evidently does not know, what heat-treatment this piece of iron received when it was forged forty years before, or whether, during these forty years, it was ever heated, straightened, annealed, or otherwise subjected to heat-treatment. Yet such treatment, as is well-known, might induce a crystalline structure both coarser and less firmly cemented than would have existed without it. It is to this unquestionable fact that Mr. Howe refers, (23) when he says, in discussing the present case, and also that of the 20-foot porter-bar at the Morgan Iron Works, cited by Mr. Argall :

"Now I find nothing here which indicates strongly that any change in crystallization occurs under vibration or shock. The cases of the Washington testing-machine and of the Morgan Iron Works porter-bar may well be due to over-heating under manufacture."

We have, then, as equally "probable," the hypothesis that the crystalline structure, ultimately exhibited upon fracture, had existed in the iron ever since its last heat-treatment ; (24) and the only remaining question is, why should the iron break under a smaller strain than it had previously sustained without breaking?

The answer to this question is given by Wohler's experiments, and may be summed up in popular phraseology by the statement that repeated stresses, no one of which is sufficient to produce fracture in mass, may, when they individually surpass the limit of elasticity of the weakest elements of the mass, gradually loosen (not transform) the existing structure, and thus by their comulative effect, ultimately produce visible mass-rupture. This is a fact ; and it offers a sufficient explanation of all the facts thus far observed with scientific precision.

The theory which it suggests may be, either that the loosening of structure is gradual and uniform, so that, at a given moment during the process, the cohesion of all the granular or crystalline elements under strain which has been equally dimished; or that it is progressive, like the breaking of a wire-cable, wire by wire, so that the final visable mass-fracture is simply the cumulative result of incipient fractures, or minute separations of structural units, which have left fewer and fewer coherent units to endure strain. To my mind, the appearance of all tension-fractures, indicating, as it does, that the strain upon the mass is not equally sustained by all parts of the section of fracture (*i.e.*, that some parts elongate more than others before breaking), favors the second of these theories, which is, moreover, made plausible by what we now know concerning the unequal internal strains produced (especially by heat-treatment) in manufacture. But it is not necessary to maintain either theory. The true explanation of the phenomenon may involve them both ; and neither the phenomenon nor its theoretical explanation involves any process of re-crystalliation under shock at ordinary temperatures.

Under careful analysis, therefore, the instance presented by the U. S. Board (which is, in my judgment, the strongest that Mr. Argall has adduced) amounts only to a guarded opinion, based upon an incomplete statement of facts, which permits a different explanation.

The declarations of Fairbairn and Greenwood, quoted by Mr. Argall, are simply reiterations of the traditional belief, unsupported by fresh experiment. Like many similar passages in the text-books, they have merely the force of the earlier opinions of which they are echoes.

Rankin's statement that "iron ought to be as little as possible exposed to sharp blows and rattling vibrations," is not only consistent with the theory of breakage without "crystallization," but immediately follows the intimation of Rankin's doubt of the earlier theory, and a report of experiments made by him on railway-axles, which do not confirm the notion of crystallization by vibration.

The only question here at issue is, does the vibration to which stamp-stems are subjected in practice, change the structure of the iron of which they are composed? It is not, "Do stamp-stems break after condinued use?" Nor is it, "Do they show a granular fracture when they break?" A thousand instances of such breakage and fracture will prove nothing. But any one of the following suggested tests would prove a good deal.

I.—Let a stamp stem which has been running a long time without breaking be taken down and examined as to fracture and structure. This has never been done, so far as I know.

II.—To make the result of I conclusive, let a comparison be made between such a stem and one made at the same time from the same metal but not used. This has never been done, so far as I know.

III.—Let a stem which has broken in service be examined as to its structure at other points than that of fracture.

IV.—Let such a stem be tested to ascertain whether, *at any point in it*, it is not possible to produce at will either granular or fibrous fracture by simply varying the means and method of fracture. This has never been done, so far as I know. Nor has Mr. Argall's claim, that such a granular fracture is very different from the "crystallized" fracture, ever been supported by the actual production and comparison of the two.

V.—Let any stem, new or old, used or unused, be tested as in IV. This has been done often with bars of iron or steel, and it has been proved that a granular or a fibrous fracture can be thus produced at will. But if there is anything peculiar about stamp-stems the experiment would show it. It has never been performed upon a stamp-stem, so far as I know.

It is such evidence as this that would convince doubters, and prove the crystalization-theory. That theory is now a fable, because such evidence in its support is wholly lacking. And it will never cease to *have been* a fable, because it was framed and held without evidence. It may, indeed, cease to *be* one, and become an acknowledged fact—when the necessary evidence is forthcoming, but not before.

SILVER LEAD MINING IN BRITISH COLUMBIA.

Contracts are being let to various packers and teamsters to bring ore to the Forks. The rates of hauling are low in many cases, some of the contractors not being familiar with the packing of ore down steep mountain trails filled with many feet of snow.

The concentrator which is being built on Carpenter creek will be completed and put in operation in the early spring.

A 1,600 pound sample of "Nonpareil" ore delivered at Three Forks this month went 640 ounces to the ton. The "Nonpareil" claim is in the Jackson basin, 25 miles from Kaslo.

Three car loads of machinery for the Pilot Bay smelter are at Nelson.

Shipments from the Alpha have averaged $105 to the ton, and high grade ore has been struck on two levels lately run.

A 50-ton concentrating plant has been shipped from Fraser & Chalmers, Chicago, to the Pilot Bay smelting works.

The development work on the Noble Five group of claims to date is as follows: There are two short tunnels in on the 'World's Fair,' but the main work is done on the ground of the 'Bonanza King.' The No. 1 tunnel has been run 204 feet on ore all the way. The depth beneath the surface at the breats of the tunnel is about 200 feet. Eighty feet from the mouth of this tunnel a winze has been sunk 50 feet to the middle drift. The middle drift itself, was run 100 feet in ore towards the face of the hill, and from that point an upraise made to the mouth of No. 1 tunnel. No. 2 tunnel is in 340 feet and for 300 feet they have been drifting on ore. At 145 feet in depth a raise has been made connecting with the middle tunnel. No. 3 tunnel is in 150 feet, with a raise to the surface of 110 feet for air. Only the smallest fraction of the immense quantity of ore in sight has been shipped as yet. The first shipments were made during the winter of 1893-4, and aggregated about 500 tons of an average value of $125, making during last winter an output of $72,500 gross. The highest grade shipment ever made from the Slocan country came from this mine. One carload was shipped of which the average return was 549 ounces to the ton in silver. Far below the Bonanza King a tunnel is being run on a fine chute of ore on the Noble Five. It is now in 60 feet and there is a considerable quantity of clean ore on the dump; not less than 50 tons. The amount of ore shipped this winter will depend very largely on what the railway facilities are. There is in the mine a large quantity of oxidized ore which cannot be concentrated, and is not sufficiently high grade to stand a long haul. It is possible that it may be shipped to the Golden Smelter. At present, the ore has to be rawhided from the mine to Cody creek, and then transferred by sleigh to Three Forks, from which it will be shipped by rail if the railroad runs, and it will.

A most remarkable sight on the Ruecau is the outcrop of solid ore on the surface. The galena is 8 feet 8 inches wide, and for that distance is solid and clean. The ledge has beeen traced for a few hundred feet and prospect holes dug on it. It shows up clean ore all the way, at the widest place about twelve inches. Part of it is clean galena mixed with seams of oxidized ore, which assays 900 ounces to the ton. The clean galena is said to average $50 a sack. There is some of the prettiest looking ruby silver ore on the ground that was ever seen. It is not by any means beyond the capacity of the Reucau to ship at least 600 tons of ore this winter, and the owners are preparing to ship all they can. The Reucau has the makings of a great mine in it. The upper tunnel is in 353½ feet. There has been continuous ore in this tunnel for 330 feet of its entire length. There is a raise from this tunnel of 65 feet, and 100 feet of the vein in length by 24 feet in height was stoped out last winter, and resulted in the shipment of about 80 tons of clean ore. In sinking, a very fine showing of ore was struck in the winze.

Byron N. White of the Slocan Star mine has contracted for the delivery of 1,000 tons of ore at Three Forks before the 1st day of January. The teams will begin to haul the ore on or about first of December and will haul 30 tons a day at least. The mine will ship not less than 3,000 tons if transportation facilities are available. But Byron White does not venture to figure ahead of the first of the year. The output of the Slocan district has been conservatively estimated at 10,000 tons; 1,800 from the Slocan Star and 1,000 from the Alpha, makes 25 per cent of that amount from two mines, with the Idaho, the Fisher Maiden, the Cumberland, the Mountain Chief, the Alamo, the Wonderland, the Noble Five, the Reucau, the Payne, and a number more to hear from.

ASBESTOS CLUB.

Mine Explosions Generated by Grahamite-Dust.

At the ordinery quarterly meeting of the Asbestos Club, held in their rooms, Black Lake, Que., on Thursday evening 8th inst., a paper on this subject was contributed by Mr. William Glenn,* Baltimore as follows:

"The Ritchie grahamite-mines of Ritchie county, West Virginia, were situated near the central part of the upper barren coal-measures of the Appalachian coal-field. The rocks of the region are shales and sandstones, which lie almost horizontal. They show no evidence whatever of containing carbonaceous ingredients, except that they enclose, at long intervals, thin veins of exceedingly impure coal.

The vein of grahamite is a straight and vertical fissure, which cuts downward across the horizontal strata of the rocks mentioned. It will be sufficient here to state that the fissure is about 4 feet wide, and that it was compactly and completely filled with the asphalt-like mineral first described by Prof. Leslie in 1863.† He regarded it as a mineral pitch or insipsated petroleum, which he called asphaltum. The name grahamite was proposed in 1865 by H. Wurtz,‡ who more fully considered and described the mineral. Both these writers together with Prof. Blake,§ who studied the body in 1890, maintain that it is a form of asphalt.

An accurate and comparatively full study of the mine was made in 1873 by Prof. W. M. Fontain, of the University of Virginia, who published his observations under the title "Notes on the West Virginia Asphaltum Deposit,"‖ thus further maintaining that grahamite is an asphalt.

Fig. 1. represents that part of the mine first to be considered. As no maps can now be had, the writer has been compelled to construct the sketch in part from material found in his leather copy-book and in part from memory; yet, so far as concerns the present purpose, it may be regarded as accurate. The figure represents a vertical section of the mine, and is in effect a view of the vertical vein with one side-wall removed, showing all the workings therein existing at the date presently to be mentioned.

The levels numbered 2, 4 and 6 represent workings made for removal of vein-matter when it was supposed that the proper way to mine the material was by means of a succession of such levels. The rooms lettered A B were the initial rooms, constructed when it was determined to mine by a method called by miners "standing breasts." In this method the miner stands upon the material he already has broken down, and attacks in turn that above his head. As all rocks occupy increased space when broken into smaller masses, it will be seen that the miner at work must soon nearly fill the space between the vein-matter over his head and that which he has mined already. To prevent this, the latter is removed at proper times and in necessary quantities. When a room is mined upward to its extreme height, then all its contents may be withdrawn. The details of the process do not pertain to this paper.

In the west mine (Fig. 1), on Feburary 9, 1871, room A had been completed and the material had been removed from it. Also, the communication between its bottom and level 4 had been closed, so that air could not be passed from the level through the room. Room B was being mined, and had attained about the condition indicated in the figure. Mining consisted simply in digging down the soft vein-matter by means of the exceedingly light pick used by bituminous coal-miners in Pensylvania and West Virginia.

The contractors for room B, believing they could blast out the grahamite cheaper than they could dig it, received permission to try the effects of powder. But the attempt failed, either because the charge was insignificant or because the powder failed to explode. The Dupont mine-powder used in this hole was contained in a paper cylinder 1¼ inches in diameter, in which it occupied 3 inches height. Two days after a second hole was prepared and charged with a similar cylinder containing 6 inches depth of powder. The position of this blast is shown at *a*, Fig. 1. The shot was fired at 3 p.m. of the date given, and immediately there occurred what was apparently a mine-explosion; such a disaster as is known among miners as a fire-damp explosion. For the size of the workings, it would have been judged unusually severe.

The first effect observed was, that so much of the pit-head structure (not shown in Fig. 1) as lay near the prolongation of level 4 had been demolished, A man who had been standing at that moment on the bridge leading from level 4 to the storage-bins, had disappeared, together with his mine-car. The latter had been driven almost horizontally for 90 feet, and there had been wrecked against the east hillside of the ravine of Mine Run. Even the cast-iron car-wheels had been broken by impact against soft earth, while the wooden car-body was little more than splinters. The man was driven 60 feet, when, by impact against a heavy tool-chest, he received injuries almost immediately fatal. "He was burned and blackened past recognition.'(1)

The effect was as if level 4 had been a great gun, out of which the man and car had been projected. So much of timber structures as lay near the line of fire had been swept away.

Before those near the pit-head had recovered from consternation, one of the men belonging to room B appeared at the portal of level 4. He was seriously burned and could tell no connected story. Upon his clothing and on his bare arms adhered more or less of what seemed half-burned coke, and some of this material was still aflame. His burns were fatal. His brother and partner was found under room D, or nearly so in level 4. This man survived, and was subsequently able to give a clear account of the incident up to the moment of his injuries.

The third and only remaining man in this level was 140 feet inside of room B, and was engaged in constructing the initial work of a room, such as is indicated at C, D, E, Fig. 1. When the explosion occurred, he came down into the level and walked along it to the open air. He had seen the reflection of a flame in the level, was aware of what had occurred, but was in nowise injured.

Two other men were driving the end of level 2, then 640 feet long. They had heard the sound of the explosion; their lamp-flames had nearly been extinguished by an air-wave; but otherwise they had nothing to relate.

The ravine of Mine Run, less than 100 feet wide, contained all the pit-head structures. Upon so much of them as lay near the prolongation of level 4, and upon the east hillside, there adhered a coating of coke. This was not only peculiar but striking and prominent. On all parts of the old storehouse left standing, and upon the hillside near the portal of level 3, there remains adhering, about a ¼-inch thick of cinder such as our mineral makes. The fire seems to have melted the mineral, thrown it from level 4 towards level 3, and left it a cinder sticking to every opposing

*The observations herein set forth were studied and discussed by the late P. G. Sauerwein, of Baltimore, who was the president of the Ritchie Company, together with the author, who was the manager of that company's mines and railway. As the more learned and able one of us cannot take part in this paper, the author alone must be held responsible.

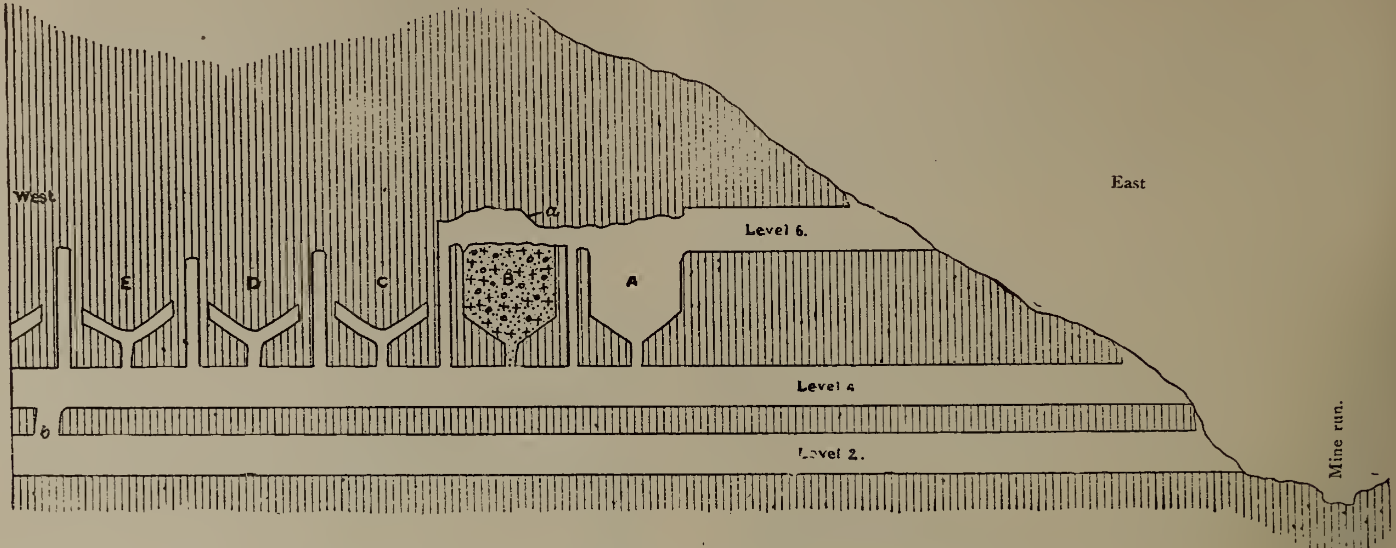
†Proc. Am. Phil. Soc. ix., 185.

‡Am. J. Sci., 1866, ii., xlii., 420; Proc. A. A. A. Sci. xviii., 124.

§Trans. xviii., 563.

‖Am. J. Sci., iii., vi., 409, 1873.

1 Report of the manager upon this explosion. It was written February 10th and contained abou four thousand words.



Vertical Section of the Ritchie Mine (West) as it existed February 9th, 1871.

Vertical Scale, $\frac{1}{375}$: Horizontal Scale, $\frac{1}{750}$

thing. To use again the illustration of the cannon: Imagine it (level 4) to have been loaded with melted mineral with which its discharge coated all opposing objects; then imagine the mineral to have charred after sticking fast."* It might be well to mention that grahamite is plastic while hot; upon cooling it again solidifies.

In comparison with what was to be observed about the pit-head, relatively small quantities of the half-coked grahamite were found adhering to objects within the mine. The coarse-grained, whitish sandstone forming the two walls of the mine was quite free of it, except at two points, namely, about the top part of the air-way next west of room B, and about the portal of level 4, where the walls were much blackened. The occurrence of this material within the mine was noticeable chiefly because of its exceeding peculiarity, and not because of its abundance.

We supposed that little vein-matter had been burned within the mine, because of lack of air there, and that the abundance of dust in level 4 had been swept along it to the portal, and there heated to the plastic state and thence projected by the explosion. As the material had been thrown forward along the projected axis of level 4, and not laterally as well, we were led to suppose that the explosion had occurred just without the portal, where the restraining side-walls were without a roof-covering.

The evidences were that the disturbance initiated in room B by the blast was propagated downward along the air-way next west of it, as shown by the coked vein-matter adhering along the air-way, chiefly about its upper part, as already stated. Having reached level 4 it extended itself westward along the level at least 30 feet, as proved by the severe burns received, as above narrated, by the two men there. But it did not extend 140 feet in that direction, because the flame was not evident to the miner working above and in plain view of the level there. He saw only the reflection of a light in the level, and heard the sound of an explosion. The principal extension of ignition was eastward, outward to the portal of level 4 where that explosion occurred.

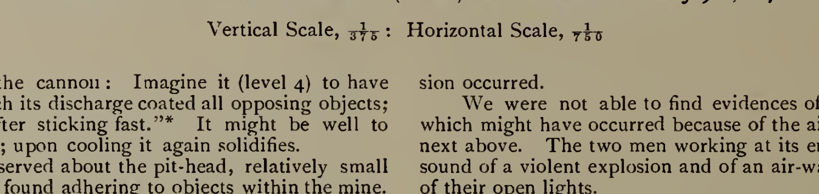
We were not able to find evidences of any ignition or of violent force in level 2, which might have occurred because of the air-way *b*, Fig. 1, between it and the level next above. The two men working at its end were conscious of nothing beyond the sound of a violent explosion and of an air-wave which nearly extinguished the flames of their open lights.

Nor could we learn of a commotion in any part of level 6; it exhibited no evidences of heat. Room A exhibited blackened walls at top, at least; but otherwise there was detected in it nothing unusual.

The impression entertained first and finally was, that gunpowder had been responsible for the accident. It was for this reason that its agency was promptly examined into. The magazine, a primitive structure, had been erected 1400 feet from the pit-head, and it stood intact after the explosion. The guardian of it was able to state that all the powder in or near the mine at that time had been contained in a tin tomato can which he described. We recovered this, and by his aid we determined that 18½ cubic inches of powder had disappeared out of it. The quantity was ridiculous as compared to the results we had witnessed. The report already cited contains this passage: "I have said to the men that the burning of the powder generated an explosive gas, which was driven out, mixed with air, and ignited." A supplementary report further stated in explanation: "Explosion of the powder pulverized a certain quantity of mineral, and in that state it was easiest decomposed. The mineral lying in the room B was slack, and every adjacent wall contained dust to be acted upon. The indications are that gas burned along all the air-passages and exploded at the portal."

The Ritchie mine above water-level was dry beyond all mines of which the writer has any knowledge. The only water which entered the part now under consideration

Fig. 2



Distorted Vertical Section of Ritchie Mine (East) as it existed February 25, 1873.

came after heavy rains through the roof of room A and through the adjoining part of the roof of room B. It was, in fact, surface-water, which found its way through the partly decomposed grahamite forming the backs of those workings.

It is also important to recall that the vein-matter was soft and friable, much reduced to dust in mining; and that it was pulverized in the levels by the traffic through them. Within the mine, all surfaces were abundantly coated with its dust, and the floors of the levels contained more than an inch in depth of it; and, of course, room B contained it in quantity, because it was nearly filled with the already mined vein-matter.

It may be said at once that so far we had not observed any indications of fire-damp (chiefly CH^4) within the mines. To quote once more from the report: "No fire-damp or choke-damp (CO^2) ever was detected in these mines, even when there was no ventilation; and the explosion began where ventilation was excellent. We have a level (No. 2) 600 feet long and no ventillation for it." An inspection of Fig. 1 will disclose that the air-currents flowed in through levels 2 and 4, then up the air-way next west of room B, then across both rooms and onward to and out of level 6. As February 9, 1871, was comparatively a cold day, ventilation then was all that could be desired. Moreover, we could not suppose that so light a gas as fire-damp could lie in room B, when at times water dripped from the natural surface into the east end of it, as well as into room A. Fissures which can convey water must readily permit the passage of a gas. We supposed that if fire-damp were present at all, necessarily it must have found lodgement in the small workings above the roof of level 4. These were ideal receptacles for it, and yet we had not found it there; we had not observed even so much as the lengthening of the naked lamp-flame of the miner who constructed them, or of that of the writer who visited them frequently. The tight end of level 2 was another good receptacle for the collection of fire-damp. If such had been present, we supposed it must have exhibited its presence any morning, after the quietude of a night in which to collect. But it had not done so.

Anticipating a little, it may here be said that fire-damp was first encountered in an inclined traffic-road (mine-slope) sunk subsequently, from the narrow ravine of Mine Run and under level 2. At about six fathoms vertically under water-level a blower was disclosed in the south wall of the slope. The gas was promptly ignited; but it soon ceased to burn. While the lower levels disclosed other gas-blowers, none of them were serious, and the gas was readily disposed of. It never became necessary to use safety-lamps.

It was rather a curious fact that gas was never observed to issue out of the vein-matter. Apparently, that was so compacted into the fissure that, practically, gas could not circulate through it.

In these damp lower levels, shots were frequently put into the side-walls because of the necessity of widening the roads. And even though fire-damp at times must have been present in some degree, yet no disaster ever followed.

Among the many surprises which grahamite offered, none were so striking as the peculiarity of combustion of the mineral and of its dust. When warmed over the flame of an open light, the mineral grew viscous, and then might be drawn out into a thread. Warmed yet more, it kindled into a dull and smoky flame, which burned until the mass became a smutty coke of slight tenacity. Dust which fell from one's hand about the flame of the lamp, created a halo of scintillations around the light. Yet more widely diffused and brilliant effects at times followed the falling of dust from one's clothing upon a flame.

*Report already cited.

Vein-matter mined in the rooms was permitted to slide from them into cars standing in the level below. More or less dense dust-clouds necessarily followed ; and when one of these clouds was sufficiently dense, if it then enveloped an open light, a flash followed. Several men were in this way burned ; but none seriously. Such flashes always produced watery blisters upon their victims. Glass lanterns offered a remedy ; but dust soon coated the glasses. Following the invariable ways of unrestrained miners, these car-loaders risked the danger of open lights. These they would place at a distance greater, as they supposed, than the dust-cloud would roll, and they would then open the chute and permit the grahamite to descend, almost flowing like water, from the room into the car below.

A few weeks after the explosion of February 9th, the writer stood near the car-loaders' lamps when a car was being loaded in level 4. He saw the dust-cloud extending unpleasantly near to the lamps, which stood upon the floor of the level, and observed it to roll onward until it reached a lamp full 30 feet distant from the column of falling grahamite. Immediately a flash followed, so brilliant and complete that one might have judged it due to gunpowder-dust disseminated through the air.

An unsuccessful attempt was made to recover the details of a grahamite dust-flash which occurred in the waters of New York harbor, perhaps in 1871. While a cargo was being discharged, a workman in the hold of the barge attempted to light his pipe by means of a match. Agitation of the grahamite had afforded the sufficiently dense dust cloud, and a flash resulted. The flash was reported to be unusually vigorous ; or more likely it was so regarded because the observers were unused to such occurrences.

The reader is now in possession of all information known to us as bearing upon the explosion of February 9th, and almost necessarily he must anticipate our conclusion as to its cause.

We are compelled to assume that the blast pulverized, and immediately decomposed into coke and inflammable gas, a great deal of the dry vein-matter ; these assumptions are imperative. The remainder follows easily from what is known of the behaviour of mixtures of marsh-gas and air.

The first effect was a burning of the air in room B, as proved by blackening of the side-walls and the adhesion to them of coke formed from the dust which had lain upon them. Expansion of heated gases could occur in two directions. Toward the open air there was but little fuel to feed the flame; and it ceased in level 6, because no dry dust was found there. Inward, every surface supplied its store of dust whereby ignition was led downward through the airway next west from room B. Once in level 4, the dust so abundant there was freely converted to gases which burned vigorously. After reaching and passing the two men 30 feet west of the airway, there was a cessation. We supposed it was due to the resistance of the air-cushion offered in that direction to the widely expanding gases. The line of least resistance was toward the open air, in which direction ignition was propagated to the portal of the level. The hot gases there encountered that abundance of air necessary to form with the mixtures which were explosive, and the result has been stated.

No explosion occurred within the mine, because the requisite volumes of air and gas were nowhere present. That is to say, there was at no point as much as eight volumes of air to one volume of explosive gas, if each had been measured at the same temperature.

Coke found within the mine was, of course, a product of destructive distillation, and it was the best of evidence as to what had occurred. Moreover, its abundance about the pit-head demonstrated that a great deal of grahamite dust had been swept along the level to the open air ; in a hot state it had been projected thence upon all opposing objects. The Executive Committee of the Company's Directory, of whom Mr. Enoch Pratt alone survives, attempted to find a remedy against the future occurrence of dust-explosions. They had the advantage of good advisers, among them Dr. D. K. Tuttle, a chemist, now of the United States Mint, at Philadelphia. But they could suggest nothing better than to dampen the dust by means of small jets of water thrown from pipes secured within the mine, a method suggested by the fire-protection pipes in the cotton-duck mills of Mr. William E. Hooper, at Woodberry, near Baltimore.

The precaution actually taken was to put no more blasts in the vein-matter, and to fire none in the side-walls, except when the mine contained no men. Even these precautions at length failed ; the east mine suffered an explosion which much injured it, and in connection with which four men assumed risks which cost them their lives.

Fig. 2 is a distorted diagram of a vertical section of the east mine, at February 25, 1873. There are no existing records from which a scale-drawing might be constructed ; and unfortunately the writer has not clear memories of the distances involved. However, we shall not be seriously in error if we accept these assumptions ; Distance between east and west portals of the two parts of the level, 1,800 feet, length of cavern in level, 3,350 feet, and height of it, 40 feet ; the distance from airway to the closed end of the level is important, perhaps, and yet the writer cannot recall what it was—it may have been 30 feet, or even somewhat more.

It should be stated, that the back of the east part of level 1 was mined-material, about 300 tons, which rested upon boards supported by timbers upheld by the two side-walls.

About the closed end of level 1, the road-way had to be widened by means of blasts in the side-walls. Shortly after 10 o'clock in the morning of the date last mentioned, a shot was ready to be fired there, near *e* of the figure.

Blasts were invariably charged and fired by the mine captain's helper, and nearly always they were discharged when the mine contained him only. But occasionally, as in this instance, when but few men were at work, noon or evening was not waited for, but those few men were notified to leave the mine while a shot was fired. So in this instance they were notified, and the notice was repeated. The two men who were mining down the back of level 3, about the point *g*, twice replied that they would take the risks of any accident. The car-loader in level 1 was ordered to leave, but instead of doing so concealed himself in some timbering (a battery) about the point *n* in the back of the level. All the above was learned later from the man who fired the shot. The four men mentioned were all who were at the time in the east mine.

After the captain's helper had ignited the fuse of the shot in the side-wall of the level near *e*, he walked east to about *s*, a point in the level at which the north side-wall had been cut away that cars might there pass each other. He passed under the car-loader who had concealed himself, and for whom he was on the lookout, but did not observe him.

A mine-explosion resulted, fully as violent as those which occur at fiery coal mines. Cars which had stood in level 1 were shot in complete wreck out of its portal, and onwards far into the valley of McFarland's Run. Some timbers took a similar course, notably an oak board which was driven through an irregular track and which landed at last upon the opposite hills of the valley, more than 500 feet distant from the level-portal.

In the ravine of Mine Run, at the portal of level 3, there was another explosion which did no little damage to the pit-head structures. At *c* a crater was formed, and from it were thrown what we judged to be 40 tons of earth and stone, A tree which had stood there was thrown at least 50 feet, and being a mountain hemlock of complete growth, it afforded some measure of the energy which had formed the crater. According to my present memories, the latter was 14 feet deep. Its figure was tha of an inverted flat cone.

The helper who fired the shot was found wandering in the level, burned and mentally deranged, but otherwise uninjured. During lucid intervals which preceded his death, he told us the story of the accident, as he alone knew it ; of his warnings to the men, and of his having seen the level filled with bluish flame as it approached him.

After several hours of labor, the car-loader was dug out from under a pile of hot vein-matter which had fallen into the level when its supporting timbers were swept away. The two men who had remained at *g*, level 3, bore no marks of injury whatever, no burns and no abrasions ; yet both of them had been killed. We judged they had died of asphyxia, or because of the pressure which had existed in the level at the moment the crater was formed.

The already-mined grahamite which had formed the back of level 1, had, in part, fallen into the level when its timber supports were swept away. It was ignited and it afforded a troublesome fire to deal with. By throwing upon it water from pipes led into the level, we were able to shovel it into cars and thus remove it from the mine.

The writer is aware that this second explosion may be explained by use of the theories now held of coal-mine explosions—that it was a result of fire-damp and dry-dust as well. There was a sort of gas-trap where ignition began, and, possibly, there was another in the roof of the cavern in level 3, even if surface water did drip at times through it. But, as fire-damp had not been observed, and as it was not essential to the explosion, it seems more rational to regard this as having been a dust-explosion simply.

In the paper published in 1873, and already cited, while relating the characteristics of grahamite, Professor Fontaine says :

"The fine dust produced by handling the mineral, is capable, when very dry, of inflaming from an open lamp. This has led to two accidents from explosion. The dry dust having caught fire in the lower levels, the gaseous products became mixed with air in the upper works and exploded."

This mention is but the briefest statement of bare fact ; yet it has this additional interest—it seems to have been the first printed announcement of a purely mine-dust explosion.

Nineteen years after the conclusions reached by us in the early summer of 1871, while reading in the library of the British Museum, the writer saw, for the first time the paper printed by Faraday and Lyell in Janurary, 1845.* It was a report made by them to the British government upon the Haswell collieries explosion of the year previous ; a report written in parts by each of them, as is clearly indicated in the text. Faraday wrote :

"In considering the extent of the fire for the moment of explosion, it is not to be supposed that fire-damp is its only fuel ; the coal-dust swept by the rush of wind and flame from the floor, roof and walls of the works would instantly take fire and burn, if there were oxygen enough in the air present to support its combustion."

They found upon the mine-timbering "coke gradually increasing in thickness," as they "neared the place of ignition ;" coke which, they believed, had resulted from partial combustion of coal-dust so abundant in the mine. The report continues :

"There is every reason to believe that much coal-gas was made from this dust in the very air of the mine itself by the flame of the fire-damp, which raised and swept it along ; and much of the carbon of this dust remained unburned only for want of air."

Thus Faraday announced what has come to our present belief regarding fire-damp explosions in coal-mines.

In a Royal Institution lecture,* Professor Abel took for his subject the dust-explosions which then had become so numerous in wheat and rice-mills. The lecturer stated that such explosions had, "prior to 1872, appeared enveloped in mystery, until their probable cause was indicated by an Austrian observer." Referring to the paper of Faraday and Lyell, printed in 1845, the lecturer continues, "ten years later, M. de Souich, an eminent French mining-engineer, published as original" work which sustained the deductions of those writers. Professor Abel added, "Later on M. de Souich extended his inquiries into the part played by coal-dust in mine-explosions.'

After an ordinarily diligent search, made in the library of the British Museum, and in the Peabody Library at Baltimore, the present writer must say, that he failed to find records of any work done by the Austrian observer of Abel, or of M. de Souich. Several recent writers mention both of them, but nobody has cited the places of their communications.

Phil. Mag., iii., xxvi., 16

Nature, xxvi., 19, given April, 1882.

The Blast Furnace.*

By E. C. Potter.

Raw iron, or "pig iron" as it is commonly called, is produced by deriving from iron ores (oxides of iron) the metallic iron they contain in their composition. Stated briefly, this is accomplished by exposing the ores to the chemical action of carbonic oxidide, formed by the combustion of coal or coke, which, by taking up the oxygen of the oxides of iron, leaves the metalic iron free. In addition to this, the earthly impurities of the ores have to be dealt with in a manner to be explained later.

The apparatus in which this process is carried on is known as a blast furnace, so called because the ordinary combustion of the fuel is augmented and accelerated by forcing into the furnace by mechanical means large volumes of air. This air, delivered into the furnace under high pressure, is known as "the blast." As indicated above, the materials to be dealt with in the operation, are, first, the ore ; second, the fuel, by whose combustion we obtain the active element in the reduction of the ore, carbonic oxide (this fuel is a more or less pure carbon in the shape of charcoal, coke or anthracite coal) ; third, a material technically called a "flux" is required, whose office is to remove the earthy impurities of the ores. For this purpose limestone is usually employed. The way in which this is accomplished is rather an intricate chemical reaction, but stated as simply as possible the action is as follows :—The principal earth associated with the ore is common clay, or silicate of aluminum, as it is chemically called. This material, as everyone knows, is qulte infusible, and hence impossible to remove by the mere application of heat. It is a chemical fact, however, that by the addition of lime to the silicate of aluminum, forming the double silicate of lime and aluminum, this double silicate being quite fusible and being lighter than the metallic iron floats upon its surface, and is thence drawn off in a manner to be indicated later.

This is, briefly, the office of the flux. These three materials together with the air blown into the furnace are all that are required to carry on the operation of smelting pig iron. I mention the air, as that is not by any means as insignificant a feature as would be at first imagined; for the actual weight of air blown per ton of iron produced is six or seven times the weight of the solid materials charged.

The blast furnace itself is a very large structure, circular in section, of a height varying from 60 ft. to 90 ft., and a largest diameter of about one-fourth the height. The contour of the interior is not that of a perfect cylinder, but from the point of largest diameter (technically called the "bosh" diameter) the walls are drawn in both upward and downward, so that at the bottom of the furnace the diameter is only about one-half the bosh diameter, and at the top about 30 per cent. smaller than the bosh. The lowest part of the furnace is called the "hearth" or "crucible," for it is here that the molten iron collects before being drawn off. The walls of the crucible are from 5 ft. to 6 ft. in height and usually perpendicular. From the top of the crucible walls the furnace slopes outward and upward till the bosh is reached. This whole section of the furnace is also known as the "boshes," and it is here that the actual fusion of the materials takes place. From the bosh up to the top the walls slope in again.

The materials, viz., ore, fuel and flux, are charged into the furnace by means of a mechanicism known as a "bell and hopper," which at the same time closes the top of the furnace. A heavy cast iron hopper is fitted over the top of the furnace, leaving an opening in its centre of about half the bosh diameter. This opening is closed by a heavy iron bell, lifted into position from the interior of the furnace so that the lower edge of the bell laps over the lower edge of the hopper on its under side for three or four inches. Thus when the bell is drawn up tightly against the hopper, the furnace is tightly closed even to the escape of gas. The materials are then dumped into the hopper until it is full, when the bell is then lowered by means of a mechanically actuated and balanced lever arm, so that a space of 15 in. to 20 in. is opened between the contact edge of the bell and the hopper, and through this space the materials slide over the sloping sides of the bell into the interior of the furnace. This bell shape is used for the purpose of obtaining an equal and uniform distribution of the materials over the area of the furnace, which would not be possible were the materials dumped into an ordinary opening. This uniform distribution in charging is very important to the uniform working of the furnace; for if the materials were all dumped into the centre or to one side, the ascending carbonic oxide gas, seeking the easiest way out, would but imperfectly act upon the great mass accumulated in one locality, and the furnace would work one-sided. The great height of the furnace is required in order to expose the ore for a sufficiently long time to the action of the carbonic oxide. The descent of the ore from the top to the bottom of the furnace occupies from 18 to 24 hours. On a level with the floor of the crucible, on the front side of the furnace, is the situated the "tapping hole." This hole pierces the wall of the furnace to its interior, and through it the molten iron is drawn out. The tapping hole leads directly into a trough which communicates with the casting beds. This hole is stopped up with clay during the time the iron is collecting in the crucible. Tapping takes place usually every six hours. About 3 ft. above the tapping hole and sometimes directly over it, sometimes to one side, is the slag tap or "cinder notch" as it is technically called. The slag formed by the flux, floating upon the surface of the iron, is here drawn off from time to time as it rises to its height. It is usually run directly into buggies or cars constructed for the purpose and hauled of to the cinder dump.

The blast is introduced into the furnace at the top of the crucible, about 5 ft. or 6 ft. above the floor. At six or eight equi-distant points in the circumfrence of the furnace wall openings are made into the interior of the furnace. Into these openings water-cooled "holders" of bronze or iron are fitted. Into these holders are accurately fitted the blast nozzles or "tuyeres," also water-cooled. The water-cooling is accomplished by casting a coil of pipe in the iron holder or tuyere, through which water is continually forced, or in the case of the bronze tuyere and holder the walls are made double, with a space between, in which water is kept circulating. At a sufficient height above the tuyeres a main blast pipe encircles the furnace, from which branches are let down to each tuyere. The tuyere nozzles are inserted from 6 in. to 10 in. beyond the inner wall into the furnace. The water-cooling of the tuyeres and holders, while designed primarily for their maintenance, aid much in preserving the brick work adjacent to them. Following up this hint, the bosh walls of the furnace are now greatly prolonged in life by inserting rows of water-cooled plates completely encircling the furnace at distances of about 30 in. between the rows. These are built in the brick work and are invisible, except the outside edge of the plate and the water connections. These plates are removable in case of leak, which is rare.

The accessories to the blast furnace proper are the boilers, blowing engines, hot blast stoves, hoists and water supply. The boilers and stoves are heated by waste gases from the furnace, so that the furnace is practically self-supporting in the matter of power, the only fuel necessary being that put into the furnace for the purpose of smelting. The furnace gases rise to the top of the furnace, and are thence conducted away by a large pipe called the "down-take," which carries the gases down to the main flue which lies underground. This flue conducts the gases to the boilers and stoves. The lower end of the down-take is enlarged just before it enters the flue into a chamber of considetable size known as the "dust-catcher," which name sufficiently describes its function. The gases carry with them considerable quantities of dust which accumulate in the flues, stoves and boilers, seriously impairing their effeciency by choking them. This the dust-catcher is designed to obviate. The boilers and blowing engines need little description, as they speak for themselves. The use and operation of the hot-blast stove is a subject of much interest, and to the furnaceman it is a very considerable factor in the furnace economy.

It is apparent that if air at the temperature of the surrounding atmosphere be blown into the furnace it will require a certain amount of fuel to bring it up to the temperature of the seething mass. If this air could be heated, and that, too, without further expenditure of fuel, before it is delivered into the furnace it is evident a considerable economy of smelting fuel must result. This is what is accomplished by the hot-blast stove. The waste gases of the furnace, which formerly were permitted to escape into the air, are by this apparatus utilized for the heating of the blast. Stoves as constructed nowadays consist of a large shell of tank plate enclosing a mass of fire-brick so disposed as to form a large number of small flues or checkerwork. Each stove measures from 15 ft. to 20 ft. in diameter, and 60 ft. to 70 ft. in height, being nearly as large as the blast furnace itself. A total cross-section area of, say 300 square feet is subdivided by the brickwork into a large number of small flues, of say, 40 square inches, thus multiplying the heating surface enormously. These flues are constructed perpendicularly. The gas is admitted at the bottom of one side into a chamber where it is mixed with the proper proportion of air to produce combustion; thus ignited it rises to the top of the stove, where it is deflected down again through a series of small flues. On reaching the bottom, it is deflected up again and then down, having traversed the height of the stove four times before it passes off by the chimney. The gas having been passed through the stove a sufficiently long time to bring the whole mass of brickwork to a bright red heat, it is then shut off and the blast from the blowing engines is then admitted on the opposite side of the stove from the gas, and is made to travel over the same path through the stove in the reverse direction. During its passage it absorbs the heat from the brickwork, raising its own temperature to from 1,200 to 1,500 deg. F. From the stove the air is then carried by the blast main directly to the tuyeres. There are usually three and sometimes four stoves attached to each furnace. Each stove is kept on gas for two hours and on air for one hour; three stoves, therefore, permit of two stoves being kept continually on gas and one on air, a stove being changed every hour. Of course before the blast is shut off of one stove it is admitted through a fresh one, as the blast must be kept continuously on the furnace.

Another valuable feature of the hot-blast stove is the fact that it places within the control of the furnace manager an amount of caloric or heat energy entirely subject to his manipulation; thus, if the furnace is disposed to work cold, an increase of temperature of the blast will usually act as a corrective, and *vice versa*. In the uniform production of a desired grade of iron, this is of the highest value. In this connection a very brief consideration of the chemistry of pig iron may not be out of place.

In recovering from the ore the iron it contains, we do not obtain that iron chemically pure, nor is it desirable that we should do so. We have seen how the earthy impurities were to a considerable extent removed, viz., the silicates of alumina, lime and whatever of magnesia there might be in the ore. But certain other elements, notably phosphorus and manganese, are not thus removed; nor are they ever completely removed, the second only partially, the first not at all. In addition to the impurities of the ores we are adding with the fuel, especially where coke is used, another lot of impurities, notably silica and sulphur. Silica, or silicic acid, as it is chemically called, being a compound of silicon and oxygen, is not capable of being decomposed into its constituent elements, silicon and oxygen, except at the very highest heat. Therefore out of the very large amount of silica in the form of silicates that is charged into the furnace, we find only a comparatively small proportion appearing in the pig iron as silicon, which has doubtless been decomposed in some areas of very high temperatures before the tuyeres. A portion of the sulphur is carried off in the slag, but enough remains to make a good deal of trouble to the pig iron consumer. In the resulting iron then, we find in addition to the metallic iron such impurities as silicon, sulphnr, phosphorus, manganese and carbon. The carbon in pig iron exists in two states, free carbon in the form of crystals or flakes and combined or dissolved carbon which has been taken up by the iron before the tuyeres. The proportions in which these two conditions of carbon exist in the pig iron depend upon the temperature of the furnace; if the furnace is hot, the carbon exists in very large percentage as free carbon or graphite; if the furnace is working cold, the carbon in the iron will be found largely as combined carbon with little graphite. So, too, as might be inferred from what was said before, a cold iron will contain little silicon as the temperature before the tuyeres has not been sufficient to decompose the silicic acid. The temperature also has a marked influence on the behavior of the sulphur. With the furnace working hot, it is nearly all carried off in the slag, but at lower temperatures its greater affinity for the iron asserts itself and a cold iron is found to contain an objectionable amount of sulphur. Cold iron, therefore, will be low in silicon, low in graphite carbon, and high in sulphur; for most purposes an undesirable combination. The value of the hot-blast stoves in enabling the furnace manager to correct the temperatures of his furnace is thus made plain.

The operations of the blast furnace are continuous until the fire brick lining wears out. This occurs in from two to three years under ordinary circumstances; or a better way of stating the life of the lining is that it will generally yield 125,000 to 150,000 tons of iron, though one or two of America's famous furnaces have turned out 300,000 and even 400,000 tons on a single lining. The management of a blast furnace, the proper mixing of the materials, the regulation of the working of the furnace itself for the production of a large, uniform and economical output calls for the highest skill, watchfulness, patience, and often courage. An accident to the furnace is almost always expensive and often dangerous; the apparatus is always operated under high pressure and the highest heats known to science. Altogether the management of a blast furnace presents a most intricate problem in economical metallurgy.

Cheaper Steel Rails.—A significant article on the steel rail trade appeared recently in the *Iron Age*. The opinion expressed is that the trade is on the eve of important improvemen.s and that new factors will have to be taken into account next year. The Youngstown mill now nearing ccmpletion, may enter the rail trade whenever there is a sufficient difference between billets and rails; and thre is the possibility of foreign rails being imported on the Gulf and the Pacific coast. The six great mills, however, may be able to hold their whole territory in spite of any rivals. One has made important important improvements in plant; another has secured a source of supply of cheap raw material; a third has the advantage of a lower duty on foreign ore; and a fourth is extremely aggressive in its management. There is a widespread opinion that lower prices for rails would help the billet market by increasing the consumption, and with present prices of raw materials the rail mills could afford to sell at lower prices than those ruling if they had a larger tonnage. But the financial condition of the railroads is such that the prospect of a tonnage up to anywhere near the capacity of the mills, is not bright.

CONDITIONS

OF

Obtaining Government Drill to Explore Mines or Mineral Lands.

Owners or lessees of mines or mineral lands in Ontario may procure the use of a Government Diamond Drill, subject to the provisions of the Rules and Regulations relating thereto, upon giving a bond for payment to the Treasurer of the Province, of costs and charges for (1) freight to location, (2) working expenses of drill, including labor, fuel and water, (3) loss or breakage of bits, core lifters and core shells, (4) wear or loss of diamonds, (5) other repairs of breakages and wear and tear of machinery at a rate per month to be estimated, and (6) an additional charge of $50 per month after the mine or land has been shown, through use of the drill, to be a valuable mineral property.

Of the aggregate of costs and charges above enumerated, excepting the sixth item, forty per cent. will be borne by the Bureau of Mines in 1894, thirty-five per cent. in 1895, thirty per cent. in 1896, and twenty-five per cent. in each year thereafter until the end of 1900. All accounts payable monthly.

For Rules and Regulations *in extenso* governing the use by companies and mine owners of Diamond Drills, or other information referring to their employment, application may be made to ARCHIBALD BLUE, Director of the Bureau of Mines, Toronto.

A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.

MINING LAWS OF ONTARIO.

ANY person may explore Crown Lands for minerals.

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Claims range from 10 to 20 acres on vein or lode.

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Rent of locations first year 60c. to $1 per acre, and subsequent years 15c. to 25c. per acre.

Rent of claims, $1 per acre each year.

Claims must be worked continuously.

Royalty on ores specified in the Act, 2 per cent. of value at pit's mouth less cost of labor and explosives.

Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.

Original discoverer of ore or mineral on claim entitled to stake out a second claim.

Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines.

TORONTO, May 25th, 1894.

Canadian Mining Review

Established 1882

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The Canadian Mining Review
Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Victoria Chambers, Ottawa.

VOL. XIII., No. 12 DECEMBER, 1894. VOL. XIII,, No. 12

The Broad Cove Coal Co.

After no inconsiderable difficulty, the result apparently of the care and discretion exercised in its distribution, we have been fortunate enough to obtain a perusal of the prospectus of this company issued from its head office, 70 Kilby St., Boston, Mass. Through the medium of this neat and nicely gotten up little phamphlet, Mr. Wm. Penn Hussey and his friends seek to induce the investing public to subscribe a small matter of $600,000, divided in equal proportions into 6% 1st mortgage bonds, preferred cumulative stock and common stock, in a coal area situated in Inverness County, Cape Breton Island. The pamphlet opens with a portrait of the great Mr. Hussey himself, the promoter in chief of the enterprise. Mr. Hussey, who is described as a coal merchant of Davensport, Mass., might be unknown to 999 out of every 1,000 investors, and it was, therefore, very thoughtful of him to adopt this way of making his features familiar to those to whom he offers such an unrivalled chance of getting rapidly rich. He would be the more readily recognized by residents in the vicinity of Broad Cove had he carelessly fingered in his hand, while being photographed, one or two of those $1,000 bills with which he sought to dazzle the simple country folk of Inverness during recent visits to their midst. Following his picture comes a map of North America, shewing the position of the company's mine and harbor, with steamship lines radiating from the latter to the principal ports of Canada and the United States. A study of this map. by people unacquainted with this part of the world, is calculated to leave the—no doubt desired—impression that, as a shipping point Broad Cove is easily first, with Sydney and other shipping ports in Cape Breton, simply nowhere. For instance, the distance from Broad Cove to Montreal is shewn by this map to be less than the distance from Sydney to Broad Cove! Ergo, what an overpowering advantage will Mr. Hussey's company possess over other mines, in supply-the principal market in Canada. The distance from Sydney to Broad Cove is represented by about eight hours steaming. From Broad Cove to Montreal, according to the Hussey map, it must be, say, seven hours steaming. It can thus at once be seen that Mr. Hussey's steamers can easily make at least two round trips per week as against one round trip in nine or ten days, which is the best that can be done at present from Sydney. Surely Mr. Hussey has made his estimate of cost of carriage to Montreal, 85c. per ton unnecessarily high.

Incidentally we may point out that the company's property (which consists, we understand, of 2 square miles) is painted in black on a pink ground and is made to dwarf into insignificance by comparison the whole adjacent island of Prince Edward! Fronting this remarkable map is an equally remarkable picture of Broad Cove Coal Mines and Harbor. By any one acquainted with the locality and with the piece of water, separated from the ocean by a strip of sand, and known as McIsaac's Lake, the rich humor of this picture of thriving industry will be readily appreciated, shewing as it does a steam tug towing two whaleback barges out of a snug harbor, upon whose sheltered waters lie other tugs and barges, with a few square-rigged sailing vessels scattered about.

Coming to the letter-press, our attention is at once arrested by the opening paragraph which pompously gives out that "The Queen of "England has leased this property to the Broad Cove Coal Company, "Limited, for a period of 80 years, with privilege of renewal, with a "royalty of ten cents per ton." Why! what has Mr. Fielding been up to again? This puts the lease of the Whitney Syndicate, for granting which he got such particular fits from his political opponents, altogether into the shade! It is true Mr. Whitney got a 99 years lease, as against Mr. Hussey's 80 years, but on the other hand, Mr. Hussey has privilege of renewal (for another 80 years?) and only pays 10 cents per ton as against 12½ cents paid by Mr. Whitney—verily, a greater than Whitney is here!

Perhaps, after all, it is unjust to lay upon Mr. Fieldings' shoulders the blame for this second shameful bartering away of the province's mineral wealth. Mr. Hussey has been to England, presumably upon business connected with this company, and while there, is it not conceivable that he obtained this concession directly from Her Gracious Majesty—perhaps letting her in "on the ground floor" as a quid pro quo? We really should like to know how Mr. Hussey came by this lease.

The quantity of coal possessed by the company is briefly given as over one hundred million tons. This is rather a large quantity for two square miles but then, we are told, they have 65 feet 10 inches of splendid coal (with or without interlying strata not mentioned) and, when further on, we learn that this coal can be mined for, at the outside, 50 cents per ton and freighted to any port in Canada you like for another 50c., it can at once be seen that here is a gilt-edged chance of knocking the Dominion Coal Company into smithereens and making millionaires in next to no time of Mr. Hussey and of any one who is lucky enough to have stock in the company allotted to him.

Then follow testimonials and reports from persons more or less competent to be quoted as authorities. The testimony here given is very favorable and we seek not to detract from the value thereof, merely remarking that every other company that has done business in the island, has possessed a small stock of equally favorable certificates among its archives. A collection of testimonials such as is here presented is rather calculated to produce "that tired feeling" to which allusion is made so frequently in a certain class of current literature. By the way, Mr. Hussey cleverly steals some thunder from the Dominion Coal Co. by quoting Mr. Revere, who is described as "the expert of the Whitney Syndicate" as responsible for the statement that "by the use of electric or compressed air-cutters coal can be mined "and shipped f. o. b. for less than fifty cents per ton." This brief dictum, of which we should imagine unauthorized use is made, is perhaps more valuable than a lengthy one from Mr. Wm. H. Wiswell, a "gentleman of high social and financial standing who was, we believe, one of the vendors of the property to whose opinion in that capacity and as County and City Treasurer of Halifax" is hardly worth the space accorded to it.

Leaving unnoticed, but for a smile in passing, the confident statement that Broad Cove coal can be placed alongside Boston at $1.88 per ton duty paid, as also the prospect held out to consumers of bituminous coal in New England of a saving to them, to be effected by the beneficent operations of this company, of no less a sum than $11,250,000 per annum, we finally come to what is perhaps the "bonne bouche" of this delectable prospectus, viz., the "estimated profits." The page devoted to the working out of these is calculated to rouse enthusiasm, even in the breast of Her Gracious Majesty, if, as we have already surmised, she has really been let in on the ground floor by Mr. Hussey. The receipts are based on an estimated shipment of 300,000 tons per annum, to be delivered at points left to the imagination (which at this stage should be equal to almost anything) at $3.60 per ton—not a cent less. Good business! Then follow the disbursements to be deducted. Mining and shipping are placed at 50 cents per ton, royalty, thanks to the special dicker with Her Gracious Majesty, only 10 cents per ton, freightage all round 50 cents per ton, (the method by which this average is arrived at is one of the most ingenious and at the same time most charmingly simple processes we have met with in our experience to date). Commissions, insurance, wear and tear, salaries and &c., are all rigorously deducted. $125,000 is laid by as a sinking fund for redeeming bonds, 6 per cent. is paid on $800,000 of bonds, 8 per cent. on $1,100,000 of preferred stock, no less than 30 per cent. on $1,100,000 of common stock, and yet, behold! a surplus of $81,000 yet remains as "undivided profits."—Ye Gods! was the like ever seen or heard? And this, Mr. Hussey is careful to point out, is regarded as "a conservative estimate" and he adds "this output can be easily doubled the second year"!

From the tenor of our foregoing remarks in notice of the Broad Cove Coal Company, our readers may have concluded that we don't "take much stock" in it. Well, honestly, whatever opinion we may have of their property (and we want it to be distinctly understood that we do not seek to impugn for a moment the value of their coal area, either as regards the quantity or quality of coal therein) we have a very poor opinion of their prospectus. From a great deal of silly bombast and fudge, some reliable truths can doubtless be picked, but the whole thing is an aggravation in style, so to speak, of Mr. Hussey's favorite habit of flourishing $500 and $1000 bills in the faces of the farmers of Inverness County—presumably as evidence of his limitless wealth. Both are very bad form. While we desire to encourage to the utmost legitimate enterprise in mining by whomsoever it may be started, we feel it our duty to raise our voice in protest against the use of any illegitimate means that may be taken to induce investors to embark their money in mining ventures, and we certainly think we are justified in using the term illegitimate in respect to this prospectus, which plays battledore and shuttlecock with millions, and which teems with reckless and misleading statements. When the Broad Cove Coal Company withdraws or modifies its Hussey pamphlet, we shall be glad to say and do all we can in favor of an interprise which, with proper handling, deserves and no doubt will command success.

The Coal Trade of Cumberland and Pictou Counties, N.S.

The record of the work done during the year 1894 shows that the business depression was more severely felt in these counties than in Cape Breton. The expansion, however, in the case of the latter county in the Montreal market being largely due to lower freights and improved terminal facilities. The sales of the companies during the past season were about as follows:—

Acadia Coal Co	205,000	tons.
Intercolonial Coal Co	212,000	"
Canada Coals and Railway Co	90,000	"
Cumberland Railway and Coal Co	410,000	"
Other mines	500	"
Total	917,500	"

The sales of Pictou and Cumberland mines for the year 1893 were:—

Nova Scotia	433,856	tons.
New Brunswick	204,932	"
Prince Edward Island	40,443	"
Quebec	238,507	"
United States	9,297	"
Total	927,035	"

The trade of these counties has been marked by no new features of special interest. The depression in iron-making and the general quietness in manufacturing lowered the demand for coal, but advantage was taken of the labor troubles in the United States to increase the shipments of coal in that direction.

The Intercolonial Coal Company sent 69,151 tons to Montreal, a slight decrease over the preceding year. The shipments of coal from the Springhill mines to the United States *via* Parrsboro amounted to about 40,000 tons, compared with about 8,000 tons during 1893. A few thousand tons were also shipped from Pictou to United States ports. Sales to other points present few features of interest.

The sales to New Brunswick and local sales felt the general lessened demand for coal for railway freight movements. St. John, Prince Edward Island, and all points purchasing Cumberland and Pictou coals were subjected to a competition on the part of the Dominion Coal Co. of a keener nature than was the case with the former Cape Breton collieries. This, while a disadvantage to the competing mines on account of reduced profits, correspondingly pleased the consumer. From the standpoint of a disinterested observer, competition between several companies for a market naturally secured against outsiders appears to be a most unbusinesslike proceeding. The fair price for a coal at any given point is readily deducible from the cost f. o. b., freight charges, and a reasonable profit. In a market taking, for instance, 100,000 tons a year any competing companies could readily agree upon a proportionate delivery at an agreed price, which would yield a reasonable profit and still supply consumers with a fuel at a rational price. However, the cheapening of freights will tell against the sales of Pictou coal in Halifax, and of Cumberland coal in St. John, unless the Intercolonial Railway can be induced to lower its present rates, which are excessive, between Pictou and Halifax, and capable of reduction between Springhill and St. John.

At the Acadia colliery the work of extracting the coal on the 3,000 feet lift was carried toward completion. The levels from the 4,000 feet landing are well advanced. It is proposed to raise the coal from the 4,000 to the 3,000 feet lift by means of a hoisting engine placed on the latter lift driven by compressed air. During the month of November the bank head took fire and was totally consumed, putting an end to hoisting coal for several months. The belt screen erected at the Foord pit some time ago will be utilized in the new bank head.

Thorburn.—Work at the Vale colliery has been dull during the year, and no points of interest are to be recorded.

In the Third seam work has been vigorously carried on and several connections have been made with the Cage Pit seam, and two tunnels are driving to the Main seam. The coal from all these seams will find an outlet at the Third seam slopes.

McGregor Pit.—In this mine the lift is now down 3,000 feet, and the workings placed in excellent condition. As a large amount of gas is given off in the new lift no explosives are used.

Intercolonial Colliery.—In the Main seam the operations of the year have been confined principally to the 3,600 feet lift. On the 4,000 feet lift levels have been driven preparatory to regular work. Arrangements have been made to re-open No. 4 slope, which commands a large area of coal in the eastern part of the area. It is expected that the coal within reach of this slope and the available pillars will serve to fill their orders for several years without calling upon the deep workings now being opened.

At the Scott pit, which it will be remembered was damaged by lightning igniting gas in it while it was standing idle last summer, repairs have been made, and work will be done in the way of development during the winter.

A little work was done on the East River Pottery seam during the spring.

In Cumberland County the Springhill mines maintained their output. The management have had the gratification of finding that their barge towage system has worked well during the winter between Parrsboro and St John, and has shown that Parrsboro is practically available as a winter shipment port.

In Nos 1 and 2 slopes the extraction of the pillars in the upper lifts has been carried almost to a finish, and before long the extraction of coal in these slopes will be carried on in a systematic manner. This desirable condition of affairs has been kept steadily in view for some time past, and its attainment will doubtless be felt in a reduction of haulage expenses, etc. In the north slope work has been regularly continued and a large amount of coal won. Improvements have been made in the airways, slopes, roads, etc., of all the mines, and everything possible done to meet the difficulties imposed by the angle of the seam, the pressure, etc.

At the Chignecto, Scotia, Maccan, and Minudie collieries a little work has been done, and a few hundred tons of coal mined. The Chignecto and Minudie mines will raise coal for local sales during the present winter.

Joggins Mines.—At this colliery the water has been removed from No. 1 slope in order to work the coal, which is said to improve to the westward. At No. 2 slope a return has been made again to the system of longwall. Some work has been done at No. 3 slope. New boilers and a new winding engine have been added to the plant. Improvements have been made which will facilitate the handling of the coal at the pit heads, and the wharf has been raised ten feet so that vessels can load at all stages of the tide. The improvement effected at this mine will enable it to materially increase its output during the coming season.

Coal Dust an Explosive Agent.

In a recent work by Donald M. D. Stuart, M.E., of Bristol, England, is given a minute discription of the Camerton Colliery in the district of Radstock, seven miles from Bath, and of an explosion that occurred there in November 1893. A special interest to coal miners generally centres in the latter for the district has been worked for 100 years, always with open lights, never found to give off inflammable gas, and explosions were unknown.

The exceptional conditions that led to the disaster are detailed, the roof of the main airway and hauling road had settled and was being brushed for height. A shot that was lightly stemmed in the stone, blew out, or as the miner expressively says "gunned" in the direction of a pile of dust on the roadside, and doubtless, as supposed by the author, caused a thick cloud of dust to rise, which the heat of the burning gunpowder flashed into flame. The resultant gases from the burnt dust expanded in both directions from the shot hole and in their course developed centres of maximum violence which revived and further extended the initial explosion. These centres the author styles as separate explosions and he explains them in a novel manner that commends the book to students of the subject. The explosion was propagated 279 yards with the air current, and 1278 yards against it, terminating when the ground was wet and damp.

In addition to a description of the pit and the explosion, the author gives extracts from the report of the Royal Commission, and refers to the writings of previous investigators; but this portion of his book is somewhat disappointing, although he expresses a hope that the observations and views his volume embodies will be found to contribute to a thorough (*sic*) understanding of the danger arising from coal dust in the working of a mine.

In the introduction it is stated the records of mining show that explosions cause greater destruction of life and property than any other class of accident; now Blue Books make it clear that the average loss of life by "falls of roof and sides" alone in British coal mines far exceeds the loss by explosions. In many years it has more than doubled. Issue has also to be taken with the statement in the preface that the Camerton explosion was the first in a non-gaseous mine, and again in the conclusion that "it is the only one which recorded observation has shown must have been due to the coal dust." Putting aside English explosions which have occurred in intake airways where not a trace of inflammable gas had been seen either before or after the explosion, there is the case of Pocahontas in Western Virginia, 1884, and the explosion in the Ritchie Grahamite mine fully described and discussed in our last issue (p. 229). Both as absolutely free of gas as Camerton. In fact it might be questioned, from all the proof supplied, whether Camerton is totally free. It is a new pit, rapidly opened at some depth, through faulted ground, shut in by latter geological systems and might well contain pockets of gas. The very general immunity of the district with a consequent want of practice in the detection of gas would unfit the miners to readily detect exceptional exudation of the absence of gas. A proof is offered, but it is not satisfactory, it is the position of the unfortunate victims on the intake side of the shot. Their open lights would furnish proof merely of the absence of more than five per cent. of gas. A careful series of tests, say by Shaw's machine, which our readers will remember detects one-tenth of a per cent., would be of course conclusive.

Exception is taken (page XVIII) to a dust explosion being considered analogous to an explosion of gunpowder in a very long cannon, and questions and answers touching this analogy are quoted from the Commissioner's Report, but it is evident the drift of the comparison has been missed by the author. The object of the artillerist being to avoid imparting to his explosive a detonating wave, but to find a powder that will take an appreciable length of time to explode grain by grain proportionate to the length of the cannon, and so impart a progressive impulse to the projectile.

Reference is also made (page XX) to dry dust taking fire in an intake airway without exploding as proof of the absence of danger. Illuminating gas issuing from a burner is lit time after time with perfect safety, because it is pure, but intimately mix it with air, an explosion follows. So with the dust, concentrated it burns but when disseminated in air in due proportions it explodes. The probability is that all other allied organic substances, when very fine and very dry will do the same. There is no mystery about it, given only the necessary conditions and an explosion will follow. There is this, however, it is not often that all the necessary conditions exist in a coal mine, and only in comparatively recent years has it been recognized that the required concatenation of circumstances may occasionally arise.

To avoid these exceptional occasions watering the coal dust has been proposed and the author very properly remarks that to make this precaution sure, the process must be effectively done; to simply dampen the dust and the danger would remain. It was evidently so at Spring Hill, Nova Scotia, where water was used but not in sufficient quantity to prevent the vaporisation of the water and the disturbance of the dust. We in Canada are deeply interested in this question for there is no doubt but that the primary explosions of gas in the Wellington, Spring Hill, Foord, Drummond and Sydney mines, would have proved comparatively harmless had dust not aggravated them.

How to avoid the danger due to dust is still a question, it is useless to talk of wetting thoroughly or removing the dust throughout a pit, all attempts at doing either are shams. The dust may be wetted thoroughly of course about each shot hole, but will it always be done? Probably not, and therefore it will be more efficacious to avoid the use of an explosion that supplies one of the conditions necessary to produce disaster from this cause. Gunpowder of all explosives used is the most to be dreaded, for not only does it generate a high temperature, but its so-called explosion is not a detonation with instantaneous decomposition, it is only a very rapid inflammation. Not so rapid either but that when a blown out shot occurs there are projected many unburnt grains mingled with the heated gases and dust of those that are first consumed and it is probably these unburnt grains that then igniting carry the inflammation into the mixture of dust and air aroused by the violence of the primary explosion in the unruptured shot hole, and so the inflammation is communicated to the dust so long as it is both dry and finely comminuted.

The Cape Breton Coal Trade, 1894.

The shipping season in Cape Breton is drawing rapidly to a close, and although, as we go to press, the steamers owned by the Dominion Coal Co. are still running from the mines to Halifax, Boston and Portland, another week or two will probably see the practical closing down of the shipping wharves until the opening of navigation in 1895. The new pier in Louisburg harbor has been under construction for a few weeks, and the railway is rapidly nearing completion, but it is not likely that the pier will be far enough advanced in construction to admit of vessels being loaded before other ports are open again.

The season of 1894, so far as the Dominion Coal Co. is concerned, has been remarkable rather for great activity in reconstruction and development than for anything extraordinary in the ordinary business of shipping coal. Not that there has been any falling off—on the contrary the total shipments from the company's piers for the year will show a comfortable increase of about 90,000 tons over the previous year, and thus a new "best on record" will have been established. At the same time, it cannot be denied that, as regards the quantity of coal shipped, the season has been something of a disappointment. This time last year it was confidently expected that the season of '94 would see a shipment from the company's mines of well over one million tons, but on the 31st instant the total will fall short of the seven figures by about 60,000 tons. Picnics and breakdowns must be blamed for this shortage. (N.B. By "breakdowns" we mean accidents to machinery, &c., and not the dancing, which is such a prominent feature at the picnics.) Putting the picnic scourge aside, there can be no doubt that the shipments would have easily topped the million, had one or two of the collieries, upon which such attention was bestowed last winter, done anything like as well as was anticipated, and it is, after all, a comforting reflection for those interested to console themselves with, that the failure to fulfil prophecies was due, not to a lack of demand for coal, but to unexpected difficulties and hindrances at the works; temporary difficulties which can and will be surmounted before another shipping season is upon us. The demand for coal has been unprecedented, and this too in the face of great depression in business generally the wide world over. Not only was the company unable to take full advantage of the demand for foreign coal in the United States in May and June, occasioned by the protracted labor troubles in that country, but they were also forced at quite an early period of the year, to cease booking orders in Montreal, so great had been the quantity of coal contracted for up to that time. This state of things carries with it great encouragement and hope of better times in the future.

The following list of shipments from the various piers is made up to the 30th November, and with it, for the purpose of comparison, we give the shipments at the corresponding date last year. It will be seen that a substantial increase is shown all round, save and except at the Caledonia mine, upon which so much money and skill were expended last winter and which was expected to show a clean pair of heels to the others in the race for first place

Colliery.	30 Nov.,'94.	30 Nov.,'93.
Caledonia	107,249	152,057
Glace Bay	137,117	113,712
Gowrie.	125,782	205,525
International	219,795	184,762
Reserve	193,071	161,636
Victoria	107,429	90,000

From the International pier are shipped the outputs of the International and Old Bridgeport Mines and also of the new shaft at "Dominion No. 1.," which is yet in a state of comparative infancy. The Gardener Mine, the coal from which was shipped at this pier, has been closed down and definitely abandoned. During November about 5,000 tons of Caledonia coal were hauled to Sydney and shipped at the International Pier, so that the shortage at Caledonia apparent from the above table of shipments, must be reduced by this quantity.

The International Pier itself is one of the chief points of interest on the company's works and has been quite a show place during the year. It was entirely rebuilt last winter of Georgia pine upon creosoted piles and is without a doubt the finest structure of the kind in Canada. A description of it has already been given in these columns, and reference has also been made to the hoisting and loading plant—entirely novel to the coal trade of this country—which has been erected upon it by the Ludlow Manufacturing Co., of Cleveland, O. Without going into a detailed description of this interesting machine, we may state briefly, for the benefit of those who have not seen it, that it is built of steel and consists of a tower revolving on an arch, which spans the width of the pier at a sufficient height to allow the rolling stock to pass underneath. The whole rests upon four four-wheeled trucks, by means of which it can be propelled up and down the wharf to any position desired. Thus, when a vessel has once been moored alongside no further shifting on its part is required, as the tower can be propelled from one hatch to another. The tower containing the boiler and the machinery, resembles a tea pot with a long spout. The spout in this case is the steel boom or derrick over which runs a steel rope with an hook attachment at the end. The latter takes hold of an iron tub (of 5½ tons capacity) which is loaded at the mines in the same way as an ordinary hopper and is brought in on a flat car—two tubs to a car. The tub is then hoisted a few feet and the tower and derrick with the suspended tub, revolve upon the arch until the tub is poised over the vessel's hatch; the tub is lowered as far down into the hold as is needful, and by a patent device worked by the engineer from the tower, the bottom of the tub, (which is cone shaped, like the bottom of a bottle) drops down a couple of feet or so and the coal quietly and easily runs out all round the tub. It can be at once seen that hereby a great saving of coal is effected as compared with the old method of shipping by "drops" or "shutes," and it can justly be claimed for this process that the run of mine coal shipped in this manner, will look as well in the hold of a vessel as screened coal shipped by the old fashioned methods just mentioned, of course there are drawbacks and perhaps the chief one so far encountered has been the comparative slowness with which coal is shipped. The plant was completed at too late a period in the year to admit of a thoroughly exhaustive test, but it is computed that 150 tons an hour is about as much as one tower can be relied upon to handle, using the 5 ton tubs. It is not yet known whether the management think sufficiently well of the plant to adopt it outright. If their verdict is favorable to it, they will probably place two towers on each side of the wharf (which is divided into two arms by the return track for empties running down the centre) and these four towers should be good for a shipment of 5,000 tons in the ten working hours, placing the capacity for each tower at 150 tons per hour, and deducting 1,000 tons for inevitable delays from one cause or another. Another drawback to the new plant is that it is only available for large vessels, *i.e.* for vessels with hatches large enough to admit of the tubs being lowered into them, but the disadvantage can be met by building another smaller wharf at which the lesser craft can be loaded from hoppers in the old way, or by loading.

them at the company's other piers in the harbor. An experiment is to be made with a ten ton tub, and as the labor and time consumed in handling would be practically the same, a great deal will be gained if the larger tub can be used.

But it is at and around the mines that the greatest amount of work has been done, and more particularly at Glace Bay, the centre of the company's works, and the head quarters of Mr. David McKeen, the resident manager. For anyone who knew Glace Bay a year ago and has not seen it since, the place has been altered and built up almost beyond recognition, of course the Dominion Company are responsible for most of the new buildings which comprise, among the most noteworthy erections, new general offices, railway station, freight sheds, machine shops, roundhouse, warehouses, houses for officials and miners houses. A lot of work has also been done around the Old "Roost" pit where the well known "Hub" seam is being re-opened. But apart from the buildings erected by the company, there has been a great general "boom" in the building line at Glace Bay, merchants and business men having recognized the fact that the town is destined within a very short time to occupy the foremost position in the country, from a business standpoint. Looked at merely from a residential point of view, it has no charms for us. It may thrive exceedingly and we hope it will be cheerful, but we fear it never, never can be beautiful.

And while Glace Bay has been growing apace, an entirely new town has sprung up within a few miles from it, at "Dominion No. 1," the new colliery which occupies a breezy and healthy position between the company's railway and Lingan Bay. It is separated only by the railway from Old Bridgeport, which is practically absorbed by it, the Old Bridgeport pit being evidently destined at an early date to form but an humble adjunct to its younger and more vigorous neighbour. A large number of very neat and comfortable miner's houses have been erected by the Rhode and Curry Company, of Amherst, and a novel feature has been introduced on the Old Bridgeport side in the shape of a "Miner's Hotel" or large boarding house, where men who do not reside permanently on the docks, can get comfortable accomodation on moderate terms. Space will not permit us to describe the buildings connected with the mine itself. Suffice it to say that "Dominion No. 1" is being equipped with the best and most efficient appliances for mining and hoisting coal in large quantities.

At the other collieries but little has been done in the way of further development and yet they have not only done well during the past year, but have done better than their more fancied neighbours, upon which such lavish expenditure had been made. A "*laudator tempori acti*" will no doubt indulge in many a chuckle and "I told you so" over this result, and it will be "nuts" to scoffers at new fangled notions to note that the good old Reserve (where an endless rope for hoisting from the slopes has been used with marked success) has the best record for steady work of all the company's mines and has shipped over 200,000 tons, a record beaten only by old Sydney Mines. But, perhaps, our old fashioned friends will be wise to wait another year or two to see what Caledonia and Dominion No. 1 are going to do when they really get into their stride, before committing themselves to a definite judgment in favor of the "good old ways."

We mentioned at the start that the railway to Louisburg was nearing completion. This important undertaking—the boldest stroke of all in the company's policy—has been actively prosecuted throughout the year under the able supervision of Mr. H. F. Donkin. The weather has been almost abnormally favorable to rapid progress and within a few weeks the company's through line, laid with 80-lb. steel rails, from Sydney Harbour *via* the collieries to the waters of historic old Louisburg, will be an accomplished fact. A regular daily passenger and freight service is carried on between Sydney and Port Morien (late Cow Bay), *via* Bridgeport and Glace Bay.

Before closing our very inadequate summary of the Dominion Coal Co.'s operations for the year just ending, it may not be altogether out of place to make brief mention of a too prominent feature which has gone a long way to mar a season that has been not without many encouraging and satisfactory signs of progress and enlightenment: we allude to the great increase in drunkenness and its attendant evils around the mines. If a sober calculation were made of what the workmen lost in earnings during the past year (to say nothing of the great loss of profits to the company) through the machinations of the rum fiends, who serve the devil by dispensing liquid poison to the miners, boys as well as men, it would stagger even people who have given this question much thought. It behooves the management to handle this growing evil with firmness and decision, and it likewise behooves the respectable majority of the workmen themselves to give a loyal and hearty support to efforts that may be made to subdue this hydra-headed enemy, which is sapping the moral and physical forces of the rising generation.

Having finished with the Dominion Coal Co. we turn for a moment to the old times and the old methods, and heartily congratulate the General Mining Association upon the splendid work they have accomplished at their Old Sydney mines. We understand their shipments for the year will total something like 220,000 tons, the best year they have ever had, and the best record ever made by an individual mine in the island. Working harmoniously side by side with their powerful rival, they show that able and economical management, working on the old, well-worn lines, has by no means lost its effectiveness. Arrangements have been made to improve their shipping facilities before next spring, and it will take the Dominion Coal Co. some time yet to "wipe the eye" of this conservative old corporation.

At the small colliery with the high-sounding name at New Campbellton, work on a small scale has been carried on with all the activity inseparable from the management of Mr. Burchell, and if he gets that 6-foot seam he is hunting for, oh, my!

EN PASSANT.

The REVIEW'S heartiest greeting and good wishes for a prosperous New Year to the mineral operators of the Dominion.

A thoroughly complete index to the present volume will be furnished our readers with next issue.

A liberal and attractive programme has been arranged for the meetings of the Ontario Mining Institute at Kingston on Thursday and Friday, 3rd and 4th prox. The papers down for consideration include "Nature's Concentration Works," by Prof. W. L. Goodwin, B.Sc., F.R.S.C.; "Boron, its detection in Minerals, and Uses," by Prof. W. Nichol, M.A.; "Gold in Ontario and its Associated Rocks and Minerals," by Dr. A. P. Coleman, Toronto; "Notes on the Glendower Iron Deposits," by Mr. Willet P. Miller, B.A.; "Typical Ontario Rocks" (illustrated by lantern microscopic views), by Mr. W. P. Miller; "Examples of Nature's concentration of valuable minerals," by Mr. T. L. Walker, M.A.; and one from Mr. Peter McKellar, F.G.S.A., Fort William the title of which has not been announced. The sessions will commence at eleven in the forenoon of each day and be concluded at the afternoon meeting on Friday, when in the evening the members will be entertained to a public dinner given by the citizens of the limestone city. As, by arrangement with the railways, specially reduced fares are available to members and their friends, a large attendance is expected. Anyone interested in the mineral development of Ontario will be cordially welcomed at all the meetings.

In the following week the General Mining Association of the Province of Quebec will inaugurate its fifth year with a series of meetings in the New Club Room, Windsor Hotel, Montreal, commencing on Wednesday, the 9th, at eleven o'clock. The contributors of papers include Dr. G. M. Dawson, C.M.G., who will have something of interest to say on the recent important developments in British Columbia placer mining; Dr. Ells, Ottawa; Mr. Burley Smith, M.E., Glen Almond; Mr. John J. Penhale, Black Lake; Mr. Dwight Brainerd, Montreal; Mr. S. L. Spafford, Capelton; Mr. George E. Drummond, Montreal; Dr. Robert Bell, Ottawa; Mr. John Hardman, Halifax; Mr. Jas. T. McCall, Montreal, and Capt. R. C. Adams, of Montreal. It has not yet been decided whether to hold a dinner or a smoking concert, but one or other will be held during the week. Members attending the meeting will have the privilege of reduced fares on the certificate plan by courtesy of the Quebec Central, Canada Atlantic, Grand Trunk and Canadian Pacific Railways. The meeting promises to be the largest and most successful in the history of the Association.

Since our figures of the coal deliveries to St. Lawrence ports were published, some additional shipments have been received which make the total returns up to the close of navigation as follows:—

Company.	Montreal.	Sorel.	Three Rivers.	Quebec.	Total.
G. Mining Association..	74,359	8,485	3,952	22,555	109,351
Dominion Coal Co.....	512,269	3,151	5,529	24,004	544,953
Intercolonial Coal Co...	69,151	....	....	....	69,151
Scotch, English, Welsh & American Bituminous	55,849	1,932	....	15,877	73,658
Total	711,628	13,568	9,481	62,436	797,113

Mr. John E. Hardman, S.B., President of the Mining Society of Nova Scotia, has been very ill at his home in Lowell, Mass., but is, we are glad to say, at last reports, making satisfactory progress towards recovery.

The Bureau of Mines Act has passed its second reading in the British Columbia Legislature. This measure provides for the establishment of a central office for information and instruction concerning the mining industries of that province. A museum of minerals, offices and lecture rooms, assay laboratory, appointment of a deputy minister of mines, examinations for efficiency in assaying, granting certificates to successful candidates, and the affiliation of Art and Science Societies with the Bureau. This is a higher commendable measure for which Col. Baker, M.P.P., deserves to be congratulated. There can be no question that British Columbia with her enormous areas of mineral wealth stands in need of the establishment of such an institution, inasmuch as the collation and dissemination of accurate official reports concerning the rapidly increasing mining industries will be of the greatest service in attracting capital. There seems to be, however, some difference of opinion as to the advisability of establishing now a *quasi* school of mines, at all events at Victoria. The better place would be at Kaslo with its working mines in the immediate vicinity, and its opportunities for gaining practical acquaintance with milling processes.

At a recent meeting of the Midland Counties Branch of the National Association of Colliery Managers, held at Nottingham, Mr. A. S. Douglas read a paper in which he gave the result of a series of observations on the working of a ventilating fan placed underground. Mr. Douglas said the experiments which he desired to explain were taken with a view of determining the advantages derived by the working of an auxiliary fan placed underground under ordinary conditions, working in conjunction with another fan of a larger type at the surface. The Hucknall Torkard No. 1 colliery, where both fans are working, is sunk to and works the top hard seam at a depth of 386 yards from the surface, reached by two shafts, in both of which coals are drawn. The downcast shaft is clear of any obstructions; a set of pipes, supplying steam to the underground hauling and fan engine, pass down the shaft, and the exhaust steam from both engines delivers into the same shaft a short distance from the bottom, the difference in temperature from this and other causes being 32 degrees. The whole of the workings of the pits, comprising three districts, named respectively the north, south and west, were, prior to May 1890, ventilated entirely by a Guibal fan In 1889 the working in the north district had progressed so rapidly that the fan was found to be incapable of producing a surplus amount of ventilation and as the workings had a considerable further distance to go, it was apparent that some means of increasing the supply to this particular district was required. After considerable thought it was decided to erect a fan underground at a point situated in the north main return. The fan erected was a double-inlet one of the Guibal type, and called the Walker Indestructible. Its dimensions are 15 feet by 4 feet, driven by a pair of 23 inch engines with a 3 feet-stroke. The power is conveyed from the engines to the fan through ten cotton ropes, the fan being geared 3¾ to 1. In May 1891 it was set to work to assist that on the surface, and since then both fans have been regularly running. Three experiments were made—(1) with the surface fan alone working; (2) with both fans working; (3) with the underground fan alone working. The experiments showed that the method worked with success. The amount of natural ventilation passing when both fans had been standing upwards of three hours was considerable, amounting in the whole of the pit to 36·226 cubic feet per minute, with a water guage in the surface ventilator drift of 75 inches.

In his report to the Home Secretary for 1893, the inspector of mines for the North Staffordshire district, England, says: The use of "safety" or so-called "flameless" explosives continues to increase in this district, by displacing gunpowder, those chiefly used being roburite and ammonite; trials being also made of ardeer powder and bellite. The water or gelatinous cartridge also continues in use, with geglignite and tonite. No case has come to knowledge of any injury received from the fumes produced by any of these explosives, and although inquiries have been made of the workmen in several of the pits, no complaint was heard on the subject. The wisdom of adopting those safer ex explosives (with electrical firing) in dusty or fiery pits is not to be doubted. The substitution of these safer explosives for gunpowder, coupled with the spreading conviction that coal dust is the most important factor in extensive colliery explosions, and that it may be the sole cause of such disasters, will have a marked effect in reducing the loss of life by explosions in coal mines.

At a recent meeting of the South Staffordshire Institute of Iron and Steel Managers Mr. J. W. Hall read a paper on "Conditions which Determine the Choice of a Steam Engine." He stated that the purchasers of engines were most apt to err in their choice under any given circumstances, either in paying too much attention to the first cost of the plant, to the exclusion of the other factors, or, less frequently, in considering nothing but the coal-bill. It was commonly taken for granted that a cheap engine meant a tolerably high fuel bill, and that to economize fuel a very costly engine was requisite. Did the cost begin and end with the engine there would be some reason for this view; but the engine and boiler must be regarded as one installation, and the cost of the whole as the basis of comparison. The higher the pressure of steam a boiler would supply, the higher was the economy of fuel it was possible to obtain from it, the limit of increased pressure being determined by prudential considerations of safety, of first cost, and wear and tear. The question of the best pressure to adopt was the first to be settled, as upon that everything else turned. The inclination to employ higher speeds, which, under suitable conditions, were also conducive to economy of fuel, was quite as noticeable as the tendency to work at high pressure; and now that most of the difficulties experienced in the earlier days—to which much of the prejudice still existing in many minds against high-speed engines was undoubtedly due—were successfully overcome by more suitable design and proportions, and the use of a better class of material, the original objections to them had entirely disappeared. No engine could be considered fit to run at high speeds which was not fitted with sight-feeds, or, at least, continuous or automatic lubrication, to every bearing, by which it could be constantly supplied with oil while running for days and nights together, without any necessity to stop for greasing; indeed, as much care and thought was now spent by the designer on the lubricating details as upon any other part of the machine. Experience proved conclusively that a compound engine was in all cases, at all pressures likely to be employed in these days, more economical in the use of steam than a single engine using the same pressure and number of expansions. During the last ten years a type of engine, formerly almost unknown, had become very common—that was the compound condensing engine, which, particularly for engines of small size, proved exceedingly economical. It was very commonly assumed that a compound engine having two cylinders was necessarily a costly one, but for given power it frequently was cheaper than a single cylinder; and, seeing that the amount of steam consumed was less, the boiler might obviously be smaller. There was another important advantage in compound engines—namely, the much smaller relative loss of efficiency due to leakage past pistons and valves when the engine was worn. When an engine was liable to a sudden temporary demand for power much in excess of its normal output, a single cylinder met the difficulty well, and with the lowest first cost; but anything approaching economy was impossible in this case unless an automatic cut-off was employed.

The editor of the Review was presented last month with a handsome silver mounted cabinet by Mr. Thos. J. Drummond, Sec.-Treas. of the Canada Iron Furnace Co., Montreal, on behalf of the Canadian iron companies, in recognition of services to the iron industry during the past year.

In a paper recently published in the Transactions of the American Society of Civil Engineers, Mr. G. A. Goodwin, A.M.I.C.E., sums up the comparative advantages of steam, hydraulic and electrical hoisting gear as follows: Steam requires the lowest initial outlay, and each crane being independent of the rest, a break-down at one point does not affect the whole system. New plant can also be added without trouble. Steam cranes are, however, much slower in working, and they require skilled drivers. The consumption of coal and water is considerable, and the cranes are noisy, whilst the working cost is higher than with either hydraulic or electric power. Hydraulic cranes have the advantage of being worked from a central station, so that there is but one set of boilers to fire, and the amount of fresh water required is saved. The cranes work twice as quickly as with steam, and for the same speed of lift the wear and tear is less than with electric power. One driver and stoker only are necessary, and cheap labor can be employed to work the cranes, though one skilled mechanic is necessary to look after the plant. The machinery is noiseless, and the cost of working is less than that of steam, but about the same as electric power, whilst its upkeep costs less than either of these systems Its initial cost is, however, much greater than steam, and a little more than electric power. Electric cranes have also the advantage of a central power station, the machinery works quickly, only one driver and stoker are required. Like the hydraulic system, the plant can stand idle with a minimum of loss, and the cranes are fairly noiseless in working. In the case of a breakdown, however, all the plant would be stopped, and the drivers have to be men of above average intelligence. The upkeep costs slightly more than in the case of hydraulic machinery.

At the monthly meeting of the Leeds Association of Engineers a paper was read by Mr. J. Clark Jefferson, A.R.S.M., Wh. Sc., on "Balancing the Load on Colliery Winding Engines." The most economical and perfectly developed type of steam engine, he said, was probably the marine engine. The very opposite was the case with most winding engines, owing to their intermittent action and the great alteration in the loads. The latter drawback was due to the variation in the lengths of the coiling and uncoiling ropes during the raising of coal, necessitating, in the case of shafts of comparatively modern depth, an engine of double the power to what would be required were the load even approximately uniform. The attempts to render it so divided themselves into two classes. First, those which aimed at an actual balancing of the weight of the rope; and second, those which varied the leverage of the engine during the course of the winding, to counteract the alteration due to the changing lengths of suspended rope. The former class comprised balance chains, balance weights suspended in staple pits, or hauled up and down straight or curved inclines, balance ropes, the tail rope and Koepke system. All these methods (although the balancing might be perfectly effected) possessed two disadvantages. The total weight to be moved being greater, the frictional and other resistances were increased, and the deteriorating effect on the winding rope near its junction with the cage necessitated its more frequent shortening and reduced the life of the rope. Meinicke's system, in which the balance rope is attached to auxiliary ropes, which are wound and unwound from a separate drum on the winding axle, obviated this difficulty, but required a larger amount of rope. This objection was more apparent than real, since discarded winding ropes could be used up as auxiliaries. The alteration of leverage was effected by using conical or spiral drums, instead of cylindrical ones. Some degree of compensation always took place where the load was raised by a flat rope, coiled upon itself. A probable reason why conical drums had only to a slight extent been used was that the principal of designing them had not been sufficiently known. The main point in their design was not in the proportion of diameter and breadth. These might be varied within very wide limits and still agree with the conditions of keeping the load uniform. This could only be ensured by preserving a proper ratio between the large and the small diameter of the drum, such ratio being dependent only on the respective weights of the cage empty corves, coal and the fully unwound rope.

Two pumps in the Short Mountain Colliery, in Pennsylvania, that have been buried beneath 60 feet of water for some weeks, were located recently by a professional diver, and one of them started. The company was so pressed with orders that it was compelled to do something at once to get the water out of the flooded shaft, and a diver was the only remedy. He put on his diver's suit and started down into the shaft. He was down but five minutes when he re-appeared at the surface staggering. In answer to questions, he stated that the water was at a temperature of 108°, compelling him to return after going down 20 feet. He was told that this temperature did not exist for any great distance, and went down a second time. In eleven minutes he came back, reporting that he could not find the pumps. He was instructed to go 10 feet farther down, and did so, locating the pumps. On the fourth and last trip he started one of the pumps to working, and put a weight on the wheel to prevent it from jarring shut. The other pump refused to work.

An account is given, in the *Australian Mining Standard*, of a plain endless ropeway lately installed at the Jumbunna colliery in the Gippsland district of Victoria for the haulage of coal from the mine tunnels to the railroad. The distance is one mile and the difference of elevation only 300 feet at terminals, with an up-grade to the railroad, but surveys showed that the construction of a branch railroad would have been so expensive as to be economically out of the question, on account of sharp curves and heavy grades over intervening country. The capacity of the line is 30 tons per hour. The case is interesting because of the selection of the plain single-rope system in preference to either of the more recently developed cableways.

The English Board of Trade has issued a new code of instructions to its surveyors regarding the surface ventilation of coal cargoes. The surveyors are enjoined to inspect the ventilator fittings in all coal-laden vessels, and should report any case in which they appear to be weak or improperly constructed, and all inefficient fittings should be replaced by those that are proper and efficient. The regulations prescribe that surface ventilators for coal-laden vessels should, whether placed on the upper deck, poop or forecastle, be made entirely of wrought iron, and should be fitted with cowls.

The Logan Club Dinner (Geol. Sur. of Can.) has beed postponed in respect to the lamented death of Sir John Thompson.

The second session of the Prospectors Course at the School of Mining, Kingston, will open on 8th prox.. and be continued for eight weeks. The attention of such of our readers as may be interested in in this work, or who may be disposed to take such a course, is directed to the following features of these excellent classes :

1. CHEMISTRY—A short course of lectures illustrated by experiments, introductory to the courses in mineralogy and assaying.—DR. GOODWIN.

2. MINERALOGY—Lectures illustrated by specimens, dealing with the general principles of mineralogy, and accompanied by practice in identifying minerals by field tests.—PROF. NICOL.

3. GEOLOGY—Lectures on the elements of geology, with illustrations from the geology of Ontario. *Ore deposits* will claim special attention.—MR. MILLER.

4. LITHOLOGY—The character and modes of occurrence of rocks generally—Examination of hand specimens—Special attention will be given to the crystalline rocks of Ontario, the most typical mineral-bearing rocks being well presented by specimens in the collection.—Mr. MILLER.

5. DISCOVERY AND WINNING OF ORES—This course will be of particular interest to mining men and prospectors, as it will deal with the application of the principles of chemistry, mechanics, mineralogy and geology to the discovery and winning of valueable minerals, and to the usual methods and machinery in vogue to open up the deposits and exploit and prepare the ore.—MR. HAMILTON MERRITT.

6. MILLING—The class will have opportunities of learning in the *mining laboratory* the use of crushers, stamp mills, and other machines.—MR. HAMILTON MERRITT.

7. BLOWPIPING—A practical course intended to give facility in the use of the blowpipe for the identification of minerals.—PROF. NICOL.

8. ASSAYING—Opportunities will be given for practice in furnace methods, particularly in the use of the portable assay furnace.—PROF. NICOL AND MR. WALKER.

9. DRAWING—The elements of mechanical and free-hand drawing as applied to urveys of mining claims and mines, to mining plant, &c.—MR. MASON.

10. ADVANCED WORK—Those who are prepared for such work may attend without charge) lectures on the *chemistry of fuels*, *ores*, *flvxes and furnaces*, and on *advanced mineralogy* and *geology*. Every facility will be given for work in the chemical, mineralogical, petrographical, and assay laboratories.

FEES—Every student must pay a registration fee of one dollars. For all the elementary courses (Nos. 1 to 8 inclusive) a fee of ten dollars will be charged ; for any one of them two dollars. Fees for the use of the laboratories for advanced work will be in proportion to the number of hours a week ; but not to exceed eight dollars.

OTHER EXPENSES—Good board can be had in the city at from $3 to $4 a week. The other items of expense (for books, &c.,) need not be large.

The annual report of the Division of Mineral Statistics and Mines for the year 1892, has been issued by the Geological Survey. As on previous occasions, we must complain of the extreme dilitoriness of this publication. Statistics must be issued promptly, to be of service to business people.

The Quebec Crown Lands Report just published, while containing much interesting information respecting the mining industries of that province, is very incomplete in the nature of statistics there being, for instance, no mention of the quantity of chromic iron mined, during the year, altogether about 1000 tons.

This is the day of small things in gold mining, pertinently remarks the London *Mining Journal*. A quarter of a century ago anything less than an ounce to the ton was usually regarded as unprofitable, unless the surroundings of the property worked were exceptionally favorable to cheap production. It was then a question of "How many ounces to the ton?" Now we ask, "How many pennyweights will it yield?" Of course, we are speaking of quartz mining, for in working large alluvial deposits, "pennyweights" to the load open up vistas of wealth which only distant—very distant—and inaccessible fields venture to promise. In placer mining the calculation of cents is indulged in, and one mine in New Zealand pays on a yield of a grain of gold to the yard. The cost of treatment averages 1½d. per load, and the other ½d. furnishes a handsome dividend to those interested in the property. Labor-saving machinery, the utilization of Nature's ample resources in the shape of water, the skill of the hydraulic engineer, the advance of science, and last, but not least, the application of careful business principles in the management of gold mines, have all tended to bring about these results. Many years ago the late Sir Warington Smyth ventured to predict that if the quartz reefs of Wales would yield 8oz. to the ton, they might with economical management be made to pay a substantial return on the money invested in their development, but Professor Crookes is well content with as many pennyweights, though his recent average at Cefn Coch has exceeded ½oz. to the ton. The Alaska Treadwell property mines, mills, and otherwise treats low grade ore at a cost of 6s. per ton, and another property, worked on a smaller scale with Huntington mills, finds a gold return of 2s. 6d. per ton profitable, the whole cost of mining, treatment and management being covered by 2s. 3½d. per ton. As we said at the commencement of our article, this is the day of small things, and as even with the greatly increased production there is still a dearth of gold, it would be well if the attention of miners and capitalists reverted to some of the fields long since discarded, but which, when worked under old conditions, failed to pay because they yielded only pennyweights and not ounces to the ton. The old-fashioned gold miner was a man in a hurry to be rich, and with little capital, and less skill, he was ever ready to discard one field, and betake himself to pastures new, in the hope that a few months' labor would enable him to spend the remainder of his days in that luxurious ease which wealth is supposed to ensure.

MICA MINING.

The Phosphate King Mine, situated on lot 15, west ½ Range VIII., in the town ship of Templeton, operated by the Lake Girard Mica Mining System, has been opene this year with gratifying success. The main shaft worked in 1891-92 for mica has been sunk further down to a depth of 65 feet in a solid deposit of phosphate, measuring in the bottom of the shaft 8 ft. wide. Since April this year 650 tons of pure phosphate have been taken out and sold to a Montreal concern. Perfect mica crystals are frequently met with in the vein and yield a fine commercial product. It is the intention of the system to sink the shaft further down and to test the vein body thoroughly. Twelve men are steadily employed. Prospecting work in the northern part of the property has resulted in finding different valuable outcrops. One of the recent discoveries shows a solid phosphate body measuring 20 ft. long and 4 ft. wide, and operations will commence here at once. The Wallingford's mine, on lot 16, west ½ in the 8th range of Templeton, continues to turn out large quantities of mica. The shaft is now about 100 ft. deep, and has been sunk entirely in a solid mica vein, which shows in the bottom of the shaft 9 ft. in width and is still increasing. A drift in about 70 ft. depth has laid bare the vein for 60 ft. and the latter is still continuous. Fifteen persons are employed. The bulk of the material cuts from 2 x 3 to 5 x 6 inches. The mica is being sold in a trimmed state to a Boston concern and to Mr. Franchot of Buckingham. The monthly output averaged 15 tons of trimmed mica sheets.

Forty men and boys are engaged cutting the mica from the old dumps of the Blackburn mine. The quantity and quality of the mica taken out is reported to be highly satisfactory. All the mica is sold to Mr. Franchot at Buckingham.

In the township of Hull the Vavassour Mining Association continues its successful operations on the old Gow mine. This property has been in operation for over three years, more or less actively, having produced a quantity of not less than 250 tons of merchantable mica. The mine consists of four main veins of calcite, pyroxene and phosphate, running in a north north-easterly direction, with a dip of 45° east. One of these has been followed for a distance of 1,200 ft. and the thickness varies from 2 to 3 ft. and from 12 to 15 ft. Considerable work has been done, consisting chiefly of an excavation of 200 ft. and shafts of 90 and 70 ft., with a gallery of 80 ft. The principal vein was opened for a length of over 300 or 400 ft. The work seems to be stopped in the shaft owing to the difficulty of extracting with a derrick, but will probably be resumed with a more suitable plant. At present a small vein is being worked, which is about 3 ft. thick, at a depth of 30 ft., very fine mica crystals being in sight. A shop has been put up at the mine for cleaning and drying the mica. Some phosphate has been taken out, about 250 tons being on the dumps.

At the Beaver Lake mine, sold recently to the Canadian Mica Company, a road 15 miles is being constructed to Escoumains, which will be in future the point of shipment.

The shipments of mica from 1st January to 30th November are reported by the collectors of customs to have been as follows at the following ports :—

Port of Ottawa,	to United States,	$21,790 ;	Europe,	*nil.*
" Montreal,	"	147 ;	"	$4,200.
" Quebec,	"	*nil ;*	"	120.

In the Saguenay district, the McGie mine (Block G) was worked all summer on a new deposit, and on the northeast part of the first workings, yielding a fair quantity of good mica.

Mr. John J. Penhale,
Black Lake, Quebec.
Supt. United Asbestos Co., President of the Asbestos Club.

COMPANIES.

The Anglo-American Gold and Platinum Hydraulic Mining Co., Ltd.—The officers of this company are: J. Barnet MacLaren, New Westminster, *President;* Capt. S. F. Scott, Vancouver, *Vice-President and Managing Director;* G. D. Mackay, Vancouver, and Capt. R. Hughes, Vancouver, *Trustees.* The property comprises four claims on the south fork of the Similkameen river, Yale district, B. C. The result of recent prospecting shows the average value of the gravel to be 27½ cents per cubic yard; the value of the platinum more than 6½ cents per cubic yard. There is an ample supply of water, and work will be prosecuted vigorously next season.

Acadia Coal Co., Ltd.—Reporting on the operations of the year, Mr. H. S. Poole, M.A., A.R.S.M., General Manager, writes: "At the Albion Colliery entry was made into the rise Foord pit workings, looking to a separation of the crop fires, which cannot be extinguished, and the drowned deep workings. Progress was made, but work had to be postponed, the unavoidable admission of air stimulating combustion. Stone drifts 400 feet long were driven across from the deep to the main seam, and deeps driven in the deep seam to open up ground to the west of the abandoned workings. Arrangements are making to operate here by endless rope. In the McGregor seam the slopes have been sunk 600 feet, and a new lift is being won out. Total length, 2,807 feet. For steam generation the new form of Stirling boiler carrying high pressure has given satisfaction. For cleaning the coal at the slopes a picking belt is in operation, and the slack is conveyed to a bin from whence it can be drawn off, as required, by a Jeffrey's rope conveyor. No changes were made at the Yale colliery, the bottom of the basin having been reached. At the Acadia colliery air was substituted for steam in pumping from the lowest, the 9th lift, to the 6th lift, where the main steam pump is placed. Experience confirmed the advisability of substituting the modified longwall system of working the seam at the depth attained for the old plan of bord and pillar." To replace the works destroyed by fire on 20th ultimo a more modern screening arrangement will be erected at this colliery.

Intercolonial Coal Co., Ltd.—Respecting the past season's operations at the Drummond Colliery, Mr. C. Fergie, M.E., General Manager, reports: "Our surface extras consist so far of a new locomotive, the 'Henry Budden,' being a six-wheeled coupled Mogul Forney. Weight in running order, 60 tons. Dia. of cylinders, 17 inches; stroke, 24 inches. This engine is fitted with steam brake and the latest improvements in construction. To meet the requirements of ventilation of our present seam and provide for the opening out of our underlying seams a new 'Indestructible' ventilating fan is being erected with a ventilating capacity of 200,000 cubic feet per minute. Size of fan 18 feet dia. by 6 feet. Rope driving gear. Engines for driving fan are of the compound expansive cut-off type. High pressure cylinder, 17 inches dia.; low pressure cylinder, 23 inches dia. Engines constructed to work independently of each other, and in case of accident without stopping the fan. More mechanical labor saving appliances having been introduced it was found necessary to erect two more boilers; these are of the Stirling water tube safety type. Two of this class have been erected with a passive power of 300 horse. We are now about to erect a new mechanical screen, complete with picking belt, patent tippler, etc., capable of handling 600 tons per day. To meet the pumping requirements underground a Northey compound condensing, duplex, plunger pump has been erected at the 4,000 feet level with a capacity of 80,000 gallons, throwing a vertical distance of 600 feet. To further increase the already many precautions taken with our miners' safety lamps and principally to protect them in very high currents a new small air compressor has been erected in the lamp room; to this compressor a ½-inch pipe is connected, arranged so that by opening a foot valve the glass and joints are subjected to a pressure of 30 lbs. per square inch. In case of any defect the lamp is immediately extinguished. This same compressor also supplies air for cleaning the gauzes of dust. To meet the extensive requirements two reservoirs have also been built capable of containing from five to seven million gallons. Underground everything is very favorable for an extended output whenever required. To reduce the cost in handling underground and meet the requirements of a larger output in one section of the mine we have substituted a system of steam haulage for the ordinary 'back balance,' running a trip of six boxes each journey. The output for present year will probably reach 230,000 tons. For the future our new works, levels, etc., are all well advanced, and only need a brisk demand to far exceed any of our past years in the matter of output."

Canadian Copper Co., Ltd.—Official returns furnished by the head office show that this company's mines produced up to 1st December about 400,000 tons of smelting ore and 41,600 tons of matte, which is equivalent to 7,638 tons of nickel.

The Montreal and British Columbia Prospecting and Promoting Co., Ltd.—Registered at Victoria, B.C. Authorized capital, $20,000, in 4,000 shares of $5. Head office, Vancouver, B.C. The trustees are J. M. Browning, F. C. Innes, and S. O. Richards. Operations are to be carried on in British Columbia.

H. W. McNeill Co., Ltd.—During the year ended 1st June last this company raised 65,000 tons.

New Vancouver Coal Mining and Land Co., Ltd.—In the report to the shareholders under date of 20th ulto., the directors report for the six months ended 30th June last as follows: "The net output for the half year was 176,100 tons and the sales 175,600 tons. Prices have continued to rule exceedingly low, and trade continues dull." An interim dividend, payable on 26th inst., of £2 per cent., was declared.

General Phosphate Corporation, Ltd.—A shareholder writing from London under date of 19th inst. says: "The General Phosphate Corporation business is not by any means buried yet, and I shall probably be able to send you some spicy bits shortly. Sando's examination in bankrupty takes place soon, and expect there will be something interesting."

The Canada Iron Furnace Co., Ltd.—The output of this company for the past year has been: Ore raised, 20,648 tons (short); charcoal made, 756,000 bushels; charcoal iron manufactured, 7,900 tons of a value of $190,000; ore charged, 17,500 tons; fuel charged, 750,000 bushels; flux charged, 1,750 tons. 600 persons employed in all the various operations of the company.

Prince Albert Flat Hydraulic Mining Co., Ltd.—During the season this company completed an open cut 500 ft. long and 50 ft. deep to a supposed back channel of the Fraser river. Equipped with latest hydraulic plant. Ground averages 20 cents per cubic yard. Now closed for winter.

The Drury Nickel Co., Ltd.—The sale of this company's lands, machinery and mining property advertised to take place at Sudbury on 5th September, was not consummated, as the reserve bid was not reached.

Tilt Cove Copper Co., Ltd.—At the annual general meeting of shareholders held in London, E., on 28th ulto., the accounts of the working of the east mine at Tilt Cove, Newfoundland, showed that the value of the ores and regulus won during the year amounted to £73,028 0 11d., and the mining costs £20,545 9 10d.; smelting, £32,029 15 7d.; freight, insurance and Swansea charges, £20,278 15 2d.; leaving a profit balance of £174 0 4d. The revenue and expenditure for the year, however, shows a debit balance of £36,408 4 1d.

British Columbia Coal, Petroleum and Mineral Co., Ltd.—The directors of this company for the ensuing year are: Lt.-Col. Baker, M.P.P., *President;* Col. E. G. Prior, M.P., *Vice-President;* B. W. Pearse, A. W. Vowell, F. B. Pemberton, W. Fernie, W. Hanson and J. A. Gemmill. The company owns 11,169 acres of coal lands near Martin and Morrisey Creeks in the East Kootenay district, B.C. On the easternmost property, near Martin Creek, containing 3,969 acres, there are fifteen seams of coal, four of which are a very valuable cannel or gas coal. The remaining seams are bituminous and admirably adapted for coking. The importance of this coal field will be greatly enhanced by the completion of the line of railway surveyed by the Canadian Pacific Railway through the Crow's Nest Pass, and in view of the connection of the mines with the great silver-lead country of the Slocan. Up to 1st Dec. this year about $65,000 have been spent on preliminary development.

The Baltimore Coal Mining and Railway Co., of Albert County, N.B.—Some time ago we published a notice of the incorporation of this company under the statutes of New Brunswick. The area controlled by the company is 640 acres by license to work, and 2,560 acres by license to search, which in time will be converted into a lease, covering such area of the above as the company may direct. Mr. Wm. Hall, M.E., formerly of the Springhill collieries, reports the various seams to be of a thickness of 5 ft., 4 ft., 4½ ft., 20 ft. and 21 ft. respectively. The officers of the company are Mr. Charles Archibald, *President;* Mr. W. F. Workman, *Secretary*, and Alex. L. Wright, *Treasurer.*

Tulameen Hydraulic and Improvement Co., Ltd.—In consequence of several propositions to purchase the properties of this company on the Tulameen river, B.C., all work in 1894 was delayed and held over until the mining season closed. It is expected that before next season the future ownership of the mines will be arranged and work recommenced either by the present company or one of the companies in treaty with it.

Low Point, Barrasois and Lingan Mining Co., Ltd.—This English company, practically a branch of the General Mining Aseociation of London (Ltd.), is reported to have made another sale of its property to the Dominion Coal Co. The latest deal comprises property at New Victoria, C.B., and the price paid is said to be $10,000.

Bothwell and London Crude Oil and Tanking Co., Ltd.—This company, having failed to find oil in paying quantity, has suspended operations.

Quesnelle Quartz Mining Co.—At a meeting of shareholders held at Quesnelle, B.C., on 29th ulto., a proposition to give a syndicate a half interest in the Hixon Creek mine on condition that $100,000 were spent on the property was submitted and adopted. The intention is to work the ore by the cyanide process, tests having demonstrated that 95 per cent. of the gold can be saved by that method. It is expected that arrangements will be concluded during the winter and that the new company will be organized and ready to begin operations next summer.

The Victoria Hydraulic Mining Co.—This company has constructed 8 miles of ditching, erected a sawmill and put in 3,500 ft. of steel pipe, with monitors, etc., at Keithley, B.C., the total expenditure on the property to date being about $65,000. The mines have practically been sold out to the Victoria Hydraulic Consolidated Co., now applying for a special charter of incorporation from the Provincial Government. The principals of the new concern are Messrs. McKenzie and Cox, of Toronto, D. D. Mann and T. G. Holt, of Montreal, and Wm. Wilson, of Victoria. Work on a large scale will be pushed in 1895.

The Pictou Development and Mining Co., Ltd.—The gold mining property of this company at Renfrew, N.S., is under option of sale to an American syndicate.

Victoria Gypsum Mining and Manufacturing Co., Ltd.—The new board of directors of this company are: W. Gibson, Williamsport, Pa., *President;* Jas. C. Pender, Chester, Pa., *Treasurer;* W. F. McCurdy, Baddeck, C.B., *Resident Manager;* Hon. G. G. Hubbard, Washington, and H. P. Blanchard, Baddeck, *Secretary.* In 1893 and 1894 about 28,000 tons of gypsum of excellent quality were shipped.

Kootenay Hydraulic Mining Co.—At a recent meeting of the shareholders held at Nelson, B.C., J. F. Ritchie was elected president; R. J. Bealey, vice-president; G. W. Richardson, secretary-treasurer, and J. Elliott and F. M. McLeod, directors.

Wentworth Gypsum Company.—This company has recently purchased from the Canadian General Electric Co., Toronto, two electric drills and the necessary dynamos for working them. One drill is for soft plaster and is rotary; with it and one man to tend it a hole can be drilled at the rate of two feet in less than a minute. With the motor it weighs 150 pounds and is very convenient and simple. The other is a percussion drill for hard plaster, and is an improvement on the steam drill previously used. The company is also to erect two cable lifts, each 1,000 feet long and capable of supporting six tons. These will carry the plaster from the different places where it is carried to the cars which will greatly facilitate the work. The length of the cables will convey to any, who have not visited them, a comprehensive idea of the extent of the quarries worked by the company.

The Ontario Peat Fuel Co., Ltd.—The experiments with the Dickson peat fuel plant conducted during the past year by this company have proved eminently satisfactory. The methods heretofore adopted have either been simply cutting and drying the raw material, or by using extreme heat in the process of manufacture. Both plans have not succeeded, the first by reason of the light, loose and bulky nature of the article, and the second because the volatile oils of the peat, which give it real value, were dissipated by the heat, and the fuel was, it is claimed, thereby rendered almost useless. Moreover the process of manufacture was very slow and therefore expensive. The machine which Mr. Dickson has patented completes its work within a few minutes from the time the raw material is taken from the bog, produces the finished article at the rate of two tons per hour and without the application of heat. The peat is pressed to a density practically the same as anthracite coal. Its heating qualities have been amply demonstrated by comparative tests of peat and anthracite egg made by the Abell Engine Works, Toronto, running a 200 horse power engine and all the machinery in a large shop. The supreme advantage, however, of peat fuel is its adaptability for domestic purposes. It lasts longer than bituminous coal, makes a bright, warm fire, is perfectly clean, leaves but a small percentage of ash, and it makes neither dust, soot, smoke or clinkers. It is absolutely free from sulphur and will cost in all probability much less than coal. The property acquired in the County of Welland contains about 5,000 acres, for which the company pays the sum of $1,530 per annum for 15 years and thereafter a rental of 25 cents per acre. Peat moss covers the whole area to a depth of about 2 feet, and the company has already cut from an area of about 3 acres something like 2,000 tons. This moss litter is of a very superior quality for stable bedding, and we understand a contract has been made with an American firm to purchase not less than 1,000 tons for the first year and to increase the purchase thereafter by not less than 5,000 tons annually. The price agreed upon is reported to be not less than $4.00 per ton delivered at the company's works for all shipments made eastward, and $5.00 for shipments to Buffalo and westward. This company, it may be said, have expressed the belief that they will require 25,000 tons the first year, and a large quantity each successive year. It is worthy of remark that the Welland marsh was thoroughly drained by the Ontario Government at great expense some thirty years ago, so that the moss is perfectly dry. The company has equipped the works with an expensive plant and arrangements have been made for immediate railway connection with the works.

American Gold Mining Co.—This company's operations in the Chaudiere, Que., were somewhat hindered this year by scarcity of water, but what washing was done gave very satisfactory results. It is the intention to open out a large tract of gold territory next season.

New Brunswick Brown Stone Co., Ltd.—The organization of this company has not been completed and the business is carried on by Messrs Wm. Clarke & Co. In 1894 about 30,000 tons were raised of a value of $30,000, a considerable portion being shipped to Toronto for the new city buildings.

Blue Lead Hydraulic Co., Ltd.—No work was done in the past season on Hixon Creek, B.C., but may be resumed next season.

Fraser River Mining and Dredging Co., Ltd.—Forty men have been employed during the past season on this company's claims in the Yale and Lillooet districts, B.C. The plant in use comprises a clam-shell dredge assisted by powerful centrifugal pumps, used to raise the finer material, such as sand and gravel containing the gold, while the dredge is used to raise the heavier material. On the bow of a scow, 130 ft. long by 30 ft. wide and 7 ft. deep, built for greater security with water-tight compartments, is laid a pair of steel rails firmly bolted on to the deck, the bolts passing through the kelsons on the bottom. On these rails on eight wheels hauls an immense carriage made of steel beams which, by a worm gearing, can be locked and held fast at any desired point, a series of counterweights holding it from tipping up as some might think it would. On top of this carriage rests a large cast-iron turntable 13 feet in diameter, firmly bolted to the carriage, and on this, mounted on six bevelled wheels, is a platform. On this platform are two immense drums which carry the chains which pass up and over the top of a 45-foot boom, from which depends the clam-shell buckets, the latter having a capacity of a yard and a half. The clam-shell is divided into four quarters, and when it is lowered down to the bottom of the river it is covering a space of about four feet. By an arrangement of poles an additional force is given to it, so that it always goes down straight into the water and as soon as the raising chains are tightened the four quarters come together with a pressure of five tons, thus gathering everything together within its radius and bringing it to the surface. Of course it is worked by steam, the power being supplied by a 200 h. p. boiler, situated about the middle of the boat, the power or steam being admitted to the centre of the plant above described. About the centre of the boat is a large 8-inch rotary pump, which pumps sand and gravel up to 6 inches in diameter at the rate of about 30 feet per second. To this is connected a suction hose, having the same diameter, which traverses the side of the scow under water and passes out to the bow, where it goes down vertically into the water. Some idea of the magnitude of the plant may be gathered when it is stated that the weight of the machinery operating the clam-shell bucket is 30 tons; the complete plant of machinery will weigh about 100 tons. The plant was put into operation on 4th instant, and will cost about $40,000.

The Ledyard Gold Mines Co., Ltd.—Work proceeds at this company's Belmont mines with satisfactory results. A new 5-ft. Huntingdon mill has been ordered, it having been found to treat the ore economically. The Golden Gate concentrator is reported to be doing good work on the sulphurets. No. 1 shaft is down 70 ft., and at a depth of 25 ft. a drift has been run for 30 ft. on good crushing material.

Nelson Hydraulic Mining Co., Ltd.—The secretary writes under date of 6th inst.: "We were all ready to mine last spring when the disastrous floods which played such havoc with this country carried away our sluice boxes. We, however, managed to put temporary boxes in before the water was entirely gone, and mined sufficiently to reach bed rock. The results we obtained were highly satisfactory, the gravel averaging 80 cents per cubic yard, and when we stopped working we were in gravel that went $8.00 per cubic yard. We are putting in a more expensive plant and hope to have a very prosperous season next year. The gold is very coarse and easy to save; the largest nugget we got was of a value of $5.00."

Kamloops Coal Co., Ltd.—The development work on this company's property on the North Thompson River, for the year just ending, was not up to anticipations. The quality of the coal having been fully demonstrated by previous year's operations caused the company to direct its attention to the uncovering of larger seams than those found on the surface. With this object efforts were directed in the early part of the year, not to win coal, but to find larger seams, and several prospect holes were put down at great cost with no beneficial result. The capital and equipment at the company's command being inadequate, operations have therefore been suspended. Negotiations are pending for the service of a diamond drill with which to determine the thickness of the seams underlying those shown to be on the surface. Active operations will be resumed in the course of a few months.

Stratheyre Mining Co., Ltd.—Mr. W. Hamilton Metritt, A.R.S.M., Toronto, has returned from a visit of several months' duration to this company's property in the Okanagan County, B.C., where he was preparing a report for the directors. The 10-stamp mill is running on custom's work, crushing ore from the Morning Star mine.

The Crown Pressed Brick Co., Ltd., has been incorporated under Ontario Statutes, with an authorized capital of $100,000 in shares of $100.00, to manufacture brick, terra cotta, tiles, drain pipe and other building materials. The incorporators are: H. L. Corbett, G. W. McCullough, H. H. Williams, E. J. Butterworth, J. G. Butterworth and M. S. McCullough. Head office, Ottawa.

Bootanie Creek Gold Mining Co.—During the summer of 1894 sufficient development has been done to thoroughly prove the existence of an old bed of the Thompson river, which gradually narrowed as the tunnel progressed. In all 479 running feet of tunnelling has been done and 2,400 cubic feet of stopeing, the results ranging all the way up to $4.00 per cubic yard in gold. When operations were temporarily suspended a canon in the old bed of the river had been struck, with a somewhat steep grade on bed rock and bearing N.E.

Quesnelle Quartz Mining Co., Ltd.—At a meeting of directors held on 30th ult., an assessment of one-fourth of one per cent. on the capital stock of the company was levied on the shareholders.

The Consolidated Electrical Mining Co. of Canada is the name of a new company being promoted by Dr. James Reed, of Reedsdale, Que., to take over and work the Harvey Hill copper mines at West Brompton, Que., and to acquire and mine asbestos, antimony, copper and Chomic iron properties in the Province of Quebec. Dr. Reed purposes utilizing the fine water power of the Palmer Falls in the Township of Nelson to drive the electric plant. He wants $100,000 working capital.

Boston and Nova Scotia Coal Co., Ltd.—The plans of this company have been altered so as to make Mabou Harbour, 14 miles from the mines, the shipping port. This will necessitate extensive dredging in Mabou Harbour, for, while inside the main harbor there is ample sea room and plenty of water, the channel leading to it for half a mile has a depth of 14 feet only. This change has necessitated an entirely new location of the railway, as the old line was some four miles from the proposed shipping pier. This new location has been made during the past summer, the intention still being to build the line through to a junction with the Intercolonial Railway at Orangedale, a distance, by the new route *via* Cape Breton, of forty miles.

The Standard Gas and Oil Company of Essex, Ltd.—Gives notice of application for charter of incorporation under the Ontario statutes with the object of drilling for Petroleum and gas in the counties of Essex and Kent, Province of Ontario. Aead office: Windsor, Ont. Authorized capital, $400,000, in shares of $100. The Directors are C. Currie, J. B. Moore and C. M. Swift, of Detroit; E. H. Harris, Ringsville, and A. H. Clarke, of Windsor, Ont.

British Columbia and Puget Sound Coal Co.—Has been formed at Tacoma, Washington. Capital, $10,000, in shares of $100. Incorporators, W. L. Kinsey, E. E. Beharrel, W. W. Clifton.

Falun Mine of British Columbia.—Organized at Spokane, Wash. Capital, $500,000, in shares of $10.00. Incorporators, G. S. Anderson, O. G. Seward and A. Edlund.

PHOSPHATES.

The following returns of the output and shipments of Canadian Phosphates may be interesting as showing the worst year's business in the history of the industry:

Phosphate of Lime Co. to Great Britain	2,693 tons
British Phosphate Co. " " about.......	600 "
Phosphate of Lime Co. to United States............	1,200 "
J. S. Higginson, Buckingham, to United States	800 "
Sold to Capelton and Hamilton, Canada	700 "
On dumps at 1st December, estimated....	3,000 "
	8,993 tons

Last quotations for 80 per cent. C.I.J. Liverpool 7d. per unit equal to $11.65 at 8½ ex., and $8.74 Montreal F.O.B., and $6.88 Buckingham. Low grade 60 to 65 per cent. F.O.B. cars, Buckingham ground and in bags $5.50 equal to $3.00 per ton unground Buckingham; 70 per cent., 6d. per unit equals $3.70 per ton Buckingham.

The following is a comparative statement showing the prices for Canadian Phosphate realized since 1882 to date:

Year.	80 per cent.	75 per cent.	70 per cent.	60 per cent.
1882	16d. with $\frac{1}{8}$ rise	15d.	14½d.	—
1883	15d.	13d.	12d.	—
1884	14d.	12d.	10d.	9d.
1885......	14d.	11½d.	10d.	8d.
1886	11d.	10¼d.	9½d.	9d.
1887	11¼d.	10d.	8½d.	—
1888	11½d.	9½d.	8½d.	—
1889	12½d.	11d.	10¼d.	8¾d.
1890.....	16½d.	13d.	12d.	9½d.
1891......	14d.	10d.	9d.	8d.
1892.. ...	10½d.	8½d.	7d.	5½d.
1893	9d.	7½d.	6½d.	5½d.
1894......	7d.	—	6¼d.	5½d.

Last quotation 80 per cent. in June 1894, realized 8¼d., and in August 7½d., the last quotation being as given viz. 7d.

The following statistics were presented at the Antwerp Exposition, showing the increasing importance of the fertilizer industry in Belgium. The surface covered by warehouses and manufactories in 1888 was 65 acres; in 1893 it was 73 acres. The motive-power in 1887 was 1060 horse-power; in 1893 it was 1903 horse-power. In 1887 there were 1238 men, 137 women and 24 children employed; in 1893 there were 2065 men, 33 women and 35 children employed. The wages paid in 1880 amounted to 180,000 francs; in 1887 to 900,000 francs; in 1893 to 1,612,735 francs. The production of superphosphates in 1880 was 10,500,000 kilograms; in 1887 the production was 70,500,000 kilograms, and in 1893 it amounted to 256,372,000 kilograms. These figures refer only to the concerns of the members of the "Company General" of the chemical fertilizer manufacturers of Belgium, and to the manufacture of superphosphate for the chemical fertilizers, properly so-called.

CORRESPONDENCE.

G. M. Ass'n. Shipments.

Sir:—Referring to your remarks on page 216 of November number *re* General Mining Ass'n., Ltd., we would say that in 1893 this company shipped from two mines. One of these (the Victoria), which in 1893 shipped 29,700 tons up the St. Lawrence, was sold to the Dominion Coal Co. on 1st January, 1894; so that practically the General Mining Association, working from one mine alone (North Sydney) has increased its shipments to the St. Lawrence.

CARBRAY & ROUTH,
Agents.

MONTREAL, 15th Dec., 1894.

New Find of Copper Ore.

Sir:—I was requested a short time since to examine and report on a new find of copper ore, which is of some interest, both from its location in a new section (new, as a mining section) and the unusual character of its ore. This vein is situate in a land-locked harbour off the Georgian Bay, about 10 miles below the town of Parry Sound. The vein is from 6 to 16 feet in width, quite uncovered, and distinctly seen for upwards of one mile, save when covered by the waters of the harbour. The ore may be loaded on vessels of any tonnage, direct from the mouth of either of two pits, about 1,500 feet apart. The vein is mineralized from wall to wall, and is noteworthy as containing, at some points, nearly equal amounts of chalcopyrite and dark zincblende; at other points a pure, clean ore of either metal, and again quite appreciable quantities of molybdinite. The gangue is an amethystine quartz and spar, making a beautiful ore in appearance. I would be obliged to any reader of the REVIEW who would inform me where I can see a deposit of commercial value, carrying such quantities of zinc and copper intimately mixed, or where such ore is being treated. I will be glad to send samples of this ore to anyone interested. Another vein has lately been discovered, about 10 miles from the above, which is a conglomerate, carrying bornite and chalcocite, with considerable free gold. At the time of my visit to this vein, a little dump pit had been formed, the dirt from which gave from 2 to 8 and 10 colors to the pan. The gold was crystalline or sharp in appearance, and apparently occurred in the quartz which cemented the vein. This was mostly clear and hard, but in places contained rolled grains the size of a bean, almost an opal.

W. THOS. NEWMAN.

TORONTO, 15th Dec., 1894.

Richardson Gold Mining Co., Ltd.

Sir:—I see that in your last issue you have classed the Richardson Mine among those working twelve months. Such is not the case. The mine was closed down and no quartz crushed for over two months during the past summer. This was while new plant was being erected.

As it is hardly fair to class nine and a half months work from this mine with twelve months production from other properties, I would take it as a favor if you would kindly have it rectified.

C. F. ANDREWS, Manager.

ISAAC'S HARBOR, N. S., 7 Dec., 1894.

LEGAL.

Tilley vs. Walker—This suit, of which some note was made in our last issue, came up for trial at Hull, Que., on 27th ulto. The three witnesses examined by Mr. Brooke, counsel for the plaintiff, were Mr. J. Burley Smith, Manager of the British Phosphate Co.; Sanborn Smith, laborer; and W. J. MacKenzie, merchant, of Buckingham. MacKenzie testified that he knew the defendant and the mine in question, that he did not consider the defendant solvent, and in fact his financial position was very bad; that he had about two years ago sued Walker for an amount of six hundred and odd dollars, for due bills of wages given by Walker to various of his employees, who had turned them in for payment of goods purchased at his (MacKenzie's) store, and that this judgment had been paid in instalments, by cheque of the Hon. R. W. Scott, there being a small balance still owing. In regard to the value of the mine in question, he said that he would not give $5,000 for it. Cross examined by Mr. Belcourt, he admitted that he had no knowledge of minerals or of graphite mining; that this mine might be worth $100,000 or $500,000, for all he could say; that he was aware that the defendant had a very creditable exhibit of graphite in the window of his office in the city of Ottawa; that he did not know the value of the mineral. Sanborn Smith stated that he resided near the mine in question, and had worked in it occasionally; that the mine had never yielded a revenue, and that attempts had been made to work it two or three times in the last fifteen years, but they had been given up. Cross examined by Mr. Belcourt: He understood that the mine was now being worked and that a lot of money had been spent upon it during the last year by a Mr. Hammond, of Toronto; he did not know how much or with what success. Mr. J. Burley Smith knew the mine in question, but did not know the financial standing of the defendant, he considered the mine very valuable, but not as valuable as one of the same kind which he owned a short distance from it. This closed the plaintiff's case, and the defendant examined the Hon. R. W. Scott at considerable length, who testified that during the last ten months about $30,000 had been expended by Mr. Hammond in excavations and mining, and additions to the buildings upon the property and in putting up machinery. He considered the mine very valuable, but could not say what it was worth; he thought it ought to be worth considerably over $100,000. Cross examined by Mr. Brooke: He was interested in this case to the extent that he was interested in the property, having a large mortgage upon it prior to that of the plaintiff. He had paid a judgment taken against Walker by the attorney questioning him, partly out of his own monies, rather than have the property brought to a forced sale; he could not specify any *bona fide* cash offer that had ever been made for the mine in question; he would not deny having told Mr. Brooke when threatened with the seizure and sale of this mine that if this property was sold at sheriff's sale, that nothing would be realized by defendant's ordinary creditors and that he himself would probably lose the amount of his claim. Re-examined: The conversation referred to with Mr. Brooke was in the summer of 1893; since that time the mine had been worked and $30,000 had been put into it. The case was then briefly argued by the counsel of both sides, Mr. Brooke urging that judgment should be rendered for the full amount of the mortgage, inasmuch as the insolvency of the debtor had been established, and that plaintiff has a right to his judgment, and it was not in the interest of justice that he should be obliged to incur the costs of another action in taking judgment against an insolvent debtor for the principal, when it became due. Upon the question of $650 of interest and the costs there could be no dispute. Mr. Belcourt, for defendant, urged that the proof did not substantiate the allegations of the plaintiff, and that in any case, it not having been established that the property had deteriorated in value since the giving of the mortgage, that the principal could not be considered exigible. Judgment was rendered for the amount of interest.

Allan Granger v. Fotheringham, Askwith, McMurdo, Irving, Ellis and McCabe—*A Warning to Claim Jumpers*—This action in the Supreme Court of British Columbia, was to determine the title to the 'Bobbie Burns' gold mine in the McMurdo Basin, B.C., and for its possession and damages. The Hon. Mr. Justice Crease, in rendering judgment for the defendants with costs, said "He who comes for equity, must do equity." The plaintiff himself bore witness in the box, and the evidence was drawn from him, that while doing business as a miner and a mine dealer, he obtained employment from the Mining Recorder in copying out the government mining records at Golden and at Donald; that it was May, 1893, while copying out such records at Golden, that he discovered the slip made on the 12th May, 1893, through the laches of Harry Cummins, the surveyor employed on Fotheringham's behalf, to complete the survey, notices, affidavits and certificates required by the act, as preliminary to obtaining the Crown grant of the 'Bobbie Burns.' He claims that he was allowed by the Mining Recorder, at the same time that he was so employed—living, too, for some time in his house, having constant access in the course of his duty to the government to the records—to practise his calling as a mining agent; in other words allowed to look out blots in mining titles—a permission which the Mining Recorder, who appeared as a volunteer witness at the trial, had no right whatever to grant, and plaintiff as an honorable man while in such employ had no right to accept. The Recorder, if he had such a right, could have exercised it himself. Now, no person in government employ is allowed to expose or himself take advantage of discoveries which he makes to the prejudice of others in the course of such employ. It is no answer to say that the public have free access to and can freely search all mining records—that is perfectly true and proper, *sub modo*—but a public officer, entrusted with the charge of public mining records, can only (except in exceptional cases, such as a record coming in at night in a race to record some new discovery, where five minutes may make all the difference) allow anyone to come in and search such records, or make his own, except within reasonable hours in the day, and then only, for very obvious reasons, in the presence of the Recorder or someone duly authorized in his stead to protect the records, which are frequently the only title which the working miner has to sometimes a vast amount of property. Any trifling with, or irregularity or favoritism in the keeping, or giving access to the records at unusual times, if known, will breed such a distrust among the mining population as will seriously affect their confidence in that department; a result which is earnestly to be deprecated, as it would be followed by all manner of evil consequences to the mining interests of that part of the country. While honest working and expenditure of capital, which was undeniably the case here in the opening and exploration of the mining ground, and in the employment of labor, should be within lawful limits encouraged. While mere colorable working, or neglect of working, should, under the stringent provisions of the Act in that behalf, be followed by forfeiture of the privileges which the holders have been proved by experience unworthy to retain, it is of the utmost public importance in a mining country requiring the safe investment of capital for its development and the steady employment of labor, that the practice of jumping claims by persons—who, not working themselves, make a business of hunting for accidental or unintentional slips in records happening to men more engaged in hard work underground, than accustomed to clerical work, hard-working (prospectors, who undergo infinite labor and hardships in bringing hidden wealth to light)—should be discouraged, as they always have been by this court. They are the parasites who always hang about rich mining camps. Long experience in mining camps, including British Columbia itself, from Cariboo downward, shows that there is no more fertile source of insecurity of investments (and money is a sensitive plant) ill-blood, ill-feeling, not unfrequently culminating in violence and bloodshed—than the practice of what is known to miners by the terms of jumping claims. For the reasons already given, and after a most careful consideration as a jury, as well as judge, of all the sections of the Gold Mining Acts, evidence and arguments adduced on both sides, I find myself constrained to, and accordingly do give judgment for the defendants, with the usual accompaniment of costs.

Phosphate Milling and Shipping Co. vs. Montreal Warehousing Co.—In the Superior Court, Montreal. This was an action to recover damages for the loss of a barge. The court held that the plaintiffs had proved the following facts: That while the barge Alice Pacy, belonging to them, was moored alongside the steamship Amyrinthia, in the harbour of Montreal, and was discharging her cargo of phosphate into the Amyrinthia, the barge Saturnary, which was then being towed by the tug W. C. Francis, violently struck and collided with the Alice Pacy, which was in such a position as to be unable to escape the full force of the collision, she being caught between the steamship and the barge, and this collision was caused by the unskilful and negligent manner in which the barge Saturn was navigated. The barge Alice Pacy was so injured by the collision that she began to take in water and had to be towed ashore and grounded, and, in fact, became a total loss. At the time of the collision the barge Saturn was under hire to the defendants and was under their control, and they were responsible for the damages. The court further held that the collision was not one of those which a barge might be expected to sustain in the ordinary course of navigation. As to the value, it was shown that the plaintiffs had paid $1,250 for the barge, and at the time of the collision it was worth at least $1,000. The defendants had failed to prove that the loss of the barge was owing to her unseaworthiness or to the negligence of the plaintiffs in mooring or overloading her. Under all the circumstances the plaintiffs were entitled to recover $1,000, value of barge; $20, expenses; and $2.15, difference between amount realized by sale of wreck and auctioneer's charges, making a total of $1,022.15, for which amount judgment was rendered in their favor by Mr. Justice Ouimet.

Fatal Accident at Sudbury—On Monday 10th instant, at the Copper Cliff nickel mine, Wm. Martin and a number of men were employed scaling in the shaft leading down from the seventh level to the bottom of the mine. The shaft is about 125 feet in depth, and the men were on a platform of 3-inch plank, about forty feet down from the level. While at work a large mass of rock was loosened, and one of the men gave warning, but before all could get safely out of the way it fell on the plank on which Martin was standing, smashing it, and he fell to the bottom, more than 80 feet, falling into eight feet of water. His companions were quickly on the spot, and locating his position by the air bubbles, he was quickly got out, still alive, but unconscious, in which condition he remained until Tuesday evening, when he died at the Sudbury Hospital. Several ribs were broken, and there were a number of other wounds and bruises on the body, principally on the head and breast.

Mining Society of Nova Scotia.

Report of the Proceedings of the Autumn Meeting.

Continued from November issue.

The evening session was called to order in the Halifax Hotel at 8:15 p.m., (Tuesday, 6th ulto.) Mr. John E. Hardman, President, in the chair.

THE CHAIRMAN—The only thing we have on the tapis this evening is the discussion of those papers which were read at the the Cape Breton meeting. The first paper is that by Mr. Blakemore.

"THE INTRODUCTION OF ENDLESS HAULAGE INTO CAPE BRETON."

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

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

In connection with endless haulage I may here anticipate a future hoped for report on a trial at the Albion mines where the grade will be very severe, about 30°, yet, I am assured the system can be satisfactorily adopted on such an inclination, and preparations are now being made. Much, doubtless, will depend on the make of clip used for clamping the boxes to the rope, and I would like to know the style Mr. Blakemore has found effcient on his lighter grade.

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

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

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

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

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

MR. FERGIE—Springhill has the tail rope system.

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

MR. FERGIE—Mr. Blakemore said he would give preference to the endless rope haulage system in any case. I would like to have asked him, taking seams like those in Pictou where we work the coal by pillar and stall and run out our level three or four thousand feet, whether he would consider the endless rope better. I think it is not; for in our system, once we are at our boundary, our levels are being shortened every day, and the system is too elaborate where they are only going to last a few years. With the endless rope you must have a double track, and consequently drive wider levels.

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

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

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

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

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

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

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

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

MR. BLAKEMORE—Replying first to Mr. Poole's remark on the construction of driving wheel. I am acquainted with the alteration he refers to in the periphery of the wheel with an inclined tread instead of being semi-circular as in the "C" wheel. I have used both classes of wheel, but my experience is that the "C" wheel gives better results. I found that in course of time the wheel with the inclined tread grooved deeply at the lower edge of the tread, and I also found that in the earlier stages the rope was more disposed to slip than on the "C" wheel. The only objection to the latter is the side friction of the various coils of rope as they press upon one another and are forced across the tread of the pulley; but if leading pulleys are used, so as to open out the ongoing and offcoming rope a little, this side friction is reduced to a minimum; and in fact I do not know that it has any appreciable effect upon the life of the rope. I should also remark that I am now having loose segments of cast steel to form the tread of driving pulley; these being moveable, can be taken out as soon as they are grooved, and replaced by others. In this way, I believe that the "C" pulley is calculated to give the best possible results.

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

Replying to Mr. Poole and Mr. Fergie on the broader question of the relative advantages of endless haulage compared with other systems, I may say, that whilst I am well aware that under exceptionally favourable circumstances journeys are hauled out on the single rope system at a much higher speed than 10 miles an hour, I maintain that on such a system the wear and tear, and also the risk, is much greater than with a slow haul. It should also be borne in mind that much larger engines are required for the higher speed; whereas the endless haulage can be worked with a very small engine, because, running slowly, you can afford to gear it as high as 8 to 1. But I would point out that however excellent the arrangement might be for single hauling, or even main and tail rope hauling at a high speed bringing out a journey at a time, there is a limit to the distance which any practical machinery will fetch a large output of coal, say, 1,500 to 2,000 tons a day; and that distance is unfortunately reached all too soon, in the case of a large mine; whereas, distance does not enter into the consideration of the engineer who is able to put down endless haulage. And here I wish to correct a misapprehension, probably due to inadequate explanation in my first paper on this subject; when I stated that it was as easy to haul by the endless rope system a distance of 5 miles as one, I did not say with the same machinery and appliances, but I meant, and maintain, that the system is as easily adapted to the one distance as the other. Now I put it to any practical engineer, first of all, whether it is possible to haul 2,000 tons a distance of 5 miles, or even 2 miles on the single rope, or main and tail systems, that is bringing out large journeys of coal each trip, assuming a dip of 1 in 12, but suppose it were possible, let him sit down and calculate what size engines he would require, what steam power, what strength of rope, and what size of pit tub to achieve this result; and then let me set against that the fact that a pair of horizontal high pressure engines, with 24 in. diam. cylinders and 5 foot stroke, geared one to eight, and furnished with steam by 1 Babcock, or 2 Lancashire boilers 30 x 7 feet; and a steel cable 1⅛ in. diam., with tubs carrying, say 2 tons each, would easily deliver the larger quantity mentioned from a station 5 miles distant, under the conditions named, in every working day of 9 to 10 hours. Of course the longer distances to which I am able to point on the endless haulage system are not in a mine, but upon the surface, and I would refer to one with which I am well acquainted in the City of Birmingham, England; there the cable is 14 miles long, the haul being 7 miles from start to finish; the engines are placed midway, and travel the cars at the rate of 8 miles an hour. The grades are very steep, as much in places as one in six, and over the whole distance the road is undulating. At times there are as many as twenty cars, each weighing about 10 tons, without passengers, and the size of the cable is only 1¼ in. diameter. The system works perfectly, and has already far superseded in popularity and effectiveness the steam tramway and the electric tramway, which are both operated in the same city; and on the score of economy I may say, that since the introduction of this system the concern has for the first time been placed upon a paying basis; steam and horse traction both having previously been tried.

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

"COAL CUTTING MACHINERY AT THE COLLIERIES OF THE DOMINION COAL CO."—DISCUSSION ON MR. J. G. S. HUDSON'S PAPER.

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

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

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

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

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

Mr. FERGIE—What power does it take to drive the Ingersoll drill?

Mr. BURCHELL—Sixty pounds of pressure. We have our compressors 16x18 and I don't think they will drive any more than five.

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

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

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

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

Mr. DICK—I want to know that myself.

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

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

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

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

"THE RAILWAY SYSTEM OF THE DOMINION COAL CO."

The CHAIRMAN—I do not expect any discussion on that paper.

Mr. FERGIE—I think that a number of our members wish that it had been built sooner, so that we could have gone that way to Louisburg.

"SINKING OF DOMINION NO. 1 SHAFT."

Mr. POOLE—I think it would be well to show in the sketch that the irregularity in the dip is false bedding in the ply.

"THE SYDNEY COAL FIELD"—DISCUSSION ON MR. HUGH FLETCHER'S PAPER.

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

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

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

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

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

"GOLD MINING IN NOVA SCOTIA—A REVIEW OF OPERATIONS IN THE VARIOUS LOCALITIES."—DISCUSSION ON MR. RUTHERFORD'S PAPER.

The CHAIRMAN—I have been told by one or two members to-day that they would like to say something about that.

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

"In other official reports it is stated that one lode at Tangier of mixed quartz and slate could be raised and crushed at a cost of $2.50 per ton." It does not state that it was ever raised for this sum. "And in another case a yield of gold of 4½ dwts. will pay all expenses. In another locality the cost is placed at from 8 to 12 dwts." Then I see he goes outside of the province. "It is stated in the case of two gold mines in Australia, with reference to the cost, as it may be inferred from the payable yield of gold, that at one of these, 2 dwts. 21 grs. per ton proved sufficient to pay the proprietors ten per cent., and at the other the average yield in 1870 was only 4 dwts. 20¾ grs., in connection with which it is remarked that the quantity of gold lost in the early stages of gold mining in Nova Scotia sufficed in Australia under careful management to give a fair profit to the adventurer." I find in going over some figures tonight we at our own place have done better than that. Since the 9th of August to the 1st of this month we have paid out $5,504.00 for mining, crrrying to mill, crushing and placing the gold in the market at Halifax. We have milled 2,372 tons, which make the actual cost delivered in Halifax $2.27 per ton.

Mr. POOLE—Does that include office expenses?

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

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

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

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

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

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

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

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

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

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

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

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

Mr. WILLIS—I was at Oxford three years and I made assays on every mill-run made in that time. The samples were taken every day once an hour. I tested these tailings in all sorts of ways. I used to concentrate. They gave from two to three per cent. in concentrates. These concentrates were worth seven to eight dollars.

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

VOTE OF THANKS FOR COURTESIES DURING CAPE BRETON MEETING.

The following resolution was carried unanimously: "The hearty thanks of the Mining Society of Nova Scotia are hereby tendered to the Dominion Coal Co., Ltd., and the General Mining Association of London, for the courtesy extended in opening their colliery and surface works to this Society and its fellow-guest, the General Mining Association of the Province of Quebec, for visiting and inspection at the united meeting held in Cape Breton last July; and also to Messrs. MacKeen, Blakemore and R. H. Brown, for their great personal kindness in attentions shown and hospitalities extended to the visiting members and the ladies of their party; and also to the president and members of the Sydney Club, for courtesies extended."

The meeting then adjourned to the dining room, where an oyster dinner was served; after the dinner the newly elected members were called upon and replied by songs and speeches.

Advices respecting the Winnipeg coal market report that Souris coal continues to meet with a good demand, and the new pit opened this fall is giving better satisfaction than that supplied last winter. Prices delivered to consumers in Winnipeg are as follows:—Imported anthracite, $9 per ton for egg, stove or nut sizes; western anthracite, $8.50 per ton for stove and furnace size; Lethbridge bituminous, $7.50 per ton; Souris lignite, $4.25 delivered or $3.75 on cars here, and $1.50 to $1.75 on cars at the mines.

The shipments of coal from the New Vancouver Coal Mining and Land Company's collieries for November were 21,579 tons.

Mica: Its Uses, Mining and Trade in India.

By Edgar Thurston, Reporter on Economic Products to the Government of India.

In view of the importance of Canadian mica mining, the following excerpts from a paper published by the Imperial Institute, (Indian Section, No. 19), will prove of interest to our readers.

The somewhat exceptional nature of the petrological conditions necessary for the formation of large sheets of mica must always be a serious contributor to the irregularity of its production, and make a local industry of a somewhat precarious nature. Moreover, large crystals, which have been formed under the most favorable conditions, may for industrial purposes, be rendered useless by subsequent changes; from the nature of the mineral it is extremely liable to depreciation. The transparency, for example, is sometimes wholly or partially destroyed by interlaminar inclusions or infiltrations of other mineral substances. In the Nellore district, large sheets of muscovite, otherwise devoid of flaw, are rendered almost useless on account of the included films of brown and black material in bands crossing one another at angles of 60°, like the dentritic inclusions in the Pennsbury and New Providence (Pennsylvania) muscovite, which Dana proved to be thin films of magnetite. Secondary decomposition by exposure to weathering agents impairs the transparency of the crystals; and being one of the weakest of rock-constituents, it suffers deformation from the slightest earth movements, and thus becomes permanently disfigured by irregular crumplings, or by fractures along the cleavage, and so-called "gliding-planes." On account of these circumstances there is always a wide, and exceedingly variable, margin of waste in mica mining; but the percentage of rejected material is subject to such great local variations, that it is impossible to give an estimate of any value for a large country, or for any considerable length of time in a limited area.

The minerals included by mineralogists in the group of *Micas* are frequently known in commerce as *talc*—a name now reserved fur the foliated variety of steatite, a hydrous silicate of magnesia occurring in "micaceous" laminæ and scales, which are flexible, but not elastic, as is the ease with mica, and which differ from the latter mineral also in possessing a soapy touch. This confusion between the two names seems to have extended as far back at least as the 16th century, when Agricola, in an appendix to his works (1546), speaks of *talck* and *glimmer*, (the name now used in Germany for mica) in a manner which showed that they were characterized by sparkling star-like appearances as seen in scattered flakes of either mineral. The word *talc* is said to be of Arabic or of Moorish origin, and refers either to the glittering spangles, or to the phenomena of *asterism*, frequently displayed by micas (especially some phlogopites) when a candle-flame is viewed through a sheet of the mineral; and the frequent use of the substance for windows before the invention of glass may have facilitated the observation of this peculiar property. If this explanation be the true one, then the mineralogist, not the merchant, is for once in error in so limiting the definitions. But whoever may have been the original offender in introducing the not unnatural confusion, we shall, for the sake of convenience, employ only the more generally established name, *mica*, for the minerals described in this hand-book.

USES OF MICA.

The peculiar physical properties of the micas have secured for these minerals very widely extended uses in the arts—the size of the crystals, their highly perfect cleavage, their flexibility and elasticity, transparency and athermancy, chemical stability and imperfect powers of conducting electricity and properties which no other mineral can combine, and which cannot be readily or cheaply imitated by artificial means.

Use in Windows and Lanterns: The earliest use of mica was probably in windows and lanterns, and for some time the material was known as Muscovy glass (*Vitrum Muscoviticum*), the name *muscovite* being restricted to a special variety by Prof. J. D. Dana in 1850. It was, however, subsequently replaced by the cheaper artificial substance, glass; but in the early stages of glass manufacture, when the processes for annealing plates had not been devised, mica was still retained for use in places where the window would be subject to sudden shocks or violent vibrations, as, for example, in the windows of men-o'-war, where the shocks of artillery firing shattered the badly annealed glass. Since, however, the annealing of glass has been brought to such perfection, it has entirely replaced mica even for this purpose. In lanterns mica has been replaced by glass and horn; but in places where there would be considerable risk attending a breakage, mica is still retained to some extent for lantern uses.

Stoves: No artificial transparent substance has, however been devised to replace the mineral where high degrees, or sudden changes of temperature take place. It has, therefore, considerable use in anthracite-stoves, where it is desirable to obtain the cheerful glow of the fire without the direct heat. Its transparency is little affected by the repeated and alternate heating and cooling, and it is not readily attacked by the gases and vapors, although it does not so effectually resist the attacks of the gases from a bituminous coal, and is, moreover, so quickly blackened by the soot, that it soon looses its transparency. Its use, therefore, is confined to anthracite or to gas-asbestos stoves.

Lamp Chimneys: Chimneys for oil and gas lamps with round burners are sometimes made of mica, especially those outside drapers' show windows, where glass would not stand rain-drop splashes and sudden changes of temperature, whilst a breakage would involve considerable risk from fire.

Fire Screens: In consequence of its transparency for light and its capacity for radiant heat, we find mica employed as fire screens, in the peep holes of furnaces, and as screens in the laboratory and workshop for observing the processes in a highly heated furnace without suffering from the intense heat.

Electrical Appliances: Mica has been used for vibrating plates in the photophone, Edison has employed it also for vibrating plates in the telephone, and as a substitute for glass in the reflectors of electric lamps. By far the largest demand for this mineral for electrical purposes obtains in America, the construction of dynamos and electric motors finding an important use for it on account of its excellent insulating properties and its elasticity; strips of various dimensions, but usually about one inch wide and from four to eight inches long, being used. The main drawback to use of the mineral for this purpose is its want of toughness. Perhaps one of the latest uses to which ground mica has been applied is in the manufacture of the insulators on telegraph poles.

Ornamental Uses: Probably the most extensive use of mica, at least in India, is for ornamental purposes, either in its natural state or artifically colored. In the days of ancient Rome the powdered material was scattered over the surfaces of the ampitheatre, to obtain a brilliant glistening effect. In India it is used at native festivals, marriages and in the Mohommedan maharam for processional ornaments as lamps and tinsel decorations on banners, on fans, in temples, palaces, etc. The powder is used for ornamental pottery, on curtains and cloths, in calico-printing and hy the *dhobi* (washerman) to give a sparkle to cloth, to which the fine particles easily adhere. Coloured micas have also been suggested as a substitute for coloured glass, but its use in this direction must be limited, and as the coloured micas contain larger proportions of iron, they are more susceptable to destruction when exposed to the weather. There seems no reason, however, why the quantities of amber-coloured biotites, as well as the muscovites, with inclusion of magnetic oxide in regular patterns, should not be so used in unexposed places. Natives in the Trichinopoly district of the Madras Presidency, and elsewhere, sell large numbers of pictures and portraits painted on mica sheets of various sizes. The writer is informed by the Collector of Trichonpoly that the mica used in that district for painting pictures on, etc., is purchased by the painters from the Marakoyers (class of Mussulmans) of Negapatam, who purchase large quantities of mica every year from ships arriving there from Calcutta and other sea-coast towns, for making the big taboots for the Kanthiri festival, and retail some to the painters. Mention may be made of the use of mica for ornamental purposes by the aborigines of America, where it has been found in the graves of ancient tribes of Indians, and in localities which would indicate a certain amount of commercial intercourse amongst widely separated tribes, during, what has been called by an American writer, prehistoric times, although it must be understood that the local interpretation of that term does not necessarily imply anything very ancient.

Utilization of Mica Waste: The utilization of waste mica and clippings became an important consideration in the latter development of the industry. There are a few firms engaged in the grinding of mica waste, the products being sold in different grades. Some of this is used as already indicated on wallpapers and for other decorative purposes, some is used for steam and water valve seats; the poorer qualities are sold for mixing with fertilizers, for which purpose it is claimed to aid in the retention of moisture. In consequence of this property also it has been used in an absorbent for nitroglycerine in the manufacture of one of the forms of dynamite known as "rend rock," or "mica powder." The poorer grades of pulverized mica are successfully employed, when mixed with graphite or grease, as a lubricant for carriage axles.

The substance recently named "micanite" by its inventors seems to add another, and perhaps, successful means for utilizing mica waste. The films of mica are cemented together, and moulded to make sheets—plain or curved—tubes, and other forms for electrical uses.

Under certain circumstances mica would be a convenient substitute for glass plates or celluloid films in photography, if perfectly polished and even plates could be obtained.

Used by Hindus in Medicine: Finally amongst the many uses to which this wonderful mineral has been applied, may be mentioned the use of black mica by the Hindus in medicine. According to the Sanskrit writers it is first purified by being heated and washed in milk; the plates are then separated and soaked in the juice of *Amarantus polygamus*, Linn, (*tandulia*) and *kanjika* for eight days. It is then reduced to powder by being rubbed with paddy (rice) within a thick piece of cloth; the powder passes through the interstices of the fabric and is collected for use. In this form it is called dhanpabhraka. It is further prepared for medicinal use hy being mixed with cow's urine and exposed to a high degree of heat for a hundred times. The process is said to be sometimes repeated one thousand times. When this is the case the preparation is called *sahasra putita abhra* and is sold for as much as R8 per *tola*. Mica thus prepared is a powder of a brick-dust colour, and saline earthy taste. It is considered tonic and *aphrodisiac*, and is used in combination with iron in anaemia, jaundice? chronic diarrhoea and dysentery, chronic fever enlarged spleen, urinary diseases, etc. Its efficacy is said to be increased by combination with iron. Dose: grains six to twelve (U. C. Dutt, *Mat. Med. of Hindus*). Ainslie states that the Vytians consider mica to have virtue in pulmonic affections, and a dark sort to be of value in flux cases. He further mentions that the Chinese imagine it to have the power of prolonging life. Although the effects obtained or imagined to be obtained, in these cases are more probably due to the substances administered with the mica, it certainly possesses one property which cannot be claimed for all medicines—it is perfectly inert and harmless.

By-Products: Mica is invariably associated with feldspar crystals, and these have very frequently undergone considerable decomposition by the action of percolating atmospheric waters with the result that kaolin—often very pure—is produced and may be washed out for use in pottery manufacture; and, in fact, in America the Indians in the 17th century carried this mineral from the mountains of north-west Carolina to the sea-board for exportation. It has been proposed to utilize the large quantities of potash in the felspars sometimes associated with the mica for the manufacture of potash salts; but this is not likely to be practised in India or indeed anywhere whilst the wonderful beds of soluble salts at Stassfurt last.

INDIAN MINING AND TRADE.

Mica seems to have been an article of commerce for several hundreds of years. The aboriginal Indians of North America were apparently acquainted with the mineral, and have left considerable traces of excavations made for raising it. It has been commonly found in the graves of Indians east of the Mississippi, and in localities which show that a considerable amount of intercourse must have prevailed between widely separated tribes.

In India, too, the natives have long applied mica to industrial purposes, and have mined it in large quantities, especially in Bengal. European methods are, of course, now employed and need no special description. The methods formerly pursued by the natives in the Behar district have been described by Captain W. S. Sherwill (1851) as follows:—

"A small and convenient hill having been chosen as the spot for commencing operations upon, a party of the wild hill tribes, named Bandathis, the members of which party have freely propitiated the local tutelary god or goddess, both by sacrifice and by getting very drunk, ascend to the top of the hill and commence sinking a series of pits, the whole way down the profile of the hill, about three feet in diameter each, and a few feet apart. These pits are not continued vertically downwards, but in a zig-zag shape, but nevertheless not so much out of the vertical proper, as that a basket containing the mineral cannot be hauled up from the bottom of the pit to the top; the zig-zag shape of the shaft being formed by sinking the shaft first inclining to the left a few feet and then to the right a few feet, the head of each cut or notch forming a landing-place or step, and thus the necessity of ladders is obviated; the projecting of salient angles of the notches forming a perfect flight of steps from the top to the bottom of the pits, which seldom reaches to a greater depth than 40 feet, when, darkness interfering with the workman's progress, the pit is forsaken and another commenced upon a few feet further down the hill. A slight frame-work of faggots, cut from the neighboring trees, is placed over the mouth of each pit, upon which a man sits, waiting till the signal from below is given to haul up the basket containing the mica and rubbish which has been dug from the sides of the pit by the aid of a rude pick. On arrival at the surface the good and bad materials are separated; the earth and rubbish are shot down the precipitous side of the hill; the good mica, which arrives at the surface of the pit in ragged masses about 1 foot 6 inches in length, 6 inches broad and 3 inches in thickness, after having its ragged edges trimmed off with a reaping-hook-looking instrument, is placed by itself in a heap, and the bad or refuse, that is the softer kind, is also placed aside in a heap by itself.

"The mica reaches the surface in three different states, viz.: the good, hard and serviceable mineral; the soft, wet and flimsy mineral; and the chipped and powdered mineral.

"The tests as to whether the mica is good for anything, or whether, as the natives say, 'it is alive,' are its firmness, specific gravity, and the power of reflecting the countenance free of contortions; the latter test, I imagine, showing the perfect parallelism of its individual plates, and consequent likelihood to split well; the heavier the mineral and the more perfect the reflection, the more valuable is the mineral considered; all the plates not standing the necessary test, are of a soft and flimsy nature, without any of the brilliant sparkle of the better sort; the natives call this the 'dead mica,' and it appears to be in a state of decay.

"The mines are worked by Mahajans or native merchants, who reside at Patna and depute agents to the spot to superintend the mining. The excavators or miners are Bandathis or inhabitants of the hills, a race allied to the Kols, Bheels and Sonthals; they are a wild-looking set of demi-savages, slightly clad, the fore part of their head shaved, the rest of their hair standing up in wild curls; they have the high cheek bones, thick lips and small eyes of the Vindhyan races; they are also a hard-working and merry race. The miners receive as monthly wages one maund (80 lb.) of rice, and a piece of cloth, the whole valued at two rupees.

"The mines are worked during the months of January, February and March only; for during the hot months, or from the latter end of March to June, the great heat dries up all the water for many miles around the mines, and during the rainy season the pits fill with water; and subsequent to the rains the unhealthiness of the dense miasmatic jungles in the neighborhood prevent the work commencing before January.

"During the three working months about 400 maunds or 14 tons of mica, yielding upon calculation 20,000,000 transparent plates of mica, each plate being about nine inches square, are conveyed away to Patna upon bullocks, the whole being valued at R4,000 (£400). To obtain larger plates than are generally exported does not seem to be an object with the agents, who by their constantly urging the miners to wrench out the mica from its matrix, whether in large or small pieces, cause about three times the amount of mica actually carried away to be destroyed in the mines. The head Bandhati assured me that, were time allowed him, he could produce plates of almost any size.

"The largest plates are dug from the Deilwar mine where the miners have hit upon a seam of mica, running along the base of one of the small hillocks; it is thus worked in the open air only a few feet from the level of the country; this seam, however, will be soon lost as the half wild miners have no idea of propping the roof of a mine, which must very soon fall in by its own weight." (Journ. As. Soc. Beng., Vol. xx., (1851), pp. 296-298).

In describing the mines of North Hazàribàgh in 1873, Mr. Mallet gave an account of the sampling of mica into different grades and qualities as follows:—

"The plates of mica are generally brought to the miners' village, and there after being slightly trimmed with grass-cutting knives (which are not particularly adapted to the purpose, but are probably the only ones the people are able to purchase), they are sorted into different heaps according to quality and size. The quality depends on the mineral being in a perfectly unaltered condition, its transparency and freedom from cloudiness caused by internal foreign matter, the absence of minor cleavages which render it liable to split into ribbons and triangles, and the planeness of its fissile surfaces. Six kinds are recognized according to the size of the plates, viz: —

1st. Sanjhla.	3rd. Rasi.	5th. Urtha.
2nd. Manjhla.	4th. Karra.	6th. Admalla.

"Some of the miners intercalate *failurtha* between *urtha* and *admalla*, and speak of another size, *barka*, still larger than *admalla*. All these terms are used rather vaguely in respect to the absolute size of the plates indicated thereby. At Dhàb and Jamtàra I induced the miners to separate a quantity of the mica into different grades, and measured an average specimen of each, with the following results:—

	Dhàb.	Jamtàra.
Sanjhla	3" x 4"	4" x 3"
Manjhla	7 x 5	5 x 4
Ràsi	9 x 6	6 x 5
Karra	12 x 9	8 x 6

"The above four sizes include the greater portion of the mica found, it being only in the best mines that *urtha* and *admalla* are procurable.

"The mica is sold by the load, which is built up of plates either into one frustrum of a cone and carried on the head, after being bound together with cord, or into two such, and carried in a *banghi*. A load equals 6 *paseris*, one *paseri* being equal to 5 *kacha seers* of 12 *chataks* each, or to 3¾ *paka seers* of 16 *chataks*; the load, therefore, being 22½ *seers paka*, or 46 lb. avoirdupois. The miners informed me the price paid them by the *mahajan* were as follows:—

Sanjhla	3 annas.	per load
Manjhla	5 "	"
Rasi	7 "	"
Karra	12 "	"
Urtha	2 to 6 rupees	"
Admalla	4 to 9 "	"

The selling prices being about double the above." (Records, Geol. Surv. Ind., Vol. vii.)1873), p. 42).

Dressing Mica: Under the present system of working, the blocks of mica raised from the mine are cleaned of all extraneous matter, such as quartz and felspar, in the stripping room, and when split, either for convenience of size or for the removal of material included along the cleavage-planes, the sheets are sent to be "scribed," and afterwards cut with a pair of shears into rectangular shapes along the scribing. Sheets, tin, zinc or iron, are used as patterns in scribing; and the natives after a little training become quite expert in selecting the size and shape of pattern which will give the maximum area of clear mica in the rough sheet.

Yield of Marketable Mica: The yield of marketable mica will naturally be very variable. In the Inikurti mine of the Nellore district, Mr. Sargent sent to the market 23 per cent. of the rough block mica raised from the mine. In the American mines 10 to 12 per cent. seems to be the average yield, whilst 5 per cent. is considered inferior and 33 per cent. exceptionally high. In one case, however, as much as 75 per cent. of marketable mica was turned out.

Prices of Different Qualities: Large quantities of ruby-coloured muscovite are still exported from Bengal to England and America, the former being the principal market for the rest of Europe. The prices of this mica range from R8 to R400 per maund of 80 pounds; and according to the late Mr. E. T. Hollingsworth, who exported large quantities from Calcutta, the average price of rectangular pieces may be set at R20 per square inch per maund. Thus plates 6 x 6 in. of best quality would bring 36 x 20, or R720 per maund, or 11s. 3d. per pound at 1-3 exchange. I find from data kindly supplied me by Mr. Sargent who has worked the Nellore mines so successfully, that as much as 14 or 15 shillings a pound has been obtained for large plates, whilst plates 2½ inches square will bring only a few pence per pound, and up to 20 square inches at least long rectangles brought better prices on the average than squares of the same area. The demand for lower grades is at present somewhat dull owing to the quantities of small plates which have been turned out of the Canadian mines. The American prices are stated to vary from 5d. to 24s. per pound and averaging about 7s. Whilst the price increases in such rapid ratio with the area of the plates for the smaller sizes, the ratio does not seem to be preserved for plates larger than about 6 x 8 inches owing to the few uses to which very large plates of mica are put. Some very large plates, have however, been turned out of the Indian mines. In a recent consigment of ruby-coloured mica from Calcutta there were sheets measuring 9 x 32½, 10 x 29½, 11½ x 27 and 12 x 23½ inches respectively.

Very different rentals are paid for the mines. In the Hazaribagh district they vary from R8 to R1,000, but probably average about R200 to R300.

Rentals of Mines: In the Nellore district (Madras Presidency) land has been put up to auction with the result that at Utkur in September, 1888, a piece measuring 5 acres was leased for R75 per annum, whilst in April, 1889, Mr. Lonsdale obtained 10 acres for an annual rental of R250, but the lease was afterwards cancelled on his own application and a portion of this, which was afterwards rented to Mr. Sargent for R50 per annum, has since turned out to be a most successful mine. The mine which was sold in 1888 for R75, having yielded good mica and the lessor having been credited with having made larger profits there was undue competition when the term of lease expired in November, 1890. It was put up to auction and fetched as much as R3,005 as a yearly rental, but the mine soon after stopped work, and the purchaser has applied for a cancelment of the lease. Other speculators have also taken up land in apparently the same indiscriminate manner, and have been subsequently compelled to abandon operations. There is no reason, however, why still larger quantities of mica should not be obtained in Nellore, Mysore, the Wynad and Travancore, whilst the Bengal mines are still most decidedly successful.

Trade: The following statement shows the exports of mica from British India to foreign countries since 1886, so far as official statistics are available. It will be seen that the United States have been the principal consumers, and this agrees with the statistics of imports given in the official reports of that country, in which it will be noticed that, coincident with a falling off of production from the North Carolina deposits, there has been an increase in the quantity of imported mica, and a decided increase in the quantity exported from India. From Bengal alone Mr. Hollingsworth estimated an output this year of about 500 tons, which is about one and a-half times the total production of North Carolina from 1868 to 1887, and more than 15 times the amount raised in the United States in 1887 (*vide* "Mineral Resources of the United States," 1887). India is, therefore, the principal producer in the world, and may thus be able to fix the prices of an article for which there is a great and steadily increasing demand. This fact should be an encouragement to further exploration amongst our crystalline rocks.

STATEMENT SHOWING THE EXPORTS OF MICA FROM BRITISH INDIA TO FOREIGN COUNTRIES IN EACH OF THE FIVE YEARS FROM 1886-87 TO 1890-91, AND IN THE NINE MONTHS ENDING DECEMBER, 1891, SO FAR AS OFFICIAL STATISTICS ARE AVAILABLE.

Countries to Which Exported.	Quantities.						Value.					
	1886-87.	1887-88.	1888-89.	1889-90.	1890-91.	1891-92, 9 mos.	1886-87.	1887-88.	1888-89.	1889-90.	1890-91.	1891-92, 9 mos.
	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	R.	R.	R.	R.	R.	R,
United Kingdom	375	389	1180	1857	3248	790	87937	69346	193305	336151	448864	115382
France	96	5	10	....	8	10	15075	4300	6579	.....	785	1340
Germany	...	...	24	51	170	69	......	......	3510	7596	34363	16417
Mauritius	....	....	...	1	....	....	......	......	......	25	......	......
United States	411	316	387	714	2947	1097	112487	80650	156418	218316	428878	233878
Arabia	....	....	....	....	....	10	......	......	......	......	......	84
Ceylon	....	....	3	....	....	....	......	......	20	......	......	......
Straits Settlements	....	3	....	9	11	...	.....	270	......	155	135	.....
Total,	882	713	1604	2632	6384	1976	215499	154566	359832	562243	913025	367101

The Ross Rock Drill.*

By J. Macewan Ross.

The Ross rock drill is a departure in principle and design from the ordinary rock drills at present in use.

An American publication states that the "percussive rock drill has been invented and developed within the latter half century." It also also goes on to say that "it is distinctly an American invention, though claims are sometimes made that it had its origin in France and Germany. Rock excavations were carried on even before the discovery of America, and it is easy to understand that those who were engaged in removing rock would look for some means by which a hole might be drilled with greater rapidity than by striking a piece of steel with a hammer.

In 1683, a drop drilling machine was used in Germany, and "with ten blows it would sink a hole 1½ inches deep and about 3 inches in diameter."

Mr. G. G. André states concisely the requirements of a good rock drill as follows:—†

1. A machine rock drill shall be simple in construction and strong in every part.
2. It shall consist of few parts, and especially of few moving parts.
3. It shall be as light in weight as it can be made, consistent with the first condition.
4. It shall occupy but little space.
5. The striking part shall be relatively of great weight, and it shall strike the rock directly.
6. No other part than the piston shall be exposed to violent shocks.
7. The piston shall be capable of working with a variable length of stroke.
8. The sudden removal of the resistance shall not be liable to cause injury to any part.
9. The rotary motion of the drill shall take place automatically.
10. The feed, if automatic, shall be regulated by the advance of the piston at each stroke.
11. The machine shall be capable of working with a moderate degree of pressure.
12 It shall be capable of being readily taken to pieces.

Mr. J. J. Couch, of Philadelphia, invented, in 1849, a percussion drill embodying some of these features. Later in the same year Mr. Joseph W. Fowle, of Boston, invented a drill in which the drilling-tool was attached directly to the machine, or

* Transactions Mining Institute of Scotland.
†A Practical Treatise on Coal Mining, 1879, page 148.

was a continuation of the piston rod. Subsequently, Mr. Charles Burleigh constructed a drill embodying important improvements on the Fowle drill. Since then, Messrs. Ingersoll, Wood, Githens and Sergeant have brought the rock drill more nearly to the requirements stated by Mr. G. G. André.

All the early drills were what are now known as "tappet drills," that is, the movement of the valve was effected by tappets projecting into the cylinder, and struck or moved by the piston. This was the principle of the valve movement of the first Ingersoll rock drill, and Mr. J. C. Githens perfected the tappet movement, as embodied in the little giant rock drill.

The tappet construction, however, does not fulfil one of the most important conditions of a perfect rock drill, as a part other than the piston is exposed to violent shocks. Mr. Henry C. Sergeant made the first departure from tappet moved rock drills in 1873, when he constructed the Ingersoll eclipse rock drill, which, with a few alterations, is now known as the Ingersoll rock drill. He has since designed a new valve motion and a new rotating device embodying them in what is known as the Sargeant rock drill. The valve motion of the Sergeant rock drill is similar to that of the Ingersoll, with the addition of an auxiliary valve introduced between the main valve and the piston, by means of which the valve movement is made more positive.

All the rock drills referred to work on the same principle—that is, they have the drill attached to the piston, so that each upward stroke of the piston lifts the drill and the downward stroke brings the cutting edge of the drill into violent contact with the rock to be bored. This action entails great shock and vibration on the framing and working parts of the tool, necessitating great strength of construction and consequent heavy weight.

The diamond drill works on a different principle: the drill is revolved, a steady pressure is brought to bear upon it, and thus by the abrasion of the diamond surfaces upon the rock, a hole is rapidly bored.

The Ross rock drill combines the two principles—for while the piston reciprocates with a short stroke and at a high speed, the drill is always kept to its work at a uniform and carefully regulated pressure.

The casing A is bored and fitted with a phosphor bronze liner B, forming the cylinder, in which the piston works. On the outside of the bronze liner rings are cast, so as to leave annular spaces between them and the outer casing. These spaces are divided into inlet and exhaust passages for the working fluid, by suitable projections cast on the outside of the liner, and turned to fit the casing. Communication between these passages and the interior of the liner is effected by several admission ports C, and exhaust ports D, formed in the liner, and so placed that the piston, in its reciprocating movement, operates as a self acting valve, automatically admitting and exhausting the working fluid. The piston E is a solid forging, turned and ground into the cylinder so as to work freely. It is 5 inches in length, and 2½ inches in diameter, and is slightly reduced at the centre where the actuating fluid is introduced into the cylinder. The piston weighs 4½ lbs., and is the only working part in the tool.

The principle upon which the tool works is simple. The piston is reduced in diameter at the centre, leaving a collar at each end. The inside edges of these collars form the cut-off edges, while the outside edges govern the exhaust ports.

As soon as the compressed air is turned on, the piston reciprocates with great velocity, and is cushioned at the back end of the cylinder.

The piston at each stroke strikes a centrepiece fitted into the nose of the tool, and through this the blows are conveyed to the end of the steel drill. The collar on the centrepiece bears a phosphor bronze thimble, and takes up the pressure given by the automatic feed. The collar also acts as a guage, and keeps the centrepiece at a fixed distance from the striking end of the piston.

There is a ram attachud to the back end of the cylinder, fitted with a piston working in the automatic feed cylinder. This cylinder is connected to the framing by 2 clamps, which are bored to fit the standard and the feed cylinder, and this forms a perfect universal joint. The clamp has an open jaw, fitted with a bolt and nut by means of which the feed cylinder may be fixed in any position.

As soon as the thumb cock is turned on, the piston immediately gets into rapid motion, and simultaneously the air finds it way by a small channel to the outer end of the plunger, thereby pressing the drill up to its work with a steady and unvarying pressure. All that the attendant has to do is to turn the hand wheel steadily and somewhat quickly. When the drill has penetrated to a depth of 18 inches, the plunger in the feed cylinder having travelled out that distance, the attendant slackens the clamp a little, pushes forward the feed cylinder till its outer end is near the clamp fixes it by a turn of the nut, and the drill is ready for another length of 18 inches of travel.

It will be seen that holes 3 feet in depth can be bored by this rock drill with one length of drill, and without shifting the framing in any way. The drill is clamped to the combined tripod and stretcher-bar by a single bolt. One turn of this bolt enables the workman to raise or lower the rock drill, or to swivel it in any direction.

The top screw and nut enable the frame to be used as a stretcher bar where the roof of a tunnel or the side walls afford support. In such cases the back stay can, of course, be disconected and laid aside.

The advantages claimed for the Ross rock drill are: a combination of efficiency, with lightness and strength of construction. The total weight of this rock drill mounted on the compound tripod and stretcher bar is 190 pounds. Great weight in the different parts is unnecessary, from the fact that the work done does not depend upon heavy blows being struck, as in the case of the ordinary rock drill, but upon a multiplicity of light blows being given by a light piston travelling with great velocity. The piston being the only moving part in the tool, liability to fracture and derangement is reduced to a minimum.

In rock drills made on the ordinary principle, the piston and piston rod are actuated in their reciprocating motion by a separate valve, which very much increases the wear and tear of the tool. The different parts of the Ross rock drill are of light weight, and are easily put together; it is exceedingly portable, and the heavy weights attached to the tripod, necessary in other types of rock drills, are entirely dispensed with.

The Ross rock drill has been thoroughly tested on a variety of rocks. With an air-pressure of 60 pounds per square inch, the 2½ inches rock drill will bore holes, 1¼ inches in diameter, in the hardest whinstone, at the rate of about 4 inches per minute; and in ordinary sandstone at the rate of 15 to 20 inches per minute.

Mr. Ross, in reply to questions, said that the drill was always pressed against the rock by the automatic feed The drill readily cleared itself, and was not liable to heat. It had been tried in every kind of rock, with thoroughly satisfactory results. Sandstone could be drilled at the rate of 20 inches per minute, and the hardest whinstone at the rate of 5 inches per minute.

Mr. W. Archibald (Cambuslang) said that the mechanism seemed similar to that of the Harrison coal-cutting machine, which proved a regular nuisance.

Mr. Howie (Larkhall) said that with drills on the Harrison principle the great difficulty and drawback was the back stroke, but this drill was entirely different. There was no doubt that the want of an automatic feed was a drawback.

Mr. Ross said that the drill described in his paper was an entirely distinct from the Harrison machine.

DOMINION COAL CO.

A New Record for Canada—One Million Dollars Spent on Improvements and Close Upon a Million Tons Shipped in the Twelve Months.

Those people, and they were not a few, who ventured to predict that the American Syndicate had only bought up the Cape Breton mines for the purpose of closing them in the interests of American collieries, must by this time be convinced that their conclusions were, to say the least of it, premature, and they would do well in the future to act upon Mark Twain's advice: "Never prophesy unless you know." There were a few superficial observers who considered that the first year's operations of the company lent colour to such a supposition, and not a few ran about exclaiming "There, we told you so, the Emery & Gardner mines are already closed, and others are sure to follow;" but what the critics failed to see, is, at the end of the second year, perfectly obvious to the most casual observer, *i.e.*, that the company were pursuing a wise and carefully considered policy in lopping off the unprofitable branches of their concern and consolidating the whole upon a firm and reliable basis. The record of the present year shows the first fruits of this sagacious policy in a development of the best mines, a largely increased output from the whole, and a provision of the most modern and approved appliances for transporting, handling and shipping the coal. In view of the result already achieved it is a tolerably safe prediction that, in a few years, this company will so have developed its most profitable mines, and, so thoroughly established its markets, as to have rendered itself tolerably independent of all competition, and one of the strongest and best paying concerns on this side of the Atlantic. This opinion is based upon a thorough knowledge of the enormous mineral resources of the company, and their advantageous position for economical working; together with an appreciation of the vigorous and intelligent manner in which the whole business of the concern is being established. And although it is no doubt a disappointment to find a 40% tariff against them upon coal exported to the United States, we venture to think that in view of the foregoing considerations even this will not prove an insuperable barrier to a large business with the New England States; and if in addition it should be found practicable to open up a trade with the West Indies and South America, there would be sufficient scope for a still greater development than has yet been contemplated. In this connection we are pleased to note that the company has recognized that, in the probable absence of any considerable quantity of back freight, the only hope for this class of trade lies in cheap transport, and they have contracted for several large vessels of the "turret" type, carrying 4,000 to 5,000 tons each, which should enable them to carry coal to the River Platte at about $2 a ton. Their enterprise in this respect and in the opening up of a winter port at Louisburg, of which more anon, are worthy of the highest commendation, and deserve the success which they seek. These general observations are forced from us by noting the details of the year's work, which we are able to give below, and which we hope to be able to supplement in our next issue with similar details of the work done in the railway and shipping departments. We may say, just as we are going to press, the information reaches us that the total amount of coal hoisted for the year exceeds 1,000,000 tons, and the quantity shipped is about 930,000, representing an increase on the year of 200,000 tons, or 27%.

Caledonia Colliery.

The largest outlay has been at the important Caledonia mine, which has been almost revolutionized, and is now the best equipped mine which the Company possesses. The following are the additions this year:—

Chimney stack erected 125 ft. high, with 6 ft. flue.

Three Babcock & Wilcox boilers of 200 h.p. each.

One Rand compressor, capable of driving 50 coal cutting machines, working at 80 lbs. pressure.

One pair of hoisting engines, 20 in. double cylinder, 3 ft. 6 in. stroke, 5 ft. drum, to replace a smaller pair.

One iron bank-head and pit frame, covered in with corrugated iron sheets.

Two self-dumping cages.

New screening apparatus.

3,000 ft. of additional railway sidings on surface.

Additional shaft for raising and lowering workmen, 11 x 8 ft.

Endless haulage for operating the west level; capable of hauling 1,000 tons per day if required. This re-opens an old district which has been standing for some years, and which is expected to yield a large output of coal next season.

The west levels have been driven in by Stanley headers, about 900 ft. each up to date. The east deep has been carried down about 600 ft., and levels driven to the south 700 ft. and to the north 1,000 ft.—the latter connecting with the south level from the west deep. This has opened up two new districts equal to about 50 rooms. It is in these districts that the Ingersoll coal cutters are working.

A pipe line has been constructed from the compressor on the surface to the bottom of the east deep, and into these two latter levels, supplying the coal cutters with air.

A pipe line has also been laid to the back of the west levels a distance of nearly 3,000 ft. to drive the Stanleys. This will subsequently be used for coal cutting.

A large steam pump has been put in at the bottom of the shaft to raise the water to the surface, in lieu of the old lifts.

The two bank heads from east and west deeps, and the approach to the shaft are being regraded and enlarged.

Note:—The output from Caledonia mine was restricted to very little for the first few months of the season owing to the new machinery not having been completed. Since then, however, a larger tonage has been raised than in previous years.

A concrete compressor house has also been erected.

Little Glace Bay Colliery.

Two multitubular boilers have been set up on the Jeffrey system to supply steam for driving air machinery.

One Rand air compressor has been erected which is working 12 coal cutters.

A pipe line has been laid from this compressor down the deep, and into the north and south levels.

A new pump has been fixed at the bottom of the deep, which is raising the water to the pumping shaft. This supersedes the old system of hauling it with tanks.

A hauling engine 18″ x 36″ has been erected on the surface for the purpose of working endless haulage below ground. And this system has been laid along the shaft level to the north, a distance of 3,000 ft. This level has been widened and a double road constructed the whole distance.

A concrete engine and compressor house has been commenced.

International Colliery.

New engine and boiler house has been erected.

A chimney stack 100 ft. high with 6 ft. flue has been erected.

Two Lancashire boilers 30 ft. x 7 ft. are ordered for erection at this mine.

Also one hauling engine 18" x 36" to drive endless haulage, which it is intended to introduce here during the coming season.

Old Bridgeport Colliery.

One additional Ingersoll air compressor has been laid down, and pipe line constructed along the shaft level into the Reserve mine, from which air is taken to drive Ingersoll air cutting coal machines in Old Bridgeport mine and two Stanley headers in the new deeps.

New bank head and pit frame have been erected, and new screening machiuery put in operation.

Self dumping cages bave been introduced.

A new pair of hoisting engines 14½" double cylinders have been erected.

Two additional multitubular boilers.

Reservoir constructed and pipe line laid to supply water for steam purposes.

Hauling engine placed in the mine, and tail rope haulage laid down from the shaft to the extremity of the main level towards Reserve mine.

Two new deeps have been driven down by the Stanley headers, a distance of about 700 ft. This will open up a new district.

A connection has been made with the Reserve mine, which is now drained through the old Bridgeport sea level.

Reserve Colliery.

The French slope has been widened and a double track laid from surface to face, a distance of 4,000 ft. Endless haulage has been put in, the motive power being supplied by the hoisting engine previously used.

A new district has been opened up on the main slope, yielding a greatly increased tonnage. By this means the total output of the mine has reached about 1,300 tons per day during the shipping season.

Gowrie Colliery.

One additional air compressor has been erected and a pipe line laid down the deep and along the north level, to supply air for coal cutting machinery ; also for pumping and hauling.

One tail rope hauling engine has been fixed in the south level, and is hauling the whole of the coal from this district.

A Mitchell long-wall undercutter has been placed in the north level, and is cutting nearly 1,000 tons of coal per week. This north district is a new one, and has been opened entirely this year.

The levels have been driven about 1,000 ft. from the deep, and the whole of this district is being worked on the long-wall system. All the coal is extracted and the roads are protected by substantial cogging, which is constructed from the fallen roof.

A new pound room has been driven at the foot of slope ; also a new water way from the same in a direct line to the pumping shaft.

A range of pipe has been laid from the pump through this new road and the old road abandoned.

A new pipe-way has been constructed on the surface from Sand lake to Gowrie mine, which will yield a permanent supply of water for steam purposes ; distance about 3,500 ft.

Victoria Colliery.

Two new cylinders have been put in, 26 in. diam., in lieu of 24 in. previously used.

The centre slope has been enlarged and driven down about 300 ft. and a double track laid throughout. This has been connected by new levels with the west deep. The latter has been abandoned and the whole of the coal west of the centre slope is now hauled from the latter point.

The water has been pumped out of the district which was flooded three years ago, and the output raised to 700 tons per day.

A bore-hole 8 inches in diameter is being put down from the surface to the pump room for the purpose of pumping water vertically.

Two new multitubular boilers have been erected on the surface, and the bank-head has been regraded and improved.

Dominion No. 1 Colliery.

The whole of the work here, except a small portion of the sinking, has been done this year.

A shaft 24 ft. x 10 ft. 6 in. has been sunk through the Phalen seam, a depth of about 150 ft.

Large and expensive plant is being erected, consisting of two Ingersoll air compressors.

A pair of 20" x 54" hoisting engines.

A pair of 18" x 36" hauling engines for endless haulage.

Three Babcock boilers 200 h.p. each.

One 12 ft. diam. Murphy fan, driven with 6 ft. flue, has been completed.

All the permanent erections are of brick.

Railway sidings have been constructed.

An air shaft 10 ft. in diameter has been sunk.

And below ground over 5,000 ft. of deep and level work have been driven.

Steam pump has been placed below, which is raising water to the surface.

A pipe line has been constructed from Old Bridgeport mine to supply water.

Upwards of 70 miners' houses and a large boarding house have been built adjacent to this mine.

At Caledonia, Glace Bay and International Mines:—Fifty to sixty other miners' houses have been erected, also new offices, machine and engine shops, roundhouse, warehouse and other buildings, have been erected at Glace Bay.

Caledonia, postcript:—A new long-wall undercutter has recently been started, which has given very satisfactory results, having undercut 500 lineal ft. of coal 3 ft. under, in one working day.

Shipments.

We append herewith the total shipments (approximated) of coal for the year and are able to state that, if trade admits of it, the output for the next season will be considerably in excess of that for 1894 ; and during the winter every preparation will be made to this end.

Caledonia	Mine	119,195 tons.
Glace Bay	"	138,417 "
Gowrie	"	127,782 "
Dominion No. 1	"	32,840 "
International	"	129,324 "
Old Bridgeport	"	54,185 "
Reserve	"	208,071 "
Victoria	"	118,429 "
		928,243 tons.

In addition to extensive outlays on mechanical appliances at nearly all the collieries now being operated, the company has commenced to re-open the celebrated Hub seam of coal, which is one of the finest in their property, and was formerly owned by the Little Glace Bay Mining Co. Operations are being carried on day and night, and it is hoped that this mine will be ready to ship coal by the opening of navigation next spring. By that time also, the new Dominion No. 1 mine will be ready to deliver something like 1,000 tons of coal per day. And the company's arrangements for transporting coal to Louisburg, as well as their new pier at the latter place, and their crane and bucket arrangements at the International Pier will be completed. We have only to say at the close of this article that, a company which has developed the mineral resources of Cape Breton in the short period of two years, to an almost unprecedented extent, and which has expended on the spot upwards of $1,000,000 in that time, has more than justified its existence as a *bona fide* commercial undertaking, and has given hostages for the due fulfilment of its many obligations, which should be satisfactory to the most exacting critic.

COMPANIES.

(Continued from page 243.)

East Waverly Tunnel Co.—The management of this company, operating the Laidlaw's Hill gold mines, at Waverly, N.S., write : "It was intended this year to erect a steam crushing plant, but in January an extensive water privilege was secured, and the summer was devoted to developing this and bringing it to the mine. As a consequence but a limited force was employed in the mine driving levels and upraises, the combined length of all these aggregating about half a mile. In consequence of the peculiar folding of the vein which still continues, the ore fills a space of from 2 to 3 and frequently 4 ft. thick in the belt. About 500 tons are piled outside and several thousands of tons are stripped standing in the mine. A new plant will therefore be put in the ensuing spring.

Horsefly Hydraulic Mining Co.—The clean up of this company's mine in Cariboo, B.C., for the season just closed was $26,000 net. This is the bonanza property from which great things are expected next year.

Texada Lime Co.—Owing to general depression the output for 1894 was only a little over 4,000 bbls.

General Mining Association of London, Ltd.—The output from this company's old Sydney colliery, not quite completed for the year, may be put down at 250,000 tons. 466 persons employed below ground and 220 above ground. Little addition has been made to the works during the year. A Fairbanks 20-ton track weighing scales, a new locomotive built by the Baldwin Locomotive works at Philadelphia, and 21 new coal cars of 6 tons capacity, built by Rhodes, Curry & Co., of Amherst, N.S., were added to the plant. There was also imported a ventilating fan of the Murphy pattern, 10 ft. diameter, built by the M. C. Bullock Mfg. Co. of Chicago. Early in the season extensive repairs were made to the Company's Western shipping pier at North Sydney.

Whitewater Mining Co.—No work was done on this company's gold preperty in the West Kootenay district, B.C. It is now under bond to a Duluth syndicate for $71,500.

General Phosphate Corporation, Ltd.—In connection with the General Phosphate Corporation, Ltd., now in liquidation, an application was recently made for a public examination of the directors. Mr. Justice Vaughen Williams refused to grant the application, on the ground that a public examination was not justifiable, unless the report of the official receiver showed actual fraud, and the report in this case did not go that far. The Court of Appeals has just upheld the riginal judgment, but has given leave for a last and final appeal to the highest English tribunal, namely, the House of Lords. The decision was received favorably.

Mooseland Gold Mining Company, Ltd.—This company, operating in the Tangier district, N.S., is building a new 10-stamp mill, with all the latest improvements, to be in operation before February next.

Van Winkle Consolidated Hydraulic Mining Co., Ltd.—On account of water supply suddenly failing, this company was only able to pipe 3 months when gold to the value of $4,489.77 was taken out. The main sluice is now 1176 feet long and is within 250 ft. of the second bench where, judging by careful prospecting, it is expected to get the rich pay. When up to this bench the company will have a face of 96 ft. in height of gravel, and having two No. 6 monitors and the requisite pipe in place, a very large quantity of gravel should be put through next season. The property is at Lytton, B.C.

The Cariboo Hydraulic Mining Co., Ltd.—This company's claim is situate on the left bank of the South Forks of Quesnelle River, about four miles above the Forks of Quesnelle. It comprises about 500 acres held under title acquired by private charter from the legislature of B. C. The ditch now under construction, will when completed, be about 17 miles long with a capacity of 4,000 miner's inches, and will operate from two to four monitors. 160 persons were employed during the past season.

Horsefly Hydraulic Mining Co., Ltd.—This company has brought water a distance of nine miles through a very difficult country for ditching, having in several places to convey the water across the depressions in pipes for several thousands of feet at a time. The ditch has a capacity of from 3,000 to 4,000 miner's inches of water, and they use from two to four monitors of large size. The works were completed and in full running order by the end of this season when very satisfactory results were obtained.

On the Origin of Gold Nuggets.

By A. Liversidge, M. A., F. R. S.*
(Professor of Chemistry in the University of Sydney.)

From time to time various theories have been put forth to account for the existence of alluvial gold and nuggets, *i.e.*, other than the old and generally accepted one, viz., that such gold has been derived or set free from mineral veins and rocks by the ordinary processes of disintegration and denudation.

The one first propounded by Mr. A. R. C. Selwyn, C. M. G., F, R. S., when Government Geologist to Victoria, has always interested me, and within the last two years I have been able to make some experiments bearing upon the matter, but before stating the results I will refer briefly to some of the theories above referred to.

Simpson Davison advanced a theory ("The Discovery and Geognosy of Gold Deposits in Australia," p. 132, London, 1860), "that alluvial or placer deposit gold has been distributed and deposited horizontally by means of an igneous liquid or perishable lava, and that quartz veins as well as some other dykes traversing constants had been the fissures of discharge,—the only unchanged existing solid remains of the ejected matter being gold, quartz and some few other minerals besides clays and ferruginous earth;" he advanced the theory because alluvial or placer deposit gold has often a fused appearance, and the metallic grains frequently present ragged and irregular surfaces, such as must have been destroyed by abrasion. He also gives other reasons, but they are equally valueless and unimportant.

Mr. C. S. Wilkinson, F. G. S., formerly Government Geologist of New South Wales, refers in a paper read before the Royal Society of Victoria, 11th Sept., 1866, "On the Theory of the Formation of Gold Nuggets in the Drift," p. 11, to Selwyn's hypothesis, viz.:—"That nuggets may have been formed, and generally that particles of alluvial gold may gradually increase in size through the deposition of metallic gold (analogous to the electro-plating process), from the meteoric waters which circulate through the drifts, and which must have been, during the time of our extensive basaltic eruptions, of a thermal, and probably highly saline, character, favourable to their carrying gold in solution," and states that "Daintree had on one occasion prepared for photographic use a solution of chloride of gold, leaving in it a small piece of metallic gold undissolved. Accidentally some extraneous substance, supposed to be a piece of cork, had fallen into the solution, decomposing it, and causing the gold to precipitate, which deposited in the metallic state, as in the electroplating process, around the small piece of undissolved gold, increasing it in size to two or or three times its original dimensions." Wilkinson then made certain experiments to test Daintree's theory. "Using the most convenient salt of gold, the terchloride, and employing wood as the decomposing agent, in order to imitate as closely as possible the organic matter supposed to decompose the solution circulating through the drift, I first immersed a piece of cubic iron pyrites taken from the coal formation of Cape Otway, and therefore less likely to contain gold than other pyrites. This specimen (No. 1) was kept in a dilute solution for about three weeks and is completely covered with a bright film of gold."

He also used galena, copper and arsenical pyrites, antimony (*i.e.*, antimonite?) molybdenite, zinc blende and wolfram, with similar results. Brown iron ore only gave a deposit of gold powder. He found that when iron pyrites was tried with metallic copper, zinc and iron, the gold was only deposited as a fine powder at the bottom of the vessel, and came to the conclusion that organic matter was necessary to form a coherent coating of gold on the nucleus, for without the presence of wood, or similar organic matter, he found that the six sulphides were unaltered.

In his second experiment with iron pyrites, he found that the gold was deposited on it in a mamillary form, analogous to that presented by the surface of nuggets.

To sum up Wilkinson's paper, his points are (1) that gold is deposited upon sulphides in the presence of organic matter; (2) that the organic matter is essential; (3) that the coating is mamillary in some cases; (4) that gold is probably present in solution in mineral waters; (5) that nuggets are purer than vein gold and that this may be due to the nuggets having been deposited *in situ* from a solution of gold.

The next to take up the subject was Mr. J. Cosmo Newbery, in a paper "On the introduction of Gold to, and the formation of Nuggets in, the Auriferous Drifts" (Trans. Roy. Soc. of Victoria, 1868, p. 52). In this he admits that some nuggets and alluvial gold may be derived from the denudation of reefs, but points out that the largest masses are sometimes found at great distances from the reefs and in the sand overlying the gravel, both of which are inexplicable when the very great specific gravity of gold is taken into account. He also states that the presence of gold in pyrites which has replaced the roots, branches and stems of recent trees, is a proof of the existence of gold in meteoric waters of the Tertiary Times.

He quotes Selwyn's hypothesis, and Selwyn and Ulrich (Physical Geography, Geology and Mineralogy of Victoria, 1866) to the effect that all the large nuggets have been found on the western gold fields where extensive basaltic eruptions have taken place, while on the eastern and northern fields, where basaltic rocks are wanting or only of limited extent, the gold is usually fine and nuggets of more than one ounce are rare. He also states that Bischof has found gold sulphide to be soluble in pure water, and he has suggested that it may occur in that form in meteoric waters.

Newbery dissolved some gold sulphide in an alkaline bicarbonate and found that when a cube of pyrites and a chip of wood were introduced that small irregnlar grains of gold were deposited, and states that the gold is not deposited without the organic matter (*i.e.*, the wood).

Newbery repeated and confirmed Wilkinson's experiments. Newbery points out that there is little proof in nature of pyrites having acted as a nucleus; it carries gold both internally and attached externally, but we do not meet with *gilded pyrites*, such as are obtained in laboratory experiments, and that in nature the two appear to have been deposited together.

Newbery, out of one hundred samples of pyrites, found none with any coating of gold such as is obtained experimentally, but it was present in irregular grains and small octohedral crystals; in exceptional cases pieces of gold were found projecting, but all proved that the pyrites had not formed a nucleus for the gold, but the reverse has been the case in the majority of instances, *i.e.*, the gold has been deposited first; and he suggests that the gold may have been deposited first in the drift wood, as seen when organic matter, flies, &c., fall into a gold solution, and the pyrites afterwards deposited around it.

He also refers (Laboratory Report, Melbourne, 1876) to Daintree's discovery of an enlarged fragment of gold in a bottle containing chloride of gold, and states that "Ulrich, who was present when Daintree discovered the enlarged piece of gold, says that the original piece was a small fragment which remained undissolved after making some chloride and the bottle was closed with a cork; when again observed the solution was colorless and the fragment of gold of such a size that it could not be removed from the bottle through the narrow neck."

Newbery, like Skey, found that hammered pieces of gold did not increase in size, but he had little doubt of others with a rough or natural surface doing so.

Mr. Newbery was followed by Mr. W. Skey, F. C. S., Analyst to the Geological Survey of New Zealand, in a paper "On the Reduction of Certain Metals from their Solutions by Metallic Sulphides, and the relation of this to the occurrence of such Metals in a Native State." (Trans. N. Z. Inst., 1870, p. 225.) Mr. Skey also repeated Wilkinson's experiments and obtained the deposits of gold on various sulphides and arsenides, and further found that the presence of organic matter is quite unnecessary for bringing about the deposition of gold upon the above minerals. He also found that silver nitrate and acetate, and the salts of one or more of the platinum group of metals, are reduced by the metallic sulphides and arsenides. He points out that the metallic sulphides possess much greater reducing power than organic matter, and that a single grain of iron pyrites will reduce $8\frac{1}{6}$ grains of gold. And that although organic matter may have had a share in the reduction of gold, he is of opinion that the greater portion of the deposits—especially the deep-seated ones—have been due to the deoxidising effects of pyritous minerals.

In a succeeding paper, "On the Electro-motive Power of Metallic Sulphides" (Trans. N. Z. Inst., Nov. 12, 1870, p. 232), Mr. Skey describes experiments which he made to show that when such sulphides as pyrites and galena are placed in dilute acids or saline solutions and connected by a platinum wire, the current generated is sufficient to throw down gold in separate vessel from its chloride. He points out from these experiments and Mr. Fox's statements as to the existence of currents of electricity in the earth's crust that each pyritous vein or mass with its surrounding walls and exciting solutions may constitute a true voltaic pair on a grand scale.

A third paper by Mr. Skey is entitled, "On the Mode of Producing Auriferous Alloys by Wet Process." (Trans. N. Z. Inst., 1872, p. 370). He states amongst other matters, "that when chloride of gold is added to an alkaline, argentiferous solution of this nature (silver chloride in alkaline chlorides; silver chloride in either acid or neutral solutions is not reduced by iron pyrites,) such mixed solution is capable of depositing the metals contained in it in the form of coherent alloys upon metallic sulphides." Also that such alloys can be formed by voltaic action. Further "that as the water permeating rocks is usually alkaline it seems probable that native alloys of gold and silver have been deposited from alkaline solutions by the metallic sulphides."

He further remarks, that many substances will reduce gold from solution, but the only common ones likely to occur in the interior of rocks are ferrous sulphate, organic matter and the metallic sulphides, these also reduce metallic silver from certain of its solutions, but only the sulphides will reduce the two metals simultaneously and throw them down in coherent forms.

Mr. Skey continued his investigations and published still further results in the following paper: "Critical Notes upon the Alleged Nuclear Action of Gold upon Gold reduced from Solution by Organic Matter. (Trans. N. Z. Inst., 1872, pp. 372-5.) In this paper, Mr. Skey gives the results of his attempts to confirm Daintree's and Wilkinson's experiment, but, as he says, unsuccessfully; he accordingly describes minutely the methods which he adopted, and found that when a weighed piece of sheet gold was placed in a dilute solution of sodium chloraurate with organic matter until all the gold was precipitated, that the piece of gold only increased in weight .0005 of a gramme, and by calculation he found that no more gold in proportion was deposited upon the gold plate than upon the sides and bottom of the glass vessel, and even the surface of the liquid itself—the experiment was repeated four times. He points out that the conditions in Daintree's accidental result are so vague and uncertain that it is impossible to credit the organic matter with producing the phonomena described. Neither the volume nor the weight of the undissolved gold was taken, hence he considers that the statement that after some time the fragment of gold had increased in size is of but little value, as it depended entirely upon the eye memory of the original size of the gold particle, and an ocular estimate of its increased dimensions:

In his next communication, "On the Formation of Gold Nuggets in Drift," (read before the Wellington Philosophical Society, Oct. 23, 1872—Trans. N. Z. Inst., Vol. v. for 1872, pp. 377-383). Mr. Skey says, "we cannot avoid the conclusion that gold is now being deposited and aggregated in many of our drifts, and that such depositions have been going on from remotest times." He thinks that this gold is derived from the metal disseminated through slate, sandstone or schist rocks rather than from that of our reefs, and that we may reasonably suppose it is present as sulphide and is brought into solution by alkaline sulphides from which it is again eventually redeposited as nuggets, etc., by the reducing effects of metallic sulphides—a mass of iron pyrites only two pounds in weight being sufficient to cause the deposition of a nugget such as the "Welcome" weighing one hundred and eighty-four pounds, troy.

Sir Rod. J. Murchison, (Siluria, 5th edition, 1872, p. 465) after referring to Mr. A. C. Selwyn's suggested explanation as to the formation of nuggets, and to Mr. Wilkinson's experiments, says that he "prefers to remain in his old belief, that the large nuggets found in the drift are simply the reliquiæ of the chief masses of gold that once occupied the uppermost parts of the reefs, and that like the blocks of many an ancient conglomerate, they have been swept from the hilltops into adjacent valleys by former great rushes of water."

Mr. Brough Smyth, F. G. S, in his work on "The Gold Fields and Mineral Statistics of Victoria, 1869, p. 361, discusses the origin of nuggets and points out that most of the large nuggets have had a great quantity of quartz adhering to them or intermixed with them, clearly indicating that the nuggets must have come from a quartz reef, or else the gold and quartz must both have been deposited together from meteoric water in the drift.

In Mr. W. Birkmyre's list of nuggets quoted by Mr. Brough Smyth, he says of the Welcome nugget, weight, one hundred and eighty-four pounds, nine ounces, (troy) that it was apparently water worn and contained about ten pounds of quartz, clay and oxide of iron.

The Blanche Barkley, which weighed one hundred and forty-five pounds, three ounces, apparently contained two pounds of quartz, clay and oxide of iron.

The next in his list weighed one hundred and thirty-four pounds, eleven ounces, contained dark colored quartz.

In fact he mentions the association of quartz with nearly all the very large nuggets and expressly states that many of the smaller ones were free from quartz; as we might naturally expect.

Brough Smyth remarks that, "much stress is laid on the fact that nuggets are sometimes found at a considerable distance from a quartz reef;" but it may be, that the reef from which the nugget has been set free may have been completely denuded away, its matrix need not necessarily have been the nearest now existing reef. He quotes Ulrich's remarks in support of Selwyn's hypothesis of the formation of gold nuggets *in situ* in alluvial deposits; (Notes on Physical Geography, Geology and Mineralogy of Victoria, by Alfred R. C. Selwyn's and Geo Ulrich, Melbourne, in 1866, p. 43), but points out that if such is the case in the present day, then the older sedimentry rocks ought, from the greater lapse of time, to contain large masses of gold. Moreover large nuggets are not confined to deep leads, but many have been found only a few inches below the surface. He also says that the statement that all the large nuggets have been found on the western gold fields where basaltic eruptions have been prevalent, is erroneous, many large nuggets have been found remote from basaltic areas, and Mr. Birkmyre's list shows that the fields most remote from basaltic areas have produced the most large nuggets; in Gippsland if not large they are numerous.

Mr. G. Attwood, in a paper on Gold from Guayra, Venezuela, S. America—

* Read before the Royal Society of N. S. Wales, September 6, 1893.

(Jour. Chem. Soc., London, 1879, p. 427-9), concludes, from an examination of one particular specimen, that gold nuggets do gradually increase in size owing to the accumulation of fresh particles of finely precipitated gold.

Prof. Whitney, in a paper, "The Auriferous Gravels of the Sierre Nevada of California," Cambridge, U. S. A., 1880.—says that "it does appear as if there was some truth in the idea that the finding of large pieces of gold in the gravel is not justified by what we see of the occurence of the metal in the quartz. It is certain, at all events, that the form of the ordinary nugget is something different from that which is offered by the gold as originally deposited. In quartz it is either quite invisible or else it is scaly, foliated, filamentous, arborescent or crystalline, quite unlike the rounded and smooth or flattened pieces met with in alluvial deposits." He, however, points out that this difference could be produced by attrition, and he thinks it highly improbable that masses of gold in gravel could be enlarged by any chemical influence.

The bark of some of the tree trunks found buried in the blue gravel (Cal.) is largely replaced by iron pyrites and this is rich in gold, "hence we cannot deny that some gold has been deposited in the placers from solution, but this certainly does not include the nuggets and gold dust." He also says, "if the gold of placers were deposited from solution, we should necessarily find much of it crystallized and forming strings and sheets running through the porous material; whereas, as a matter of fact crystals are never found in placer gold, nor are sheets or threads. Scales, grains, pebble-like nodules, round battered masses. these are what we find."

Prof. J. S. Newbery, in a paper, "On the Genesis and Distribution of Gold," (Sch. of Mines Quarterly, III., New York, 1881), does not support Selwyn's hypothesis. He points out that a mass of vein gold was obtained, weighing ninety-five and a half pounds, and originally one hundred and forty pounds, from the Monumental Mine, Sierra Buttes, Cal., which proves that large masses do occur in veins as well as in the form of nuggets.

He thinks that the proportion of large masses from veins is quite equal to that from placers or alluvial deposits. The smaller proportion of silver in alluvial gold, he thinks, is accounted for by the greater solubility of silver in various solutions, and its consequent removal just as in the process of "pickling" by jewellers.

Other "nuggets" from veins might be cited *e.g.*, a mass of gold and quartz celebrated as Dr. Kerr's "hundred weight of gold" was found in 1851 in the Meroo or Louisa Creek, River Turon, N. S. W., at a place now known as Hargraves. Although in three pieces when discovered, it apparently had formed one mass; the three pieces weighed one and three-quarter hundred weight and yielded one hundred and six pounds, troy, of gold. Another mass of gold and quartz which yielded one hundred and twenty pounds of gold on being pounded with a hammer, was found at Burrandong near Orange, in New South Wales, in 1858. Some very large masses of gold were found in Beyers and Holtermann's quartz reef at Hill End, N. S. W. From ten tons of quartz 102 cwt. of gold were said to have been obtained. (A. Liversedge —Minerals of N. S. Wales, p. 21, London, 1888.)

Walter B. Devereux, E. M., in a paper, "On the Occurence of Gold in Potsdam Formation, Black Hills, Dakota, (Tran. Am. Inst. Mining Engineers, 1881, p. 465, states that careful observation in the field and consideration of the facts have led him to reject the theory that the gold has been deposited in the conglomerates from solution, and he regards it as a purely mechanical constituent; but states, p. 471, that "the larger and grain of the alluvial gold the greater the amount of silver it contains."

Prof. Egleston, in his work upon "Metallurgy of Silver, Gold and Mercury in the United States," (New York, 1887, Vol. ii., p. 57) takes up the question of the origin of nuggets, and quotes a letter from Mr. Selwyn, 28th March, 1882, in which Mr. Selwyn stands by his original hypothesis as follows;—"The cause (*i.e.* of nuggets) was the percolation through the gold bearing strata of very large quantities of saline and acid thermal waters, during the period of great volcanic activity, which produced the basalts. This action accompanied, but to a great extent succeeded, the phenomena which produced the present placer deposits. This gold from meteoric waters deposited on that already in the sands, produced the nuggets. He further states that his opinion is confirmed by the fact that large nuggets only are found in the western gold fields, as at Ballarat, Daisy Hill, &c., where immense basaltic eruptions had taken place all over the district. In the eastern and northern districts, as Gippsland, Ovens, &c., where streams of basalt occur only to a very limited extent, or are altogether absent, the gold is generally very fine, and nuggets of over one ounce in weight are of the greatest rarity." Brough Smyth, however, states otherwise, (see p. 25).

Prof. Egleston urges that in cases where the "gold does come from the destruction of veins, the surfaces are rounded and worn smooth.' . . . . "This is an entire contradiction to the mammillary structure of the nuggets." . . . . . They would have been water worn on the outside, and the cavities "would have been in the condition in which they left the vein, and the edges of any crystals found there would have been sharp; while in the nuggets the mammillary form exists even where crystals or the commencement of crystallization is observed, the edges of the crystals are very often blunted or rounded, showing both deposition and solution on these edges."

Egleston also urges, as others have done, that if the gold had come from the eroded rocks, it should have the same composition as that of the veins of the district in which it is found; whereas he says it is well known that vein gold is usually poorer than the alluvial gold of the same district, *e. g.*,

	California.	Australia.	Transylvania.	Nevada.
Nuggets	800 to 980	992.5 to 966	..	..
Veins....................	730 to 860	..	600	333 to 554

Egleston states, "that the violence of the old placer currents was very much greater than that of the ordinary streams of these days," and that "if this were the whole process and no further action had taken place, the gold would have been found in the comminuted condition exclusively" Further "that, gold is, however, also found as nuggets, and in small particles in rocks which have never been disturbed from their original positions, but which have been decomposed to a considerable depth and it then has the same mammillary form, occupying positions which make it evident that it must have been formed *in situ*, and never have undergone any abrasive action. The nugget found in 1828 in Cabarrus Co. N. C., which weighed thirty-seven pounds and also the one found in the valley of Taschku Targanka near Miask in Siberia, which weighed ninety-six pounds, were both found under such circumstances in a decomposed dioritic rock. In some few cases it has been definitely ascertained that the gold has been dissolved and precipitated in the decomposed rocks, or it has penetrated only just so far as the decomposition has allowed it, the yield in gold ceasing entirely at the point where the rock allowed no further filtration; while in other rocks of a more porous nature in the same district the gold has penetrated to a depth not yet ascertained."

(*To be Continued.*)

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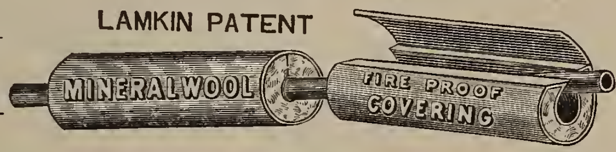

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