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Established 1882

Vol VIII.—No. 10.

1889.—OTTAWA, OCTOBER—1889.

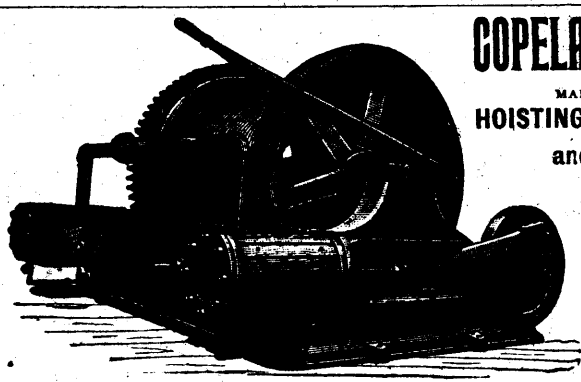
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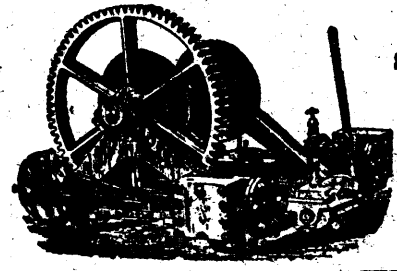
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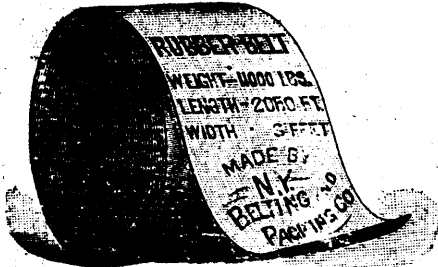
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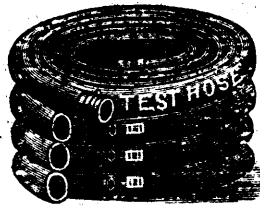


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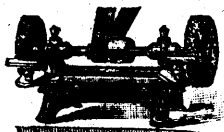
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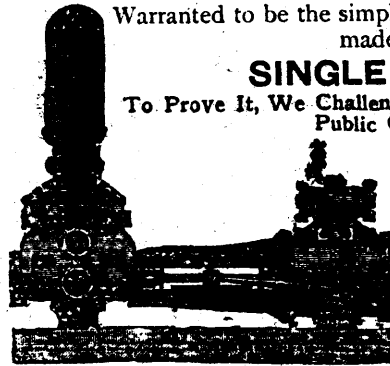
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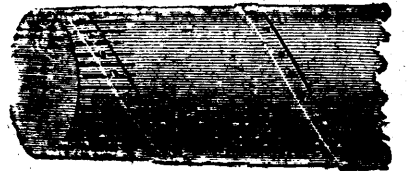
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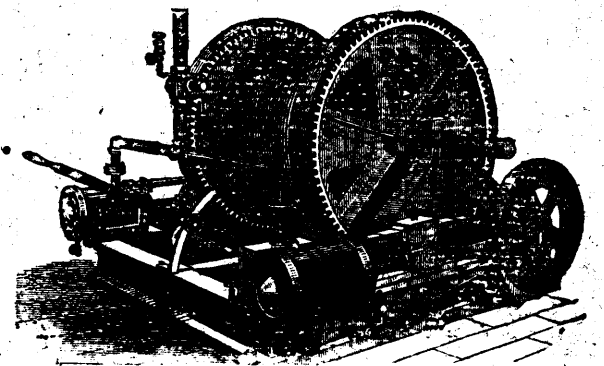
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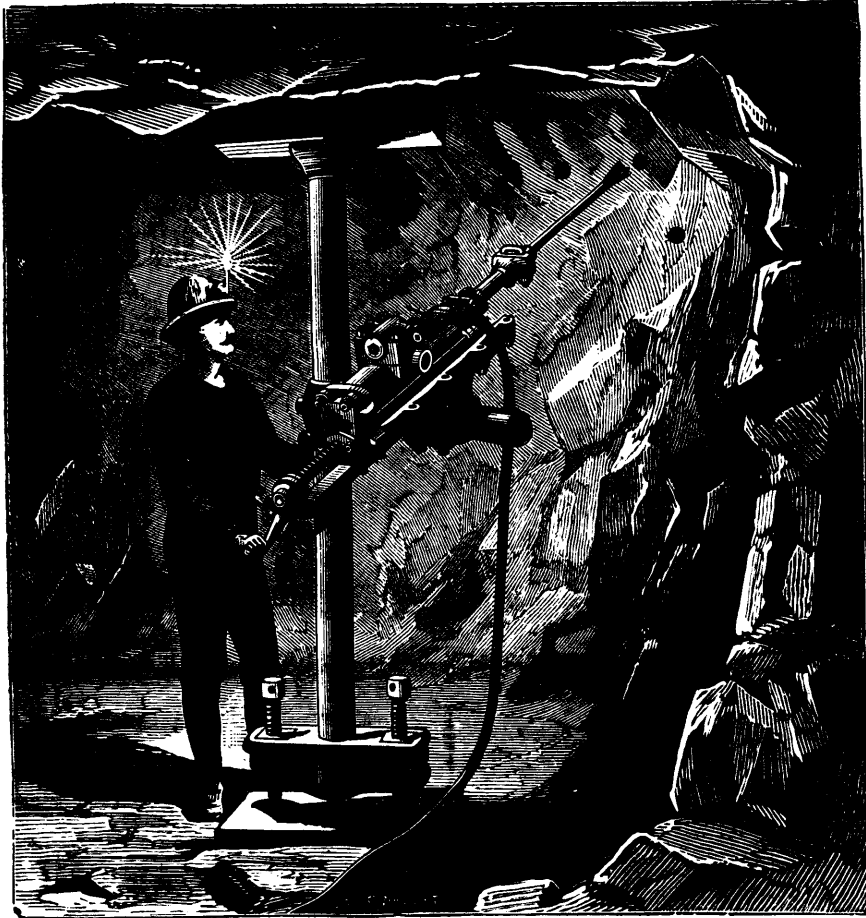
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The following summary of the principal provisions of the General Mining Act of the Province of Ontario is published for the information of those interested in mining matters in the Algoma District, and that part of the Nipissing District north of the Mattawan River, Lake Nipissing and French River.

Any person or persons may explore for mines or minerals on any Crown Lands surveyed or unsurveyed, not marked or staked out or occupied.

The price of all lands sold as mining locations or as lots in surveyed townships is two dollars per acre cash, the pine timber being reserved to the Crown. Patentees or those claiming under them may cut and use such trees as may be necessary for building, fencing or fuel, or for any other purpose essential to the working of mines.

Mining locations in unsurveyed territory shall be rectangular in shape, and the bearings of the outlines thereof shall be due north and south, and due east and west astronomically, and such locations shall be one of the following dimensions, viz: eighty chains in length by forty chains in width, containing 320 acres, or forty chains square, containing 160 acres, or forty chains in length by twenty chains in width, containing 80 acres.

All such locations must be surveyed by a Provincial Land Surveyor, and be connected with some known point or boundary at the cost of the applicant, who must file with application surveyor's plan, field notes and description of location applied for.

In all patents for mining locations a reservation of five per cent. of the acreage is made for roads.

Lands patented under the Mining Act are free from all royalties or duties in respect to any ores or minerals thereon, and no reservation or exception of any mineral is made in the patents.

Lands situated south of the Mattawan River, Lake Nipissing and French River are sold under the Mining Act at one dollar per acre cash.

Affidavits showing no adverse occupation, improvement or claim should accompany applications to purchase.

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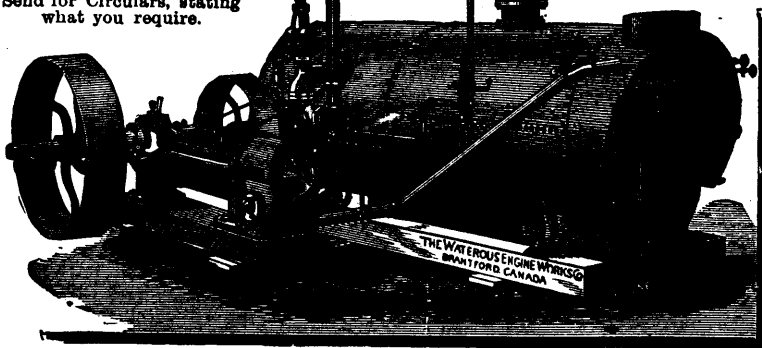
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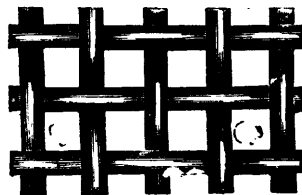
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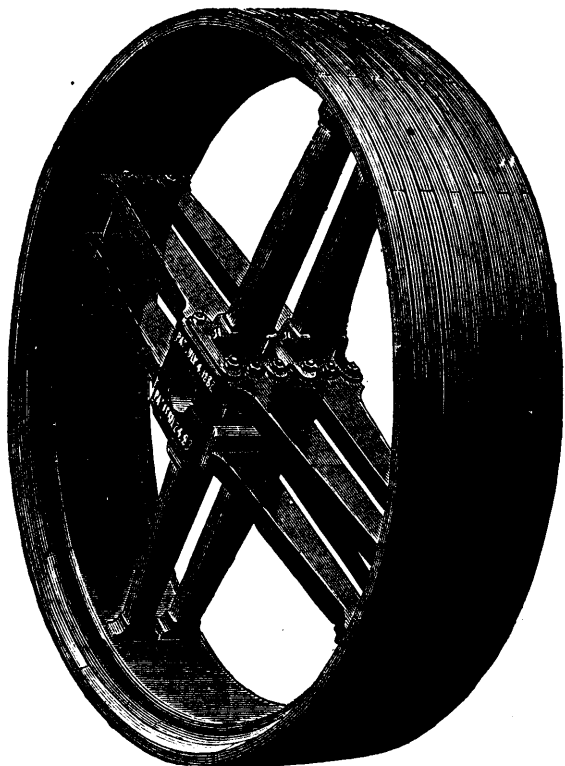
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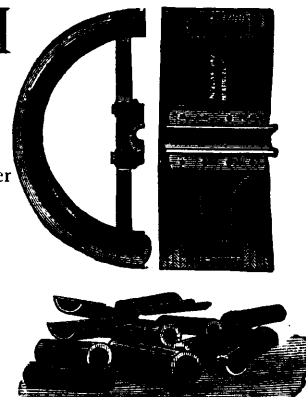
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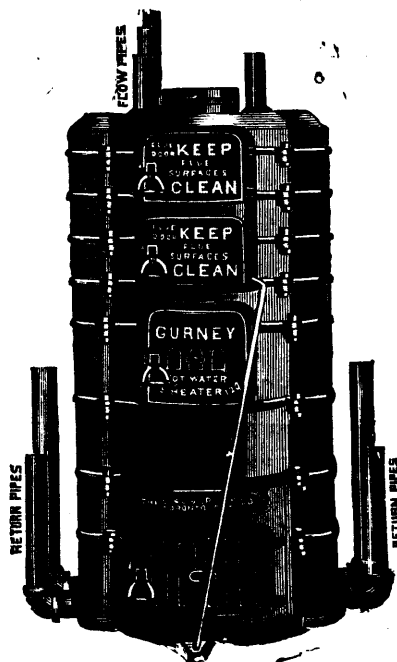
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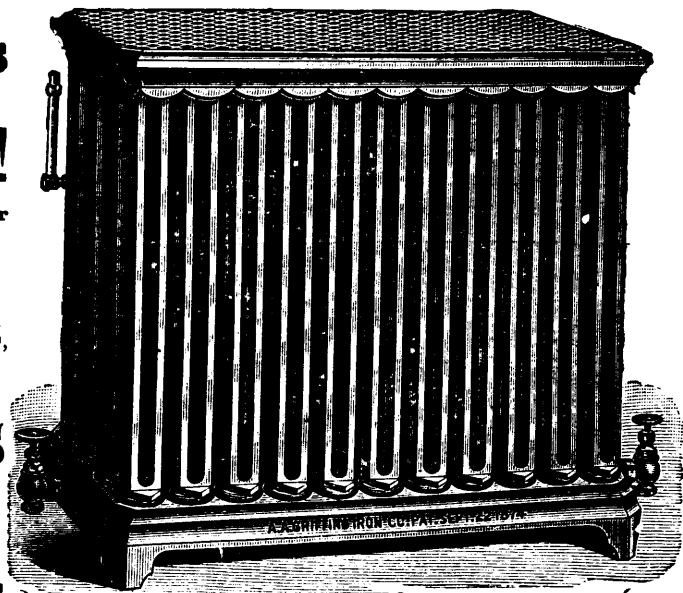
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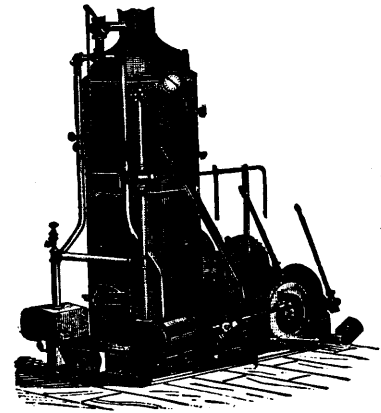
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Vol. VIII. SEPTEMBER, 1889. No. 9.

**To Our Readers.**

Owing to the press upon our space incidental to the recent Meeting in Canada of the American Institute of Mining Engineers, we have been compelled to hold over our usual notes from the mines, and other interesting matter.

**Obituary.**

We regret very much to have to record this month the sudden demise of Professor David Honeyman, Curator of the Nova Scotia Museum of Natural Science. The deceased gentleman will long be remembered as one of the greatest authorities on the Geology of eastern Nova Scotia and Cape Breton.

The sudden death of T. H. Hulbert, M.E., chief owner and manager of the Mink Mountain Mine, near Port Arthur, from an accidental overdose of morphia, takes from us one of the ablest pioneer explorers and mining engineers this district has ever seen.

**The Visit of the American Institute of Mining Engineers.**

The recent visit paid by the American Institute of Mining Engineers, and the holding of their autumn Session at the Capital was a feature of international courtesy amongst members of the mining profession which would well bear repetition, and the fruits of which cannot but be productive of immense advantage to Canada. When it was definitely ascertained early in the year that this visit was decided upon, a large citizens' committee was formed to take the necessary steps to carry out all requirements. This, however, soon resolved itself, as all such gatherings do, into a few energetic workers, to whom it became a "labour of love" to think out and arrange for the comfort of the coming guests, and to select what excursions would best enable them to see the mineral treasures of our country, and at the same time afford a pleasant trip in each of the provinces of Ontario and Quebec. Well did this committee carry out its work, and the voice of the visitors was unanimous in praise of everything done for them. The proceedings of the Session and the various excursions are described elsewhere. The number of our visitors was not so large as had been expected, but what was lacking in quantity was made up in quality, for those who came were all leading representative men at the head of their profession, and experts in every respect.

It is a matter of regret that only one representative of the iron trade, Mr. John Birkenbine, was in attendance. The slimness in the attendance of

this most important branch of the profession is however accounted for from the unusual activity now prevailing in the iron industry, and the largely increased number of blast furnaces now at work across the line; to the fact of the Paris Exhibition having induced a number of this class of the community to pay it a visit, while the lateness of the season and the inclemency of the weather prevented many more from attending who otherwise would have been present.

To this latter fact also is mainly due the abandonment of the proposed trip to the silver and iron districts of Port Arthur. The enterprising population of that rising town were disappointed, and rightly too, at the abandonment of that trip, for they had made the most elaborate arrangements for their expected visitors. To close this brief reference without mentioning the deep interest shown in everything by the ladies who accompanied a number of our American guests, would make it very incomplete, and their presence on the excursions, where despite the very bad weather prevailing they were the life and soul of the party, added materially to the success of the whole proceedings. We look forward with pleasure to another visit to Canada at some future day, of this distinguished body, the American Institute of Mining Engineers, and hope that what the visiting members have lately seen in their tour will tend to increase in every way the relationship which nature designed should always exist between the two nations of the North American continent.

**Deep Gold Mining in Nova Scotia.**

In the gold districts of Nova Scotia an auriferous quartz vein usually presents one or more irregular patches of ore richer than the quartz bounding it on the longitudinal extension of the lode. These rich "pay streaks or chimneys" vary in length and depth up to five hundred feet. They dip at various angles to the horizon, and do not materially differ from those found in other parts of the world. It is not necessary to allude here to the many ingenious theories which have been advanced to account for this concentration of gold, etc., at certain points in the vein, but it may safely be said that no law is known governing their formation in Nova Scotia, and the remark of an old miner best fits, that there would be no fun in gold mining without it.

As already remarked the shape of these paystreaks is irregular, and they vary equally in their extent. Some outcrops of paystreaks have been followed but a short distance, while others have repaid the miner's toil to a depth of 600 feet, and others again have been struck accidentally in underground workings. Hitherto in Nova Scotia the life of a mine has usually ended when the paystreak gave out, the exceptions being the operations in slate belts, and in comparatively low grade veins, and it has become

a generally accepted axiom that there is no use in pushing explorations in barren quartz. A paper read at the last meeting of the Royal Society of Canada certainly gives reasons for expecting that the veins would thin out in depth, but it is also pointed out that the depth at which this thinning out may be met is far beyond the deepest mining yet reached here or in other countries.

In view of this abandonment of mining when the pay quartz in sight is extracted, the question of the enrichment of the veins at lower depths is of great importance to the Province as well as to the miner. Without the expression of an opinion as to the probability of the occurrence of rich paystreaks at greater depths, or the renewal of a paystreak, after an interval of barren quartz, on the line of prolongation of its greater axis, it may be remarked that, as the fact of lateral enrichment of a vein has been proved by the occurrence in it of more than one paystreak, there appears to be, in comparison with the limited extent of mining operations, no reason why similar enrichments should not be found in depth.

As yet no mining company in the Province has tried to prove this point, although its importance has been recognized by those who have been fortified by foreign experience, and the desire of securing the fullest possible return for the expense of purchase and equipment of their mines. Applications have been made to the Provincial Government to undertake the task, or to subsidise companies who might offer to carry out the test. The opinion of the applicants being that either a new shaft should be sunk in any district specially selected, or that in any district a shaft which had intersected a paystreak should be continued to a depth of from 800 to 1,000 feet.

The most apparent objection to the Government trying the experiment, either directly or indirectly, is that a failure in any district would be merely a negative proof, and would be quoted against the value of the deposits, and the consideration of experience would presumably not allow of this most admirable method of investigation being tried very often. In Australia large sums are annually expended by the Government in prospecting with diamond drills for the purpose of exploring for new gold fields. There, the conditions under which the gold occur, as comparatively level deposits overlaid by immense masses of trap, etc., are favorable to this method of exploration. In Nova Scotia the alternating beds of slate and quartzite are inclined at high angles, the veins are numerous, and the work of boring would be extremely expensive, while the comparative narrowness of the veins would make a "test core" of a free gold vein, even if the drill penetrated a paystreak, of uncertain value.

A writer in a local paper some time ago suggested another way of approaching this matter, which is free from some of the objections

alluded to. The idea was that the Government should offer a bonus to the company which should first show practically the existence of gold in remunerative amounts at a depth exceeding, say nine hundred feet. If the chance of a good bonus was displayed, a company working quartz at a depth of 300 or 400 feet at a fair profit, could try the experiment without incurring a very heavy expenditure. If unsuccessful, the bonus would remain for another test, made perhaps in a different district, and under conditions possibly more favourable.



### The Meeting of the American Institute of Mining Engineers at Ottawa.

The fifty-fifth meeting of the Institute was held at Ottawa during the week commencing Tuesday, 1st October. When the very large membership of the Institute is considered, numbering, as it does, close upon 2,500 members, a comparatively small attendance was registered when the first session was called to order. Many reasons may be given to account for this. As stated in our last issue, a large number of members had just returned from a European trip extending over several months, another considerable number were present at the Denver meeting in June, while others were present at the Toronto meeting of the American Association for the Advancement of Science and these, of course, found it difficult to get away again this year. Again, there has been a very decided revival of business in the United States, particularly in the iron trade, where blast furnaces are being blown-in, contracts are under negotiation, and engagements are more important and imperative than usual. The attendance of Canadian members was also not so large as expected. The following members of the Institute, and invited guests, were present during the meeting:—Dr. Chas. A. Asburner, Asst. State Geologist of Pennsylvania, and Mrs. Asburner, Pittsburg; S. E. Bretherton, Leadville, Colo.; Martin L. Griffin, Holyoke, Mass.; Dr. H. T. Bovey, Montreal; Capt. R. C. Adams, Managing Director Anglo-American Phosphate Co., Montreal; J. H. Bramwell, coal operator, Bramwell, Va.; C. S. Bedell, U. S. Assay Office, New York; B. T. A. Bell, editor CANADIAN MINING REVIEW, Ottawa; Dr. Robt. Bell, Geological Survey of Canada, Ottawa; John Birkinbine, M.E., editor *Journal of Chemical Workers*, Philadelphia; W. B. Cogswell, General Manager of the Solvay Process, and Miss Mabel Cogswell, Syracuse, N.Y.; J. B. Church, Mrs. Church, Miss DeLaney and Miss Bright, Geneva, N.Y.; W. S. DeCamp and Mrs. DeCamp, Lyons Falls, N.Y.; C. A. DeCamp and the Misses S. M. and M. A. DeCamp, Boonton, N.Y.; Prof. Thos. Egleston, School of Mines, New York; Dr. R. W. Ells, Geological Survey of Canada, Ottawa; T. R. Gue, President Acadia Powder Co., Halifax, N.S.; W. H. Hulick, Easton, Pa.; John E. Hardman, S. B. Oldham, N.S.; L. Holbrook, New York;

Wm. H. Hale, *Engineering and Mining Journal*, New York; Dr. B. J. Harrington, McGill University, Montreal; W. H. Hutcheson, Anglo-Continental Guano Works, London, Eng.; C. H. Joliet, Roselle, N.J.; Jas. E. Jopling, Marquette, Mich.; J. T. B. Ives, Toronto; E. D. Ingall, M.E., Geological Survey, Ottawa; C. Kirchoff, Jr., editor *Iron Age*, New York; J. S. Lane, M.E., M. C. Bullock Mfg. Co., Mrs. Lane and W. A. Lane, Chicago, Ill.; N. M. Langdon, Port Henry, N.Y.; A. P. Lowe, Geological Survey, Ottawa; Thos. Macfarlane, F.R.S.C., Ottawa; F. H. Macdowall, Consulting Engineer, Tilley Foster Mine, New York; Major R. G. Leckie, Sherbrooke, Que.; A. W. Newell, Bradford, Pa.; J. Obalski, Mining Engineer to the Province of Quebec, Quebec; J. C. Platt, Waterford, N.Y.; F. Prince, General Manager Slate Mining Co., Slatington, Pa.; Dr. E. D. Peters, Jr., General Manager Canadian Copper Co., Sudbury; John C. F. Randolph, New York; Addison C. Rand, President Rand Drill Co., and Miss Josephine Rand, New York; Dr. R. W. Raymond, Montana Smelting Co. and Secretary to the Institute, Miss Elizabeth Raymond and Miss Atherton, New York; Theo. D. Rand, Philadelphia, Pa.; F. R. Redpath, Montreal; Prof. John C. Smock, Albany, N. Y.; Prof. S. J. Sharples, Boston, Mass.; T. Trimble, Managing Director Templeton and Blanche River Phos. Co., Montreal; J. Lainson-Wills, F.C.S., Buckingham; P. Würzburger, M.E., Antwerp, Belgium, etc., etc.

#### Opening Session.

The opening session was held on Tuesday evening, 1st October, in the large room, House of Commons, usually occupied by the meetings of the Royal Society of Canada, and known as the Railway Committee Room. When proceedings commenced the hall was completely filled. Beside the members of the Institute, there were present a goodly sprinkling of local mining men and a large number of ladies.

Mr. B. T. A. Bell, Secretary of the Citizens' Committee, read letters regretting inability to be present from Sir Hector Langevin, Minister of Public Works; Hon. A. S. Hardy, Commissioner of Crown Lands, Toronto; Hon. G. Duhamel, Commissioner of Crown Lands, Quebec; and from His Worship the Mayor of Ottawa.

SHERIFF SWEETLAND—Mr. President, Ladies and Gentlemen of the Am. Inst. of M. E.: As Chairman of the Local Committee, it is my duty, and a very pleasing duty it is, to extend to you a hearty welcome to Ottawa. In doing this I speak on behalf of the citizens who appointed the gentlemen who act with me as the Local Reception Committee. We feel honored that you have made Ottawa your choice for this year's Autumn Meeting. I believe this is the third time that the Institute has met in Canada, and I trust that this may be reckoned hereafter as one of the most successful meetings ever held by the Institute. So far as the Committee and the people here are concerned we will endeavor to make it so. We have been assisted very materially by the liberal Grants from the Federal and Provincial Governments, so that the welcome is not confined to the city itself. The co-operation of the different governments is the best evidence that the country appreciates the position which you occupy as practical scientific men. I think I may use the word practical in connection with your Institute, because you are all workers as I understand it. You are all anxious to take from the bowels of the earth those economic minerals which are necessary to promote a higher civilization. We all work for that common purpose. It makes no difference whether we are on one side of the line or the other. I am glad to see that yours is an American Institute, that it covers the whole of this great continent. Although you meet sometimes in the south, sometimes in the extreme west, and at other times in the east, you occasionally pay a flying visit as you do now to the north. In Canada we have a very great deal to show you that I am satisfied will be of the greatest interest to yourselves, as well as, I hope, of interest and benefit to ourselves. The mineral resources of this vast country have as yet been scarcely touched. What little mining has been done has been but a tickling of the surface, but we have endeavored to show you by the series of excursions arranged for the latter part of this week that this northern portion of the American continent possesses vast and almost unlimited mineral wealth. We are going to take you over more

than 1,200 or 1,500 miles of our country and that is only a small portion of it, as you know, but it is as much as we can possibly show you on a flying visit such as this. I do not intend to, nor should I occupy your time this evening. I am merely supposed to extend to you a hearty and cordial welcome. I have on my right no less a personage than the Rt. Hon. Sir John A. Macdonald, a gentleman whom we in Canada look upon as being without a peer, and I think we are safe in saying so. (Cheers.) We have also a member of the Quebec Government, the Hon. Mr. Ross, Minister of Public Works, who comes from a Province which is deeply interested in the development of her mines. I will now introduce to you the Rt. Hon. Sir John A. Macdonald.

SIR JOHN A. MACDONALD—Gentlemen of the American Institute of Mining Engineers, I shall join as a citizen of Ottawa with my good friends in wishing you a hearty welcome. We are very proud indeed to know that your Institute has already honored Canada so far as to have visited it on previous occasions, and we hope your visit to our metropolis—which is still an infant metropolis of Canada—will be such as to induce you to come again. My remarks will be very brief, but they are not the less sincere on account of their brevity. We welcome you here. We are exceedingly proud and happy to greet you, and hope you will have a very pleasant time while you are here, and that pleasure may be joined to some acquisition of knowledge as to the resources of our country. Formerly, I am afraid, the majority of our American friends on the other side of the border considered us, as Voltaire considered Canada years ago, as occupying a region of ice and snow. I am glad to find that that idea has altogether disappeared, and some of my political friends going to the south of the border tell me, in fact, that the Americans are getting too affectionate. (Laughter.) They are getting altogether too affectionate. I dare say, and I hope and believe, that the intercourse between the people of Canada and you gentlemen, as representing a very important body from the United States, will tend still further to unite us together in feeling, as we are in blood and language and otherwise. I told a story a short time ago, which I shall repeat. It was a good many years ago now, when the Americans did not know Canada nor covet it so much as they do at present. (Laughter.) They were not so well aware of our very great merits. This story was told to me by a gentleman, now a Canadian but of American birth. He was traveling from Windsor, at the western extremity of Ontario, eastward, and he was sitting behind two American gentlemen who were evidently paying their first visit to Canada. He could not help hearing their conversation. After going a few miles eastward one of them said:—"This is not so bad a country." "No," says the other, "it is not a very bad country." After going a little further the one who had spoken first said:—"This is a fine country; we must have this country." "Oh," says the other, "I would have no objection to taking the country if it were not for the damned people we would have to take." (Laughter.) That is all gone now, and as I have already said, we believe that our good neighbors are beginning to think that our country is not so far inferior to theirs; not so far, at all events, as to disincline them to take the country even with the encumbrance of the people. (Laughter and applause.) I shall not detain you any longer, not being a miner myself, but a politician. Some of our enemies say of us that the only mining we know of is undermining. (Laughter.) But that is a falsehood, like many other falsehoods that are prevalent in this world. I wish every prosperity to your Institute, which I believe is calculated to do a great deal of good. I think science belongs to no country, nor does the practice of science belong to any country. I believe the examination of Canada by you, gentlemen, will be of very great service to Canada; and as a matter of self-interest, if it were not from higher sentiments, we greet you from the bottom of our hearts. We think, with your assistance, that is from the reports you will make, we will be able to stand still higher as a country capable of great development, and I can say that with your assistance we will be able to do that which is described in the rather profane language of the celebrated Sheridan when he went down to Manchester at the time of the construction of the great Bridgewater Canal. As you know, that is a great country for professional men like yourselves, and as far as canals and mines and the development of industries of every kind are concerned, that is a great centre. He was called upon to give a toast, and this was the toast—it is not profane, gentlemen: "Dam your rivers, sink your mines, and blast your canals." (Laughter and cheers.) With your assistance, and with the assistance of men like you, we hope to carry out these very objects. I greet you, gentlemen, with all my heart. (Cheers.)

SHERIFF SWEETLAND—I would ask the Hon. Mr. Ross, Minister of Public Works for the Province of Quebec, to address you.

HON. MR. ROSS—Mr. President, Ladies and Gentlemen: I have been present in this room before now, and I have witnessed some very severe bickerings and animosities on the subject of railways, but I must say I consider this meeting one of the most unanimous, as well as the most important, I have ever been at. There is no question whatever as to what Canada would be without railways; but on the other hand, what would Canada be if all the treasures that are buried under the surface of the earth were unknown? How could this country compete with other countries who have the advantage of experienced miners? Talking of experienced miners, I must not admit that we are inferior here in that material, nor in the ability of the few mining engineers we have. Some of them have world-wide fame. (Hear, hear). Nevertheless I think that such a gathering of able men as this is, from the different points of the continent must be doubly advantageous to themselves and a benefit, a great and lasting benefit, to us. The Province of Quebec is not at all blind to the advantages which follow from the visit of men who are not mere theorists, but who are practical men and who have already done great good to mankind, and will do still more. I recollect a tale of my childhood—for I was once a child—in which a magician enabled a certain princess to see all the veins of gold and silver hid in undeveloped portions of the globe by rubbing a certain ointment on her eyes. I say that mining engineers of the present generation can see as clearly through the earth as that princess ever could; but that ointment is not applied to their eyes, but to their brains, with hard study and comparisons of indications and results. There is no question whatever but that there are two magicians very helpful in this matter. These are geology and mineralogy—going hand in hand revealing the treasures of the earth, and to men who search for them their proper worth. I understand the Institute is based on a correct principle, by which practice is added to theory. Now, in the Province of Quebec the Premier, Mr. Mercier, is most anxious that the members of the Institute should call upon us, not as one of your generals called upon us several years ago, but as brothers. We extend a most cordial welcome to you. I might say that in asking this we are acting a little from selfish motives. It is to our immense advantage that these gentlemen come among us, as they may enable us to develop our resources. There is no doubt that the Province of Quebec and the other Provinces are very rich in minerals. As an instance I would refer to the extensive deposits of asbestos at Thetford and other portions of the eastern townships, which were unknown until a few years ago, and are now being worked and are yielding enormous profits. We extend a cordial welcome to you, and we shall be delighted to see you in the City of Quebec. (Cheers).

SHERIFF SWEETLAND—I have to regret the absence of His Worship the Mayor, but I am informed that Ald. Henderson, who is acting Mayor, is present. If he would be kind enough to say a few words on behalf of the City, we would like to hear him.

ALDERMAN HENDERSON—Ladies and gentlemen, I regret exceedingly that our friend His Worship the Mayor has found it necessary to be absent to-night. Otherwise I am sure he would be only too glad to have extended a cordial and hearty welcome to these distinguished gentlemen. I should like, however, to set my friend the Chairman right with regard to the remark which he made with respect to myself. I occupy no such honorable position as acting Mayor. I am simply an alderman in the City Council. When it was found that the Mayor could not attend I was asked to be present to say a few words of welcome to you. That I was delighted to do. I felt it would be a pleasant duty to welcome you, on behalf of the citizens of Ottawa, to this good city of ours. We are glad to have among us a number of gentlemen representing so large and influential a body as the American Institute of Mining Engineers. I trust you will find your stay among us not only pleasant but profitable. It is to be regretted that the weather is not promising well; but I hope that the warm welcome that will be accorded you, and the heartiness of your reception, will go far to neutralize that inconvenience. We welcome you for several reasons. First of all for your own sakes. We recognize the great work your Association has been doing the last twenty years. We recognize that amongst you there are gentlemen who have risen to the highest eminence in the different branches of your profession, some of whom are of world-wide renown. We welcome you for your own sakes because we expect and hope to realise a large amount of pleasure from that social intercourse which we trust will take place between us. Again we welcome you because your visit will be of great and lasting benefit to this section of country. As Canadians we are naturally proud of our country. We look upon it as having a great future, not only in its intellectual advantages and material progress, but from the bounties of nature which are so liberally strewn around us. You have come to see for yourselves that on which we found those hopes of

material progress. Gold we do not possess in this section. Many of us slave for it, but so far it has not been taken from our mother earth in quantities sufficiently remunerative, but I think we can safely say we boast of ores, if not so intrinsically valuable as gold, which are calculated to build up a more prosperous nation than the possession of any gold mines could do. To those of you who are strangers among us—that is, who come from across the border—I desire specially to offer a cordial welcome. Strangers in one sense you may be, but in another sense you are not. We can all boast a common origin, a common language and a common mission—a mission to ennoble and assist our fellow men. Possibly in the near future there may be a closer link between us. Who can tell but what we may have a magician here to-night. We have one sitting at that table (referring to Sir John Macdonald), a gentleman who has been intimately associated with the progress of Canada—one who has seen it rise from a few scattered provinces and united and welded into this great Dominion. (Applause). It is just possible that some day he may think it time to have done with our eternal squabbles, about Commercial Union and Unrestricted Reciprocity, and think the time has arrived when he may extend his magic wand across the St. Lawrence and invite you to become part and parcel of our great Dominion. (Applause). There may be something enticing to have the stripes wiped out of your banner and have the stars encircled with a chaplet of leaves of the maple or the oak. If that does not tempt you I do not know what will. We can only trust that in the future we may live as we are doing now and have done in the past—to work together for one great end, to live in peace and good fellowship, to emulate one another's good deeds, seeking to extend the great principles of liberty, equality and fraternity. (Applause).

COL. LAY, Consul-General in Canada for the United States, briefly welcomed the Institute. An address was also presented from the Ottawa Board of Trade by the President, Mr. John M. Garland.

DR. THOMAS EGLESTON, New York—Mr. Chairman, Members of the Institute, Ladies and Gentlemen, it is my very great pleasure, in the absence of the President of the Institute, to accept on its behalf the hearty welcome you have given to the members of the Institute visiting Canada. We are not unknown to you. Many of us have very honored and intimate friends on this side of the border. We know your hospitality. Many of us have been here before, and we know exactly what we are going to receive in the way of hospitality and what we are going to see in the way of beauty in this fair land; for it is a fair land. I think I may say there is no 36 hours' railway journey in the West that equals the ride over the Canadian Pacific Railway; certainly there is no such scenery in the East. You have gold, silver, copper, coal of every kind, and you have it all in profusion, and all that remains is to get it out. It is going to come, and this fair land is going to be a very great as well as a very good land. It is not my duty as acting president to say more; but I call upon Dr. Raymond, who is Secretary of the Institute, to reply on its behalf.

DR. RAYMOND—Mr. President, Ladies and Gentlemen: I count myself fortunate to be designated to-night as one who may speak for his brethren of the Institute in reciprocation of the cordial welcome that they have received from their brothers and from the citizens of this goodly town. The brief glimpse that I have had in the few hours since my arrival, justifies me already in the conclusion that we may congratulate you upon being the inhabitants, and that we may felicitate ourselves upon being the visitors of this imperial city, and all this region in which the beauty and the wealth of nature have been appreciated by the intelligence, and developed and utilized by the enterprise of man. As I was looking over an exquisite collection of photographs in the rooms of the Local Committee, a collection which I hope, I betray no secret in saying our members are likely to become more familiar with before this meeting is past, I was struck by the casual remark dropped by my friend of the blue ribbon; possibly he thought it had no deep significance, but in my heart it struck a very profound chord. As I gazed upon a picture of lovely sylvan beauty, trees, flowing river, swift and bright cascades, he said, "That's what runs our mills." I know, gentlemen, that the fashionable poetry of the day scorns waterfalls that run mills, but to the mind of an engineer, and to the mind of a man of science, it is not beneath the dignity of a waterfall to run a mill. (Applause). A few of those here in this gathering went last summer into the far west, and among other things we visited a vast body of water that runs no mill—the Great Salt Lake, the Dead sea of the Interior, the incarnation of a type which I am glad to say is very rare in nature, the type of concentrated selfishness, receiving ever and giving never, and growing nastier and nastier all the time.

(Laughter and applause). No fish flash in its waters; where the gulls, for they have gulls over the Great Salt Lake, simply go through the motions of gulls over real water, and pretend to dive for fish where there are none, and when they have tired themselves in this exercise, fold their wings and tread along behind Mormon ploughs and hunt for bugs. (Laughter and applause). As we left that vast, bitter, useless lake, which is made perhaps to satisfy the æsthetic sense of some modern bard who thinks that nature ought not to be made useful, and we came eastward to other lakes—your lakes, my friends, and ours—which received freely and freely gave, out of whose crystal bosom runs such streams as the St. Lawrence, on whose great banks mighty forests wave and droop their pendant branches to the stream, great cities sit to lave their feet in the cool waters, the keels of commerce and the wheels of industry bless them and use them, and all down their course of a thousand miles they are swift with beauty and musical with life and instinct with power. (Cheers). But why, need I ask before a society of engineers, and the wives and daughters and sweethearts of engineers, that beauty need be divorced from us? (Cheers). Why need I ask that power must be idle? It is a slander upon Almighty God whose power in-dwelling inspires and operates the machinery of the universe. (Cheers). So I am glad to know that the waterfall which I saw to-day in the picture, and hope tomorrow to see with my own eyes, in fact runs your mills. I shall be glad to know that all the vast enginery of nature and all the hidden treasures of nature have been snatched—not snatched, but transferred into forms of beauty and of use, of higher use, for the bodies and the souls of men. (Applause). We have heard to-night from the Chairman of our Local Committee of a truth which has been somewhat ignored in higher quarters. I for one, let me say in passing, rejoice especially that we now meet again, as we have met on two delightful occasions before, beneath the banner of St. George and among the free subjects of that sovereign, who has often honored engineers, and whose long and prosperous reign will be in history most glorious as the age of great engineering achievements. (Cheers). Therefore, you will not suspect me of any irreverence or disrespect to that august lady if I criticise something in the speech from the throne, particularly because I do not suppose it was the lady, but the Prime Minister, and not the Prime Minister, but the clerk of the Prime Minister, who made some mistake in the speech—a speech in which the United States is spoken of as America, and the Queen herself, through the lips of her Minister, talked about her diplomatic relations with America. If she does not know better, she ought to. Canadians are as much Americans as we are. At least in the title of the Institute which meets here to-night, the word "American" was never intended to stop in its meaning with the St. Lawrence river, and we have given our proof of this many and many a time. In the first place, as Secretary of the Institute I collect the fees of the Canadian members just as rigidly and with just as much difficulty as from Americans. (Laughter). We take them in and we bounce them out with equal facility. Their obligations, their privileges, their rank is just the same as that of any man on our side of the line. In the second place, as though we would emphasise the continental character, or still better the cosmopolitan character of our association, we have at this time in the person of our President, Mr. Pierce, of Colorado, whose absence to-night I sincerely deplore and he sincerely deplores—a gentleman at the very fore and front of one of the branches which the Institute represents, a leading financier, inventor and administrator, and universally esteemed, and a subject of the Queen of Great Britain. (Cheers). Gentlemen, the Mining Engineers occupy a plane very high above politics.

SIR JOHN MACDONALD—Even at the bottom of the mines? (Laughter).

DR. RAYMOND—While statesmen are debating and enquiring, and perhaps intriguing concerning diplomatic or commercial relations, we have long ago established the closest of unions—the union of hearts in mutual esteem and the union of hands in common endeavor. (Hear, hear). For my part I would care nothing at all for any other union than that, and I care very little for any other union without that. If we can but remain without scism, secession or separation in the Institute of Mining Engineers, the North American Continent can behave just as it likes. (Laughter). And this union we shall maintain for the simple reason, apart from all joking on the subject, that it is a union so high that minor differences disappear. We stand under two flags, not alternately looking up to one and to the other, but honoring both always; because we are allied in the noblest of all warfare—the warfare of light against darkness, sunrise against midnight, of power against inertia, of mind against matter—and secure in the victory, in the continual, successive daily victories of this sublime warfare we look upon our nations' battle flag and see no longer the stains of human blood, but rather mingle the hues of a new heaven bending brightly over a new earth. (Cheers).

Sheriff Sweetland then vacated the chair in favor of Prof. Eggleston, Acting President, and the regular business of the Meeting was then begun. Prof. Smock read a biographical sketch of the late Dr. George A. Cook, State Geologist of New Jersey. He was followed by Dr. R. W. Raymond, who presented a similar notice of the late W. H. Scranton, of Oxford, N. J. With the aid of a few hastily gathered notes C. A. Ashburner, of Pittsburgh, paid a tribute to the late Capt. Wm. R. Jones, of the Edgar Thomson Works.

### Wednesday.

Wednesday brought an additional number of members. The morning was given over to a drive to the celebrated Chaudiere Falls, and the great lumbering establishments to which they give life. The party was conducted through the large mills and factories of the E. B. Eddy Manufacturing Co., Messrs. Perley & Pattee, and other large industries. At Eddy's match factory and pulp mill the ingenious machinery was closely inspected and much admired. A visit was also paid to the Experimental Farm, where Mr. Fletcher, in the absence of Prof. Saunders, the Director, conducted the visitors to the various points of interest in, and around, this admirably conducted institution.

### Afternoon Session.

#### THE QUEBEC GOLD FIELDS.

DR. ROBERT ELLS, of the Geological Survey of Canada, read an excellent paper on the "Mining Interests of Eastern Quebec," in which he dealt mainly with the copper, asbestos, gold, slate, and other mining work being carried on in the Eastern Townships of that Province. As we hope to be able to reproduce this paper in the REVIEW, no further mention of it will be necessary here.

MAJOR R. G. LECKIE—Dr. Ells has referred to the occurrence of gold in the Eastern Townships, and before leaving home Mr. Ives, M.P., and Mr. Pope, M.P., allowed me to take a bottle of the gold which had been gathered during the last year from the Ditton districts, (samples exhibited). This was washed from the bed of a small stream. I think it occurs within a width of one hundred feet. The rocks of that portion of the country have been described by Sir William Logan as Upper Silurian, but Dr. Ells by more recent observation classes them as Cambrian; perhaps Lower Cambrian. They are intersected by reticulating veins of quartz, perhaps running from six inches to one foot in width. At a distance of about two miles from where this gold has been gathered, a bunch of quartz was struck from which, perhaps, six hundred dollars worth of gold was abstracted, simply by hammering, without even a mortar. No further explorations have been made, and this gold has been collected by the crudest means; farmers going in there, after harvesting, and washing out the gold in a very premature sort of way. I think that within a year or so a systematic effort will be made to trace the source of the gold, and I am in great hopes that some very valuable leads of quartz will be exposed, which will form a source of great wealth to that part of the country. Dr. Ells has remarked that this same band of slates runs into New Hampshire, and this gold occurs within 20 miles of the line; so there is hopes for your part of the country as well.

DR. ELLS—I might say that for the encouragement of those who desire to investigate that district, that similar bottles of gold have been got within two miles of the line. They had a sluice running down a hill over fifty feet, and they shovelled it out with shovels and pitchforks. They did not get all the gold out you may be sure.

#### NATURAL GAS EXPLORATIONS ON THE ONTARIO PENINSULA.

DR. C. A. ASHBURNER, Pittsburgh, followed with a paper on Natural Gas Explorations on the Ontario Peninsula, in which he made the sweeping assertion that, in his opinion, gas would not be found on the Ontario Peninsula or in the valley of the St. Lawrence in sufficient quantities to allow of its being piped for a distance of ten miles. He thought that the possibility of finding gas in Canada was confined to the strip of land in that area, but he was disposed to question whether gas would ever be found in that peninsula to be transported in pipes of any considerable thickness for any great distance, although it might be of sufficient value to consumers in the immediate district.

DR. ELLS—I do not know anything about gas in Ontario. The gentleman who had charge of that is Mr. Coste, who left us last summer. I believe Mr. Coste has struck one well which has already furnished one million feet. That well is at Kingsville. He left the Geological Survey to take charge of it, so he must think there is something in it. I do not know whether it is to be piped or not.

DR. EGLESTON—I was told recently that gas in large quantities had been discovered on the line of the C. P. R. in the middle of the prairie. Where is it?

DR. ASHBURNER—It is in Alberta Province. I have been in correspondence with the people and would have made an examination had the bank account of my correspondent been sufficiently large. It is at Langevin station.

MR. MACFARLANE—When you come to talk of gas in that region it reminds me that about twenty years ago gas was discovered away down about seven hundred feet below the level of Lake Superior, in the Silver Islet mine; it is a fact that the miners there struck into gas, which was lit and burned for over a week at any rate. That is a well authenticated and recorded fact. The very interesting paper to which we have just listened shows that we should not be surprised at the occurrence of gas anywhere from the Devonian to those rocks of the St. Lawrence which are supposed to be the oldest Silurian rock we have. Here in Canada we have indications of gas but there may be varying compositions.

DR. ASHBURNER—There is very little difference in the composition of natural gas. The only difference is the quantity of sulphur it contains. It is almost all marsh gas.

A Member—That gas at Silver Islet might have been sulphuretted hydrogen.

MR. MACFARLANE—No; it was not sulphuretted hydrogen. It burned for a long time. The question is as to the origin of this gas. It is said that in boring down we come to certain strata that contain it, or certain porous strata which ought to contain it, and there it is in fissures or cavities; but having heard more or less of gas and petroleum in the last twenty years, it seems to me that there can be no other origin for either of these than coal. I think a very interesting discussion could be raised as to the origin of this gas. I should like very much indeed if Dr. Ashburner would give us his ideas on that subject.

DR. ASHBURNER—In answering Mr. Macfarlane's enquiry, I would simply say that the question of the origin of petroleum and natural gas has been most ably considered, more particularly by Prof. Leslie of the Geological Survey of Pennsylvania, and Dr. Newbury, the State Geologist of Ohio. There is no doubt that natural gas, resulting from the decomposition of vegetable or animal organism, has got into the rocks. We know that coal results from organisms principally vegetable, but I do not think we have any authentic case where petroleum or natural gas has been derived from coal. There is not much to show that petroleum or natural gas has any relation to coal. It was thought for fifty years after the development of the Pennsylvania oil fields that there was some connection between the oil and the bituminous deposits in the hills; but that was merely coincident that coal and oil were found in the same district. Now we get gas in northern Ohio absolutely disconnected from any coal fields, and we get petroleum in the vicinity of Florence, Colorado, where there is absolutely no oil. It thus seems that this gas and coal occur independently. All this indicates independent geological relationship.

DR. RAYMOND—In further reply to Mr. Macfarlane, I would remind members that the subject of the origin of petroleum, and of natural gas incidentally, has been very well summed up and argued upon the basis not only of American conditions, but also upon the conditions in Russia, the Crimea and elsewhere by Professor Herrfort, one of the honored members of this Institute, in his recent volume on oil, constituting one of the numbers of a botanical dictionary in process of publication in Germany. Professor Herrfort maintains, if my recollection serves me, that the sole source of true petroleum and natural gas is animal remains, and he supports that theory by reference to actual synthetic experiments, by which lards and similar animal fats have actually been transformed essentially into petroleum by proper treatment and temperature and pressure. It is an interesting summary, and I think he substantially takes the same view as Prof. Leslie and Dr. Newbury. If that be the case, we can scarcely say that coal and petroleum have the same origin, as coal is not of animal origin.

DR. ASHBURNER—In further reference to Dr. Herrfort's work, to which Dr. Raymond has referred, I would say that the argument which he advances—and I was in correspondence with him for two years,—and which he supports with most conclusive evidence, or facts, or facts gathered from experiments, is very well grounded, although not absolutely an original idea. It has gained considerable ground in America and animal organism has been acknowledged as being the basis of some of our petroleum. Dr. Chandler has referred to

this matter and has done some considerable work with respect to it; and Prof. Peckham in his work on the exploration of the California oil fields, from chemical and microscopic examination of those oils, points out the difference between the eastern oils and the California oil and showed that the latter were no doubt derived from vegetable organism. When it comes to our eastern hydro-carbons, liquid as well as gaseous hydro-carbons, we feel we are able to assert with a good deal of positiveness that the petroleum which we get in the carboniferous state, and we get a good deal of the carboniferous in Pennsylvania, some largely from vegetable, but to some extent from animal; whereas the gases or petroleum of the lower Silurian are to a great extent from the decomposition of animal remains. In California the oils were probably entirely animal in their origin.

MR. MACFARLANE—I desire to say that I have read the work of Prof. Herrfort to which Dr. Raymond has referred, and also Prof. Sheddler in his recent work on oils and I am aware that the origin of these oils was attributed to animal matter. Of course, in the face of the authorities quoted I have not much to say on the subject, except to mention that the quantity of animal matter when you regard the large amount of petroleum and gas that has been produced could have been sufficient. I would further mention the fact that there does not occur in these petroleum or oils the element nitrogen to the extent that one would expect if the origin had been of an animal nature. Before resuming my seat I would like to mention that there have been some important occurrences of gas in Ontario. There was a very important well set on fire somewhere; we read about it in the newspapers as having been a very extraordinary occurrence, and the flow of gas from that well must have been very great indeed. It is a matter of regret that we have no Canadian authorities at present who are able to give this Institute any information on this subject. I think it is something we ought to be ashamed of,

DR. ASHBURNER—The gas from the Fredonia, N.Y. region contains nine per cent. of nitrogen, and quite a number of our cases do contain nitrogen.

MR. MACFARLANE—That is nitrogen in the state of gas, and that might have been derived from other sources.

DR. RAYMOND—You do not mean nitrogen of mere air mixed with gas?

DR. ASHBURNER—I mean nitrogen as part of the gas compound nitrogen.

MR. MACFARLANE—In what form does it occur if compound?

DR. ASHBURNER—I cannot speak of that, but it has been a question whether there is ammonia or not. Several analysis of the Fredonia gas show ammonia, but I have been disposed to question whether it was ammonia.

MAJOR LECKIE—I remember a discussion between Dr. Newbury and Professor Sterry Hunt sixteen years ago, and Dr. Newbury took the ground that these oils and gases were derived from bituminous shales. Dr. Sterry Hunt maintained, on the other hand, that these oils resulted from the decomposition of marine life and was to be found in the limestone of marine region. I think there is a good deal in what my friend Mr. Macfarlane says about the connection between oil and coal and carboniferous formation. What has become of the immense quantities of volatile matter given off in the change of bituminous coal into anthracite? How many millions of tons of volatile matter must have been given off.

DR. ASHBURNER—We never find gas in the vicinity of Anthracite.

MAJOR LECKIE—It may have been carried off and held in reservoirs. From the fact that Professor Eggleston mentions that of gas is found at Langevin near the base of the Rocky Mountains is important. You come there to where the bituminous coal is being converted into anthracite. I do not see it is at all unreasonable to suppose that the immense volumes, amounting to millions and millions of tons of volatile matter, which have been given off are bottled up somewhere. If not where has it gone?

MR. MACFARLANE—There are not only the volatile products that come from the bituminous coal to be accounted for, but there are also the products from the change of vegetable matter into coal. What we have also to account for is where the products of that change have gone. I mean the products of the change of peat, we will say, or vegetable matter as it originally was, to the coal. There must have been a very large amount of volatile matter produced, and it is quite

reasonable to suppose that this may have been held in reservoirs under continuous pressure.

DR. ASHBURNER—I think Mr. Macfarlane's and Mr. Leckie's views are undoubtedly correct if they will expand them into the theories and explanations so carefully described by Prof. Leslie and Dr. Newbury. There is no rock that is absolutely free from coal. You can find coal absolutely in every rock formation; but commercial coals are confined to a distinct formation. I think Sir William Logan pointed out the occurrence of carboniferous material in the Laurentian rocks of Canada, but the formation of oil, gas and coal, is practically in the same sequence or comes in the same category of phenomena.

MR. INGALL—There was an attempt made to collect some of the gas at Silver Islet, but we never happened to be around when the flow occurred.

PROF. SMOCK—I should like to ask Ashburner if there has not been natural gas found in sufficient quantities for commercial purposes in the Trenton limestone in Lewis County, N.J. The papers report the fact.

DR. ASHBURNER—That is immediately west of the Adirondacks; there had been quite a number of finds. Since my paper of two years ago in which I referred to this there have been several, but I have not known of them in commercial quantities. I know of no locality east of Fulton, N.J. As to the possibility of finding it in the lower part of New York State, I think it is not encouraging, because it does not look as if the rocks were sufficiently free from cracks to prevent the gas from escaping.

PROF. SMOCK—I should not expect it, but the newspaper reports from time to time have said so.

PROF. EGLESTON—What towns have they been found in?

DR. ASHBURNER—I do not just recollect. It is just west or south-west of the outcrop of Trenton limestone and in the Hudson River district.

The Institute then adjourned until two o'clock the following afternoon.

#### RECEPTION AT THE RUSSELL HOUSE.

It was at first proposed to tender the visitors a public Reception in the Senate Chamber, but the Government having negatived the proposal, the idea was abandoned in favor of a smaller affair in the Russell House. This proved a decided success, very many of our representative citizens turning out to spend an hour or two with the visitors. Lady Macdonald along with the lady friends of the local committee received the guests in the Ladies' Parlor. The string band of the Governor General's Foot Guards furnished music, and dancing was heartily indulged in up to a late hour.

#### Thursday.

Thursday, like its predecessor, proved wet and miserable, indeed during the early morning a considerable quantity of snow fell. Parties were, however, conveyed in the forenoon to the Geological Survey Museum, the Parliamentary Library, the Senate, House of Commons, the works of the Canadian Granite Co., and other points of interest. The Geological Survey Museum was pronounced most complete, well arranged, and a credit to the country, but the limited space at the disposal of the Director was not commented upon in so favorable terms. The visitors were delighted with the Parliamentary Library, and the handsome appointments of the various public buildings.

#### Afternoon Session.

##### NOVA SCOTIA IRON ORES.

MR. B. T. A. BELL, read a paper on the Geological Relations of the Nova Scotia Minerals, written for the meeting by Mr. E. Gilpin, Jr., Deputy Commissioner of Mines, Halifax. As the paper will be published in full at a later date, details are withheld.

DR. C. A. ASHBURNER—It was not my privilege to read the latter part of this paper, but I will make a suggestion which the secretary can carry out in correspondence. It would be interesting if Mr. Gilpin could extend his paper to the extent of referring to the geological relationship, more particularly of the iron ores of Nova Scotia and Cape Breton. Several years ago my attention was directed to the iron ores of the eastern shore by some iron masters of Pennsylvania, with the view of mining those ores and importing them into the States. At that time, with Mr. Gilpin's assistance, I collected a large mass of material, but the Pennsylvania people did not invest in the enterprise. It seems to me that if the attention of iron men could be directed to the

possibility of finding large deposits on the eastern shore there would be a great commercial demand for them, particularly the ores along the eastern shore, along the Bay of Fundy, and more particularly in the vicinity of Digby Bay. I think it would be a very acceptable thing, not only to the members of the Institute, but to a great many of our commercial iron men in the States, if this paper could be elaborated to treat, not only of the geological relationship of iron ores of the eastern shore, but to give some suggestions as to the possibility of our obtaining ore for consumption in the States—iron ores sufficiently low in phosphorus and high in iron to compete with the ores in Pennsylvania.

PROF. EGLESTON—I would like to add my request that this be done. I had occasion during the morning to look over iron ore in the museum, and I was astonished that such large quantities are found low in phosphorus and high in iron. The iron men of the States would be very glad to get it, if members of the Institute would only let the character of the ore be known.

MR. J. C. PLATT—I would also ask Mr. Gilpin to bring out the question of titanic acid in these ores.

#### SILVER ORES OF THE PORT ARTHUR DISTRICT.

MR. E. D. INGALL next occupied the attention of the meeting with a talk upon the Silver Ores of the Port Arthur District, which was illustrated with drawings and slides exhibited by lantern. The paper was followed by some appropriate remarks by Mr. Thos. Macfarlane, who as everyone knows, was one of the first discoverers of the famous Silver Islet mine.

#### GOLD MINING IN NOVA SCOTIA.

MR. JOHN E. HARDMAN, Oldham, N.S., followed gave a most interesting address on the "Methods of Gold Mining in Nova Scotia." As the paper, like Mr. Ingall's, will be supplemented with more data before publication, we regret to be unable to reproduce it now.

MAJOR R. G. LECKIE exhibited a number of very nice samples of gold from the Montague mine, Nova Scotia, the largest piece of which, he said had been carefully weighed and valued at \$1,100. For two years or more, on account of differences among the shareholders, the mine remained idle, but ultimately the ownership had passed into the hands of Mr. Charles Annand, of Halifax. The vein runs from eight inches to two feet in width and has been opened for a length of 600 feet. In this distance there are three streaks of rich quartz, dipping at an angle of 20°. Further east at 170 feet the second streak was struck, 80 feet from the surface. The third from which the specimen exhibited came, about 500 feet from the first, was struck at a depth of 100 feet from the surface. The deepest point yet reached is only 175 feet. The large piece carries considerable gold, and shows the width of the vein where it becomes rich. The smaller piece shows sulphides of copper, lead and zinc associated. These are characteristic of the richest veins in the Montague district. Arsenical pyrites is found in specs and nodules in the foot-wall, some of which are very rich in gold. In the vein itself a peculiar feature is the regular occurrence of arsenical pyrites carrying little or no gold. From 30 tons of quartz crushed last month, 174 ounces of retorted gold were obtained, exclusive of what passed away with the tailings. In addition to this, 100 ounces are locked away in the mill, and we have before us now 130 ounces in these specimens. Altogether, therefore, over 400 ounces were carried in the 30 to 31 tons of quartz raised last month. When the vein reaches its maximum thickness of two feet it becomes impoverished and yields only 6 to 7 dwts. per ton.

DR. RAYMOND—Did they treat that arsenical pyrites by itself?

MAJOR LECKIE—It is saved now in the tailings. That which is on the foot-wall is rich in gold, but the pyrites found in this vein overlying this gold is very poor.

PROF. EGLESTON—The mispickel?

MAJOR LECKIE—Yes; but when you get these nodules or mispickel off the foot-wall—that is outside of the quartz—they carry considerable quantities of gold. You can break the mispickel, and you find it held together by gold. I might say that from 30 tons of quartz crushed last month 100 ounces of gold were retorted. We have some 130 ounces here in these specimens, and altogether over 400 ounces were carried in the 30 or 31 tons raised last month. When the vein reaches the maximum it yields but six to seven dwts. per ton.

DR. RAYMOND—Would that pay?

MAJOR LECKIE—Yes; with the facilities we have for water power, and considering the high character of the gold. It is worth from \$19.50 to \$20 per ounce.

PROF. EGLESTON—You do nothing there more than direct Amalgamation.

MAJOR LECKIE—No; not to my knowledge. We are not working tailings. There is no abstraction of gold by chemical methods.

MR. JOHN E. HARDMAN—There is no attempt at working the sulphides on any scale; nor is there any attempt at Concentration.

MAJOR LECKIE—There is natural Concentration.

MR. HARDMAN—In the majority of cases they are sluiced away and pass into the sea.

PROF. EGLESTON—I was going to tell about a mill in California where they made Concentrations up to \$300, but I do not suppose my story is good for anything.

DR. PETERS—I had heard a good deal about the Nova Scotia gold mines, and I thought from the statements made that that was just the place I was looking for, but I found them just about as sharp men as you find anywhere. If any mill man went down there under the supposition that he was going to show the natives anything he would be mistaken.

PROF. EGLESTON—Some years ago in Nova Scotia there was a chlorinating mill, and they sent more gold up the chimney than they recovered. They used too much salt. I should like to know where that mill was.

MR. HARDMAN—I have only been there four years, and I have not heard of any attempt at chlorination there.

PROF. EGLESTON—This was chlorination very similar to that I saw in California. They either covered the gold with oxide, or they sent it up the chimney as chloride.

MAJOR LECKIE—The only chlorination I know of was at Capelton, and was done by Henderson Bros.

PROF. EGLESTON—Did they have Longmead?

MAJOR LECKIE—That was the origin of all these methods—using iodide of potassium.

PROF. EGLESTON—They used to use iodide of zinc.

A paper on the subject of fine and float gold by Prof. Egleson, in which Dr. Peters, Dr. Raymond and others took part, terminated the session, which adjourned until 8 o'clock in the evening.

#### EVENING SESSION.

DR. E. D. PETERS, Jr., general manager of the Canadian Copper Company, opened the meeting with a graphic and most interesting description of the mines and works of his company at Sudbury. This was undoubtedly the most important paper of the meeting. A verbatim report of the paper and the subsequent discussion upon it is given our readers in another portion of this issue.

#### DISCUSSION ON CANADIAN PHOSPHATE.

DR. ROBERT BELL, of the Geological Survey of Canada, introduced the subject of the Phosphate Deposits of Ottawa County in a brief address, in which he dwelt specially upon the geological relations of these deposits, illustrating his remarks by some excellent crayon and water-color drawings.

MR. J. LAINSON-WILLS, Buckingham, followed with some remarks on the associated minerals found in connection with phosphate, and pointed out that while the occurrence of the mineral might be irregular, there was one point of regularity, namely, that of the continuity of the formation over a large extent of country.

CAPT. R. C. ADAMS, Montreal—I have been asked to say a few words on the practical side of the phosphate business to supplement the interesting scientific statements you have just heard. If the hour was not so late I might have been much pleased to say a good deal on this subject; but I hardly like to trespass on your time to the extent I might do. I will therefore merely allude to a few points. You have heard in graphic scientific language from Dr. Bell how irregular these deposits are, and you have seen from his diagrams their peculiar nature; that they are here and there and everywhere, and not as often everywhere as we would like. When this industry was started, you may know, it was carried on by farmers. In their spare time they picked at this little outcrop of phosphate or that which occurred on their farms. One of these was asked what he thought of phosphate occurrences, and he gave this description:

"It is long and it is short; it is wide and it is narrow; it is deep and it is shallow; it is thick and it is thin; it is here and it is there; you have got it and you haven't got it; you see it and you don't see it." Then he used some terms which are technical. He wound up by saying: "It is — of the — and I won't have a — thing to do with it." (Laughter.) That expressed in forcible terms his opinion of the mode of occurrence of apatite. The occurrences differ in the two sections where it is mined—in the Ottawa District and the district between Perth and Kingston. In the Ottawa region it occurs more in masses through the rock; whereas in the Kingston district it is found in distinct veins. They are smaller in size than those found in the Ottawa district and this has led to different methods of mining in the respective districts. In the Ottawa district the steam drill comes in very well and large masses can be blown down and the phosphate separated. While in the western district it is not so appropriate to use the drill, as I have found to my cost. I have squandered a good deal of substance in riotous rock drilling. I thought I would depart from the old system, which Mr. Hardman has described as the flour-barrel-and-windlass system prevailing in Nova Scotia. I got an Ingersoll Compressor, but on using it found we had to break so much rock that the work became too expensive, and that it was cheaper to work by hand. The scientific phases have been described by Dr. Bell and Mr. Wills, and although you might think the commercial side does not bear on your sphere, it certainly does so, inasmuch as your reward depends on it. Some of the troubles we have had to encounter in the commercial field have hindered our enterprise here. With regard to ordinary mining we certainly want your assistance. Things have been done heretofore in these mines without the assistance of science, and we wish we had some men like Dr. Peters to apply a little thought and brains in developing the best methods of working the mines. I know that mining engineers never believe anything favorable that is said with regard to mines, and they do not always believe what they see, and you will still believe that as we raise phosphate there are some advantages that we modestly refrain from mentioning. The commercial points are these: When this phosphate is shipped we sell it at what we think is a good price. The first thing we discover is that there is a discount of 2½ per cent. That comes off. Then it is sent over to the other side under a guarantee that it is to go a certain percentage. This is determined there in samples as the stuff is discharged, and it is a contest of wits and chicanery between the two parties. The buyer's agent and the seller's agent have the drawing of these samples. The buyer's man has the most experience because he receives large quantities, while the seller's agent may handle but a few cargoes in a season. The buyer's man is the most skilful. These two samples are sent to different chemists and the astounding fact is presented that the buyer's chemist is generally lower than the seller's. In an entire season's shipments, seven out of eight, the buyer's chemists would be lower than the seller's, and in some cases as much as three and a half per cent. I have seen as high as 3.57 difference, and another 2.52. This is a problem between mind and matter which is overwhelming. When you remember that our success depends upon the correspondence of the analysis with the guarantee, you see how great is the uncertainty where there is a possibility of 3.5 variation between the buyer's and the seller's chemist. If the cargo is rejected we get into a great deal of trouble. It is taken off by the buyer into his works before the quality is determined. If it goes ½ or 1% below the guarantee it is rejected, and we are told they cannot use such worthless stuff. To take it away involves great loss. I know of a shipment this summer which was rejected only 1½% below the guarantee. I know of another reduction of £1 10s. where a fall of two per cent. took place. I think it is a mistake to have the article pass into the buyer's control before its value is determined, but it is a problem how to remedy this. I will not detain you by going into other points in this direction; but I want to say one thing with regard to the future of Canadian phosphate, and I hope the chemists among you will give it attention. That is with regard to crude phosphate. Many believe it to be valuable in its raw state. We have good authority for saying that superphosphate reverts and becomes to some extent insoluble, and if phosphate be ground fine it may be that in being acted upon by the carbonic acid of the soil, or juices of plants, renders it available for plant food. I have seen remarkable results from it. I went into a barnyard where they had used this Canadian phosphate for years and I saw some beans which reminded me of an advertisement in Boston. One man who was very corpulent was represented as saying: "I dine at Blank's while the other, lean and cadaverous, replies, 'I do not.'" These phosphate beans were immense fellows, climbing to the top of the poles, while those which had not been so fed were miserable little things. In this case it was combined with suitable manure, which perhaps occasioned some fermentation, and in that way made the phosphoric acid available. We feel that if this

fact is established it will be of immense benefit to our industry and to the progress of Canadian agriculture. (Applause.)

MR. P. WURZBURGER, Antwerp, followed with a few remarks in which he expressed himself as most favorably impressed with the great future of the phosphate industry in Canada, judging by the progress being made in the development of the mines which he had visited.

MR. W. H. HUTCHINSON, London, Eng.—In coming here I came more as a listener than intending to speak, but as I have heard a few words on the commercial side of the question I may reply to some of them. I represent a firm of fertilizer manufacturers in London, England, of some importance, and buy large quantities of phosphate. This is the first time that I have heard of any great difficulty on the other side. We buy very large quantities of South Carolina phosphates as well as Belgian and French phosphates. They are taken to our works and sampled by our chemist. The sample of the seller goes to another chemist, and they usually agree. The only time we have difficulty is when foreign chemists come in, who have slightly different methods of determining the phosphoric acid. Then differences do occur; but with the chemists in England there should be no difficulty at all; certainly not more than one per cent. I think if you take a good respectable chemist, such as those of the Royal Agricultural Society, and others of world-wide fame, there should be no question of *mal fides* as there is in this case. The Canadian phosphate mines supply about 20,000 tons annually to England, whereas we import from South Carolina, France and Belgium from 270,000 to 300,000 tons. So you see what we get from here is quite immaterial. Still the phosphates that come from Canada are highly appreciated, and I think the industry has a great future. The only thing is to remember this: The farmers in Great Britain are many of them very poor, and we have to sell to them at very low prices. We must, therefore, buy on the best terms, and unless the Canadian phosphates are sold as those of South Carolina and other countries it cannot find a place in the English market. We must bear that in mind. I wish the industry here every success. I have been here now about a fortnight, and everywhere I have been received with a great deal of hospitality. I have been afforded every facility for looking through the mines, and I can only express my thanks to everybody for the way in which I have been received.

MR. H. B. SMALL, Ottawa—The Minister of Agriculture, the Hon. Mr. Carling, has during the past few years given particular attention to this question of the utility of crude phosphates as a fertilizing agent, and has asked the directors of the Government Experimental Farms to make tests with highly pulverized phosphates with the object of ascertaining what results might be expected from various crops. These experiments have been in progress over two years, but the actual results are not yet known. Some of them will probably be tabulated and laid before the House during the next session of Parliament. Experiments made by private individuals in this locality have been rewarded with a good deal of success. As Captain Adams has said, if highly pulverized phosphate be mixed with other suitable manure, such as that known as black or swamp muck, containing a higher percentage of acid than ordinary soil, good results are more quickly produced. Pulverized phosphate by itself would probably take years to produce a good effect, whereas when mixed with suitable manure, or soil having acid in it, results are had in a short time. I understand that Capt. Henwood, of the Emerald mine, has used fine ground phosphate with very great success. Last year some potatoes were brought to my notice which had been grown near Buckingham. Half the patch had been sown pretty thickly with pulverized phosphate, and the other half with ordinary stable manure. The potatoes where the phosphate had been put were much larger than the others, and perfectly clean, while the others were scrubby. I believe myself that crude phosphate in a pulverized state will come to be very largely used by our agriculturalists in combination with stable manure.

PROF. EGGLESTON—I wish to say that some years ago I had occasion to make some experiments respecting the action of feldspar on the soil. I commenced with orthoclase, and ground it from the size of a pea to the fineness of flour. The effect it had was almost like guano. Experiments have recently been made with regard to the action of organic acids on soils and rocks, and I believe these experiments show that organic acids act more powerfully than mineral acids. If the phosphate is ground fine enough, it does seem that if feldspar would act in this way phosphate would behave in a similar manner.

The hour being late it was reluctantly decided to have Mr. John Birkenbine's paper, "The Possibilities of the

Manufacture of Iron at Ottawa," read by title. The other papers submitted to the meeting which were not read, but which will appear in the Transactions are: Gold Quartz, by W. M. Courtis, Detroit, Mich.; Notes on Some Coals in Western Canada, by W. Hamilton-Merritt, A.R.S.M., Toronto; Stamp Mills, by John Hayes Hammond, San Francisco, Cal.; Ventilation, Progress and Cost of the New Croton Aqueduct, by J. P. Carson, Dobbs Ferry, N.Y.; The Wear of Rails as Related to their Section, by P. H. Dudley, N.Y.; The Columbia Iron and Steel Works, Pittsburgh, Pa., by G. W. Maynard, New York; The Physical Properties of Aluminum, and Comparison of it with other metals, by W. J. Keep, Detroit, Mich.; Phosphorous in Cast-Iron, by W. J. Keep, Detroit, Mich.; The Davis-Colby Roasting-Kiln, by S. G. Valentine, Lebanon, Pa.; Commercial Economy, by Dr. R. W. Raymond, New York; Remarks on the Metallurgy of the Tellurides, by Frank Clevis Smith, Ann Harbor, Mich.; The Huanla Mining District, State of Morales, Mexico, by G. W. Maynard, New York.

This terminated the business of the Meeting.

### Friday.

#### EXCURSION TO THE PHOSPHATE MINES.

The members of the Institute, accompanied by a number of prominent citizens, in all about 100 ladies and gentlemen, paid a visit on Friday to some of the phosphate mines on the Lievres river. Early in the morning the party was conveyed by special train to Buckingham, where the steamers *Agnes* and *High Rock*, with a large scow specially fitted up for the accommodation of the party, were found in readiness to take them to the mines. Despite the bleak, bitterly cold weather which prevailed, the sail up the picturesque river was greatly enjoyed, and many were the expressions of delight at the charming scenery decked out on every hand in all the gorgeous splendour and varied hue of its autumn tints.

At the Little Rapids, twelve miles from Buckingham, the mines now being developed by Mr. W. A. Allan, of Ottawa, were first visited. Many of the party descended the shaft and closely examined the various levels at which large masses of rich green phosphate are prominently exposed. After inspecting the engine house, cobbing machinery, and the other plant and buildings, a return was made to the Landing, where a large marquee had been erected, and an excellent lunch was served. A number afterwards took the steamer and ran down to the Emerald mines, operated by the Ottawa Mining Co., where Capt. Herwood, the genial superintendent of the mines, received and escorted them through the various workings of this old and richly productive property. Others spent an hour examining the large lock and dam in course of construction by the Government contractors, the Messrs. Poupore. Here several of the ladies greatly enjoyed a run down the rapids in a canoe.

The return journey was beguiled with dancing, tug-of-war and all manner of diversion and entertainment. At Buckingham the good ladies of that hospitable little village had thoughtfully provided steaming hot coffee and other refreshments which were most heartily enjoyed after the somewhat cold experience of the river. Ottawa was reached a little after eight o'clock. Special thanks for the thorough success of this excursion are due to the mine owners and managers at Buckingham, and particularly to Mr. J. Keith Reid, whose untiring efforts to promote the enjoyment of everyone cannot be too fully appreciated.

#### EXCURSION TO SUDBURY.

The following members took advantage of the excursion to Sudbury leaving Ottawa by the midnight express: Messrs. F. Macdowall, Dr. R. W. Raymond, Professor Sharples, M. N. Langdon, C. A. De Camp, A. W. Newell, Major R. G. Leckie, L. Holbrook, Thos. Macfarlane, J. T. B. Ives, Dr. E. D. Peters, Lieut.-Col. Anderson, C. E., and Dr. Robert Bell. As the majority of these were most desirous of participating in the series of excursions arranged for the following week through the Province of Quebec, only some five hours were spent at the mines and works at Sudbury, but under the able guidance of Dr. Peters this proved amply sufficient to give the visitors a thoroughly good impression of the nature and extent of the copper, and particularly of the rich nickelliferous deposits being so extensively operated by the Canadian Copper Co., the Dominion Mineral Co., and other concerns in operation there. By making close connection with the returning trains, the party was enabled to join the other members at Montreal on Sunday evening, in time to join them on their trip to the Eastern Townships. It was most unfortunate, and none regret it more than the Local Committee at Ottawa, that the elaborate programme arranged for the

#### EXCURSION TO PORT ARTHUR AND DISTRICT

had most reluctantly to be abandoned at the last moment. It should be stated that when Mr. Bell, Secretary to the Committee, submitted the plan of the proposed excursions to the Council of the Institute, Dr. Raymond

replied that the greater number of those visiting Canada had signified their intention of taking advantage of this trip to the Port Arthur silver mines. The people of Port Arthur nobly responded to the invitation from the Ottawa Committee to welcome them and went to a great deal of trouble in arranging the following elaborate and complete programme for their reception and entertainment:—On Monday, October 7th, the party was to arrive and be met at the station by the members of the committee, who were to accompany them to the mines, proceeding by train to Murillo, where, at 4 p.m., conveyances would be in waiting to carry the party to the mines. The Beaver would be reached at 6 p.m. That night would be spent at the hotel. Tuesday would be devoted to a minute inspection of the Beaver, Badger, Elgin, Porcupine and adjacent mines and silver mills. Wednesday morning would be given to the journey from the Beaver to Silver Mountain, the afternoon and Thursday morning to the Shuniah Weachu, West End and Crown Point mines. A detachment could visit the Whitefish Lake group or the Mink Mountain, Silver Fox, Silver Gance, Wolverine and Queen mines. Thursday afternoon the homeward journey would be commenced, spending another night at the Beaver. Friday morning the party would drive to the Kakabeka Falls, where an informal luncheon would be prepared, and Port Arthur would be reached at 4 p.m. After supper at the Northern an informal reception would be held. Saturday, the last day, would be occupied by a visit to that famous historical spot, Silver Islet, and at 2.30 p.m. all would be homeward bound, on a C. P. R. train for the east.

The weather, however, during the meeting was so inclement and forbidding that when a canvass of the members was taken on Friday night a very large number were disinclined to undertake the long journey, and indeed only some twelve, of whom the greater number were Canadians, were found willing to go. A meeting of the committee was hastily called together, when it was unanimously decided that it would be manifestly unfair in the circumstances, to put the hospitable people of Port Arthur to so much trouble and expense on behalf of such an insignificant party, and the trip was accordingly reluctantly abandoned. When Mayor Gorham heard of the decision he promptly wired that even if twelve came they would be fittingly received and entertained, but the message came too late, for the Sudbury party had gone west and the remainder were in Montreal. We trust this statement of the facts will eliminate the harsh and unfair judgement of some ignorant persons who have published that the failure of the trip was entirely due to the indifference of the Ottawa Committee.

In view of this unfortunate occurrence—the only hitch we may say in the whole programme of an eminently successful Meeting—the committee will return to the Ontario Government a large portion of their liberal Grant, from which only a *pro rata* rate will be deducted for operating expenses, as well as the cost incurred by the trip to Sudbury. We now hasten to describe the

### Excursion to Montreal, the Eastern Townships and Quebec.

(By A. S. Bestus).

The recent visit of the American Institute of Mining Engineers to our city is one which, taken in connection with the several excursions with which it has been associated, should be of the greatest importance not only to the mining industries in our immediate vicinity, but to those of the neighboring Province of Quebec. With the exception of the unfavorable condition of the weather, which, unfortunately, the local committee could not control, it may safely be said that not only the Ottawa meetings, but the several excursions were successful in the highest degree, and it is hoped that our visiting friends and brethren of the profession will carry away with them many pleasant remembrances of their trip which will not speedily be forgotten. The gentlemen who composed that distinguished body represent not only the various mining industries of the country, such as gold, copper, silver, iron, coal, etc., but also number many who are intimately connected with those industries, viz., manufacturers of all kinds of mining plant, such as steam drills, smelting works, and in fact all kinds of engineering machinery, and we trust that during the few days they have spent with us many facts have been presented to their more immediate attention, which, if not entirely unknown to them before, will give them a much broader idea of the extent and value of some of the leading economic minerals of the country, both as to their mode of occurrence, the great value of the mineral wealth of the Dominion, and the great inducements presented at many points for the investment of capital judiciously applied and skillfully administered. While with limited time at their disposal it was of course totally impossible to show them even a small part of our resources in this direction, sufficient has, it is hoped, been done to give them some slight impression of the growing importance of Canada from the miner's standpoint, and the time and money so generously spent by our several governments have, we feel, been well and judiciously expended.

The excursions contemplated during their visit with us were three, viz.: that to Sudbury and Port Arthur, of which, unfortunately, it was found impracticable to carry out a part of the programme; that to the phosphate deposits, in which all participated; and that to the Eastern Townships of Quebec. This last may be said to have been eminently successful, and many points of interest were presented, some of which at least were new to many of the party.

IN MONTREAL.

Leaving Ottawa by the 8 a.m. train on the Canada Atlantic Railway the excursion eastward, which numbered nearly forty persons, including ladies, had a pleasant run to Montreal, a special parlor car being set apart for their accommodation *en route*. Here, though scant notice of their coming had been received, the visitors were kindly received by acting Mayor Perreault, Aldermen Wilson, Dufresne and Rolland, City Surveyor St. George and other prominent citizens, by whom carriages were provided and the entire party driven to the St. Lawrence Hall. On arrival a short address of welcome was tendered the visitors by Mr. Perreault, and replied to by Prof. Egleston, of New York, and by Mr. B. T. A. Bell, the general secretary of the general committee at Ottawa, to whose indefatigable exertions much of the success of the excursion must be attributed. A kind invitation was at the same time presented through Prof. Bovey, of McGill University, from Sir Wm. Dawson, to visit the Redpath Museum as well as to a Reception by Sir Wm. and Lady Dawson at their college residence in the evening. Lunch over the party again assembled and were escorted by the Mayor and aldermen, with others, in carriages provided for the occasion, through the principal portion of the city, then to the Redpath Museum, and subsequently along the beautiful mountain drives to the mountain park where a nicely appointed luncheon had been provided by the city fathers for the entertainment of their visiting friends. Though the weather was chilly, the drive, new to many, was thoroughly enjoyable, and the magnificent views that were presented at various points along the drive, and from the foot of the mountain called forth many hearty expressions of admiration on all sides. At the restaurant happy speeches were made by several of the aldermen, and replied to in well chosen words on behalf of the Institute by Mr. J. C. Platt of Waterford, N.Y., and Dr. Ashburner of Pittsburgh, the whole entertainment being a delightful surprise throughout. A point which particularly delighted the visitors was the magnificent fountain in Victoria Square, which played for some time during the drive, and forcibly impressed all who saw it with the immense head of water with which the city is provided in the event of fire, and for the general purposes of the city supply.

In the evening in response to the cordial invitation of Sir William and Lady Dawson, a considerable number attended at their residence, when a very pleasant hour was passed, the party returning to their headquarters highly delighted with the splendid hospitality which had been extended to them during the day and at the very outset of their eastern excursion.

Sunday was a day of rain. In spite of the disagreeable weather most of the visitors attended worship at some of the many churches for which Montreal is famous. In the evening a cordial invitation was extended to the engineers by the Hon. Mr. Mercier to a reception at his own house on St. Denis street, which in spite of the fact that many were tired and had preparations to make for an early start next morning, was responded to by a dozen or more. Among those present to receive them with the Premier were Mr. Robidoux, M.P.P., Mr. James McShane, ex-Minister Public Works for Quebec, and Mr. Wainwright, of the Grand Trunk Railway. A couple of hours were pleasantly spent in discussing the aim and work of the Institute, after which Mr. Wainwright cordially tendered on behalf of the Grand Trunk railway, a free Pullman service and transportation to Quebec and return, for as many of the members as could accept it, that they might inspect the scene of the late disastrous rock slide and view the other attractions of that historic old city, Mr. Mercier kindly promising them the hospitality of the city during their brief visit. It is needless to say that those of the engineers who attended Hon. Mr. Mercier's Reception on Sunday evening were delighted with the courtesy and hospitality they experienced, and came away with pleasant feelings towards all concerned.

AT CAPELTON COPPER MINES.

Monday morning opened dark and threatening. Jupiter Pluvius was evidently to the front, but in spite of the rain there were no laggards when the time for departure to the train for Sherbrooke was announced. The party during Sunday was augmented by the arrival of several of the members who had gone west to Sudbury from Ottawa on Friday night and returned to take part in the eastern excursion, and nearly fifty persons embarked on the two Pullmans provided for the Townships portion of the programme. The heavy rain in no wise served to damp the happy spirits of any on board, and the best of good fellowship prevailed. All seemed determined that

in spite of adverse circumstances the trip east should be both pleasant and profitable, whatever the weather prophets might say. The 100 miles to Sherbrooke was soon travelled, and on the arrival there the visitors were met by the Sherbrooke committee, headed by Mr. R. N. Hall, M.P., Col. Lucke and others, the warmth of whose welcome speedily put to flight any dullness which the incessant rain might have provoked. Carriages were in waiting, and the whole party were speedily transferred to the Magog House, where a well appointed lunch and the best of good feeling soon made everyone as cheerful as possible. Owing to difficulty of transport and train service the programme was of necessity changed slightly at this point, and it was decided to visit the copper mines at Capelton in the afternoon of Monday and proceed to Thetford and points of interest on the line of the Quebec Central Railway on Tuesday. An engine was therefore attached to the Special, and the whole party proceeded to the Eustis mines, where the general manager, Mr. John Blue, was on hand to render any assistance in his power, and to furnish any desired information concerning the workings either above or beneath the ground. Owing to the heavy rain it was impossible for the ladies to visit these interesting works, while the magnificent scenery for which this portion of the township is celebrated, had perforce, also to remain invisible. The gentlemen, however, visited the smelting works which have lately been put in working order, and then arraying themselves in all kinds of motley garments known to mining men, a number explored the deep workings for which this mine is famous, to a depth of nearly 1500 feet, viewing with much interest the immense body of ore which is now being worked so successfully and which is reported to have in places a thickness of from 50 to 60 feet. The greater part of the output is shipped in the raw state to the acid works near New York, but about 1,000 to 1,200 tons per month are smelted on the spot, the sulphur, which represents about 40 per cent of the ore, being burned off and wasted. The ore contains a small amount of silver, from 3 to 4 per cent, which forms an important feature in the value of the output.

The adjacent mines of G. H. Nichols & Co., with which are connected extensive works for the manufacture of sulphuric acid and superphosphate, were not thrown open to the inspection of the engineering party, but as the character of the ore and the conditions of its occurrence are presumably the same at both places, the mines being located on what is regarded as the same vein, the real object of the visit was obtained. The return to Sherbrooke was pleasant in spite of the rain, and after a cheerful supper and an impromptu concert by several members, in the train, which was side-tracked for the night, and which made the evening pass most pleasantly, all turned in for the night, delighted with the first day and with their first acquaintance with the genial people of the Eastern Townships, and more especially with the welcome which had been extended them by the hospitable city of Sherbrooke.

VISIT TO DUDSWELL AND THE ASBESTOS MINES.

Tuesday morning the heavy rain clouds seemed to have nearly exhausted themselves. Fiful gleams of sunlight appeared at intervals and the indications were that a tolerably fair day would be afforded for the trip to the celebrated mines of Thetford and Coleraine and the Dudswell Lime works. The former were of special interest to the members of the Institute from the fact that they are really the only mines of the kind worked to any extent in America. The mineral is not a true asbestos or hornblende, but is a chrysothole or fibrous serpentine, and occurs in veins, which traverse the serpentine in all directions, its mode of occurrence being of particular interest to many of the visitors.

After a comfortable breakfast at the Sherbrooke House, rendered necessary by the length of time which would have been required to feed so large a party in the Pullman buffets, the Sherbrooke excursion committee, consisting of Messrs. R. N. Hall, M. P., Buck, Lucke and Mitchell and others, took charge of the party. A dining car, improvised for the occasion and well stored with a magnificent lunch provided by the local committee and by the managers of the several mining centres was attached to the Pullman train, and at 8.30 the excursion steamed out of the station of the Quebec Central Railway, matters being greatly facilitated by the courtesy of the general manager of that line, Mr. Frank Grundy. The party was here augmented by the presence of a number of Sherbrooke's pleasantest people, both ladies and gentlemen, and by the managers of the several mines at Black Lake and Thetford, including Messrs. King, Sheridan, Murphy and Frchette, who had come down the previous evening in order to become better acquainted with the distinguished visitors and to better extend to them the hospitalities of the mining section. A pleasant ride through the charming scenery of the St. Francis valley brought the excursion to its first stopping place, the Lime Works of the Dudswell Lime and Marble Company, where the four new kilns of the Dominion Lime Co. were inspected with great interest. These kilns, which are four in number, have a daily capacity of 300 barrels each, and are supplied with rock



from a splendid quarry adjoining, the stone being hauled by train to the platform and dumped direct into the kilns. This 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. At the Upper Lime Ridge Works, half a mile distant, owned by the same Company, six additional kilns are in operation. The face of the quarry here is about 90 feet in height and close to the kilns. The aggregate daily capacity of these works when all the kilns are in operation is 3,000 barrels, and the owners find it difficult with this immense output to fill all the orders which come in from all parts of Eastern Canada and the adjoining States. Time did not permit us to visit the marble quarry two miles distant, but specimens of the rock were shewn and much admired. The train was again soon in motion for the 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 Black Lake, which was reached at 1.30, was enjoyable in the extreme. 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 visitors, they succeeded admirably. At Black Lake, the party quickly dispersed under the guidance of Mr. R. T. Hopper, one of the principal mine owners at this point, Mr. Frechette, Dr. Reed and others, and were soon scattered about the several asbestos mines which are in close proximity to the railway. The Anglo-Canadian, Frechette, the Scottish-Canadian, and the most remote, the American, lately started by Mr. E. Wertheim, were all visited, the mode of occurrence of the asbestos was pointed out, and a blast fired by electricity at Mr. Hopper's mine brought down a large amount of serpentine and disclosed some excellent veins of the mineral. The methods of mining, cobbing and grading were explained, and the large veins and fine quality of asbestos which show in the cuttings on the face of the hills at an elevation of over 300 feet above the railway were greatly admired. At the American Company's Mines the party examined with great interest the samples of the manufactured product, made at Frankfurt, Germany, including fire-proof wall papers, gaiters, shoes and head pieces for the protection and use of firemen, and those employed in large blast furnaces. Before leaving, Mr. Klein, the courteous manager, presented the ladies with some of these as mementos of their visit to Black Lake. One hour only could be devoted to the various mines in this locality, but the time was thoroughly occupied, and at 3 p. m. the train steamed into Thetford, the headquarters of the industry. Here the largest mines are situated, embracing those of King Bros., the Bell Co., Irving, Johnson & Co., Ross, Ward & Co., A. H. Murphy, and Lucke & Mitchell. The party were here taken in charge by Mr. Thos. Sheridan, the veteran of the industry, and by Mr. Wm. King, whose large-hearted hospitality is so familiar to all who have had the privilege of visiting this area. These gentlemen, assisted by the other managers, afforded every facility in their power to the visitors for the examination of the several mines, explaining the methods of drilling, hoisting, pumping, cobbing, etc., and everyone was delighted with the treatment they received. It is needless to remark that the visitors pronounced their entertainers "jolly good fellows" all round. The peculiar aspect of the asbestos veins, the presence of granulite dykes, the many indications of slips and faults, in these peculiar serpentine rocks, all presented points of great interest, while more than one of the engineers had their attention directed to the advisability or desirability of inventing some simple process by which the great dumps, which in places, contain a large amount of fibre, can be economically worked by machinery for the crushing and extracting of those veins which, in the present state of the industry are regarded as not warranting the labor necessary for cobbing by hand. It is confidently expected that these important problems will before long be solved and the at present unsightly dumps be made a source of profit.

#### AT SHERBROOKE.

At 5 o'clock a parting cheer was given to Mr. King and their other hosts and the train started on its homeward run to Sherbrooke, supper being served *en route*, and at 7 o'clock the city was reached in time to dress for the second part of the day's entertainment, that of the Reception in the Art Gallery by the Mayor and citizens of that charming town.

At 9 o'clock the comfortable rooms of the Art Gallery were well filled. The beautiful little museum in connection with the building was greatly admired, and the members of the Institute, together with many of the leading citizens, were formally presented to His Worship Mayor Bryant, who, with his laughter, did the honors of the occasion gracefully and well. Following the reception was the presentation of an address of welcome

from the city to the members of the Institute, which was accepted and responded to in good style by Mr. Platt, of Waterford, N.Y., on behalf of his colleagues. An excellent speech was also made by Dr. R. W. Ells, in which he ably sketched the remarkable growth and prosperity of the mining interests of that section of the Province, and predicted a great future for them. Music and dancing were in order, with light refreshments well served during the evening, and at the close all expressed themselves freely as having passed a delightful day, the remarks of the visitors clearly showing their appreciation of the unbounded hospitality and courtesy of which they had been the recipients, and their recollections of the friends made in Sherbrooke will assuredly be of the most pleasing kind.

#### THE RICHMOND SLATE QUARRIES.

Wednesday morning broke fair and sunny, the long season of rain having apparently ended. The Pullmans were attached to the eight o'clock a.m. express to Richmond, and after a pleasant run along the beautiful St. Francis, Richmond was reached at 9 o'clock. Here a special engine was attached and the cars run back to the siding of the new Rockland slate quarry, where they were met by the general manager of the works, Mr. Williams, Mr. T. P. Bacon, Secretary to the Company, and by Mr. Taylor, representing the board of directors. A special vestibule train, constructed for the occasion, had been prepared for the excursion over the company's narrow gauge road to the quarry, about five miles distant, which point was soon reached, the beautiful views along the route eliciting many hearty expressions of delight. Arrived at the quarries, which are extensive and have a depth of 200 feet, the visitors were shewn over the works, inspecting the various stages of the manufacture of slate such as planing, sawing, splitting, polishing and cutting, the making of roofing slates and the quarrying of the blocks. The material from the quarry is of excellent quality. The magnificent water power, and the admirable arrangements for its transmission by cables to various points was specially commended, as well as the splendid derrick equipment, the only one of its kind in use in Canada. Many of these improvements are due to the inventive genius of the manager, Mr. Williams, who has placed the works on a most satisfactory working basis, and has won the fullest confidence of the owners and directors by the wisdom of his management. A few of the gentlemen went down into the pit, but the ladies did not venture owing to lack of time. Mrs. Williams played the part of a most genial hostess and at 12.30 the warning whistle notified all present that the luncheon prepared for their guests was awaiting their attention. Adjourning to the school house near by, the room was found to be handsomely decorated with bunting, while three tables, covered with such a supply of good things as to fairly astonish us, were tastefully arranged. Mr. Taylor, as director of the company, presided, and was ably supported by Messrs Bacon and Williams. It is needless to say full justice was done to the magnificent collation provided and when the genial host rose to propose the first toast everyone present was in his happiest mood. Among other toasts, in addition to those of the Queen and the President of the United States, were "The American Institute of Mining Engineers," responded to by Messrs. Platt and Sharples; "The Geological Survey," by Drs. Ells and Bell; "The Ladies," by Mr. Ingall and Mr. Low; "The Manager of the Quarries," "The Secretary of the Ottawa Committee, Mr. B. T. A. Bell, etc." After a couple of hours exceedingly well and pleasantly spent, the Special was resumed and the return trip made to the main line of the Grand Trunk. Here the most of the party visited the neighboring quarry of Mr. Bedard, which is being reopened, and from which a very handsome quality of slate is being taken, although the operations are as yet in their early stages. Thence on to Richmond, where connection was made with the Quebec express for Montreal, where a special car had been provided for the trip to Quebec, through the courtesy of Mr. Wainwright, of the Grand Trunk, and attached to the through train to Levis.

#### AT QUEBEC.

Thursday morning, on reaching Levis, the brilliant sunshine was gilding the magnificent cliffs of the grand old historic city and giving promise of a glorious day, as if determined that the closing portion of the programme should surpass in enjoyment everything that had gone before. Breakfast was speedily disposed of, and the excursionists quickly ascended the heights and spread themselves along the beautiful terrace, admiring the wonderful scenic panorama spread out at their feet—that view which has been justly styled one of the finest in America. The glorious expanse of the St. Lawrence dotted with shipping, the ranges of the Levis cliffs on the opposite shore, with the handsome city along their crest, and in the distance the charming Island of Orleans, all resplendent in the early morning sun, presented a sight new to most and filled all hearts with a lively sense of its magnificence. The scene of the late terrible disaster was examined, after which the dif-

ferent members scattered through the city, some intent on shopping, others on sightseeing, but all instructed carefully to repair sharp at noon to the Champlain wharf, where the thoughtful kindness of Hon. Mr. Mercier had provided the closing act of the generous round of entertainments and receptions that had greeted the travellers at every point. Punctual to the moment the steamer *Orieans*, which had been chartered for the occasion, was reached and a distinguished gathering of Quebec's most prominent citizens, including many ladies, were ready to extend and to carry out to perfection the regal hospitality for which the old historic city has so long been famous.

After the reception, during which the members of the Institute were presented to the Premier of the Province, and to many of the ladies and gentlemen assisting him, the lines were cast off and the sail around the harbor and up the river commenced. A bright cheery day, gorgeously tinted foliage, magnificent scenery on all sides; the noble St. Lawrence was here seen at her best, and the beauty of the sail to Cape Rouge and return was one of the most enjoyable that can be imagined. A splendid collation prepared in Quebec's best style was served, and everything was harmonious to the highest degree. Returning to the city the trip was continued down river to the Falls of Montmorency, which, owing to the heavy recent rains, presented an unusually magnificent appearance. The return was by way of the St. Joseph dry dock, where opportunity was afforded to inspect this superb work, then across to the celebrated Louise docks, and back to the starting point. The distant Laurentian hills were already covered in places with their mantle of snow, and loomed white in the back ground, but no breath of wintry air served to chill or mar the flood of genuine good fellowship which reigned on board. The return trip was made doubly pleasant by the drinking of several toasts, among which that of the American Institute of Mining Engineers was conspicuous. A suitable reply to the cordial words of welcome expressed by the Hon. Mr. Mercier was made on behalf of the Institute by Messrs. Platt and Sharples, and the singing of the National Anthem with cheers for the Queen and the President of the United States, closed the proceedings for the day. The excursionists returned to the St. Louis, doubtless weary in body and mind, but so charmed with the warmth and kindness of the entertainment, and of the universal display of good fellowship, that all thoughts of fatigue were for the time, at least, entirely forgotten.

A final dinner at the St. Louis closed the round of Quebec hospitality, and at 8 p.m. the greater portion of the party re-embarked on the night express from Levis to Montreal, at which place the members of the excursion finally disbanded for their respective homeward journeys.

It is presumably not too much to say that of the numerous friendships made during the week of the visit of the American Institute of Mining Engineers many will be hearty and lasting. It is pleasant to know that throughout the entire expedition nothing occurred to mar, in the least, the good feeling and the hearty sense of fellowship that prevailed and was conspicuous on all sides. It is certainly not saying too much if we conclude that the few days spent by our distinguished visitors on the trip through the Eastern Townships of Quebec will be productive of great and lasting benefit to the mining industries of Canada. They are all specialists in their several lines of work. They have seen this section of the country with their business eyes wide open. They are quick to discern a good opening for the placing of capital, not only in mining matters direct but in many other enterprises connected therewith. We can only re-echo the wish already so often expressed, that at some not very distant day a much larger representation of our brethren across the line may invade us, with more time at their disposal, that we may show them other stores of mineral wealth—our silver, our gold, our iron, our antimony, our magnificent quarries of building stone, our coal both of the east and the west, in fact our mineral wealth as a whole—that they may be able to form some faint idea of the greatness of this fair land, "for it is a fair land." And they can safely rest assured that when they do so visit us again they will find that the hospitality they have so lately experienced is no transient thing designed for the occasion, but one of the great elements of the Canadian nationality of which we are all so justly proud.

#### A Graceful Acknowledgement.

The Secretary of the Ottawa Committee has received the following letter from Dr. Raymond, under date of 24th inst.:—In accordance with a resolution passed at the Ottawa meeting, it is my pleasant duty to request you to express to Sir John A. Macdonald and to Lady Macdonald the cordial thanks of the Institute for the abundant and graceful courtesy, both official and social, with which they received its visiting members and guests, and in recognition of which you are further requested to present to Sir John A. Macdonald a complete bound set of the seventeen volumes of the Transactions of the Institute.

## The Sudbury Mines and Works.

(Read by Dr. E. D. Peters, jr., Sudbury.)

The Sudbury ore deposits possess a peculiar interest for a variety of reasons. In the first place they are deep within the borders of the Huronian rocks, and are consequently amongst the oldest deposits that we know of, unless, indeed, the ores were deposited at a much later period than the country rock. Again, they carry nickel in unusual proportions; and lastly, they are unique in containing a small amount of platinum, although arsenic is not present.

I shall not pretend to go into the geology of this region. The Huronian and Laurentian rocks are familiar to all American geologists, and these present only the usual series of gneiss, graywacke, quartzites, greenstones, clay slates, etc., which are characteristic of this gigantic system of rocks which has excited so much discussion of late years.

As in all parts of Canada where it occurs, I believe, the rocks of this system are tilted to an extraordinary degree, and to such an extent that it may be said that the whole country is standing on edge at an angle of something like 70 degrees to the horizon. The general strike of these rocks is south-west and north-east, and as the orebodies follow the lines of stratification, if it can be called stratification, it follows that the course of the latter is the same as that of the rocks, though local twistings and faults are so frequent that no absolute rule can be laid down as to their direction.

But at least one general feature can be stated as universal, I think, and that is that all the orebodies yet discovered in this region are in close proximity to somewhat extensive dikes, or tilted beds, of diorite. It is usually the case that the ore occurs at the point of contact between diorite and the graywacke, although I think in some cases it is found in the midst of the diorite itself. This diorite is of course a volcanic rock, and is composed properly of quartz, feldspar and a considerable proportion of hornblende, but by the predominance of one or the other of these constituents, and the corresponding diminution of the one or more of the remaining minerals, it forms almost every variety of rock imaginable, and differs so greatly in appearance as to deceive any one who has not had an opportunity to observe its modifications.

This diorite forms the gangue rock of our ore deposits to a great extent, and is a rather favourable constituent than otherwise, as its varied bases and comparatively low per cent. of silica makes it far less refractory in the furnace than the quartzose vein matter that so commonly accompanies copper ores.

The ore itself is a mixture of very pure chalcopryrite and of magnetic iron pyrites or pyrrhotite, carrying a considerable amount of nickel, this metal no doubt replacing an equivalent amount of iron.

The mines were worked originally for copper, and it was not till a shipment had been sent to be smelted that it was discovered that they were nickel-bearing to an extent that rendered them far more valuable for that metal than for copper.

As the principal amount of work at Sudbury has been done by the Canadian Copper Co., and as I am naturally most familiar with these mines, I shall describe them more particularly, though I believe in so doing I shall be describing the whole district correctly. I know of no mines there that differ materially from the mines of this company, except that most of the later discovered deposits have shown neither the size or the richness of the earlier discovered ones, a fact that is notorious in the history of almost every mining camp that I am familiar with.

It is very difficult to give any correct statements as to either the size or richness of these beds, as they are so variable in the former particular as to make it impossible to give an average figure, while in the latter, it depends upon the class of deposits to which we are referring, as I will explain later.

In order to give some slight idea as to what these mines amount to, I will divide them roughly into two classes. 1st, those which are composed of extremely massive pyrrhotite and are of enormous extent, so large in fact, that we have as yet obtained no idea of their boundaries; and 2nd, those which are more rocky in their nature and less extended in size, but which are very much richer in both copper and nickel. I do not know but that in justice I ought to make a third class, to which one of our most important mines belongs, which is not only about as extensive as the first class, but nearly as rich in valuable metals as the second series. This is a most unusual and pleasing combination, but is certainly attained by the "Evans" mine, belonging to this company, and quite possibly by one or more of their yet undeveloped deposits.

As I trust that many of my hearers may in a day or two visit Sudbury in person, I will briefly describe the main peculiarities of each of these three classes of mines, illustrating them by the three mines which the Company is now working most extensively for ore, and of which, curiously, each belongs to a different class.

As an example of the first class, I will cite the Stobie mine, situated about 4 miles north of Sudbury on a branch of the C.P.R., built expressly for the use of this mine. Before being opened at all, it simply appeared to be an immense rounded hill of red gossan, presenting about as extensive an outcrop, both as to length and width as I ever saw in my life. As to the length, I will only say that although we have opened it but a few hundred feet longitudinally, yet the outcrop shows it to continue in a more or less unbroken condition for some miles over property belonging to the same company. Upon removing this gossan which consists of a brown iron ore in regular stratified layers, (the product of the decomposition of the pyrrhotite,) we come, within 2 to 6 feet of the surface, upon the unaltered pyrrhotite in an almost absolutely massive condition. At intervals, bands of rock of a very limited extent occur, and occasionally considerable masses of diorite, or of mixed ore and rock. But as a rule the ore is absolutely massive pyrrhotite, with occasional pockets of very pure chalcopryrite and not infrequently rounded and even angular occluded masses of diorite, from the size of a chestnut up to immense boulders, weighing many tons.

As you will see at the mine, the position of the ground is favorable for opencast work, and we are at present simply taking the whole hill down as we go, on a level with the valley where we start. We have in some places already cut over 100 feet across the ore, thus proving the width to be very great, and also obtaining a fine face for blasting down the ore in great quantities. Our practice here is to bore a series of holes by air drills 8 to 10 in number, and about 10 feet deep, and as far back from the face of the cliff as we think it is safe to go, and then load the holes heavily with dualin, and fire the whole series at once by a small dynamo, operated by hand, in the usual way.

In this manner we throw down several hundred tons of ore at a single blast, and for two or three days the men are kept busy in blockholing the large fragments and breaking up and loading the ore, preparatory to a fresh blast. Of course there is nothing original about this practice, but it is rather unusual as applied to nickel ore, and we hope to be able to show you one of these large blasts on your proposed visit to Sudbury.

This ore, although lower in both copper and nickel than the ore from the other two mines that we are working, is yet rich enough in both metals to compare with the best Norwegian or German nickel ores, and is especially valuable to us locally on account of its high percentage in iron, which, after roasting to remove the sulphur with which it is combined, makes a most welcome flux for our richer but more rocky ores from the other mines.

Besides cutting across the vein for a considerable distance, as already mentioned, two tunnels have been continued still further across it for some 60 feet, showing massive ore in their entire extent, as well as in their extreme face. We hope, and intend, to extract a large portion of our winter's supply of ore from these two tunnels, which will enable us to work in comfort when the weather out of doors would be too bad.

You will probably notice that our work at present is not economical, the ore being handled mostly in barrows, and being spalled down to size by hand. This is only a temporary make-shift until a new crusher comes to take the place of an old one that was moved elsewhere, when the ore will be handled directly from the face of the quarry by a derrick operated by steam power and conveyed in cars directly to the breaker, where it will be crushed and screened by machinery and delivered automatically into the small cars, which will run directly over the large railway cars and dump the ore into them very cheaply and conveniently. Within a fortnight this will all be in operation, and the hand work entirely discarded.

The second type of deposit is well illustrated by the Canadian Copper Co's "Copper Cliff" mine. This is situated about four miles west of Sudbury, and some six miles south west of the "Stobie" mine in a B line. The ore here consists of the same pyrrhotite and chalcopryrite, but by no means so massive nor in such an enormous deposit. There are many places in the Copper Cliff mine where the ore is as massive as is possible, but in other parts, though rich in the valuable metals, it is much intermixed with diorite.

The ore occurs here in irregular masses of several thousand tons each, situated apparently between two cleavage planes in the country rock, so that we can usually find new ore deposits by drifting in the right direction. Although there are absolutely no stringers of ore or veinlets of quartz to connect these ore bodies, the country rock in their vicinity is usually speckled to a greater or less extent with ore; and this is often the only indication we have of our immediate proximity to a large ore body.

At present the Copper Cliff shaft has reached the 500 foot level, on an incline, and the ore at the greatest depth yet discovered retains its full value in nickel and copper. As the pitch of the shaft is somewhat less than that of the ore, the shaft has long since left the vein, and is now

at some distance above the hanging wall of the latter, so that we have to drift some distance to the rear to strike the proper cleavage plane where we may expect the ore. In the fourth level we have struck a fine deposit of ore, while the fifth level is just fairly started. The third level is our active level at present, though we hope before long to have the fourth and fifth levels in even better shape than the third.

The pure sulphide of nickel, Millerite, is found in many mines which contain no nickel in paying quantities, while in our mines it has only occurred once in the Copper Cliff mine. Then it was in very small quantities, and presented its characteristic appearance of fine wires.

### MACHINERY.

The Copper Cliff mine is well equipped with machinery, and has as good a plant as need be desired. It has a double skip-road on an incline way to the bottom of the shaft, the skips dumping automatically at the mouth of the breaker in the top of the rockhouse. Here the ore is sledged to a proper size for the 15x9 Blake breaker, which has a capacity of close on to twenty tons an hour, and passes through a revolving screen, where it is sized into three classes suitable for the succeeding operation of heap-roasting. The coarse size will pass a 4 inch ring, the medium size, or ragging, will about pass a 1 3/4 inch ring, while the fines go through a circular hole of 3/4 inch diameter. Each of these sizes falls into a separate bin, under which a car runs on proper T rails. Thus the ore is loaded automatically into cars holding 1 1/2 tons, whence it is transported to the upper story of the ore shed, there falling into a series of bins, from which the ore is loaded by means of inclining steel chutes into the railway cars, and goes direct to the roast-heaps.

Aside from the rock-breaker and its engine, this mine has a fine double cylinder hoisting engine with two drums, and a 7-drill air compressor of the Ingersoll Co's make. We do about all of our drilling with Ingersoll drills, using compressed air, and on the whole find them efficient and tolerably economical.

The further equipment of the mine consists of a machine shop just about completed, and containing a 20 ft. lathe, a good sized planer, as well as a drill press and an Acme bolt cutter, so that we expect soon to do all our machine work at home, thus effecting a large saving. These tools are driven by a 10 inch vertical engine, taking its steam from the main boilers in the compressor building. We further have a couple of home-made hydraulic piston jigs, which we are about to use on some of our fine ore that is too rocky, mostly to demonstrate how well this ore will concentrate, as we have very large reserves of ore that is too rocky for smelting, but that should pay a handsome margin for concentrating.

Our laboratory is also situated here, though it will soon be moved to a much more commodious building at the Smelter, where all our samples will be prepared by machinery, and where our electricity for assaying will be furnished by a small dynamo, thus avoiding the annoyance and uncertainty of batteries for that purpose. I need hardly mention that nearly all our copper assaying is done by electricity, but I think it is more unusual to assay nickel in the same manner, but our chemist, Mr. F. L. Sperry, has succeeded in perfecting a method for so doing, which he will no doubt be pleased to show to any who are interested in this matter.

The third class of deposits is represented by the Evans mine, situated about one mile S.S.W. of the Copper Cliff. This mine contains an immense body of pyrrhotite, which is nearly as massive in places as the lower grade Stobie pyrrhotite, while it runs high in nickel. The copper contents is also very satisfactory in many parts of this deposit, and although it is by no means fairly developed, yet I cannot but regard it as an exceedingly valuable property. The company has valued this mine highly from the commencement, and has thought it worth while to provide it with one of the finest shaft and rock-houses in the country. The ore will be hoisted in cars, on a platform hoist, to the top of this high rock-house, where it is dumped 12 feet on to the breaker floor, which will hold several hundred tons. The breaker jaws are on a level with the floor, and it is fed with great ease, the ore being automatically sieved, as described at Copper Cliff, and the different sizes falling direct into separate bins, whence it flows direct into the railway cars by merely lowering the respective steel chutes.

At present we hoist with a kibble merely, but even this small affair gives us daily some 50 tons of ore. We have here a three drill compressor, and two good pumps, as I regret to say that both the Canadian Copper and this mine make considerable water.

### THE ROASTING PROCESS.

The metallurgical treatment of this ore begins at the roast-yard, where the ore is roasted in heaps to remove the major part of the sulphur and oxidize the iron present as far as practicable.

As I trust you may see in person, this roast-yard has been made at much trouble and expense, owing to the

rough and rocky nature of the ground, and the fact that the only proper site for it was heavily wooded. Two railroad tracks of standard gauge stand in connection with it, one being a high trestle-track which extends longitudinally over the entire roastery, the other being situated 4 feet lower than the roaster-yard and extending parallel with the upper track along one edge of the yard. The upper track is to deliver the raw ore from the mines which, as soon as we can make the necessary arrangements, will be brought in dump cars and dumped on to elevated platforms at the side of the track, whence it will be wheeled on to the heaps which extend in a long row at right angles to the tracks. The roastery is nearly half a mile long and 100 feet wide, so that the length of the piles is limited by the width of the ground, which, after allowing space to get around them, and for drains, is about 80 feet. They are about 40 feet wide, and as the ore is piled about seven feet high on the wood, will hold about 800 tons. They are built in the usual manner, about 30 cords of wood being sufficient to kindle a pile. After the main body of the pile is built up of coarse ore, a layer of ragging or medium ore is put on, six inches to a foot thick, according to the supply on hand, and this is covered in the usual manner with fines. By interposing a layer of rotten wood and chips between the ragging and fines we are enabled to roast both of these smaller sizes more perfectly than is usually done, and in general find the whole heap well enough oxidized to take it direct to the smelter without re-roasting any portion of it, which adds materially to the economy of the operation.

A heap of 800 tons will burn about 60 days, if properly managed. Very great care has to be exercised in this operation, or the combustion will be too rapid, and a great part of the sulphides in the ore will melt down into a solid matter, which is most difficult to break up, and which carries far more sulphur than is permissible. As I have stated many times before when writing upon this subject, almost the entire success of the smelting process depends upon a good roast. If the sulphur is not properly removed a great quantity of low grade matter is formed, into which the iron goes, leaving the silica without sufficient flux, and making the furnace run slowly and badly. While, if it is reduced to the normal amount of seven or eight of sulphur in the roasted ore, a rich matte is formed in comparatively small quantity, thus lessening freight and treatment charges, while the iron that was combined with the sulphur is thoroughly oxidized, and thus in a condition to combine at once with the silica, forming exactly the flux required, and making a rapid, clean and fluid run in the furnace. The importance of this process must be my excuse for devoting so much space, but thousands of dollars are lost every year in metallurgical operations for want of attention to this most difficult and delicate process.

The ore is roasted by contract at a very small figure both for fuel and labor, and by a second contract is dug out of the heaps, which are frequently so fritted together as to require light blasts to loosen it up, and wheeled a few yards to the cars which are standing on the lower-level track already described. Thence it is pushed by the engine up a rather heavy grade on to the track which runs over the bins back of the Smelter, which are calculated to hold nearly a week's supply. At this point, we begin the description of

#### THE SMELTING OPERATION PROPER.

I think the first thing that will strike most furnacemen on seeing the Canadian Copper Co.'s furnaces is the small size of the building covering them. There are 2 smelting furnaces and 2 buildings, but as they are practically duplicates of each other, it will suffice to describe one. The entire building is 40x65 feet, of which 40x35 is on a lower level, and contains the furnace, while the rest of the floor is 8½ feet higher, and is devoted to the ore and fuel bins. When you consider that the furnace averages 125 tons per 24 hours on favorable ores, I think that the space it takes up is unusually small, though amply large for all requirements. The furnace itself is a steel water-jacket of the Herreshoff patent made by the Jenckes Manufacturing Co. of Sherbrooke, P.Q. It is rectangular with rounded corners, and a slight convexity all round, so that it really approaches an oval. Its section at the tuyeres is 3 feet 3x6 feet 6, and it has 11 2½ inch tuyeres, there being 5 on each side, and 1 at one end, the discharge opening being at the other end. It is 6 feet high from tuyeres to charge-door, and is an unbroken water-jacket, the entire distance from the cast bottom-plate to the charging-door. Above the threshold of this opening, is a housing of boiler iron, lined with fire-brick, which lasts as long as the furnace does. The charge-door is situated at one long side of the furnace, while the flue opening is opposite to it, the entire flue as well as the iron charging platform resting on a series of girders and 1 beam, which are supported by the stone walls of the building and by 3 iron columns which are located so close against the furnace as to be entirely out of the way. The red brick flue enters into a series of zigzag dust chambers outside of the building which are connected with a stack of the same material, 60 feet

high, and 5 feet square inside from bottom to top, its diminution in size, due to the taper of its walls, being fully compensated by the increasing thickness of its walls in height, they being only 8 inches thick for the top 20 feet. All the brick work is securely ironed, so thoroughly that though in operation for nearly 9 months, no crack of any moment has shown itself, and it promises to last indefinitely. This is due to extreme care in preparing the foundations in this frosty climate, and to proper ironing.

The water space in this furnace is only 2 inches wide instead of 6 or 8 as is often the case, and we experience no trouble in consequence. The chief peculiar feature of this furnace is its front connecting reservoirs, or "well," as we term it. It is a circular, cast-iron, water-jacketed vessel, mounted on 4 stout wheels, and so designed that its hole in one side connects directly with the outlet hole of the furnace. This forms a connecting channel a few inches in length thoroughly protected by water-cooling, through which the molten slag and matte flow out of the furnace as rapidly as they are formed. They thus escape the influence of the blast, and any possibility of the great bugbear of copper-smelters, the formation of great masses of cast-iron, metallic iron, called "sows" or "sal-amanders," is completely avoided, thus robbing smelting of half its terrors. Many of the new varieties of furnaces have some similar provision, but none so convenient and perfect as this, I think.

The slag and metal separate very perfectly in this quiet, spacious reservoir, and the slag flows in a continuous stream over the jacketed lip of the same at a height of some ten inches above the outlet hole of the furnace. This ingenious arrangement completely traps the blast, and owing to it, we never have any foul slag to re-smelt from one week's end to the other. The matte is tapped at intervals of 10 to 20 minutes through a separate bronze, water-cooled taphole-casting, which is bolted to one side of the well, and which is plugged with clay in the usual manner. Owing to its proximity to the hot stream of molten matter from the furnace, the taphole never chills, and instead of the ordinary sledging and labor every time the operation of tapping takes place, with us the furnace-man uses simply a half inch steel bar, which he drives through the clay plug with a few light taps of a carpenter's hammer, the matte flows quietly into a slag pot placed for the purpose, and the small taphole in the casting is closed without any chance of failure by a clay plug, as usual. There is no interruption of the blast, and none of the ordinary excitement and confusion so generally attendant on the operation of tapping. A slight matter, but one worth mentioning, is an arrangement that we have for the better preservation of the cast-iron plates that form the floor of the building around the furnace, and which it is particularly essential to have very smooth and solid, so as to easily draw heavy pots of molten material over them without spilling it. Usually whenever a potful of slag is drawn away from the furnace, and before a new pot can be run in in place of the old one, a considerable amount of slag drops upon the iron plates, which in spite of more or less protection from sand, soon become so warped and out of shape, that within three or four weeks they are totally destroyed, and have to be replaced by new ones, at a considerable expense of time and money. To obviate this universal difficulty, we have cut a circle in the plate just where the stream of slag naturally falls, and have introduced into this a shallow cast-iron basin. The slag drips into this without injuring the plates, and is taken out from time to time by the fork and thrown into the slag pot. The basin stands two months or more before it is destroyed, and is replaced at a cost of 75 cents, and without a moment's loss of time to the furnace.

There is nothing particularly worthy of notice about the charging-floor, except what I have already described. Every pound of ore and fuel is accurately weighed on a 5-beam charging-scale, and is also sampled. In the same way, the matte produced is daily sampled, as well as accurately weighed, before it is dumped from the pot, and the slag is sampled from every potful and assayed once every 24 hours. From these data, we are able to prepare an accurate daily history of the furnace work in each furnace for the benefit of the Directors at home, to whom it is sent in a weekly sheet.

By properly mixing our three different ores, we are enabled to get along without ever using a pound of flux, which is a very fortunate circumstance, as I know of neither limestone or iron ore in the vicinity, that would be suitable for this purpose.

For fuel, we use Penn coke of the best quality, which is brought here via the Great Lakes and the Algoma branch of the C.P.R. at a less cost than might be imagined. We smelt seven to eight tons of ore to one ton of coke, as proved by having our coke over-run when we clean up and estimate our large shipments of some thousands of tons, for there is very apt to be a heavy deficit in coke.

Our furnaces are supplied by wind with two separate No. 6 Baker blowers, one to each furnace. The blower to our No. 2 furnace is provided with a vertical engine which forms a part of the blower itself, while our No. 1 furnace is run by a large Brown automatic engine which

has ample power for other additional work. Our water is pumped from a neighboring stream where we have built a dam and formed a small lake by two duplex Worthington pumps, either of which has ample capacity to supply both furnaces. Two steel tubular boilers, set in one battery, supply steam for the entire plant.

#### NOTABLE FEATURES OF THE WORKS.

If I were asked to point out the most notable features of these works, apart from the mines, I should mention first the very large capacity of the furnaces, nearly or quite 125 tons per 24 hours for each on fair ores; also the entire absence of flux, owing to a more or less basic gangue rock, and some very massive pyrrhotite from one of our mines, the Stobie; also the very favorable ratio of ore to coke, 6 or 8 to 1, not as the result of an especial trial under favorable circumstances, but from months of average work. The same may be said of the capacity of the furnaces, which is greater than any that I know of running on pyritous ores.

Of course, the chief peculiarity of our product is the large percentage of nickel which our matte contains in addition to its copper contents. Our average matte will be about 27 per cent. copper and 15 per cent. nickel, and both of these metals are of such a purity that when separated they are fitted for the most delicate work, and will stand any tests that any similar metals stand. As every copper smelter knows, we can determine the percentage of copper matte by eye with such exactness that from any percentage between 25 and 80 I have never cared for an assay of it for my own benefit, as my eye will always tell me its copper contents near enough for metallurgical or chemical purposes. But even a very slight admixture of nickel completely masks the color and texture produced by varying percentages of copper, and in our matte I do not think that any one could distinguish between a matte carrying 15 and one carrying 40 per cent of copper, providing that nickel were also present in our usual proportions.

At present we break our matte into large pieces, which we pack into old oil barrels, chinking up the interstices with the smaller fragments. These are shipped to Swansea, or to various German works, according to the bids of the foreign refiners for our product.

It may perhaps be news to some of my hearers to learn that the entire world's production of nickel annually is less than 1,000 tons, the bulk of this being produced by the New Caledonian nickel mines, which are oxide deposits situated in a serpentine dyke. While I am not at liberty to give figures of our production, it will still be very evident to any observer that the world's production of this year will be a good deal larger than that of 1888, and as we are told that New Caledonia is losing money at the present low price of the metal, it is evident that we need not look far for the world's supply. The Gap mine, owned by Mr. Wharton, of Philadelphia, has been for many years the one nickel producing locality of the United States, but is practically out of the running at present prices. Therefore the United States, by its present heavy duty on nickel, is taxing its entire population without its being of the slightest benefit to anyone except a few foreign producers, while it drives away everyone who may desire to establish works for the refining of this metal within its borders, and thus loses a most remunerative industry that would employ great numbers of men and great quantities of material, without obtaining the slightest benefit in return.

#### DISCUSSION.

THE CHAIRMAN (Prof. Eglestone) — You need have no trouble about your nickel, because just as soon as you make it cheap enough it will be used in every kitchen in the world.

MR. THOS. MACFARLANE — I have no remarks to make by way of criticising this paper, but I do not think we should allow the opportunity to pass without congratulating Dr. Peters on having presented a paper so full of information on the subject of the description of the improvements made in the metallurgy of nickel in a comparatively short period. As he was reading his paper I compared his various improvements and method of treating the ore with what I saw in operation something like thirty years ago at the Reminger nickel works in Norway. I think Dr. Peters will know the locality I refer to.

DR. PETERS — Yes.

MR. MACFARLANE — The improvement in the treatment of the ore is simply enormous compared with the old method of working. I do not see any difficulty at all in this whole matter except disposing of the nickel; but I suppose that will have to take care of itself. I simply rise to express my extreme gratification at having listened to such an interesting paper.

DR. ASHBURNER — I have nothing to say with regard to the metallurgical or geological features of Dr.

Peters' paper, but I have had occasion during the past years to look into some matters in which I think my friend Dr. Peters could help me out. Some three months ago I had the pleasure of visiting Sudbury and of being his guest for several days, and examined with a great deal of interest and instruction the works under his charge. Having received a telegraphic call I regret that I shall not be able to visit Sudbury again with the members of the Institute, as the trip will be of the greatest interest to every one. The geological association of the ores is not only interesting, but the ores themselves are unique. To mineralogists it is of consummate interest, and for geologists the way it occurs in the Huronian rocks is of great interest. As far as the arrangement of Dr. Peters' plant is concerned, I regret that Dr. Peters has not had such a plant erected on the other side of the border, because it is so complete and unique in its way that it seems almost a misfortune that American engineers should have to come to Canada to see something which they cannot see on their own side of the line. The furnaces themselves are particularly interesting in the handling of the sulphide ores which Dr. Peters has been handling there, and remarkable in the quantity of ores which they reduced. We all know the remarkable experience which our recently elected member, James Douglas, although an old friend of many of us, has had in the Copper Queen mine in Arizona, where he has reduced 150 tons of ore in one day in a furnace very much the same size as the largest furnace of Dr. Peters; but the ores are quite different, being largely oxide and carbonate ores and having less than five per cent. in bulk of sulphides; so that while we have been regarding the practice which Jas. Douglas has accomplished in handling the Copper Queen ores, it is really something phenomenal to think of the sulphide ores which Dr. Peters has handled in the furnace at Sudbury. Everyone here who is interested in the matter, either as geologist, mineralogist, mining engineer, or metallurgist, will be amply repaid by a trip to Dr. Peters' works.

DR. PETERS—I forgot to mention Dr. Bell's kind offer to exhibit for the benefit of the Institute some of the Sudbury ores which he has here. One thing I might state which might be useful metallurgically. I have not mentioned the reason why we obtained such a large result from such a comparatively small furnace. I am making some tests now with steel plates which, if they are successful, will enable me to put up a 200 ton furnace to work somewhat cheaper than our present furnace. I know no reason why we cannot smelt 500 tons a day just as well as the amount we now handle. It is all a question of handling. They have conquered all these things in your furnaces, and we feel sure we will have a 500 ton furnace in operation if the steel plates will stand it. The secret of our rapid smelting is not that there is anything remarkable in our ores. It is that we use a very powerful blast, and more than anything that our different ores are most carefully mixed together before they are smelted. Of course we pay great attention to the analysis—to weighing out the exact amounts of ore—to feeding the furnace and other minutiae, but in addition to that, I spoke of two things of importance. One is the blast and the other is the percentage in the heaps. It makes all the difference in the world how the materials are to form that percentage. We find the greatest benefits result from mixing ores of three kinds and roasting them in heaps together. In that way they get so well mixed that every atom of silica has its necessary atoms of lime and iron united with it, and it does not have to run all over the furnace to get its atoms. That is not the scientific way, but it is better that way than if we mixed these ores with a shovel. It has been observed that it makes the ores flux better to mix them—to the extent of ten per cent, if not more.

DR. BELL—As I have been engaged by the Geological Survey of Canada in and around Sudbury for the past two years, and had passed through the district many years before the discovery of copper, I may say that I have listened with a very great deal of pleasure to Dr. Peters' paper. I can bear testimony to the very excellent work he is doing—the perfect working of the furnace and everything in connection with the copper company's mines there. We Canadians may well congratulate ourselves upon the good work Dr. Peters is doing there. I know he has encountered no ordinary difficulties—difficulties which might have been obviated had the authorities cooperated with him and encouraged this industry as they might have done. Dr. Peters has been subjected to criticism by persons who knew not of what they were speaking, but he has gone on and achieved a success which is unexampled in the history of metallurgy and mining in this country. I have no doubt that the company will go on and readily find a market for all the nickel they produce. One reason why it is not more largely used now is on account of the high price. The geological relations of these deposits has been one of my studies, but there is a puzzling question which I had hoped Dr. Peters would have answered, viz., "How came the copper there?" If he had explained to us the

history of the formation of these deposits I should have been very glad.

DR. PETERS—It is your province to say that.

D. RAYMOND—Dr. Peters' business is to get at it. Who put it in as another question.

DR. BELL—It is a puzzling question, and one which geologists, mineralogists and chemists cannot even answer. Dr. Peters is an experienced man, and possibly he might tell us something of the behavior of copper under high temperatures. If he has any theories I should like to hear them.

DR. PETERS—I have none.

DR. RAYMOND—I only desire to add a word or two to what has been said to express my adhesion to the praises of our friend's work. It is a good many years now—more than twenty years—since I first met Dr. Peters, struggling with greater difficulties than seems to be his perennial lot to-day, in South Park, Colorado. We lost sight of him for a while, but he has now, as the practical manager of these works at Sudbury, and as the author of our best book on the metallurgy of copper planted himself so prominently in our profession that we hope he will never get out of it. With regard to this matter I had made a note to express my own desire that if Dr. Peters had—well you know what in Dickens' novel, "Great Expectations," what Gargery says to Pip, "Wasn't there a dog Pip? Not a small dog? Nor a pup?"

Now if Dr. Peters had only a small hypothesis, or a "purp" that would become a hypothesis, that would throw any light on this paragenesis of sulphide copper ore or other minerals which surround it, we should be glad to know of it. Dr. Bell and I had a talk at the Geological Museum this morning on this subject in the presence of specimens from the old Acton mine. Allusion has been made to the presence of organic matter, indicated sometimes by bituminous rocks and sometimes by fossils, and I suppose in the gangue of reduced ores, in which class I might include native ores of sulphides. Native ores might have been reduced from oxides, and sulphides from sulphates. In the days when I was lecturing, as a desperate resort I have been accustomed to say when inquisitive students would attempt to corner me with importunate questions, that where we could find traces of bitumen we had reason to assume the presence of organic matter, and fossils the same, but where we did not find any we could assume that they had not been there. In that way I got out of it. I can say honestly, since we have grown up and have no class present I do not mind confessing it, I cannot say that I am altogether satisfied with my theory on that point. I think the whole subject of the diffusion of sulphides in places where the reducing agent is not present or indicated is not easily to be conceived—is one that is a mystery in the good old fashioned sense of a mystery. That is a thing not yet found out. When it is found out it may be simple enough. It is not necessary that the clue should be everywhere present. When we find clear proof of such a genesis we shall be able to infer it and apply it to some other place. In the Jersey iron mines the distribution of our ores is pretty much in the same position and shape of those at Sudbury—that is in chutes or pods, sometimes in echelons, as they seem to be enclosed in silicious crystalline schists, and clad as if they had been at first set up with these crystals around them. In the mines which I am managing at present for Cooper, Hewitt & Co., we have not a single case where any fault can be traced. The recrystallization of the rock had obliterated all traces of the "fault" anywhere from ten to thirty feet, and as it did not bring in another kind of rock we passed from one to the other, and not being close observers we got from gneiss to gneiss and did not realize that we had passed any "fault" at all, but finding ourselves out of the deposit we cross-cut in the direction as indicated and found another. If we had only a single case of copper ores in such condition as the Sudbury mines present, or the old Acton mines present, I think we might, in default of a better explanation, hold up our heads with courage to the young aspirant and fire off an explanation. But when these sulphides are deposited in now bituminous, now fossiliferous limestone, as in the copper of the Ducktown range, associated as they are say with pyrrhotite and also a small percentage of nickel, we have got an adequate explanation of their genesis. I want to ask whether Dr. Peters attaches any significance to the presence of nickel universally, although in small proportion, in all that pyrrhotite group of mines extending from Lichfield, Conn., way down the Alleghanies to Ducktown—the whole range—limonite at the top, then concentrated copper ores lodged down to the water line. The persistence of the line makes it a geological horizon; but so far as I know no special light has been thrown on the genesis of it. I would also like to ask another question and that is whether anything particular has been done in the

relation of alloys of phosphorus and nickel in developing metals of extraordinary strength and elasticity. Dr. Peters' paper gives us an idea of the process that has been going on during the past ten years in all American metallurgy, and has placed it at the head of the metallurgy of the world to-day. It is the process of sweeping away a thousand details and cobwebs which we supposed up to a few years ago to constitute the science of metallurgy. Distinctions and infinite comparisons beyond compare. But what could we do? In iron? We put wrought iron hoops around our furnace—got a good strong engine and blew. We have forgotten now how we crushed the ore, and a great many things we supposed to be symptoms. We are all now valetudinarians. We simply watch our furnaces and the symptoms take care of themselves. Ten years ago, I stood up at a meeting of the Institute and told those assembled that I had had more experience and knew more about taking care of a blast furnace in difficulty than in taking care of one which was running well. We went through indescribable troubles and difficulties and agonies with our Durham blast furnace. She was built for 400 tons a week, and we struggled along and were proud of an average of 250. We ran down to 50 tons, and to nothing sometimes, and we scaffolded and performed surgery upon her, and all the forms of injection, the blowpipe, dynamite and everything that anybody could do, and we had all the trouble there was to be had. Now, last week we were making 850 tons out of that furnace with very close to a ton of fuel to a ton of iron. For a long period our record of fuel had been surpassed by our neighbors, the Glenod people, but our record has not been surpassed of late. I say that not on my own authority, but on that of Sir Lowthian Bell, when our figures for a long time had been submitted to him. As soon as we got into that way of blowing very hard and working fast, keeping her feet warm and her head cool, all the internal dissensions disappeared. A great many things that used to trouble us to death if we were working along in the old fashioned way have disappeared. Main strength has been the secret of success in modern blast furnaces. We borrowed from our friends of the lead smelting industry the water jacket hearth. We are practically blowing with a certain sort of superstition in the encouragement of fire brick manufacture, for we still put fire brick there, but we have a water cooled hearth, and good hooping that holds every thing in. Our furnaces stand 15, 16 and 20 lbs. to the inch and we make things melt. What else can they do? (Laughter). With regard to the boon in water jacket furnaces, which our brethren in the lead industry have bestowed on us, we have returned it by the example of Mr. Herreschoff. He has come to use main strength as Dr. Peters has. What he has come to do in copper was done in the metallurgy of lead when they took hold of that business and restored to life the old idea of beginning to make large furnaces and smelting large amounts of ore. In the early days when there were some thirty furnaces running, we would get up in the morning and count how many were bunged up that day. When the salamander was acting it was sending off an awful lot of fumes, and by the volume of these fumes which were staining the sky we could see how many were shut down. It was a regular thing to have a salamander every eight days. They would hitch oxen to the old salamander and drag it out, until I have seen half acres covered with them, then I have known the managers to dig under them and bury them, and in days to come geologists may dig there and find curious nodules. (Laughter). There will be wrought iron found in curious deposits. In the metallurgy of the future we are going to apply energy, and we are going to get more energy by the combustion of fuel, in transmission by electric conductors, and in all ways to overcome difficulty by force. We are going to stop fooling with nature and just charge, attack, and she will give up. (Hear, hear). Put on the force and she will give up. One word further. Dr. Peters has revealed accidentally what is the secret of metallurgy and what will prevent our friends the chemists from having the control. Mr. Macfarlane looks glum; but the chemists are not going to be left out. That is the study of the slag as the true guide for the metallurgist. It doesn't lie. That is the study of the slag and increased facilities for its analysis. By practice and skill we shall be able to train our foremen to recognize the physical signs of the slag. I remember some years ago Mr. Macfarlane suggested a rapid method of determining the density. It is not always necessary to do that. There is a science not written in books, and not known to many outside of the locality where it was born; but in every place every metallurgical director who is worthy of his place and rises to the full capacity of his skill, will train himself and his foreman to read the melted surface of the slag. (Hear, hear). He will know what it is when he looks at it. Then there will be the necessity for the chemist to verify this rapid observation. I think it is being based on copper by the book of Dr. Peters. (Applause). I am proud to think that other books such as those by Mr. Staderfeldt took rise in papers read before this Institute, while many other works springing out of our

transactions are enriching the technical literature of the world, giving us a little to life and earning for us the gratitude of mankind.

DR. PETERS—I dislike to take up your time, but it would be discourteous not to reply to a few of the questions which Dr. Raymond has asked me. I am however, overwhelmed with the praise of my professional brothers. I came here ashamed of my paper because I know it is not a good one. I sat down to the typewriter and did not have an opportunity to read it over afterwards. The reason for this is because I have so much work to do, and under the circumstances I must thank you for the indulgence you have given me. In regard to this conundrum as to whether I attach any significance to the occurrence of nickel in pyrrhotite in this long range running north and south, I do not. There is a little bed in the Ely mine, but whether I have found all the pyrrhotites to have copper, I say no, I have not. I have been aware of the fact that there have been such breaks. There are such breaks in the Ely mine, where there is hardly a trace of copper, and in others where there were cobalt and platinum.

PROF. EGLESTON—You have not spoken of Sperulite?

DR. PETERS—The platinum in our mines does not occur in the form of Sperulite. It is Arsenite. I do not know of any other pyrrhotites containing one and a half per cent of nickel except those of Mr. Horton.

PROF. EGLESTON—It is three-quarters of one per cent.

DR. PETERS—I put it at a half per cent.

DR. ASHBURNER—The ores of the Pennsylvania mines certainly run less than one per cent.

MR. MACFARLANE—I think the Cap mines have had one and a half per cent. of nickel.

DR. PETERS—I speak of the Cap mine by itself. I can speak, however, of what no one seems to have noticed, I refer to this extraordinary fact that pyrrhotite occurs in one place and pyrite in another without any apparent reason. If that fact were answered it would give us the methods of deposition.

MR. MACFARLANE—Pyrite frequently contains cobalt.

DR. PETERS—Yes; but pyrrhotite does not.  
(To be Continued.)

**British Columbia's Coal Fields.**

"The Comox and Nanaimo coal fields are the most important in the province, and the latter is that from which almost all the coal so far raised has been obtained. The cretaceous rocks constituting these coal fields border the southwestern side of the Strait of Georgia, forming a belt of comparatively low rolling or hilly country between the mountainous region of the interior of Vancouver Island and the coast. The quality of the Comox coals is equal, if not somewhat superior, to that of those of Nanaimo. They contain but a small percentage of water and the ash is also very low. Several of them yield strong cokes. The area of the Nanaimo coal field is estimated at about 200 square miles. There are at least two distinct seams of workable thickness in this area, but in consequence

of folds and faults it is not easy to fix the equivalency of beds in its various parts. Three collieries are at present in operation here, the Nanaimo, Wellington and East Wellington. The works of the two first named are on a very extensive scale, embracing numerous shafts and inclines, provided with good machinery, railways and wharves. In the Vancouver Colliery the principal workings are upon a seam which averages from 6 to 10 feet in thickness. A second seam, overlaying the last and separated from it by 140 feet of sandstone, is 7 feet thick. The seam worked in the Wellington Colliery averages about 9 feet in thickness, and yields a rather dry steam coal which does not afford a strong coke. The coal from the Vancouver Colliery, on the contrary, gives a good coke and produces a large quantity of illuminating gas."

In 1850 a chalk cliff about 200 feet high, near Seaford, on the coast of Sussex, was thrown down by the explosion of 24,000 pounds of powder, and 292,000 tons of rock were dislodged.

At Holyhead, in 1850, a hard quartzose schist cliff was thrown down by 12,000 pounds of gunpowder. About 40,000 tons of rock were dislodged, which was used for the harbor works at that point. In January, 1867, another blast was fired at the same place, in which 16,000 pounds of powder dislodged 120,000 tons of rock.

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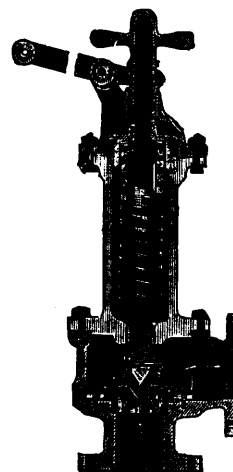
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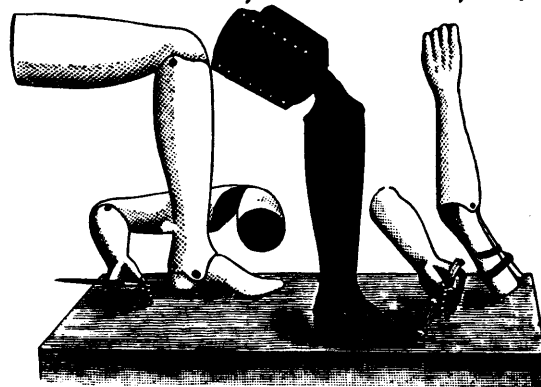
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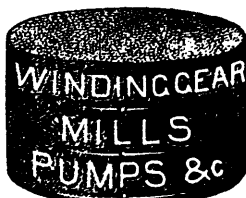
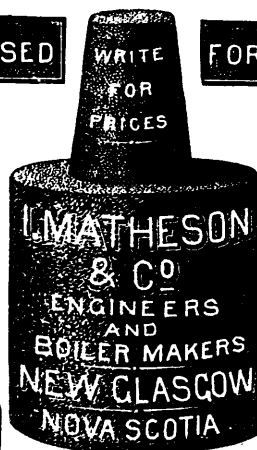
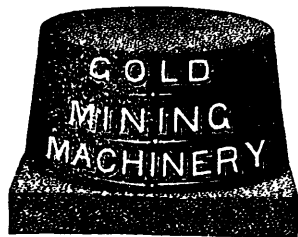
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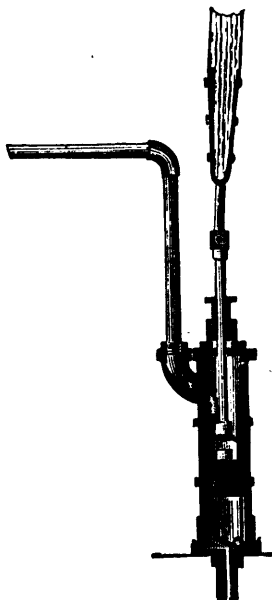
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— AND —

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**Titles given direct from the Crown, Royalties & Rentals moderate**

### **GOLD AND SILVER.**

Under the provisions of chap. 7, Revised Statutes, of Mines and Minerals Licenses are issued for prospecting Gold and Silver for a term of six months, which can be extended by renewal for another six 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. Up to five areas the cost is 50 cents per area, for every area in addition 25 cents. Cost of renewal one half the original fees. Leases of any number of areas are granted for a term of 21 years. 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 \$19.00 an ounce, and in smelted Gold valued at \$18.00 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 area 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 twelve months are issued, at a cost of twenty dollars, for Minerals other than Gold and Silver, out of which one square mile 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 free of charge, 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 a 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, 7½ 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,**

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The property formerly belonged to the Montreal Plumbago Mining Company, and was worked successfully for several years, until the company's mill was destroyed by fire, but the mill dam remains almost uninjured, and there are on the property several houses, sheds, etc., built for various purposes when mining operations were carried out.

### The Plumbago Deposits

upon the property are regarded as amongst the richest and most extensive in the Dominion. As to the quality of the Plumbago, it has been extensively used in the manufacture of crucibles, lubricating leads, stove polish, etc., etc., and given unbounded satisfaction. This is established by the experience of consumers, and by a certificate from the celebrated Battersea Crucible Works, London, England, a copy of which is open for inspection.

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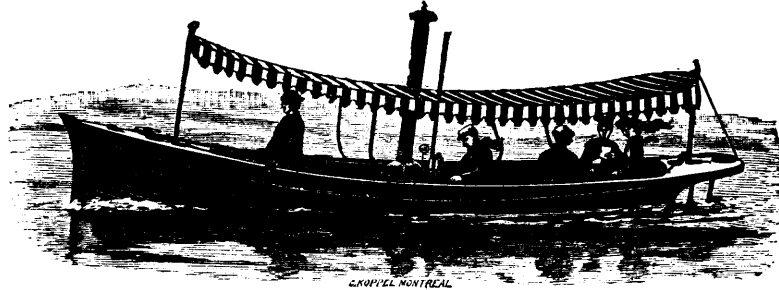
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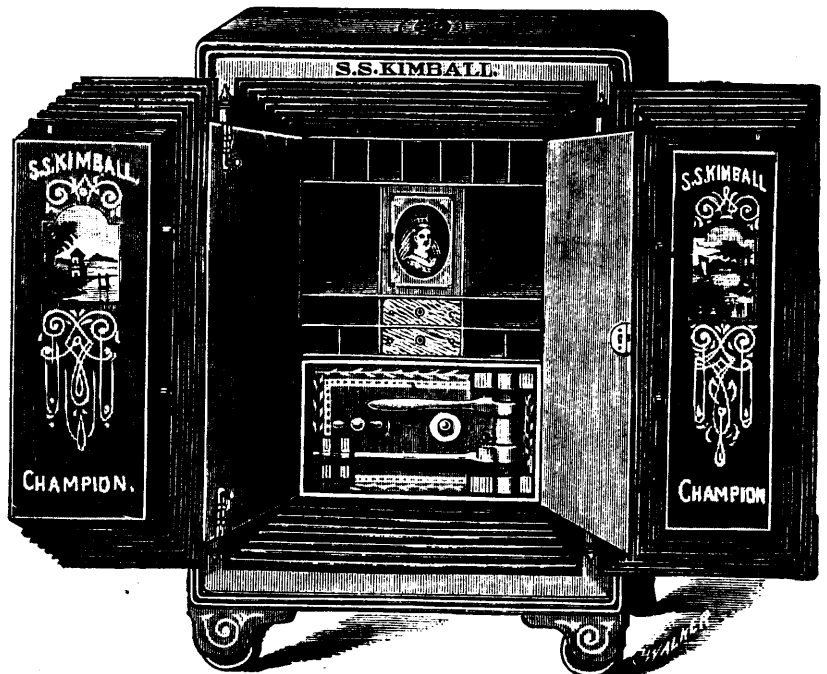
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DEPARTMENT

OF

Inland Revenue.

AN ACT RESPECTING AGRICULTURAL FERTILIZERS.

The public is hereby notified that the provisions of the Act respecting AGRICULTURAL FERTILIZERS came into force on the 1st of January, 1886 and that all Fertilizers sold thereafter require to be sold subject to the conditions and restrictions therein contained—the main features of which are as follows:

The expression "fertilizer" means and includes all fertilizers which are sold at more than TEN DOLLARS per ton, and which contains ammonia, or its equivalent of nitrogen, or phosphoric acid.

Every manufacturer or importer of fertilizers for sale, shall, in the course of the month of January in each year, and before offering the same fertilizer for sale, transmit to the Minister of Inland Revenue, carriage paid, a sealed glass jar, containing at least two pounds of the fertilizer manufactured or imported by him, with the certificate of analysis of the same, together with an affidavit setting forth that each jar contains a fair average sample of the fertilizer manufactured or imported by him; and such sample shall be preserved by the

Minister of Inland Revenue for the purpose of comparison with any sample of fertilizer which is obtained in the course of the twelve months then next ensuing from such manufacturer or importer, or collected under the provisions of the Adulteration Act, or is transmitted to the chief analyst for analysis.

If the fertilizer is put up in packages, every such package intended for sale or distribution within Canada shall have the manufacturer's certificate of analysis placed upon or securely attached to each package by the manufacturer; if the fertilizer is in bags, it shall be distinctly stamped or printed upon each bag; if it is in barrels, it shall be either branded, stamped or printed upon the head of each barrel or distinctly printed upon good paper and securely pasted upon the head of each barrel, or upon a tag securely attached to the head of each barrel; if it is in bulk, the manufacturer's certificate shall be produced and a copy given to each purchaser.

No fertilizer shall be sold or offered or exposed for sale unless a certificate of analysis and sample of the same shall have been transmitted to the Minister of Inland Revenue and the provisions of the foregoing sub-section have been complied with.

Every person who sells or offers or exposes for sale any fertilizer, in respect of which the provisions of this Act have not been complied with—or who permits a certificate of analysis to be attached to any package, bag or barrel of such fertilizer, or to be produced to the inspectors to accompany the bill of inspection of such inspector, stating that the fertilizer contains a larger percentage of the constituents mentioned in sub-section No. 11 of the Act than is contained therein—or who sells, offers or exposes for sale any fertilizer purporting to have been inspected, and which does not contain the percentage of constituents mentioned in the next preceding section—or who sells or offers or exposes for sale any fertilizer which does not contain the per-

centage of constituents mentioned in the manufacturer's certificate accompanying the same, shall be liable in each case to a penalty not exceeding fifty dollars for the first offence, and for each subsequent offence to a penalty not exceeding one hundred dollars. Provided always that deficiency of one per centum of the ammonia, or its equivalent of nitrogen, or of the phosphoric acid, claimed to be contained, shall not be considered as evidence of fraudulent intent.

The Act passed in the forty-seventh year of Her Majesty's reign, chaptered thirty-seven and entitled, "An Act to prevent fraud in the manufacture and sale of agricultural fertilizers," is by this Act repealed, except in regard to any offence committed against it or any prosecution or other act commenced and not concluded or completed, and any payment of money due in respect of any provision thereof.

A copy of the Act may be obtained upon application to the Department of Inland Revenue, as well as a copy of a Bulletin which it is proposed to issue in April, 1888, concerning the fertilizers

E. MIALL,  
Commissioner.

January, 1889.

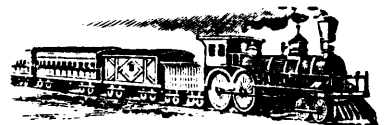


NOTICE

Is hereby given that all communications in respect to matters affecting the Department of Indian Affairs should be addressed to the Honorable E. Dewdney as Superintendent General of Indian Affairs, and not as Minister of the Interior, or to the undersigned. All Officers of the Department should address their official letters to the undersigned.

L. VANKOUGHNET,  
Deputy Superintendent-General  
of Indian Affairs.

Department of Indian Affairs,  
Ottawa, 11th May, 1889.



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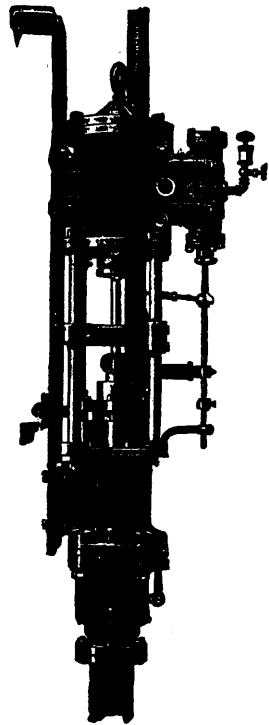
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# Mining Regulations

TO GOVERN THE DISPOSAL OF

## Mineral Lands other than Coal Lands, 1886.

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 on veins, lodes or ledges of quartz or other rock in place, shall not exceed forty acres in area. Its length shall not be more than three times its breadth and 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 labor 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 its 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 fraudulently, 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 land may be acquired for milling purposes, reduction works or other works incidental to mining operations.

Locations taken up prior to this date may, until the 1st of August, 1886, be re-marked and re-entered in conformity with the Regulations without payment of new fees in cases where no existing interests would thereby be prejudicially affected.

### 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 THE INTERIOR.

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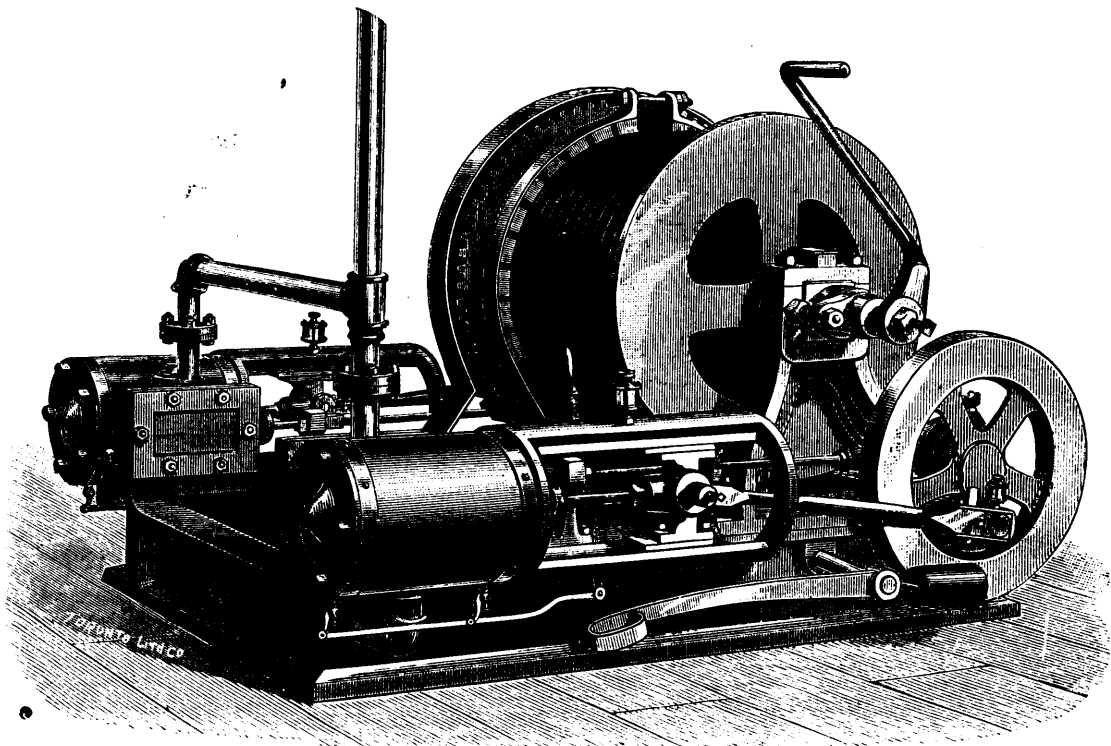
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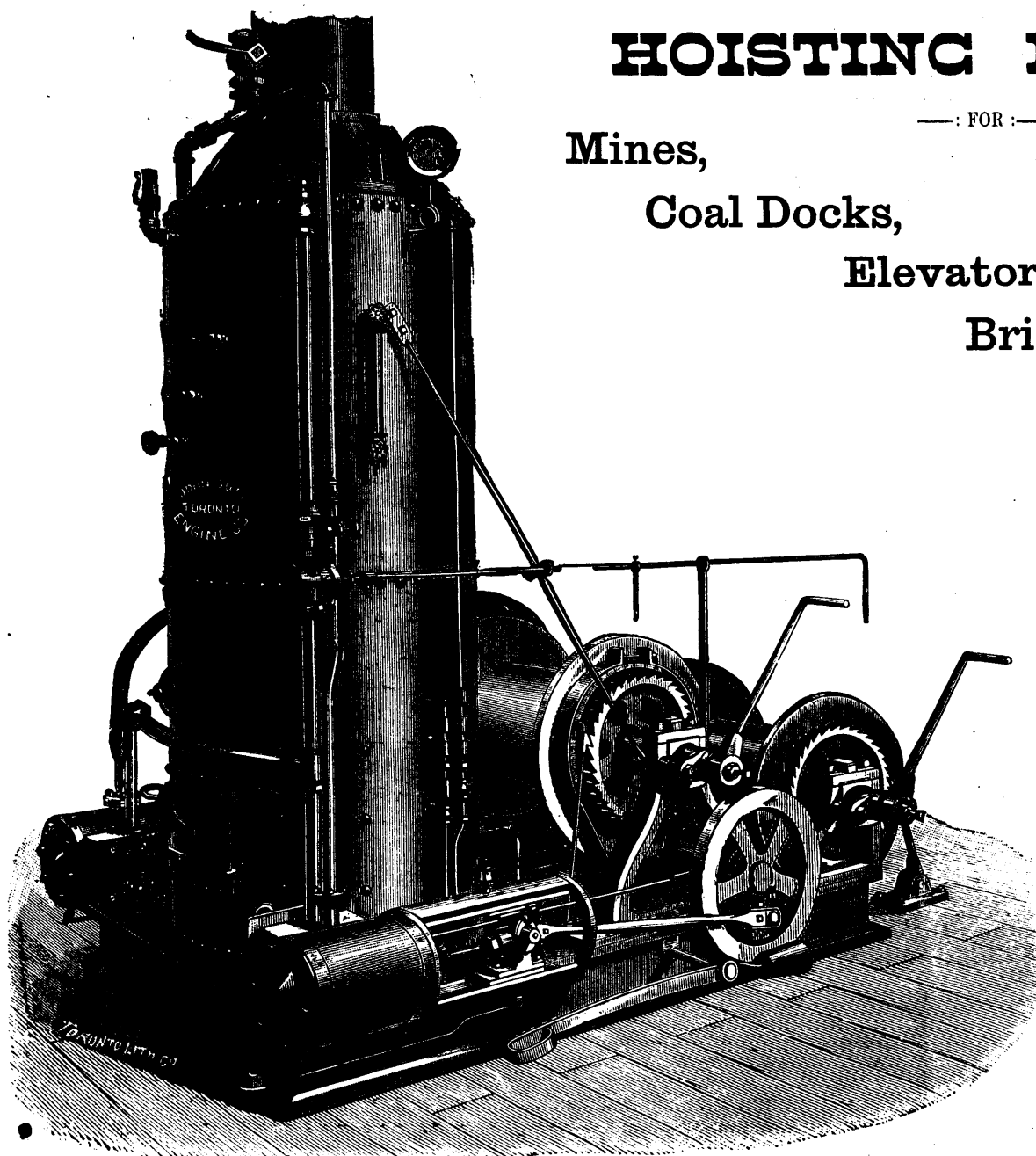
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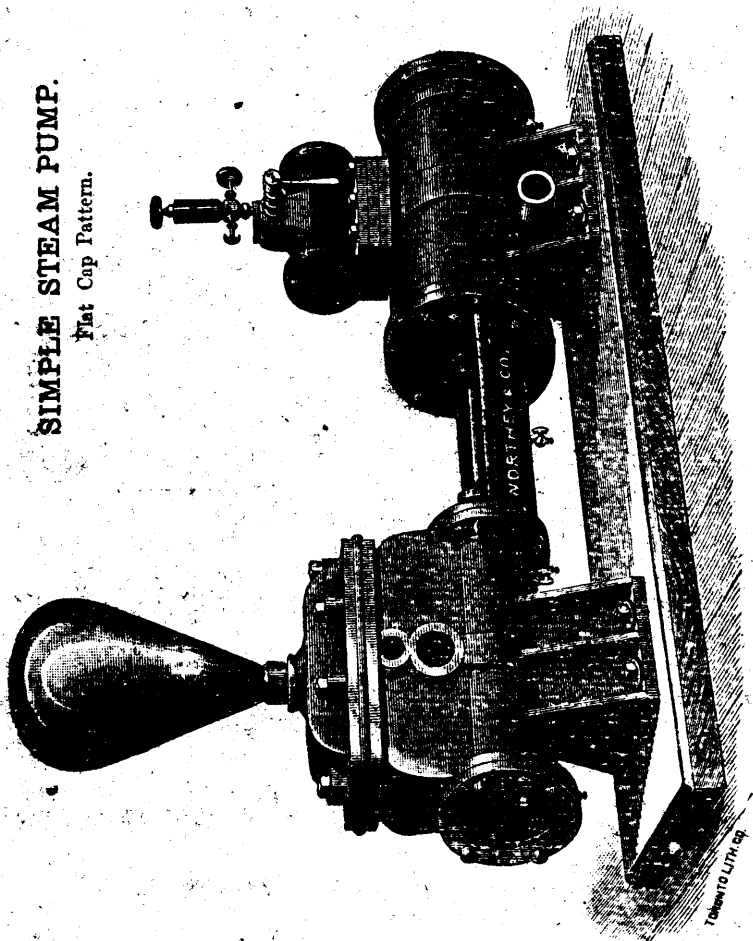
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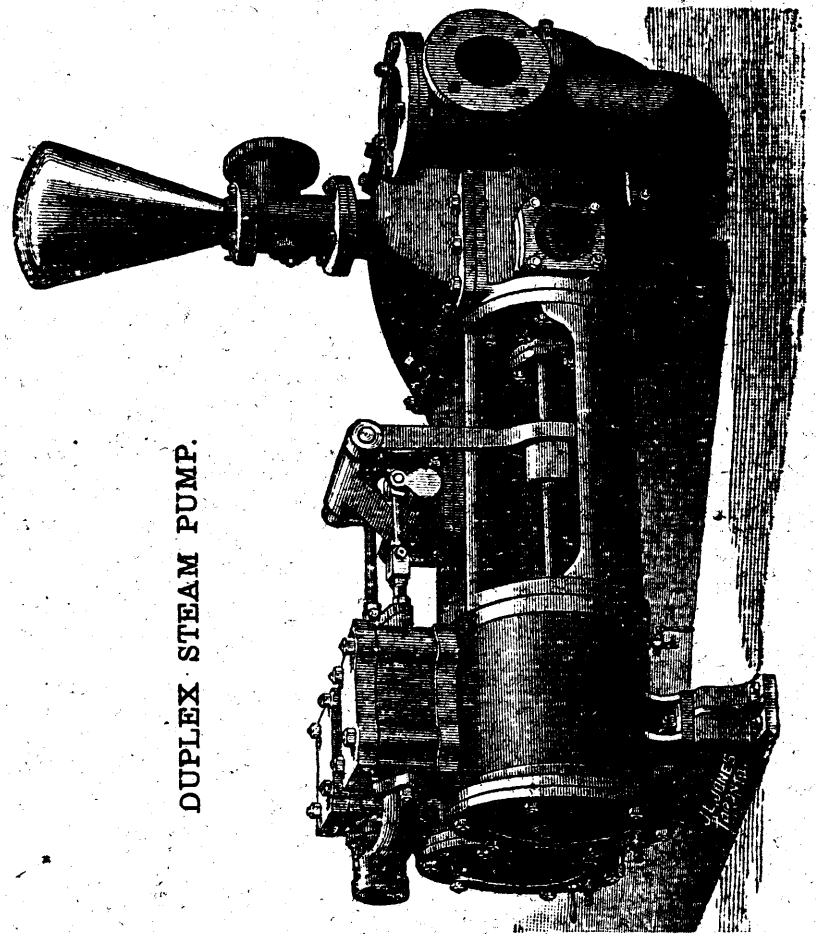
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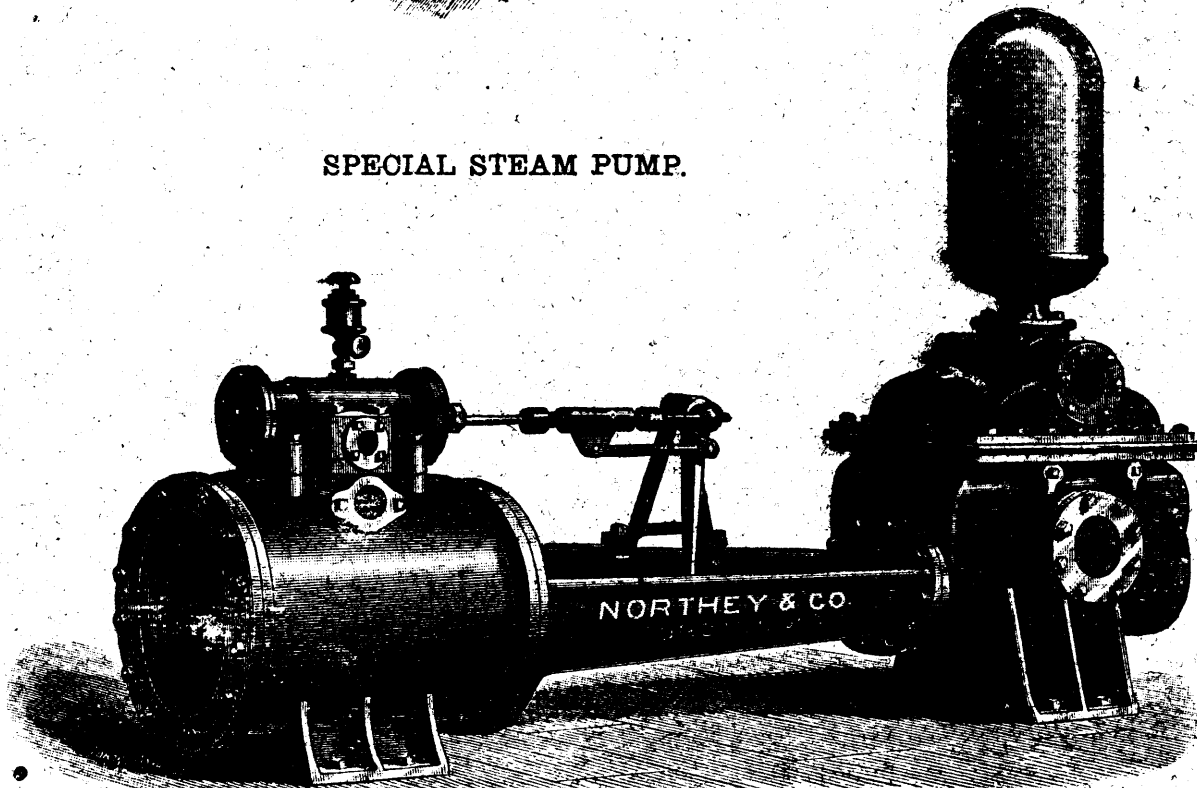
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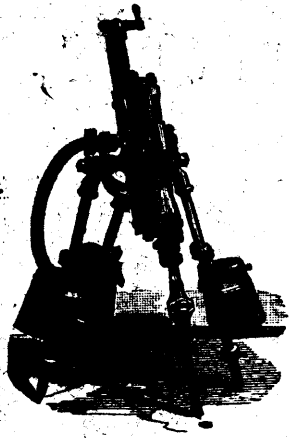


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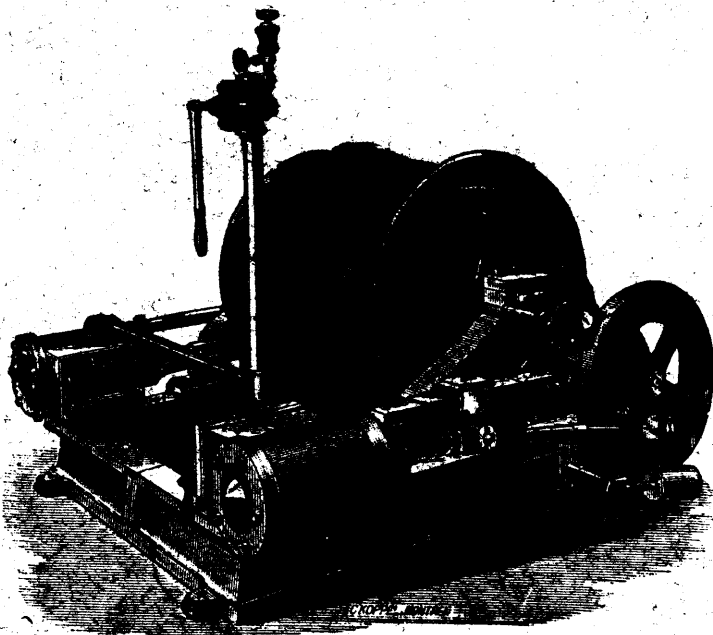


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