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THE Canadian MINING REVIEW

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Geological and Natural History Survey of Canada.

ANNUAL REPORT, 1887-88.

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Ontario's Nickel and Copper Ores.

One of the events of the month in mining affairs was the visit of the Toronto Board of Trade to the Sudbury district. Much as has been written on the great deposits of nickel and copper ore in the region north of Georgian Bay, there are few persons who have a right conception of the progress already made in raising and smelting the ore. The view of the President of the Toronto Board of Trade, and which he was frank enough, at the close of the visit, to confess having held, is no doubt that of most people in Canada, viz: that speculative holes were being sunk upon veins in the hope of starting a boom to sell locations. But Mr. Davidson knows that seeing is believing, and he has no doubt now that there are immense bodies of valuable ore in the Sudbury country, and that mining enterprise as carried on there is substantial and permanent. The thirty or forty solid and sober business men of Toronto will be able to tell their fellow-citizens and the people of Ontario generally, that all reports heretofore published have been in no respect extravagant. One of the most careful of their number, Mr. Robert Jaffray, was impelled to say, as the Queen of Sheba said after seeing for herself the glory of Solomon, that the half had not been told them. He might have said much more within the limits of moderation, and had an open and positive confession been made of the injustice done to newspaper and other reports upon the Sudbury mines it might have done the souls of the doubting Thomases of the party some good. The justification is tardy, but we rejoice in its having been made at last, and we earnestly trust that the Toronto capitalists will proceed to show their faith by their works. The authoritative statement of the experts sent by the Government of the United States to report upon the supply of ore, leaves no room to doubt that the quantity is enormous. "There are 650,000,000 tons of ore in sight," those experts stated after having carefully explored the five mines in the vicinity of Sudbury, and the great ranges discovered in Creighton, Denison and Graham. Here is enough to last for eighty years, were mining to be carried on annually at the highest rate yet reached in all the iron mines of Michigan, Wisconsin and Minnesota. But how much greater the quantity is we can only determine when the depth of the ore is ascertained and all the ranges of the district are discovered. Multiply the Washington experts' estimate of ore in sight by one thousand, and we are probably within the mark. Let us be modest, however, and see what the estimate of ore in sight implies. The nickel contents, computed at an average rate of two and a half per cent., would be 16,750,000 tons, or 33,500,000,000 pounds. At fifty cents per pound, which is about the present price of refined nickel the product would represent the enormous value of $16,750,000,000, and even if the price fell to ten cents per pound it would represent $3,350,000,000, or more than enough to pay off the public debt of the Dominion of Canada twelve times over! The copper contents computed at 5 per cent., would be 67,000,000,000 pounds, which at ten cents per pound (the current rate is 15 to 16) would equal $6,700,000,000. These figures are so large that we can scarcely realize them, but they will at all events serve to demonstrate the value of the industry which was started only four years ago at Sudbury. Recent experiments with alloys of iron and steel have made clear the fact that Ontario is wondrously rich in her mineral possessions, and if a proper spirit of enterprise is exhibited, she may look forward with confidence to the occupying of a foremost place among the countries of the earth in the production of economic metals. She has great supplies of rich iron ores as well as ores of nickel, and it will be the fault of her own people if she does not become the seat of the world's nickel-steel industry. The members the Toronto Board of Trade know the possibilities before them. Their visit to Sudbury has given them an education such as few others have had an opportunity to acquire, and we shall be disappointed in their pluck and enterprise if they do not turn what they know to a useful and practical account. It ought not to be difficult in a city of the size and importance of Toronto to organize a company with a capital of $1,000,000 to refine the matte produced at the Sudbury furnaces, open up one or more of the great iron ranges in Hastings, Peterborough or Haliburton, put up one smelting furnace and a steel converter of good capacity, and carry on the manufacture of nickel steel. They possess rare opportunities, and they cannot begin too early to take advantage of them.

The Mining Tax.

The following are the resolutions, affecting proposed taxation of mines, to be submitted by the Hon. Mr. Mercier's Government, during present sitting of Quebec Legislature:—

Resolved, 1.—That from the first day of May, 1891, a royalty shall be levied in favour of the Crown upon every mine which is now or may hereafter be sold, conceded or otherwise alienated. That such royalty shall, unless otherwise determined by letters patent already granted, consist of a percentage of three per cent. of the merchantable value of the products of all mines and minerals, upon the following:—

Iron, including iron pyrites, and chromic and titanic iron ores, copper, nickel and cobalt, manganese, antimony, lead, zinc, aluminium, molybdenum, bartya, silver, gold, including alluvial gold, mercury, tin, asbestos, phosphate of lime, graphyte, mica, coal, petroleum, ochre, soap stone. On gold, 2½ per cent. of the gross weight, estimated at $18.00 per ounce, and on silver at 2½ per cent. of the gross weight.

Resolved, 2.—That the Lieutenant-Governor in Council may appoint the officers he deems necessary for the carrying out of the law, to be based upon the resolutions, and fix their rank and salaries.

Resolved, 3.—That any person, firm or company may obtain from the Commissioner of Crown Lands an exploration permit, with the right to make all necessary works to establish the mining value of any land; which permit is valid for three months.

Resolved, 4.—That the holder of such permit may afterwards obtain the sale of the mine by paying the price mentioned in the law to be based upon the resolutions, and by complying therewith as well with the regulations passed thereunder; the whole subject, however, to the right of preference allowed to the proprietor of the surface, to the exclusion of any other, to acquire the mines and minerals found, or that may be afterwards found under the surface of his property.

Resolved, 5.—That the application for such permit shall contain as exact a description as possible of land required to the satisfaction of the Commissioner, and shall be accompanied by the following fees, as the case may be:—

1. If the mine is upon private lands, five dollars for every fifty acres.
2. If the mine is upon Crown Lands, ten dollars for every fifty acres.

Resolved, 6.—That any person may obtain from the Commissioner the sale of one or more mining concessions upon the following conditions:—

1. Upon private lands, after the owners thereof have been placed *in mora* to take a deed of sale thereof; if they refuse to avail themselves of such right; the whole in conformity with the law to be based upon these resolutions.
2. Upon public lands, by complying with the provisions of the said law.

Resolved, 7.—That a mining concession shall comprise a minimum superficies of fifty acres and a maximum of one hundred acres.

That the direction of the exterior lines of mining concessions shall be determined by the Commissioner.

Resolved, 8.—That the costs of survey and setting of bounds, as well as of setting up the posts under the law to be based upon these resolutions, are payable by the applicant.

Resolved, 9.—That every post which is destroyed or removed shall be replaced at the expense of the owner, within one month; and the proceedings to have it replaced shall be the same as for the original placing of boundaries.

Resolved, 10.—That, if need be, the owner shall pay to the owner of the surface the damages that may be caused by the taking possession and the opening and working of the mine.

Resolved, 11.—That every owner of a mining conces-

sion who neglects to again set up the posts or to replace those which have been removed or destroyed, as required by the law to be based upon these resolutions, shall be liable to a fine not exceeding twenty-five dollars for each post which he neglects to set up or replace.

Resolved, 12.—That every person who wilfully destroys, damages, breaks or removes such posts shall be liable to a fine not exceeding one hundred dollars for each offence.

At last the Quebec Government has shown its hand, and the foreshadowings of the speech from the throne have materialized in a proposal to levy a royalty of three per cent. upon the merchantable value of the products of all mines and minerals. Assurances had been privately given members of the Legislature that it was only contemplated to introduce a system of leasing lands upon royalty, that no tax would be placed upon mines already sold. We were disposed to credit this; for we entertained the opinion expressed by Mr. W. H. Nichols, of New York, at the meeting of mine owners in St. Lawrence Hall, that it was incredible that any civilized government, in this age of the world, could place a discouraging burden upon mining industries. We have repeatedly expressed approval of the idea of granting leases upon royalty subject to compulsion of working; but as far as we can see in the proposed resolutions there is no requirement of productive effort. This we presume would be provided for, as it is hardly to be supposed that a phosphate lot of 200 acres now held by the Crown at the price of $1,000, is to be sold for $40, without obligation of working. If so, speculators would speedily tie up the whole country, and all the present evils of an unproductive monopoly would be intensified. But our objections are directed against the proposal to tax the product of mines that have been sold outright, and have been fitted up, operated by the purchasers with condence in the good faith of the Government, and the belief that a sale was a sale. Apart from this breach of contract, which we stigmatize as a downright act of dishonesty, we declare that the mining industries of this Province are not in so prosperous a condition as to be able to bear the burden of a direct tax. If the proposal meant a tax upon profits it would be a different thing, and prosperous mines could afford to pay it; but mining is the most speculative of all industries, and a tax upon output would often be an additional loss to a losing enterprise. If any branch of industry is to be singled out to bear the strain of Quebec finance, let it be one that receives Government favors and enriches itself by legal aid. The sugar refineries are favored by the Dominion Government with a protection against foreign competition to the extent of 2 to 3 cents per pound. If the Quebec Government demanded one cent a pound out of this benefit, there would be some reason in it, but instead of levying upon protected and favored industries, the attack is made upon the one unprotected and unfavoured industry of Canada, which in addition to the burden of its own natural difficulties, is saddled with the restrictions made to benefit pampered and petted pursuits, by which the cost of all its supplies is increased and, if it is true, that protection raises wages, the cost of its labor is enlarged.

We denounce this piratical attack upon a struggling industry as a violation of honesty and propriety, and we warn the Quebec Government that our mining men represent an amount of influence and determination that it is dangerous to trifle with. Their manliness is shown by the tact that they have not gone whining for Government bonuses and protection, but have been content to take their chance in a fair struggle with nature's conditions, and this same characteristic will make them resist oppression by every resource within their power.

The Phosphate Season of 1890.

The close of navigation on the St. Lawrence brings the day of reckoning for all those industries whose products seek their markets beyond the sea. Perhaps no other industry in Canada is so dependent upon ocean freight as is phosphate mining. Of home market it practically has none; and its small trade with the United States consists entirely of low grade ore. All the high grade output and the great bulk of the whole production, is sold across the Atlantic, the chief portion to the United Kingdom, considerable to Germany, and a little to Holland and Sweden. The total exports, as per official returns furnished us by the shipping agents and Customs manifests have been :—

Lomer, Rohr & Co.:		
To Europe	11,338	
" United States	252	
Tons		11,590
Millar & Co.:		
To Europe	5,915	
" United States	1,207½	
" Canada	185	
Tons		7,307½
Wilson & Green:		
To Europe	5,688	
" United States	263¼	
Tons		5,951¼
Irwin, Hopper & Co.:		
To Europe	938	
Tons		938
Anglo-Canadian Co.:		
	275	
Tons		275
		26,062¼

Or a total export to all points of 26,062¼ tons; as compared with 29,987 tons during the same period last year. The distribution of these exports has been as follows :—

To Liverpool	12,647	To Newcastle	200
" London	5,239	" Swansea	130
" Glasgow	1,752	" Queenstown	84
" Hull	820	" Bristol	60
" Hamburg	2,800	" United States	1,723¼
" Grimsby	422	" Canada	185

The decrease is due partly to the lessened production of some mines, but chiefly, as we have already pointed out, to the fact that owners of phosphate lands have maintained a selling attitude instead of adopting a working policy. As nearly all the expectations of making fortunes by land sales have been disappointed, it is to be hoped that the proprietors will now try to secure for themselves the abundant wealth that they have confidently expected to dispose of to others.

The year has been a most favorable one for the business; given the phosphate and all else has been smooth sailing. It has not had to go begging for a purchaser, vessels have been ready and eager to take it, and facilities for rail and water transport from the mines to Montreal and the methods of handling it there have been better than ever before.

Ocean freights have varied from 8s. 9d. down to nothing when some tramp, going to an outside port, was in need of ballast; but the bulk of the shipments paid from 6s. to 8s. 6d. A larger supply of cheap tonnage would have been available had not the deal freights flattened out in the summer to so low a rate that vessels turned away from the St. Lawrence to seek more lucrative business, and therefore the demand for phosphate as ballast under the deal cargoes was lessened.

Prices have been very satisfactory for the higher grades; 1s. 4d. for 80 per cent., with one-fifth penny per unit rise has been obtainable in London, and 1s. 5d. in Hamburg. The London price for 85 per cent. phosphate was therefore 1s. 5d. per unit, equal to about $26 per ton in Montreal. A few choice lots have gained this handsome figure, but the bulk of the shipment have averaged much lower and there has been a reduction of price for the lower grades amounting to double the usual sliding scale, so that prices for 75 per cent. have been 1s. 1d. to 1s. 2d. and for 70% 11d. to 1s. per unit. At the latter price a ton of 70 per cent. phosphate in Montreal would realize only a little over $13, or about one half of the value of 85 per cent. phosphate. Here is where the profits lie, and happy is he who strikes a bunch of the pure green rock, as did one of our operators in November, and from the labor of fifteen men made a clean profit in four weeks of $1,500. The reduced price of the lower grades is due to the large supply of Carolina and Florida phosphates which analyze from 55 to 60 per cent. In the rivers of Florida beds of this material have been discovered, which can be raised by suction and pumped into boxes at trifling expense. On the lands of this State also great deposits of phosphate rock have been found, which were said to be of the highest quality and sufficient in quantity to supply the demand of the world. A Florida boom thereupon arose, which drowned out of sight our little Canadian boom; companies were floated and fortunes were made in land sales. Perhaps some day phosphate of higher grade will be produced in such quantities as to depress the price of the Canadian article, but at present the impression prevails that the deposits are less persistent and the quality more uncertain than the boomers have represented. There has cer-

tainly been a depressing effect from this source upon low grade phosphate and Canadian 60 per cent. which sold in the Spring at 10d. could not find a buyer in the fall at 7¼d.; and yet the price of higher grade keeps up and sales have been made for next year at 1s. 3d. for 80 per cent., 5,000 tons being said to have been placed at this rate by the representatives of the new General Phosphate Corporation.

The advent of this company into the field has been the chief feature of the year. They have made judicious selection of good lands in the Lievres River district, and have shrewdly made their payments to depend partly upon the output. All who are interested in the growth of this industry will heartily wish success to this enterprise The visit of Mr. Hutchinson, of the Anglo-Continental Guano Works, of Hamburg and London, last year, resulted in the purchase of the Squaw Hill and Aetna Mines adjoining the Emerald Mine, and effective work is now in progress there. Mr. Hutchinson's paper, reproduced in our last issue, is unquestionably the most accurate description of the phosphate industry that has ever been given by a visitor and shows a remarkable mind that could grasp the salient features of a mining industry in so brief a survey. Among other new undertakings are those promoted by one of our most enterprising phosphate operators, Mr. Adolphe Lomer, of Montreal, who, in addition to the Foxton mine, has organized work upon an adjoining property, and has formed companies to operate upon the Blackburn and the MacLaurin properties, besides doing some work upon other leased lands. An ingenious method has been put into practice by this gentleman in his grinding mill at Buckingham for the mechanical separation of the impurities from the phosphate, which will tend largely to increase the profits of mining.

Some alarm has been caused by the intimation that the Quebec Government would seek to raise its revenue by imposing a tax upon minerals. Indignation meetings have been held by the mine owners at Sherbrooke and Montreal, and the excitement aroused may bear good fruit, not only in combating the imposition of any burdensome tax, but also in inducing the miners of the Province of Quebec to unite in forming an association, which shall be ready to take action upon any threatened legislation detrimental to this industry, and shall also afford means for mutual communication and instruction. In this latter aspect such associations of special industries prove most valuable, and we have had illustrations of the practical benefits of these societies in the production of such papers as the one just referred to, written by Mr. Hutchinson, and that presented previously by Mr. Hermann Voss, to which was due a great deal of the interest that was directed last year to Canadian phosphate.

One notable feature of the situation is a disposition to reduce the capitalization of companies and the valuation of lands. It is proved that from well selected lands under good management, profitable returns may be secured from phosphate mining, but it is also perceived that the great prizes incident to gold and silver mining are not characteristic of the phosphate industry, and that it is desirable to keep nominal values low enough to permit of profits to show a fair percentage upon the investment. This healthful indication augurs well for future success, and with the assurance of a good and ever increasing demand for high grade phosphate, we may confidently predict the continued growth and prosperity of the Canadian phosphate industry.

A Wholesome Reminder.

Ontario papers have been making much ado lately over an announcement that Mr. T. A. Edison had made heavy investments in Canadian nickel lands. Here is the truth tersely stated by Mr. Edison's private secretary: "Mr. Edison has read your letter of 12th inst., and in reply thereto has instructed me to say that he is *doing nothing* at the present time in the Sudbury district and *will not, until owners* of property in that neighborhood *come to their senses.*" The italics, which are ours, furnish good food for reflection to our speculator friends. Shrewd business men of the calibre of the great inventor are quick to forsee a good field for judicious investment in our nickel deposits; but they are not to be deceived by wild-cat schemes or schemers; nor are they prepared to accept their ridiculous notions of the value, of what are often "mere prospect holes," entirely unproved and in many cases worthless. The sooner these over-sanguine individuals rid themselves of their chimerical ideas and get down to more rational figures, the better for themselves and the development of the country.

The Tariff on Mining Machinery.

The following Order-in-Council, under date of 28th ult., should simplify entries of mining machinery not manufactured in Canada, and it is hoped will obviate entirely the tedious and vexatious delays that have been characteristic of recent interpretations of the meaning of the Act:—

"His Excellency, under the authority of Section 252 of the Customs Act, and by and with the advice of the Queen's Privy Council for Canada, is pleased to order that there be required, in addition to such other evidence in each case as may be deemed necessary by the Minister of Customs, a special oath to be subscribed to by the importer before a Collector or other proper officer of Customs, whenever any free entry is rendered of Mining Machinery under item 291 of Section 11 of the Act 53 Vic., Chap. 20, such oath to be in the following terms:—

"I, ..., the undersigned importer of the machinery mentioned in this entry, do solemnly swear that it is Mining Machinery within the true meaning of the word, and that at the time of its importation was of a class and kind not manufactured in Canada, and that it is imported for use in.....mining only, at the.....mine, situated..... in the Province of.....and will be used for no other purpose whatever"

Sudbury Mineral Lands Withdrawn from Sale.

The Commissioner of Crown Lands for the Province of Ontario has taken the important step of withdrawing from sale and location, until further notice, all lands lying within what is generally known as the nickel bearing district of the Province. The official notice defines the territory thus withdrawn as lying between the east limit of the Township of Awrey, in the district of Nipissing, produced north and south, and the west limit of the Townships of Esten and Spragge, likewise produced. Upon referring to the map it will be observed that the former of these townships lies south and east of Lake Wahnapitae, and the latter some fifteen or twenty miles west of the mouth of the Spanish river. The total width of the territory is about one hundred miles, and it extends from Georgian Bay and French river, on the south, to James' Bay on the north, embracing the valleys of the Spanish, Wahnapitae and Moose rivers. There is no further intimation of the policy of the Government than the statement that the lands lying within the prescribed limits are withdrawn from sale or location "until further notice;" but it may be presumed that a policy will be determined upon and authorized before the close of the next session of the Legislature. The reasons which have influenced the Commissioner have not been divulged, but they are obvious enough to any person who knows the workings of the boom in the Sudbury district during the past year or two. Many locations have been taken up over that territory, for the the most part by speculators, and since the action of the United States Congress in appropriating $1,000,000 for the purchase of nickel, to be used in the manufacture of armor plates, there has been a great rush of prospectors, miners and speculators to secure locations. No doubt the Commissioner thought a time had come in the interest of the people, as well as of the Government of Ontario, to call a halt in the disposal of valuable public lands, and no doubt also that the future policy will be dictated by a greater regard for the public interests than was obtainable under the old one. To secure a larger revenue will naturally be one of his aims, while another should be the furtherance of active mining operations. If nickel realises the hope of some of the best practical metallurgists of America and Europe, it is almost certain that great activity will characterize mining enterprise in the Sudbury country henceforward; but the Commissioner will fail in his duty as well as of his opportunity if he neglect to make provision against the locking up of any portion of the mining territory by speculators, to be held for their exclusive benefit. The public interest should be the great consideration, and the best policy is that which will produce the greatest good for the benefit of the greatest nnmber. We hope to have an opportunity of dealing with this subject at greater

length before the Government has settled down to what they are going to do about it.

A Mining Association for Quebec.

As the outcome of the miners' meeting held in Montreal last month, a circular has been issued and liberally distributed among the mining community calling attention to the proposition to establish a general mining association for the Province of Quebec. This is an important step, and if the proposal is carried into effect—and there is no good reason why it should not be—it will unquestionably result in great good. Experience has shown that united action is absolutely necessary in Quebec in order to counteract measures, which, if carried into effect, are calculated to do serious injury to its mining interests. Apart, however, from public questions, such an association would confer an immense boon in the propogation of knowledge respecting the true state of our mineral resources, in the interchange of ideas by wholesome discussion on subjects alike of interest to the owner and the operator, and in smoothing over these petty professional jealousies which unfortunately are sometimes too noticeable among a few of our mining men.

LETTERS TO THE EDITOR.

Accidents While Thawing Dualin.

TORONTO, 26th December, 1890.

The Editor :

With each winter season we are called upon to record a number of so called accidents, resulting in the death of one or more workmen. The class referred to are the too oft recurring premature explosions while thawing dualin near a fire, stove or other dangerous manner, in which the dualin is exposed to direct heat or flame, which draws to the surface of the cartridges the over heated and mechanically mixed nitro-glycerine, of which the dualin is largely composed. This over heating or sweating, is the whole cause of the danger, and the accidents which result from it. The proper way to thaw dualin, and the manner in which it is recommended by the manufacturers, is to place the cartridges in a tin, zinc or metal box, which is made with a space for hot water between its outside surface, and with another zinc or metal box which may be lined with wood on the outside surface to prevent too rapid cooling of the hot water. These boxes are sold by the manufacturers whose responsibility ceases when they recommend a safe means of handling the articles they expose for sale. The responsibility, then, rests with the purchaser who causes workmen to use a dangerous article in a wrong manner by not providing the proper means or box for use in thawing dualin. If a box is provided by the employer or purchaser of the dualin and the workmen neglect or do not use it, then the employer is not responsible, but the blame rests with the careless workman, who endangers his own life and that of those around him. We have known instances where the managers of works have been asked to furnish boxes but neglected to do so, or objected on the pretence of cost, which he or they considered unnecessary, and accidents resulted in consequence of thawing the dualin in a wrong way. These officials were then responsible, and ought to have been prosecuted for criminal negligence in exposing the lives of their workmen to danger. This circumstance calls to mind the enquiry, Where is Ontario's Inspector of Mines and Quarries? Does he condescend to note the death of a miner or quarryman? Is he not appointed to protect workmen in seeing that due care is taken in conducting mining and quarrying operations? In the case of the Ontario Inspector is he not too busily engaged praying for aid from heaven for the poor widow and orphans of the deceased workman, and thereby filling only *one end* of his lawful calling? Truly this is a wise appointment (an ex-Baptist parson) by the over faithful Premier of Ontario in the interests of those employed in mines and quarries. In the case of Quebec, the Inspector is evidently not required to look after such things as accidents, for the Hon. Mr. Mercier has liberally appointed clerics to Government positions, and the Inspector knows that these can say masses enough for the unfortunate miners and quarrymen who prematurely "go up" as a result of their own or some other person's carelessness in not providing proper protection to employees in mines and quarries.

J. S. T.

Canada's Mineral Wealth.

The following is the pith of Mr. Erastus Wiman's memorable speech at the banquet given to the Iron and Steel Institute at Niagara:—

Mr. Wiman said:—"Canada is a land of surprises, and even to those who know her she is ever revealing some new source of wealth. Who could have imagined that Canada possessed within herself the potenialities for the defence of the world? Yet the visit just made by the Iron and Steel Institute to the Sudbury region, only twelve hours' run from Niagara, discloses the fact that her deposits of nickel are the greatest the world has ever seen. Now, it has recently been discovered by tests made at the United States navy that nickel-plated armour for ships is practically impenetaable for defensive purposes. Well was it said that these tests rendered it possible to make Behring Straits a closed sea, unless, indeed, the British Government drew on Canada for supplies of nickel with an alacrity equal to that with which the United States are making haste to gather it in from the same source." So impressed was the speaker with the importance to Great Britain of obtaining the supplies, that he had communicated an offer on behalf of the Canadian Copper Company to the authorities in Great Britain, tendering them a free supply of nickel from Canada for the tests contemplated at Shoeburyness. "The nations of Europe," Mr. Wiman continued, "seek with anxiety this peaceful land for the force for the defence of the world, as is shown by the visit of a member of the firm of Messrs. Krupp, who seeks, incognito, in the wilds of Sudbury, the power that will make guns unburstable, and armour impenetrable. A contribution to the peace of the world may thus be made by Canada. That may not be the least of her many surprises, but with nickel in Canada, in the region hurriedly passed through by the Iron and Steel Institute, will be found sister minerals in abundance. Thus, in copper the deposits in the regions just visited are the largest in the world. The Aladdin-like story of the Calumet and Hecla mines, of sixty millions of dollars of profits and premiums on the capitalisation of less than three millions on the south shore of Lake Superior, can be retold in Canada in the Algoma district on the north shore, for here there is copper in sight at least twenty-five times the extent of the American deposits. The silver deposits, too, are most extensive, and their character is told in the familiar story of the Silver Islet, which a few years ago yielded within its small area more silver to the square foot than an equal space of the earth's surface had ever given forth. Gold is here also found, and the promise of the Vermillion and other mines equals the prospect of early Carlifornia or later South Africa. Platinum is found in unusual quantities in these regions; and so complete are the surprises in this treasure-house of the continent that an entirely new metal has been revealed, and named sperrylite, in honour of the graduate who discovered it. Canada is a surprise in that she specially possesses almost untold deposits of the greatest of the world's assets, the Imperial metal, iron, stretching far out to sea in the pier-like projection of Nova Scotia. Within six miles of the Atlantic is found an assemblage of the finest iron side by side with pure limestone, and with coking coal in seams 20 feet thick. These and other near-by deposits so splendidly located are testified to be equal in value to the mineral deposits of Pennsylvania and New York combined, furnishing a providential proffer to New England in her hour of need, if only she will accept it. Quebec, communicating with the iron sands of the St. Lawrence, contains throughout the province enormous deposits, awaiting only the touch of enterprise and an open market for a vast output. In Ontario the recent report of the Royal Commission makes it clear that a surprise awaits the world in the extent and importance of the iron deposits of that fairest and richest portion of the continent. The freedom from phosphorous in Canadian ore is important, and it has been aptly said that what the devil is to religion phosphorous is to iron. In British Columbia, a mineral wealth exists, only equalled by her enormous timber regions, her 5,000 miles of coast line fisheries, and her unlimited coal deposits, which recalls another of the surprises of Canada—namely, that it is only within her territory that coal can be found on the sea board equally on the Atlantic and Pacific, a fact of profound significance if this continent should ever wake up to the realisation of the advantages of a foreign trade. Time fails to tell of the numerous other revelations which Canada makes to the observer of natural phenomena, such, for instance, as the possession of natural gas in great abundance within a radius of ten miles of Niagara Falls, to supplement the vast water power which flows at your feet, and which is but a commencement of inexhaustible force in the water powers of the St. Lawrence, the Ottawa, and the great rivers of Quebec, for it is well to realise that Canada, besides being larger than the United States, and in area being 40 per cent. of the British Empire, has more than one-half the fresh water of the globe. Still further surprises await him who follows the development of the oil deposits in the North-West, where, in the Mackenzie river basin, are found deposits of petroleum, the magnitude of which exceed that of the known deposits of the rest of the world. The gypsum deposits in Nova Scotia are the most valuable on this continent, while the eager hunt for asbestos in Canada confirms the recent boast that that Province alone possesses sufficient of the important mineral to pay the Dominion National Debt. In addition to this vast mineral storehouse, one recalls the enormous areas of the wheat-producing regions of the North-Western Territory, the future granary of the world; the five thousand miles of coast line fisheries, the limitless forests to supplement the treeless prairie of the West, and other great national assets. But of all surprises in relation to Canada, that is the chief which blinds both Canadians and Americans, not only to the value of the country, but to the advantage of an unrestricted intercourse between them. It is especially surprising that the people of the United States, now so thoroughly equipped and needing new opportunities for continued expansions of trade, have not yet realised the influences they may set in motion towards shaping that commercial destiny of the continent. This they can do by opening up their markets, promoting development, and making haste to get control by occupancy and by individual purchase of a region far more desirable than Africa, which England and Germany carve in two for the purpose of trade. The Iron and Steel Institute of Great Britain have seen much of the United States, and have, no doubt, been duly and properly impressed with the greatness of their development, the magnitude of their trade, and the beneficial example for the good of mankind. But here, under the British flag, lies a region full of promise, possessing areas, potentialities, and a people fitted for just as great a career, and needing only the magic touch of freedom and appreciation of the American people to enormously enrich them, and yet still be the brightest jewel in the British Crown, without a red coat and without a ship of war. This vast treasure of the British nation may be left exposed as a hostage of peace in the practical safe-keeping of the American people. They will not capture it by conquest, neither will they seek to acquire it by territorial or national purchase, not even imitating their own policy of the past, but will follow the British policy of the present in the acquiring of breweries and other industrial interests by the English capital sent hither. Thus, without a change in the political condition or the deprivation of a foot of British territory, would be healed, by trade and commerce, the great schism of the Anglo-Saxon race on this continent in a new union of interests that nothing could dissolve."

Nickel Steel Tried in Europe.—Commander F. M. Barber, United States Navy, recently received the following cable despatch concerning the latest trial of armour in Europe:—"The Russian navy made a comparative test of three plates of Ochta, the 11th of this month. The plates were ten inches thick. One was of plain steel made by Schneider & Co., of Le Creusot, France; the second was a compound plate made by Brown & Co., of Sheffield, England, and the third was a steel plate made by Vickers, of Sheffield. Each plate received five 6-inch Holtzer chrome steel projectiles, weighing 90 pounds each. The first two were fired with a striking velocity of 1900 foot seconds, and the three others with 2100 foot seconds. The Schneider plate arrested all the projectiles and broke three of them. The penetrations were 22 and 27 cm. In the Brown plate the first two penetrated 34 cm., the three others traversed the plate and backing and fell 750 m. in the rear. In the Vickers plate the penetrations were 23 cm. The Brown plate showed large cracks; the two steel plates had only fine cracks. The trial showed once more the absolute inferiority of the compound plate and the superiority of the Schneider plate, a superiority which would have been greater if the plate fired at, at Ochta, and delivered by the Le Creusot works a year ago had been of the same fabrication as the nickel steel plate tried at Annapolis, embodying the latest improvements in the Schneider plates."

Our Portrait Gallery.

[A series of portraits and biographical sketches of Canadian mining engineers, mine managers, inspectors, geologists, explorers, etc.]

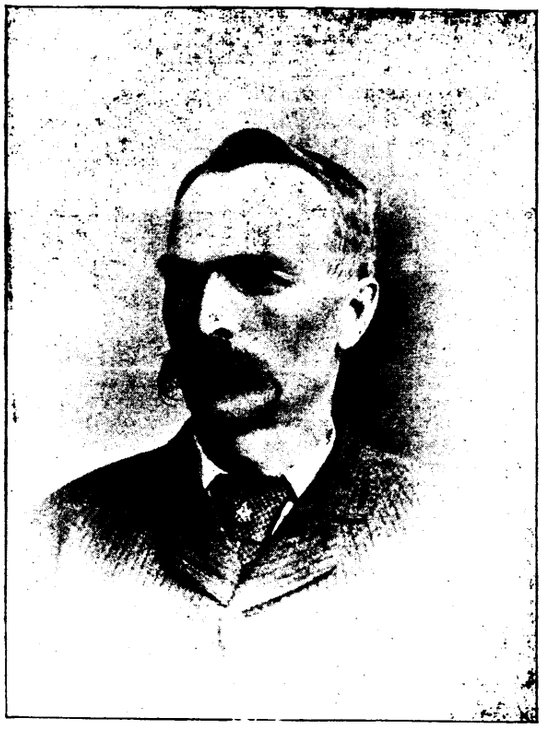
Nos. 7 and 8.

Mr. William Madden and Mr. Patrick Neville, Deputy Inspectors of Mines for the Province of Nova Scotia.

In this issue we give our readers two very good portraits of the gentlemen who act as Deputy Inspectors for the Provincial Department of Mines, for the Province of Nova Scotia.

The district assigned to Mr. Madden, embraces the Counties of Cumberland, Colchester and Pictou, on the mainland, while Mr. Neville is more particularly concerned with the Island of Cape Breton. Their duties are more intimately connected with the coal mines. Each mine is visited once a month and carefully gone over, particular attention being paid to the air ways, ventilators, and the state of the currents in the working places. The various officials are interrogated as to their care in carrying out the general and special rules, and the state of the roof and walls of the working places receives attention. Usually any neglect or omission referred to by them is readily remedied, but it is sometimes necessary for them to ask the Inspector to assist in a matter involving a fair difference of opinion. Should any matter appear of serious moment the Inspector is notified. The powers of the Deputies for all purposes of inspection are equal to those of the Inspector, and they have full access to all parts of the mines, etc. In addition to this work, they are frequently called upon to visit gold and other mines, and localities being prospected or in the course of development.

At first the mine managers were apprehensive of undue interference on their part, but it has been found that the frequent friendly inspection has been beneficial to all parties. The men, when they have any cause of complaint in the matters covered by the Mines Regulation Act, can readily turn to the Deputies who live near at hand, and the mine officials benefit by the observation they feel is kept constantly directed on them. A record is kept of all visits of inspection made by them, and an annual summary is published in the report of the Department. These gentlemen were selected for their practical acquaintance with the details of coal mining, and have, since their appointment, won the respect of the coal miners of the Province by their kindness and tact and evident anxiety to see that everything possible was done to ensure their safety.



MR. WM. MADDEN.

Mr. Neville is a native of Cape Breton, having been born at Bridgeport, on the 25th March, 1834. He commenced mining in the employ of the General Mining Association, slope driving and coal cutting, and continued at this work and mining in general until he received the appointment of underground manager at the International Colliery. This appointment he held until May, 1879, when he was transferred to his present important position.

It should be mentioned that Mr. Neville discovered and opened up the Reserve, Emery and Lorway seams, now owned and operated by the Sydney and Louisburg Coal and Railway Company.

Mr. Madden was born at Pictou, N.S., on the 30th November, 1848. For a number of years he was employed underground at Acadia mines and at the Drummond Colliery, after which he worked as a cutter in Maryland, U. S. A. Returning to Nova Scotia, he was engaged in various capacities in mining operations at the Drummond, Springhill, and other collieries, finally receiving his present appointment in 1883.

MR. PATRICK NEVILLE.

Good Words for Canada.

(The Colliery Manager.)

Mr. Erastus Wiman in speaking to the members of the Iron and Steel Institute of Great Britain, whom he was entertaining at Niagara Falls, drew such a picture of Canada as must arrest the thoughtful attention of every one who reads it—certainly of every British subject. To the young men—full of life and hope—in our own industry, this thrilling account of the vast resources of Canada must have a charm that those of us who are getting on in years cannot be affected by. Canada, he says—and Mr. Wiman has a clear knowledge of his subject—possesses almost untold deposits of the greatest of the world's assets—iron. Within six miles of the Atlantic is found the finest iron, side by side with pure limestone, and with coking coal in seams 30 feet thick. Enormous deposits are awaiting only the enterprise of capital to develop them and an open market for the output. We are sorry to find Mr. Wiman turning to the United States for co-operation in opening up the vast resources of the Dominion. Why should not some portion of the British capital which is at present utilized in the United States, or, at any rate, some portion of that which we are told is about to be transferred there, be taken to Canada? Instead of longing for reciprocity arrangements with the States, as Mr. Wiman appears to do, the Canadians would be wiser to court extended business relations with their mother country, whose ports are free and where there are no prohibitive protective duties. Stimulated by the freedom of Canadian ports, the commercial relations between the two countries would be enlarged and cemented to the permanent advantage of both. The old country has capital and population—Canada has an abundance of Nature's richest endowments. Canadians have plenty of energy and enterprise, but their entire population is absolutely useless for any speedy recovery of the wealth underlying their enormous tracts of undeveloped country. Surely it can only be necessary to make known how rich the country is, to attract to it the capital and the labour by which its riches can be developed.

So far as the deposits of nickel are concerned, the future of Canadian mining appears to have been assured by recent metallurgical discoveries. The value of the metal is shown in the fact that the United States Government has just voted $1,000,000 with the intention of obtaining a sufficient supply of the metal for armour-plate construction; and the researches of Messrs. Riley, Hadfield and Schneider have been followed by results which undoubtedly give nickel a permanent place as an alloy of steel. The United States' contemplated purchase of the metal, under the impression that it could thus monopolise the entire available supply, does not take into account the enormous resources of Canada in this respect. It would be almost impossible to form an adequate conception of the illimitable supplies in that country. It is known that nickel exists in great abundance over an area of several hundred square miles, and it is safe to conclude from surface indications that the ranges continue for many thousands of square miles, some of them passing through long stretches of unbroken wilderness. It is believed in one district alone, north of Georgian Bay, there is sufficient nickel to be found to serve the world's requirements for a thousand years to come. This estimated supply, too, is made on the assumption that the metal will enter very largely in the future into the manufacture of armour-plates. The

value of nickel for toughening steel has become so generally recognized that at least one eminent firm of continental ordnance manufacturers has been personally enquiring into the resources of Canada in nickel, with a view to obtaining supplies of the metal, and only lately an offer was made on behalf of the Canadian Copper Co. to the authorities in Great Britain tendering them a free supply of nickel from Canada for the tests contemplated at Shoeburyness. The value of nickel as an aid to the perfection of metallurgical processes is so assured to the countries in which it is to be found in any abundance, and this will be particularly the case where the metal can be more economically treated than at present—for we firmly believe that the time is not far distant when nickel will be separated with the greatest facility and cheapness from its compounds. With such admirable possibilities for nickel in the future there is an obvious opening in Canada, which will without doubt lead to practical results in a very short period. This period will undoubtedly be shortened in proportion as the commercial relations between Canada and Great Britain are strengthened since there is every probability of English capital being available to better purposes than that of other countries which still have their own internal resources to develope. Present financial conditions are not favorable to a new boom, but, when the next boom comes Canadian investments are not unlikely to be its object. This is the more probable because it is evident that the opening afforded to new Canadian developments by the McKinley Tariff Bill is not likely to endure beyond the presidential election in 1892.

Meeting of the New Vancouver Coal Mining and Land Company, Limited.

The semi-annual general meeting of the shareholders of this Company was held last month at the Cannon Street Hotel, Mr. John Galsworthy (Chairman) presiding. There was a fair attendance.

The SECRETARY (MR. JOSEPH RAMSDEN) having read the notice convening the meeting, the report and accounts submitted for the six months ended 20th June, 1890, were taken as read. They showed a net profit for the half-year of £7,462 3s. 9d. The total net output of coal for the half year was 121,971 tons, and the sales were 128,390 tons. During the half year over which the accounts extend, the coal market at San Francisco slightly improved ; prices have since become still firmer, the continuance of the miners' strike in Australia having given the market an upward tendency ; for the remainder of the present year, therefore, the outlook is encouraging. In regard to the East Field Mine, the net output during the half year was 33,477 tons. The coal in the No. 1 north level, north level incline, and No. 3 north level continues good, and about six feet thick. Of the No. 2 South Field Mine, the net output during the half year was 65,428 tons. In the No. 1 and No. 3 east levels the coal is still good, and from seven to nine feet thick, but in some of the other levels faults have been met with which have reduced the thickness of the coal, or cut it out altogether. In order to maintain the output here, the directors have determined to put down another shaft near the No. 6 bore, South Field, where coal was found about nine feet thick at a depth of 496 feet from the surface. The sinking of this additional shaft is now in progress. No. 3 South Field mine was re-opened about the 23rd June last, the market having improved, and 7,082 tons were extracted up to the close of the half year. At the present rate of output, it is estimated that there is about a year's supply still to be obtained from this mine. In new No. 4 slope, South Field, several patches of good coal have been met with, and it is hoped that a good seam may yet be found here ; if not, the slope will be used to open up the coal ground to the dip of the main slope at the No. 2 south field mine. The quantity of New Wellington coal extracted from the North Field mine during the half year was 15,984 tons. The quality of the coal continues hard and good, but the seam is not so thick as was expected. The coal is principally used in the domestic trade at San Francisco, and is much appreciated. The daily output from this mine cannot exceed 250 tons until the air shaft is completed; this is being pushed forward with all despatch, and it is believed will be completed before the close of the present year. The superintendent reports that the outlook in this mine is favourable. Mr. Tendron, a member of the board, the report states, very kindly made a visit to the mines in August last, and after fully inspecting the mines and the property of the Company was well pleased with the progress made since his former visit, as also the progress of the Company. A further dividend was declared of £2 per cent. (out of the amount of profit transferred from the old Company), payable on the 20th of December, 1890, (free of income tax), to the holders of shares in this Company, on the 3rd day of December, 1890, on which day the transfer books will be closed.

The CHAIRMAN, in moving the adoption of the report and accounts for the six months ending the 30th June, 1890, said it would not be needful for him to speak at any length, the more especially as more important business had afterwards to be transacted at the extraordinary meeting which was to be held later on. I will, therefore, he continued, content myself with the remark that during the past half-year steady and satisfactory progress has been made in the development of our property, and that, what with the great strikes in Australia, together with a strike on a smaller scale upon a property adjacent to ours, a good business has been done. We have received as usual reports from our agents as to what has been done and is being done down to the present time in the different portions of our property, and these all go to show the different mines are being gradually fully explored and examined, and as a rule with the best results. But these exploratory operations, as you know, require money. We have made a considerable profit, it is true, but that profit is already exhausted in these operations ; and without the aid, therefore, of some finance other than our own we cannot continue the work. It is this necessity for further funds, as you are aware, which has resulted in the provisional agreement which has been concluded on our behalf by Mr. Tendron with Messrs. Rosenfeld's Sons, and which will shortly be submitted to you for your approval. You will note that we have declared a dividend of 2 per cent. That is a very small dividend, but we cannot help it, for we have not the money to pay more. It comes from the profits which came over to us from the old company, and I may add that it pretty well exhausts those old profits. We could, it is true, have paid another 1 per cent.—and, indeed, we shall pay that extra 1 per cent. if our financial arragements are not upset by the rejection of the agreement with Messrs. Rosenfeld's Sons. I have nothing more to say just now, so I will at once move the adoption of the resolution in regard to the report and accounts. (Hear, hear.)

Mr. FRY seconded the motion, which was agreed to unanimously.

Mr. BLUNDELL : In regard to our having no money available, sir, I should just like to point out that, according to the accounts, we have £2,000 invested in Metropolitan Stock, so that unless our holding has since been sold out we have there a very considerable sum available. I am glad to learn from your explanation where the £2 divided is obtained from, since, as far as I can see, there is nothing in the accounts to show it.

MR. DAY : What is the difference in the selling value, roughly, between the New Wellington coal and the ordinary coal? The new kind, we are informed, is highly appreciated for certain purposes, and apparently it is more valuable than the older sort. What is the difference in value?

The CHAIRMAN : The Wellington business is virtually in a state of chaos at this moment in consequence of the strike, and very little coal is being sold. This is advantageous to us, since it has enabled us gradually to get more and more of their business, though we are not able to supply very much at present—only 250 tons per day, in fact. For that, however, we are getting about half a dollar more than the Nanaimo coal, and about the same price as the Dunsmuir coal.

A SHAREHOLDER : I see that no less than £2,000 has been expended during the past six months in repairs and maintenance. Are we not making it a very good thing, indeed, for Messrs. Rosenfeld's Sons by all this outlay, which would represent an enormous sum if capitalised?

The CHAIRMAN : You do not quite understand the matter, I think. It is absolutely necessary, in our own interest, that money should be expended in repairs and maintenance.

MR. TENDRON : There is much apprehension over this agreement. Perhaps, sir, as the author of it, you will allow me to explain to the meeting that, in regard to the particular point raised, any capital charges which henceforward are debited to us, will afterwards be repaid by Messrs. Rosenfeld's Sons. Already over £67,000 will be paid in this way by them. Whatever we spend out of profits will have to be repaid by them on this basis. We must try to put the property into better condition for our own sake. It is absolutely necessary that we should have money to carry on current work. Whence are we to obtain it? We have been unable to get it from our shareholders or from the public. Messrs. Rosenfeld's Sons have, on the other hand, helped us for years. They have a high opinion of our property, so high an opinion, indeed, that they are anxious to become partners in it to a still larger extent, and we, for our part, being in want of funds to develop it, are quite prepared to agree to this upon favourable terms. And it has been to this end that the agreement in question has been drawn up. We think its terms are favourable, and we hope that you will think the same. We shall still have the right to retain a one-third in the whole. The bargain is one, indeed, by which we cannot lose, and have everything to gain. If Messrs. Rosenfeld's Sons do not buy ultimately, they are bound to take up £50,000 of our shares at par.

The CHAIRMAN : In regard to Mr. Blundell's question about the dividend, I should have stated just now that we took over £20,000 from the old company. With this 2 per cent. we shall have distributed £15,400, leaving a balance of £4,600, and we propose to give you another pound if we have the money. In the accounts, the balance is, of course, in the amount carried forward.

The resolution was agreed to without dissent.

The extraordinary general meeting was then held.

The SECRETARY having read the notice convening the meeting.

The CHAIRMAN said : The following is the resolution which I have to make :—"That the agreement dated 1st September, 1890, negotiated by Messrs. Tendron and Robins on behalf of this company (provisionally) with Messrs. John Rosenfeld's Sons, of San Francisco, for extending the period for bonding the company's property at Nanaimo to them from the 31st December, 1890, for providing funds for certain speciged explorations and works, and for other purposes, be sanctioned and adopted, and that the directors be authorized to carry the same into effect." You have all had copies of the agreement, and it will only be needful for me to refer to one or two points in it. First of all I would call your attention to the fact that in clause 5 an important alteration has been made since the draft which you received was printed. As originally drawn up, 20 per cent. was the amount fixed upon to be paid in a certain event. That proportion has since been altered from 20 per cent. to 33⅓ per cent. Well, in regard to the agreement itself, it was brought about, as you know, in consequence of the visit of Mr. Tendron to America last summer, and was only arrived at, as he will tell you, after prolonged and laborious negotiations. The only point in the agreement to which any real objection is at all likely to be taken is clause 5, which runs "At any time during the currency of this agreement, the firm to have the call of £150,000 new shares, or any part thereof on which 33½ per cent. is to be paid by them on issue, subject to the Articles of Association of the Company. The Company's indebtedness to the firm to be received in payment or partial payment for the shares. The other share capital to be issued without the firm's consent." I think you will be justified in taking the earnest advice of the Board upon this matter, and sanctioning this agreement, in the complete assurance that the interests of the Company have been protected and advanced by it in every way, and that it cannot fail to have any but a beneficial effect upon the fortunes of the Company. I may, perhaps, just remind you in conclusion, that should the agreement be rejected by you, we shall find ourselves placed in a most embarrassing position, from which I cannot tell how we should extricate ourselves. I beg to propose the adoption of the resolution which I have read to you.

MR. TENDRON seconded the motion, which was carried unanimously.

A Large Electric Mining Plant.

The electric power plant being put in by the Virginius mine at Ouray, Col., is one of the largest in the world, and is the first electric power of such extensive proportions used in mining. A power house has been erected at the confluence of Imogene and Sneffles creeks, which is 30 x 60 feet. Two heavy copper wires are poled from here to the mine, 19,000 feet away, to convey the electricity to the mining and milling machinery. In the power house are two dynamos of 400 horse power each. The dynamos are operated by water power, obtained through a mile of pipe line, driving two mammoth Pelton wheels. The water is taken from Canon creek, and has a fall of 600 feet, The pipe line is nearly complete, and the machinery is about all in place, and it is expected to start the new plant in about three weeks. All the machinery for mine and mill will be operated by electricity at both the Virginius and Terrible mines. The largest Knowles duplex mining pump in the world will be placed at the tenth level of the Virginius mine, and will be operated by a 50 horse-power motor attached. This pump will throw a 6-inch column of water 700 feet, to the adit level, or surface. A great amount of money is expended in the large electric plant, but the reader will readily understand how well this expenditure is justified when it is stated that the Virginius and Terrible have been using 13 tons of coal per day, at $20.80 per ton, every day in the year. This vast expense will now be cut off. The coal supply has been packed from Ouray, a distance of 13 miles. The cost to the Virginius for fuel since 1887 would give any individual all the money he would ever need to live in luxury. Since electric power has been used in mining it would have saved several hundred thousand dollars at the Virginius. With the new power plant and pump the Virginius will be one of the best systematized mining enterprizes in America. —*Black Diamond.*

The Hauraki Gold Mining District, (Northern Section) Auckland, New Zealand.

BY D. H. BAYLDON, M.E., THAMES, NEW ZEALAND.

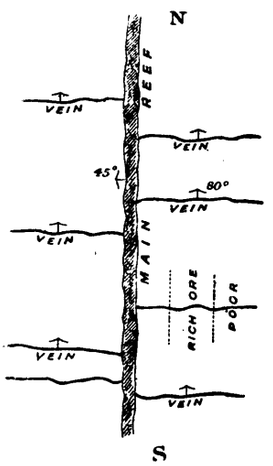
[Proceedings of the Federated Institute of Mining Engineers.]

The Hauraki mining district, in the Province of Auckland, New Zealand, lies between latitudes 36° 25' and 37° 40' S., and longitudes 175° 20' and 176° 0' E., is about 100 miles long by an average of 25 miles wide, the greater portion being known as the Coromandel Peninsula.

It is bounded easterly by the Pacific Ocean and westerly by the Firth of Thames and the beautiful fertile valley of that name, the extreme northern limit being Cape Colville, and extends southward beyond Te Aroha mountain, 3,173 feet high.

The country for the most part is rugged and mountainous, covered with dense forests of ever-green trees, intersected by innumerable streams of various sizes, which afford at all times of the year a magnificent supply of pure water for mining, timber floatage, and domestic use.

FIG. 1.



The timber on the ranges is of vast extent. Here is found the celebrated Kauri pine, from 70 to 150 feet high, some of the boles of which have been known to exceed 20 feet in diameter. Other valuable timbers exist, suitable for building, cabinet, fencing, mining, and domestic purposes. The Kauri gum, a hard substance, somewhat like amber in appearance, and which is exuded from the pine of that name, is found in the existing and extinct forests in great profusion, and is a source of wealth to the country; it is exported to England and America, where it is highly esteemed and manufactured into the finest carriage varnish.

The valleys are salubrious and fertile, composed of deep alluvium, and are, to some extent, cultivated by the Maoris, miners, and settlers. The crops are such as are grown in England. All English fruits are abundant and good. Stock of all descriptions thrive and do well.

The situation of the Hauraki mining district is somewhat unique as a gold-field, the facilities offered for the export or import of material being all that can be desired, sea carriage being afforded almost up to the pit-mouths in the instances of Thames and Coromandel. The noble and picturesque harbour of Auckland is within 40 miles of the former and 30 miles of the latter town, where ships of any draught may lie and discharge at the wharves with the greatest safety.

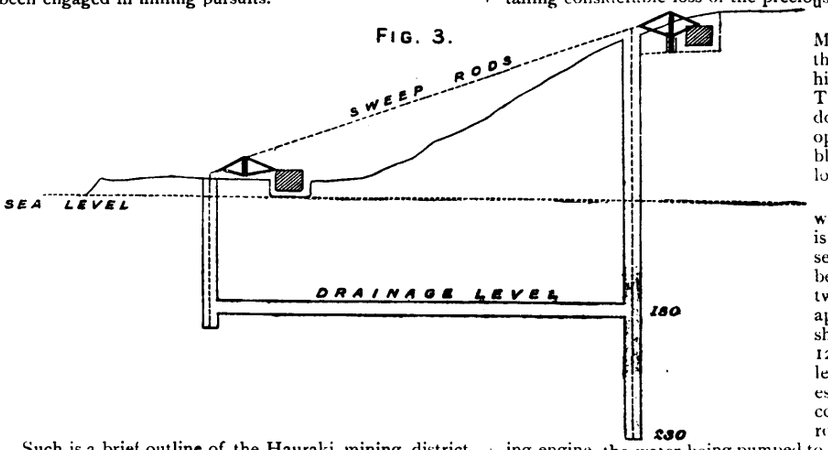
FIG. 2.

Local steamers carrying passengers and freight run at regular and frequent intervals between Auckland, Thames, Coromandel, and Mercury Bay, from whence they distribute their freight to other points by drays, coach, or river.

The Thames or Waihou River drains the south-western section of the district: it is navigable for small steamers and craft for some 60 miles on its course. Inside the river, for several miles, exists a natural harbor, suitable for vessels up to 600 tons register. The land is rich and fertile, forming a broad valley 15 to 20 miles wide, perfectly flat, intersected by other streams. The ground is somewhat swampy, which is natural from its conformation, but for the most part easily drainable. Here the *Phormium tenax*, or native flax, covers large areas and fringes the river banks; the white pine, a very useful timber, is also abundant. Much of this land, especially in the upper part of the valley, is reclaimed, and flourishing farms are to be seen as far as the eye can reach.

The lands on the eastern bank of the river are now nearly all occupied by a hardy, industrious class of farmers, many of whom are now and have in days gone by been engaged in mining pursuits.

FIG. 3.

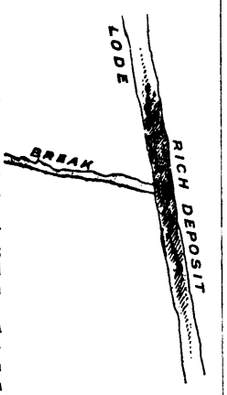


Such is a brief outline of the Hauraki mining district, and it will be seen that mining and agriculture can go hand in hand. Twenty years ago it was a howling wilderness: now there are many small towns, and villages, the country dotted over with farms, the miners penetrating the hills in search of the precious and other metals, and the country made accessible by roads and bridges. The future of such a country is not hard to predict.

The principal centres of mining in the district are Coromandel, Hastings, Thames, Hikutaia, Ohinemari, (comprising Karangahake, Owharoa, Waihi, and Waite-Kauri), Te Aroha, including Waiorongomai

Gold was first discovered at Coromandel in the year 1851, and attracted a considerable number of miners, but through native troubles, and superior attractions elsewhere, the diggings became comparatively deserted until 1861, from which time mining has been carried on, with more or less success, to the present day. Considerable tact was required to be displayed in dealing with the natives to induce them to open their land to the miners for prospecting and mining. All these difficulties have for many years been overcome; cordiality and mutual good understanding now prevails on both sides.

FIG. 4.

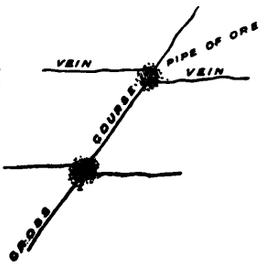


Coromandel is situated on a beautiful little harbour, and mining for gold is carried on from the sea beach across the main range toward the east coast. Coal and other minerals are found throughout the district, but are undeveloped.

The principal gold mines are the Kapanga and Coromandel (English companies), Tokatea, West Tokatea, Royal Oak, Pride of Tokatea, Success, Onslow and many others.

Throughout this district the outcrop of a main or mother reef can be traced for many miles, averaging 25 to 30 feet thick, with a northerly strike and westerly underlie of about 45 degrees. It has not been found payable, but the lateral veins, which have an east and west strike and northerly dips of varying angles, are found to yield good paying ore, which, as a rule, lies in "chutes" or chimneys of varying widths and depths. These lateral veins vary from a few inches to several feet in thickness. The Tokatea Mine, in which this system of reefs is well illustrated, is situated on the main range, the highest point being about 1,400 feet above sea-level; it is worked by adits down to a depth of 900 feet, the lowest level being about 2,500 feet long.

FIG. 5.



The Kapanga Mine is situated about one mile westward of the main reef; two well defined reefs have been worked from the surface to a depth of 550 feet. It is worked from a main shaft, properly equipped with pumping and winding machinery, capable of going to a much greater depth.

Some of the ore from this mine was exceedingly rich, and in places highly charged with metallic arsenic, which, in the course of amalgamation, had the effect of sickening the quicksilver, which, consequently did not do its work, entailing considerable loss of the precious metal.

The Coromandel Mine is situated on the sea-shore, above high-water mark. The company are doing good work, opening up new blocks 280 feet below sea-level.

The pumping and winding machinery is situated on the sea-beach, the mine being worked by two shafts about 450 apart. The inland shaft, being about 120 feet above sea-level, and the deepest by 100 feet is connected by sweep rods to the pumping engine, the water being pumped to the 180 feet level, from whence it runs back to the seaward shaft, and is then forked to the surface. The drainage water from the mine is settled in a reservoir and is used for milling purposes.

The country rock in which the lodes are encased is of igneous origin, of a tufaceous nature, highly charged with undecomposed pyrites, below water-level sometimes coarse and rotten, in other cases fine grained and hard, and has been termed "tufaceous sandstone," and in this class of country rock only have the lodes been found payable. Alternating with the tufaceous sandstone are to be found slates, diorite-porphyry, and felsites.

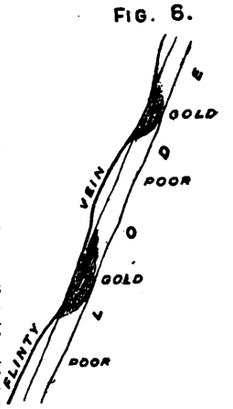
Hastings, some 20 miles south of Coromandel, is a small mining township. Considerable quantities of gold have from time to time been found in the various gullies and spurs off the main range, chiefly in decomposed slate and tufaceous sandstone. No deep mining of any consequence has been done here.

Thames is the center and most important locality in the Hauraki mining district. It was opened for mining in the latter part of the year 1867, and has been constantly worked since that date.

The population was at one time 10,000 to 11,000, but being chiefly composed of miners, otherwise diggers, who are a roving set of men, attractions elsewhere has reduced the number to something like 4,500 at the present time.

The auriferous portion of the Thames is several miles wide, and the distance back into the ranges uncertain, as not more than about six miles in a straight line has been explored for gold.

FIG. 6.



The country rock is composed of tufaceous sandstone, alternating with diorite and andesite dykes. The latter are extremely hard to penetrate, and are known locally as "hard bars." The highest points in the locality are chiefly composed of this class of rock. The country is broken and irregular, intersected by gullies and cracks, which afford excellent opportunities for mining by means of adits or tunnels.

The lodes have varying strikes between 10 degrees and 80 degrees northeast, and usually underlie to the north-west of angles ranging from 22 degrees to 80 degrees from the horizon. They are variable in thickness, from a few inches to 20 feet, and all are more or less gold-bearing while traversing the tufaceous sandstone.

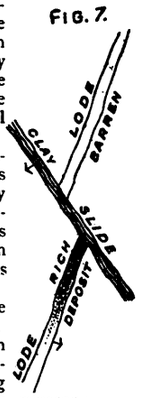
The pay ore, as is usual, lies in "chutes" of varying lengths and depths, the best paying reefs have hard walls, to which the quartz, in a great measure, adheres, which gives the impression that when the rocks were in a state of fusion they emitted certain gases, which, with other combinations when the rocks cooled, caused the deposition of gold in the veins. The deposition of gold is especially noticeable where lateral breaks occur, and which have the appearance of water channels.

Where the break does not cross the lode the chute of rich ore is of much greater extent, and the lode richest on that wall which has been subject to fracture, and the deposit of gold becomes weaker the further it recedes

from that fracture. In many instances where a break crosses the lode the deposition of gold will be at the junction, and so marked is this in some instances that the cross-courses are followed for the purpose of intersecting the junctions, and the lodes only worked at those particular points. The pay ore forms a pipe or chimney at the junction. Black veins, rich in pyrites, striking from the country rock into the lodes is a most fruitful source of gold. Flinty veins, barren in themselves, frequently run parallel with a lode, and when a contact takes place there is almost a certainty of gold being deposited.

There are also at the Thames several main slides or clay cross-courses, which have an influence on the deposition of gold. The lodes are always more productive when in contact or in the immediate vicinity of these slides, and moreover, the lode is not productive on both walls of the slide, but usually on the hanging wall contact.

FIG. 7.



The veins are very numerous and sinuous in their course, and frequent junctions occur, which complicates mining to a very great extent. As a rule the lodes maintain their underlie well. It may be as well to mention that where variations in strike and dip occur, the productiveness of the lode is influenced.

All these eccentricities entail upon the management constant care and watchfulness, as many instances have been known of mines abandoned as unprofitable, on further development turning out highly profitable dividend paying concerns.

There are about 180 stamps at work in seven mills, a Newbury-Vautin chlorination plant, and several other establishments for the treatment of tailings by grinding processes.

All these mills are driven by water power. The water has been brought on to the ground by a water-race fifteen miles long, constructed by the Government, and now administered and controlled by the Thames County Council, who let the water at a moderate rental per cubic foot per week—one cubic foot being equal to about 12 horse-power, consequently, crushing operations are conducted at a very low cost. This water is not only useful for milling purposes, but is supplied to the foundries, cabinet factories, for household purposes, and small machinery generally.

In addition to the peculiarities mentioned in connection with mining at the Thames, it has been proved beyond doubt that the gold not only lies in chutes, but that these chutes have a southerly dip, and strike across the reefs at a low angle. (See section across Thames Flat.)

Carbonic acid gas is frequently found in the mines below sea-level; it is not noticeable except during easterly weather, the prevailing winds being westerly. Several fatalities have occurred through its sudden influx, but greater caution is now observed and accidents are avoided.

Mining at Thames is carried out in a thoroughly systematic manner. The machinery is of a superior description, subject to biennial inspection by a Government officer. The administration of the gold-field is conducted by the warden or magistrate, who hears and decides all cases of dispute which may arise from time to time.

The southern portion of the district, including Hikutaia, Ohinemari, and Te Aroha, are most interesting. The lodes are different to those at Thames and north-ward

A Plea for the Sunday Opening of the Geological and Natural History Survey Museum.

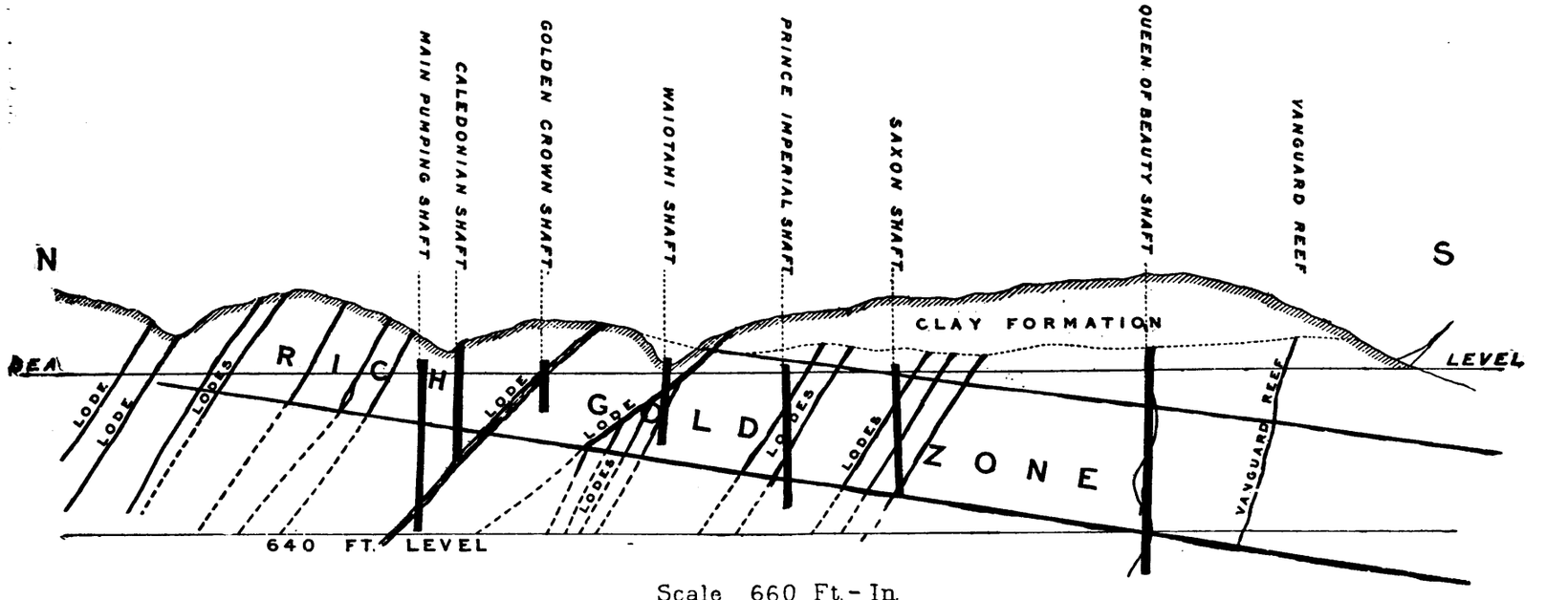
At a conversazioné given by the Literary and Scientific Society of Ottawa, at which Lord and Lady Stanley and a large company were present, Dr. A. R. C. Selwyn, C.M.G., Director of the Geological Survey of Canada, made a strong plea in favour of the opening of the Museum on Sundays. The following is a resumé of his address:—

Your Excellencies, Mr. President, Ladies and Gentlemen,—Having been requested to make a few observations on this occasion, I have reluctantly consented to do so, because I feel there are so many others present this evening who could have put before you, far more ably than I can, and with eloquence I am incapable of, the important educational and practical advantages and substantial value that the whole country derives from the researches and observations of the enthusiastic scientific and literary workers who associate themselves together and meet in this and kindred societies for the interchange of thought and for that amicable discussion of the various and oft-perplexing problems that annually suggest themselves to the careful observer of the marvellous phenomena presented in the wide fields of organic and inorganic nature. It is by such simple and unobtrusive observations, studies and discussions, and other scientific methods, pursued in the field and in the laboratory, that the secrets of nature have in the past been disclosed and made subservient to the uses of man. Yet in spite of this indisputable fact, we find that such researches are commonly regarded by a not very discerning public, as useless and practically unproductive, because the result is rarely, if ever given immediately and made directly apparent. To such patient, long continued, and often ill requited observation, study, experiment, and toil it is, however, that we owe our present knowledge of steam and electricity, of disease and its prevention, and, indeed, of all the most valuable discoveries of the age in which we live. As in the past, so it will most certainly be in the future, the secrets of nature are by no means exhausted, neither are the moral and material advantages that man may yet derive from their further study. On these, if on no higher grounds, it is the imperative duty of wise governments to foster, as it is of an intelligent public to support them, by affording every possible material assistance and encouragement to institutions and societies, such as this, whose members often thinly distributed throughout the country, and therefore pursuing their work under discouraging circumstances, are yet devoting both their time and there means in an earnest endeavour to open and to intelligently read and expound for public use and for individual advancement and welfare—the great book of nature. Truly there are

"Sermons in stones and good in every thing,"

but the sermons can not be read and understood till the language in which they are writen is learnt. And this brings me to a question which is closely related to the encouragement and promotion of the studies and researches, I have spoken of. It is that of the propriety and advisability of opening the Geological and Natural

SECTION ACROSS THAMES FLAT



Scale 660 Ft. - In.

The mines, for the most part, are small, none exceeding 100 acres, some of the richest have not exceeded a few acres in extent.

The principal mines are worked from shafts on the low ground adjacent to the sea-beach, and the workings, are, for the most part, below sea-level. t The deepest shaft is 748 feet, being over 720 feet below he sea. No trouble is experienced from sea-water, the whole of the drainage being coped with by a main pump.

An assessment is made annually on the various companies benefitted by its operations; it is by that means maintained and managed by a board elected from the contributors.

The pumping machinery consists of a low pressure Buhl engine of 250 horse-power, 82-inch cylinder, 8 feet stroke, with a 25-inch column, and four Cornish boilers; two balance bobs, one at the surface, the other at the 300 feet level, placed over a shaft 12 feet by 8 feet inside measurement, depth of shaft 640 feet. This machinery at present does all the pumping for the field down to the 500 feet level, working about six strokes per minute.

Mining in the hills is carried on by means of adits, of which there are a great number, varying in length from over half a mile to a few hundred feet.

Roads and tramways are constructed up the creeks, by means of which the ore is brought to the flat and distributed to the various reducing plants for treatment.

and different classes of machinery are being put up for treating the ores, which are of a much more complex nature.

A short notice would not do jvstice, therefore, as time will permit, I have deemed it preferrable to confine the foregoing paper to the northern section only.

NOTE—The cuts illustrating the foregoing paper have been very kindly furnished by the Colliery Engineer Co. of Scranton, Pa.

Canadian Peat Beds.

The latest experiment, with a view to utilizing Canadian peat beds, is being made in the county of Dundas, where the beds are reported to be so extensive as to be practically inexhaustible. Pressed peat, with a fine glossy texture, is reported to be selling at $1 a ton. Its relative calorific power would depend largely on the depth of the peat bed. A bed 36 feet deep should produce fuel having nearly five-sixths the calorific power of soft coal. If such fuel could reach the consumer for $3 a ton, in sufficient quantities, it would displace all other kinds of fuel. The trouble with many of the peat beds is that they are too shallow to have thoroughly solidified, and cannot be drained. The latter defect can be overcome by dredging machinery only to a certain depth.

History Museum on Sunday afternoons, and thus afford all who wish to avail themselves of the privilege, an opportunity to read and study the sermons from the *work* of the Creator, which there lie open for perusal, written as it is in the only original, universal and uncorrupted language, and one with which the whole human race is more or less familiar.

Sermons, silent it is true, yet — especially to the student of the language—unsurpassingly eloquent — sermons which, I venture to say, would be more intelligible and more interesting to most minds, and no less useful, if regarded from a moral and educational standpoint, than those sermons from the *Word* of the Creator, which some at least of the afternoon Museum congregation may have listened to during the forenoon in Church, which may, or may not, have been either interesting or eloquent. As official reports are seldom read, I may be excused for quoting here the following remarks which were made in my annual official report in 1885, on the subject of Museums :—

"Referring to Museums, it may not be out of place to call attention to what is being done elsewhere in this connection. In New South Wales, one of the Australian Colonies, with a population of only about 850.000, I find from a report recently received, that the appropriation for the year 1884 for the mantainance of the museum in Sydney was £8,750 stg., or about $43,750. The figures relating to the visitors to the Sydney Museum are also somewhat remarkable. They are for 1883; 137,401 being for week days, 86,114, Sundays, 51,287. Apparently—I might have said conclusively—shewing that there is a very large class of persons whose daily avocations prevent them from taking advantage of the means of instruction and the ennobling influences which these studies of nature's wonders in a well-arranged museum cannot fail to afford. In this matter the Australian Colonies must be conceded to have made an advance in the promotion of knowledge and civilization. I would respectfully suggest for the serious consideration of the Government the desirability of permitting the Ottawa museum to be open for visitors on Sunday afternoons."

No action was taken on this suggestion and in 1888 the subject was again referred to in my official report, when I said :—

"The result of this course having been adopted at the Australian Museum in Sydney shows that on the 52 Sundays—afternoons only— the daily attendance was largely in excess of that of the 313 week days; the average being 986 on Sundays and only 275 on week days. Such a fact needs no comment, and I venture again to express a hope in the interests of education and knowledge that the time is not remote when a similar experiment will be tried in Ottawa."

There will, doubtless, be strong objections urged against such action, based chiefly, if not entirely, on the very erroneous, but unfortunately very prevalent, idea that a museum is a place of amusement, whereas it is essentially as much a place of instruction as are the Churches and the Sunday Schools. And the principal difference between them, concisely stated, is, that in the Museum the *work* and in the Church and Sunday School the *word* of the *Creator* is expounded. This admitted, as I think it must be, there seems no obvious or intelligible reason why the one establishment should be closed and the other opened on the Sabbath. And now with your permission I shall make a few remarks on the past and present position and prospects of the Ottawa Museum. In the early reports of the Survey, there is so far as I am aware, no reference to the Museum nor any statement of its first establishment, or of its annual growth—like Topsy, however, it 'growed.' In the preface to the Geology of Canada, 1863, on pages xiii to xv it is briefly described, and we learn that "the Museum has gradually assumed a value and importance which at the present time (1863) render it second to few on the continent for the special purpose to which it is devoted." It was then divided into two parts Mineralogical and Palecontological, about 1,500 species of fossils were exhibited, and an unrecorded number of specimens of rocks and economic minerals. It was located in an old dwelling house on the corner of St. Gabriel Street and Fortification Lane. Prior to 1873 no record was kept of the number of visitors, but in that year 1,000 names were recorded; in 1874, 1,017; in 1875, 1,728; 1877, 1,980; 1879, 1,603, 1880, 1,183.

In 1881 the Museum was removed from Montreal to its present location in Ottawa. In 1882 9,000 persons visited it; and during the year just closed the number of visitors has reached 18,300. During the past twenty years, it has been my constant endeavour to increase the practical and the educational value, as well as the attractiveness and popularity of this Museum.

In this endeavour I have always received most valuable co-operation and assistance, without which my endeavours would have been fruitless, from the gentlemen who have been, or still are, associated with me in the work. Judging from the number who now visit the Museum, I am, I think, justified in assuming that our united efforts have have met with some measure of success, notwithstanding the difficulties and hindrances that have been encoutered, incidental chiefly to the very inadequate accommodation and unfitness of the building for the purposes to which it has been adapted. A far more serious consideration, however, in connection with the building, is its location and surroundings. These are now such as to constitute an ever present danger of the whole of this large and invaluable collection being at any moment destroyed by fire. This danger can easily be avoided by taking prompt action with a view to erect as speedily as possible a suitable and wholly isolated and fire proof building to receive the collection. Should it in the meantime be destroyed the loss would be wholly irreparable, while the few thousand dollars required to place it in safety are comparatively quite insufficient, and I can only express an earnest hope that no iujudicious parsimony will be permitted to interfere with the accomplishment of this important public work.

The establishment of the Royal Society in 1882 through the enlightened and active influence and interest which was shown by the Marquis of Lorne in the promotion and encouragement of all matters pertaining to literature, science and art, and the subseqeent recognition of the important functions of the Society by Parliament, in providing funds to defray the cost of publishing the annual record of its proceedings, was a memorable event in the progress and promotion of literature and science in Canada, and a boon for which all literary and scientific workers in the Dominion must always be grateful. Now, one, and by no means the least useful, of its functions is that of constituting a headquarters, or nucleus from which sympathy, support and encouragement is extended to local societies, and where annually a report can be made, and a record published of their several proceedings. Nineteen societies are now affiliated with, and send delegates to the annual meeting of the Royal Society. Of these there are four in Montreal, three in Quebec, four in Ottawa, three in Halifax; and one each in Toronto, St. John, Belleville, Hamilton and Winnipeg. There is, also, the very useful Entomological Society of Ontario whose meetings are, I believe, held in London. Only eight of these societies receive a small annual subsidy from the respective Provincial Legislatures while the others are entirely dependent on the members subscriptions and on voluntary contributions. Nearly all the Fellows of the Royal Society are also members and active workers of one or other of these local societies. I have not been able to ascertain the total aggregate membership of the local societies, but it must constitute a numerous and influential body of workers, probably two to three thousand strong, whose labours are certainly deserving of a larger share of material support and recognition than has hitherto been accorded them by the public, and it is to be regretted that in some instances even the small public grants hitherto awarded have been withdrawn. However, we must not be discouraged or turn aside, but continue the good work, patiently, industriously, honestly and hopefully to the end, forgetful of self and seeking only the truth as it is in nature, actuated by these motives our cause will triumph and our work will meet its reward.

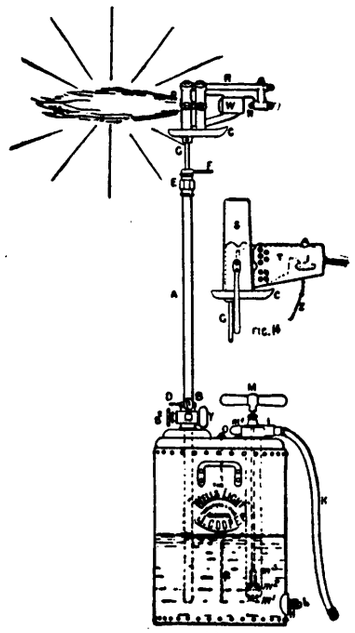
* NOTE.—The considerable increase in the number of visitors between 1875 and 1879 may be ascribed probably to two causes: The awakened interest in the mineral resources of the country caused by the preparation of the collections for the '76 Exhibition in Philadelphia and the '79 Exhibition in Paris, and secondly to the subsequent publication of the descriptive catalogues of the exhibition, and also the publication of the lists of the Survery publications in 1873, 1876 and 1879. The much greater increase after removal to Ottawa from '82 to '89 is in great part the result of the scope of the Museum having then been enlarged to embrace Natural History or Biology as well as Geology and Mineralogy, and thereby having been made interesting and attractive to a much larger number of persons. The list of publications just issued, of which copies are on the tables, gives further details respecting the Museum and the Survey publications to the close of 1889.

British Returns of Colliery Labor.—An analysis of the return of the hours worked at collieries made for the Miners' Federation of Great Britain, by the checkweighers and lodge secretaries in the federated districts, shows that at 679 collieries, employing 183,720 men underground, the general average time worked at the face by the collieries is 8 hours 25½ minutes per day; boys, 8 hours 48 minutes per day; and day laborers, 8 hours 49 minutes. The average time spent in travelling underground is stated to be 39 minutes daily. According to the parliamentary return compiled by H.M. Inspector of Mines the average number of hours worked per day from bank to bank by men and boys engaged in getting minerals in the United Kingdom is 8·6 hours, as compared with 7·43 hours, the average time per day actually worked at the face. The usual number of days worked in the United Kingdom averages 5·43 days per week.

MACHINERY AND INVENTIONS.

The Well's Light.

There has long been a demand for a powerful, portable lamp or service in situations where night work is required to be carried on, as in the case of repairs on railways, in the construction of engineering work, in open quarries, in building operations, upon docks, wharves, etc., and until lately, the only methods of illumination in use for these and similar purposes have been the employment of hand lamps and torches, which are, in nearly all cases, utterly inadequate for the purpose; or of the powerful central lights as represented by the lime light and the arc electric light. The last named devices, while affording ample illumination for the required service, have certain disadvantages with which all of us are familiar, the principal of which are the blinding effect upon the eyes, of their intense and concentrated light, and the blackness of the shadows which they throw, and which result in rendering objects, not directly illuminated by the light, more obscure than where a number of lights of feebler intensity are employed.

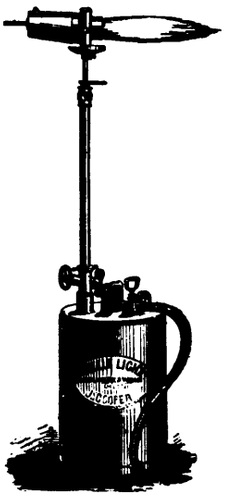


To meet the needs of night service in situations where a strong but diffused light is the desideratum, powerful oil lights have been devised, ingeniously controlled by mechanical feeding devices, so as to place at the service of the workman a light of any desired intensity, and with a large volume of flame. In this respect these oil lights differ radically from the powerful concentrated light afforded by the electric systems. They are capable of yielding an equal amount of light with the last named, but the light, being made by a flame of considerable volume, the eye is not paralysed by its dazzling glare, and the shadows cast are not objectionable in their contrast with the directly illuminated spaces.

We describe and illustrate herewith the construction and operation of one of these oil lights for night service, or for underground works, that has achieved a remarkable success in England, and that is now being introduced into Canada by Mr. James Cooper, Montreal. It is known as the Wells Light, and the accompanying description will be made intelligible by consulting the illustrations.

The Wells Light involves the use of Kerosene oil, confined under pressure in a strong reservoir, from which it may be automatically fed to the burner, the reservoir containing a quantity of oil capable of burning a number of hours. Fig 1 shows a sectional view of one of the Wells Lights. It consists of a steel tank, constructed so as to be air-tight, and therefore capable of holding the

oil without leakage under considerable pressure. When the light is to be operated, oil is first pumped into the tank by the aid of the pump M, until it is about two-thirds full. By this action the air in the tank is compressed, and the pump is again used, if necessary, to develop the pressure up to 20 pounds as will be indicated by the guage; and with this pressure the light will run for four hours without further attention.



The mode of starting the light is as follows: Preparatory to opening valve B., by which oil is admitted to the burner, a small quantity of oil is placed in the dish C, and ignited, while a chimney and back guard cover the burner, (as shown in fig. 1, A), thereby directing all the heat into it. When the burner has become sufficiently heated, which takes seven or eight minutes, the valve B is opened, when the pneumatic pressure drives the oil through the stand pipe A, running from near the bottom of the tank to the burner. When the oil reaches the generating rings of the burner, it is vaporized, and, passing out of the jet N, through the rings, keeps them at a suitable heat continuously to vaporize the oil as it flows to the burner, and as an excess of heating surface is allowed in the rings, the light burns as well in bad weather as in fair weather, and is neither affected by the rain cooling them partially, nor by the wind, as the burner can be swiveled to run with it.

The whole apparatus is simple and strongly made. Any laborer, after one lesson in its use, can manage it successfully. The Wells' lights are given solely into the care of the laborers on the Manchester ship canal in England, and are said to be the only artificial lights used on this great engineering enterprise, where they have contributed materially to the rapid prosecution of this work.

Fig. III, illustrates the No. 1 Wells Light, showing how readily it can be carried about the work from place to place, where the job is not very extensive. Different arrangements have been devised to adapt the lights to all purposes. Among these may be mentioned a carriage to carry it about; a tripod stand so that the light may be situated away from the tank when this becomes necessary or desirable; and different kinds of posts for elevating the light in fixed places.

The following valuable and useful features are claimed for this invention: It gives a powerful light, is portable, entirely self-contained, requiring no exterior motive power, is simple in construction, easy to manage, and requires little attention.

Steam Boiler Tests as a Means of Determining the Calorific Value of Fuels. *

By D. W. Robb, Amherst, N.S.

It will be recognized by those who use large quantities of fuel, especially of bituminous coals, that they differ very greatly in value, even coals which are taken from adjoining areas give very different results, so that it is sometimes very puzzling to the consumer and difficult to decide upon the merits and proportionate values of the fuels within his reach. It is likewise difficult to determine when the greatest practicable amount of work is being obtained from the fuel, and consumers are frequently subjected to great loss from the want of this knowledge. There are three recognized methods of determining the calorific value of fnels, viz.: by chemical analysis, by the use of calorimeter, and by actual measurement of the water evaporated by a definite amount of fuel in a steam generator. By the first method, it is possible to ascertain the constituents of the fuel in their various proportions, and to determine the theoretical heat value when combined with a definite proportion of pure oxygen, and approximately to compute the amount of heat which would be converted into work when combined with ordinary air, and consumed under usual conditions. But this becomes a complicated problem, as will be seen when it is considered that the heat absorbed and wasted in heating the non-combustible constituents of both the air and the fuel must be taken into account, and that these wastes vary with the amount of superfluous air admitted through the grate, and with the proportion of noncombustible matter in the fuel, therefore, any estimate of the practical value of a fuel deduced from chemical analysis can only be approximate. In testing fuels by a calorimeter, a sample of the fuel mixed with chlorate of potassium is placed in an open mouthed copper vessel, which is submerged open mouth downward, like a diving bell, in a vessel containing a measured quantity of water, combustion of the fuel takes place and the heat produced is absorbed by the water, the total quantity of heat being determined by the rise in temperature of the water. This method has some advantages over nn analysis and, if care is exercised in the selection of samples to be tested—or a large number of samples tested—is perhaps the best means of establishing a theoretical standard calorific value of a fuel, but the quantity tested is necessarily small and may not fairly represent the fuel; it also leaves out the heat absorbed by the non-combustible portions of the air and fuel, which is an important factor in the combustion of fuel, under ordinary conditions. The method by which the fuel is consumed under actual conditions and in large quantities, in evaporating water in a steam boiler is generally regarded as a test of the efficiency of the generator, rather than as a test of the value of the fuel, but somewhat extended observation of the performance of various steam generators using similar grades of coal has convinced the writer that the steam boiler test, when properly conducted, is quite as valuable as a means of determining the calorific value of fuel, and of comparing various fuels as for finding the efficiency of the generator; in fact, the latter is the more uncertain of the two, because, unless a boiler is tested with a fuel of a known calorific value, it is impossible to arrive at its actual efficiency or to compare it fairly with any other form of generator. In testing the heat value of fuel in an ordinary steam boiler two elements of uncertainty are introduced, viz., loss through imperfect combustion of the fuel, and the escape of gases at a higher temperature than the atmosphere, but as these losses, as well as the heat absorbed by the noncombustible portions, the air and fuel are unavoidable in the present state of science, they should be taken into account in making a practical test of fuel, and strict accuracy only requires that the loss be uniform and minimum in result. Practical experience teaches that almost perfect combustion may be attained in any of the common forms of steam generator by careful and regular stoking with a proper air supply; and, that the skill necessary to produce this result is possessed by many ordinary stokers, who have no knowledge of the laws which govern the combustion of fuels, will doubtless be admitted by many persons who have observad locomotive firemen or others, who are compelled to get a high rate of steam production. It is of course impossible to transfer all the heat produced in combustion to the water in a generator, because the gases cannot be reduced below the temperature of the water or steam within the generator, and a certain temperature above the atmosphere is necessary te produce draught in the chimney, but it is quite possible to so proportion the grate surface to the heating surface of the boiler that the gases will be reduced to a certain minimum temperature, and maintained at that temperature during a test. The temperature may be indicated by a pyrometer or high registering thermometer at the base of the chimney, and the rate of flow of the gases may be ascertained by the use of a draught gauge. Frequently an attempt is made to analyse the waste gases, this gives an uncertain result on account of the difficulty of getting representative samples of the gases, but from observation and examination of many tests the writer believes it unimportant, if the stoking and air regulation receive proper attention. The surface of the grate should be so proportioned to the heating, or heat absorbing snrface of the generator that the gases will, when they reach the uptake, be reduced to say 400° Far.; the skilful firing and air regulation will produce practically perfect combustion, and uniform temperature. It is not of so much consequence either, as some people imagine, what kind of generator is used. The brick furnace is supposed to possess an advantage in maintaining the temperature necessary to perfect combustion, while contact with the cooler surface of a water lined furnace is supposed to prevent ignition of the volatile hydro-carbons coming from some fuels, producing carbonic oxide; but the writer is convinced that, by a proper regulation of the fire, so that the air will pass through and the gases pass over a bed of hot coals, or incandescent carbon, with frequent and even distribution of the fuel, as perfect combustion may be, and is, obtained in a water lined furnace as in a brick one. The water lined furnace avoids the radiation of heat and and admission of air, both of which are an uncertain but certainly wasteful feature of the brick furnace. Steam boiler tests, although attended with some difficulty, are quite within the reach of ordinary consumers, and deserve to be better understood and used more than they are. In addition to their value as a method of determining the heating properties of fuel, they furnish the best possible means of ascertaining the condition and efficiency of the generator, and of checking, and if necessary correcting waste on the part of the stoker. It is desirable that such tests should be made frequently, because steam boilers are very liable to deteriorate and become wasteful, especially when set in brick, through the cracking of the brick walls, as well as by the coating of heating surfaces with scale or other deposits on the inner, and soot or ashes on the outer surfaces. It is quite practicable for steam users to have tests made by their engineers and ordinary assistants, but it is preferable to have an occasional test made by a professional engineer who has had experience in making such tests, as he will have gained special knowledge which will enable him to detect and locate imperfections in the generator more readily than those unaccustomed to such work. The writer would suggest to steam users the following practice: That one or more tests be made by an expert to determine the efficiency of the generator, and that he may direct any necessary repairs or corrections in the generator. After this has been done, and a standard of efficiency established, a good water meter should be inserted in the water supply pipe, so that a record of the water used may be continuously kept, and the stoker or engineer should keep a log and make daily reports of the coal consumed and the water evaporated. The meter readings will need correction, if absolute accuracy is desired, but for practical purposes this may not be necessary. It may seem like unnecessary labour and expense to weigh all the coal used, but a short trial will undoubtediy prove its value, as it will not only indicate, constantly, the condition of the generator, but to a certain extent, be a check upon the working of the engine and the amount of power used by the establishment, and it will furnish a constant incentive to the engineer, stoker, and those in charge of the steam machinery, to improve its working and reduce the amount of fuel consumption to its lowest limits. A general practice of this kind throughout the country would induce a rivalry in the saving of fuel, parallel to that found in marine practice, where it is claimed a horse power is produced by from one and a-half to two pounds of fuel per hour, instead of four to ten pounds,—the last named quantity being not uncommon in ordinary steam plant, and would in course of a few years cause an enormous saving to the country, as well as to individual consumers. Rules governing the standard system of boiler trial, adopted by the American Society of Mechanical Engineers may be found in the transactions of that Society, vol. vi., 1884. The following simple instructions will enable any steam user to conduct a test of his boilers for the purpose of comparing the values of fuels, etc., after the efficiency of the generator has been established by a complete test by an expert, (observations of the quality of steam, strength of chimney draught and analysis of gases are omitted as they require special instruments and skilled manipulation).

INSTRUCTIONS FOR CONSUMERS' TEST.

A test to be of any value should be continued for not

* A paper read on Dec. 8th, 1890, before the Nova Scotia Institute of Science, Halifax, N.S.

less than ten hours, and will require the constant attention of not less than four persons besides the regular attendants, appointed as follows:—One or two men to weigh the coal, and one or two to attend to and weigh the water; one clerk to keep the log of the coal and water weighed, and one clerk to record the pressure of steam, temperature of feed water, temperature of chimney gases, and to keep a gross account of the coal and water as a check to the regular log. These should be careful men, well posted as to their duties. Three good platform scales will be required, and two tanks, or clean tight casks, to weigh water in. Preparation should be made so that the water can all be delivered into the two tanks, which are placed upon two platform scales, and the water pumped alternately from the tanks to the boiler. A piece of hose attached to the suction pipe of the pump or injector will be convenient to transfer from one tank to the other. It will be advisable to procure from reliable instrument makers one or two accurate thermometers for the purpose of taking the temperature of the feed water and chimney gases. The temperature of the feed water should be taken by inserting a brass or copper cup in the feed pipe near its connection with the boiler. This cup may be filled with oil and the thermometer set in the oil. The temperature of the cold water before it enters the injector or feed water heater should also be taken. Great care should be exercised that all scales, steam gauges, etc., are correct, and that there are no leaks about the pumps, pipes or boiler, by which any water may escape without being evaporated. Steam leaks are not material except as misrepresenting the consumption of the engine. The temperature of escaping gases may be taken by inserting a brass or copper pipe, with closed end in the smoke connection where it leaves the boiler. This cup, which should reach the centre of the escaping gases, may be filled with oil and a high registering thermometer placed in it. Previous to the hour for starting, say at 6.30 o'clock, steam should be up to the working pressure and the tubes and all surfaces and flues should be swept clean. The ash pit should be cleaned and the first charge of kindling and coal, or the fuel to be used, should be weighed, every man should be at his post, those who are to note the various readings provided with ruled forms for recording the gross, tare and net weights of fuel and water, and others for the pressure of steam, temperatures of feed-water and escaping gases, which should be noted every quarter hour. At the hour for starting the height of the water in the boiler should be marked on the gauge glass, so that it may be brought to the same place at the close of the test, and the fire should be drawn quickly and replaced with the weighed kindlings and fuel, (wood kindlings are generally taken at $\frac{4}{10}$ the value of coal by weight). The working of the boiler may be conducted as usual in every way, the stoking should be done carefully, so that no waste may occur through dead spots or holes in the fire, or uneven distribution of fuel. If the fire is too thick, some of the gas will pass off unconsumed for want of sufficient air, and if the fire be too thin, too much air will be admitted. The draught or air supply should be regulated by the ash pit doors or registers, and an even fire and steady pressure of steam maintained throughout the test. If work is to be suspended at mid-day, or any time during the test, the drafts may be closed, the fire banked, and an attendant left in charge who will regulate the fire if necessary, so as to keep the pressure constant. At the close of the test the water should be brought to the same level in the boiler as at the beginning and the fire withdrawn and deadened quickly with water. The remaining coal should be weighed and deducted from the quantity charged to the boiler, and the ashes may also be weighed. The net weights of coal and water may then be summed up and the result of the test ascertained and recorded in the following manner:—

Test of boiler at
day of 18
Kind of boiler
Dimensions
No tubes
Size of fire-box
Grate sruface sq. ft.
Heating surface do
Height of chimney
Size of chimney
Duration of test hours
Kind of fuel
Boiler pressure (by gauge) lbs.
Temperature of feed-water entering boiler degrees Far.
Temperature of feed-water entering pump or injector degrees Far.
Temperature of escaping gases degrees Far.
Total fuel consumed lbs.
Percentage of moisture in fuel per cent.
Equivalent dry fuel lbs.
Total weight of ash lbs.
Equivalent combustible lbs.
Total water evaporated lbs.
Water evaporated per hour lbs.
Water evaporated per pound of dry fuel lbs.
Water evaporated per pound of dry fuel from and at 212° lbs.
Water evaporated per pound of combustible from and at 212° lbs.
Horse power developed.

The above particulars are determined in the following manner:—The pressure of steam and temperature of feed-water and gases are taken from the average readings of the same.

The total quantities of fuel, ash and water are taken from the net summing of log, great care being taken that no error is made. The percentage of moisture in fuel is determined by drying a sample of the fuel for 24 hours and getting the difference between the wet and dry weights, which difference is multiplied by 100 and divided by the weight of sample before drying.

The equivalent dry fuel is found by multiplying the total quantity of fuel by the percentage of moisture and dividing by 100, which is deducted from the total quantity of fuel.

The equivalent combustible is found by deducting the total amount of ash from the total quantity of fuel.

The water evaporated per hour is the total quantity of water divided by the number of hours duration of test.

The water evaporated per pound of dry fuel is the total quantity of water divided by the total quantity of dry fuel.

The water evaporated per pound of fuel from and at 212° is found by multiplying the water evaporated per pound by the total heat, or heat units, of one pound of steam at the average pressure, less the total heat of one pound of feed water at the average temperature of feed water before entering the pump or injector, and dividing the product by 966, which is the total heat in units, of one pound of steam at 212°.

The horse power is determined by deducting the total heat units of one pound of feed water at the average temperature before entering pump or injector, from the total heat units of one pound of steam at the average pressure, and multiplying the product by the quantity of water evaporated per hour and dividing by 1110.343 (which are the heat units required to raise one pound of water from 100° and evaporate it at 70 lbs. pressure), the quotient should be divided by 30, which will give the horse power according to the American standard. The following is an example of this method of finding the horse power:—

Total quantity of water evaporated = 2,000 lbs.
Steam pressure (by gauge) 60 lbs.
Temperature of feed water before entering pump, 40°
Total heat of 1 lb. of steam at 60 lbs. pressure = 1175.710 B. T. U.
Total heat of 1 lb. of feed water at 60 lbs. pressure 40° = 8 B.T.U.

$$1175.710 - 8 \times 2{,}000 \div 1110.343 + 216.33 \div 30 = 70 \text{ H. P.}$$

Example of finding the equivalent evaporation from and at 212°.

Water evaporated per lb. of fuel, 10 lbs.
Average pressure by gauge 60 lbs.
" temperature of feed water, 40°
Total heat of one lb. of steam at 60 lbs. pressure, 1175.710 heat units.
Total heat of one lb. of feed water at 40°, 8. heat units.
Example:

$$10. \times 1175.710 - 8. \div 966 = 12.08 \text{ lbs}$$

In comparing fuels as well as in comparing the efficiency of boilers, the quantity of water evaporated per pound of fuel from and at 212° should always be used. The actual quantity of water evaporated per pound of fuel will differ with variations of temperature of the feed-water entering the boiler, and also with the steam pressure or temperature at which the steam leaves the boiler, but the quantity evaporated per pound of fuel from and at 212° allows for these variations and gives a true comparison of the value of fuel if the efficiency of the generator is constant, or of the efficiency of the generator if the calorific value of the fuel is known. The temperature of saturated or dry steam always corresponds with the pressure, but if from any cause the steam be not dry, it will carry away less heat in proportion to weight, or, if the steam be superheated by contact of the products of combustion with the steam surface of the boiler, it will carry away more heat. In either case the result of the test will be vitiated unless the quality of the steam be ascertained and accounted for. This is usually done by means of a calorimeter, one of the best of which, known as the "Barrus Calorimeter," was designed by Mr. Geo. H. Barrus, of Boston. No attempt has been made to ascertain or account for the quality of steam in the simple test given, because it would complicate the work, it is intended that a professional test of the boiler should include this important item, and, if the boiler is found to be abnormal in this respect, the expert should either give directions for the removal of the cause, or provide a formula for the correction of the error due to wet or superheated steam in future tests.

The following table will be found useful in ascertaining the equivalent rates of evaporation, horse power, etc.:—

STEAM TABLE. Pressure of steam by gauge	Temperature	Total heat of evaporation above 30° in heat units	FEED WATER. Temperature of feed water	Tot. heat above 32° in heat units.
125	352.8	1189.555	200	168.7
120	350.	1188.695	190	158.6
115	347.1	1187.809	180	148.5
110	344.1	1186.899	170	138.5
105	341.	1185.961	160	128.4
100	337.8	1184.992	150	118.3
95	334.5	1183.986	140	108.2
90	331.1	1182.945	130	98.1
85	327.6	1181.866	120	88.1
80	323.9	1180.741	110	78
75	320.	1179.569	100	68
70	316.	1178.343	90	58
65	311.8	1177.060	80	48.1
60	307.4	1175.710	70	38.1
55	302.7	1174.286	60	28.1
50	297.8	1172.779	50	18.1
45	292.5	1171.176	40	8.06
40	286.9	1169.460	32	0

Remarkable Increase in the Value of Platinum.—Five years ago platinum was seldom used in the United States, being employed only in the evaporating stills for the concentration of sulphuric acid and in the manufacture of jewellery. It was then $3 and $5 an ounce, six months ago it had increased to $14, and it has now gone up to $20 an ounce, which is only a few cents less than the goid quotation.

Uses of Asbestos.—Asbestos in its various forms is a very useful substance, and can be employed very handily in many ways at the lecture table and in the laboratory, says Professor Markoe. Shredded or carded asbestos will serve as an excellent filtering material, used just the same as paper pulp. Asbestos twine is used in binding together parts of apparatus exposed to fire and strong acids. The professor often prevented a crack in the neck of a retort or flask from spreading by binding it with asbestos yarn or twine soaked in solution of sodium silicate, and then treated with a solution of calcium chloride, a perfectly insoluble cement being thus formed. Asbestos wool mixed with solution of silicate of sodium makes a fire-proof cement of great strength, also serves to mend cracks in stoneware. It can be made insoluble by subsequent treatment with calcium chloride, silicate of calcium being formed. Asbestos paper and card can be obtained of all degrees of thickness, and can be well employed as substitutes for wire gauze and the sand bath in small operations involving the heating of glass vessels. Asbestos paper and silicate of sodium are very useful for mending cracks in glass apparatus.

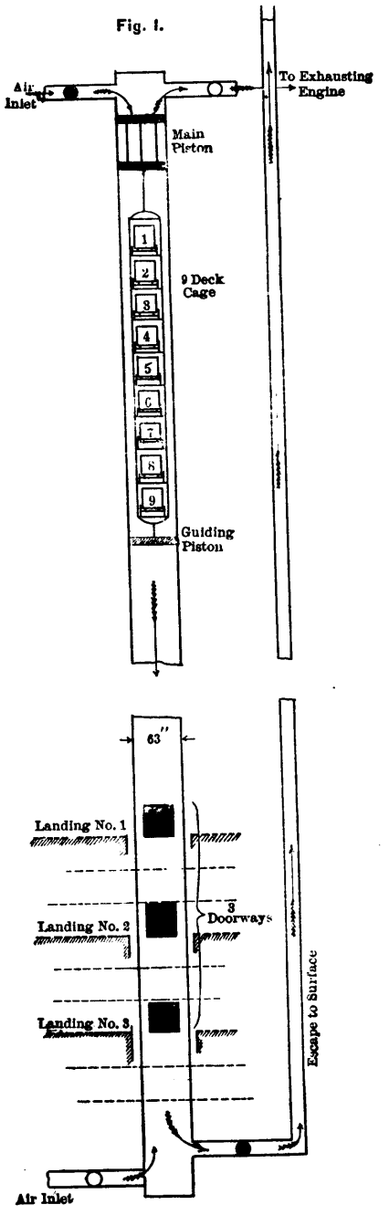
Pneumatic Hoisting.

By H. A. Wheeler, St. Louis, Mo.

[Transactions of the American Institute of Mining Engineers.]

The great depths attained by some of the older mines, and the much greater depth at which they will have to be worked in the not distant future, strongly emphasize the imperfect and inadequate character of our present hoisting practice. The depth of 3,000 feet having been exceeded at several places, and 4,000 feet almost reached at Mons, Belgium, we are brought to face the unpleasant fact that in these instances the mere dead weight of the rope itself is not only the principal part of the load on the winding engine, but that the limit is being rapidly approached at which the ordinary cylindrical rope cannot safely be used, lest it break by reason of its own weight.*

Fig. 1.



While we Americans are not apt to borrow trouble by anticipating the problems of the future involved in the latter feature, the first named defect of the present system of hoisting deserves our immediate attention, because it calls for an excessive consumption of power and consequent increased cost for fuel and plant. The European engineers have reduced the consumption of fuel by different systems of counterbalancing, while by the use of tapered ropes they have very much extended the practical working length of the rope before it will break of its own weight. Theoretically the tapered rope has no such limit, but practically, as used at present, it has its limit, though very much exceeding that of a cylindrical rope.

In attempting to replace the rope system of hoisting, on account of the disadvantages alluded to, the French engineers have tried the endless chain system of Saint Jacques at Montlucon, the Mehnman engine at Anzin and Rohnchamp, and the Blanchet pneumatic system at Epinac. The two former systems were found in practice to be too complicated, too expensive in repairs, and too dangerous, and have been abandoned; and while the pneumatic system was not a success, the failure to find workable coal and the consequent incompleteness of the plant explain that result and leave this most promising of the new systems still entitled to consideration.

The pneumatic system is entirely free from the above mentioned defects of ropes, since it is not subject to the influence of depth, and gives no initial heavy dead load due to the weight of the rope, being in this respect a theoretically perfect medium for "pulling" mineral out of the deepest possible mine. These advantages seem so great, in view of the rapidly increasing depth of mines,† that a sketch of the practical application of this system at Epinac, France, which the writer had an opportunity of visiting last summer, is herewith given. A complete description giving the details of the construction, calculations, and operation of the plant, with illustrations, will be found in the *Annales des Mines* of September and October, 1878, Paris.

THE BLANCHET PNEUMATIC SYSTEM.

The pneumatic system, as installed at the Hottinguer shaft of Epinac Colliery, Saone-et-Loire, France, was designed by M. Zulma Blanchet, who was the managing director of a large company operating several mines and a local coal railroad at Epinac, in central France. The first suggestion for thus using air was made in 1852 by M. Gruner, the director of the School of Mines of St. Etienne, and a model constructed on this principle was exhibited by M. Cave at the first Paris Exposition; but the credit of first putting the system into practical operation is due to M. Blanchet. The vertical Hottinguer shaft, started in 1863, had reached a depth of 2,133 feet in 1871, and was to be sunk to a depth of at least 3,300 feet; but unfortunntely for the company and the entire mining world, no workable coal has thus far been met with, so that instead of developing a large mine to raise over 700 tons a day, it still remains (1889) a prospect, while the plans of M. Blanchet were not satisfactorily completed on account of the great expense of installation and the discouraging nature of the explorations. So, although a thorough test of the system was not made, according to M. Blanchet's more advanced ideas, yet sufficient experience was gained to furnish evidence as to the practical desirability of this novel system of extraction.

M. Blanchet's plan was to have one or two continuous air-tight sheet-iron cylinders or large tubes extending from the bottom to the top of the shaft. See sketch. Within the cylinder moved a piston, to which was hung a cage with as many decks as desired, nine decks being used at Epinac, while suitable air-tight doors open out at each level for allowing the decking of the cars. It was operated by exhausting the air from above the piston, and as the lower side was open to the atmosphere, the piston was raised by the difference in pressure of the atmosphere and the vacuum produced by the air-pump. For lowering, it was merely necessary to allow the air to re-enter above the piston by a throttle-valve while the speed could also be regulated by throttling the escape of the expelled air from below the piston. It is obvious that, neglecting the friction of the piston, any lifting capacity desired can be obtained, for a given vacuum, by merely increasing the diameter of the tube, while the speed of hoisting will depend on the capacity (size of speed) of the exhausting engine to maintain this vacuum.

Besides its legitimates function as a hoisting device, M. Blanchet was enthusiastic about the additional services it would perform in cooling and ventilating the mine through the introdoction at each trip of the volume of air represented by the depth of the shaft and the diameter of the cylinder. Hc also proposed to make a special use of the system in fiery coal mines by closing all openings of the mine, and then by working the exhausting engine, to aid the disengagement of the fire-damp which is supposed to take place freely during a barometer depression. He urged that on snbsequently re-opening the mine and sweeping out the gas with the regular ventilating appliances, the mine would be made much safer.

EXPERIMENTAL PLANT.

Before the erection of the final plant, an experimental one was built consisting of a tube 6½ inches in diameter by 95 feet high connected with a 12 horse-power vacuum pump. With a vacuum of 18 to 19⅔ inches, a velocity of 1,181 feet per minute was attained in lifting 264 pounds, which is equivalent to any efficiency of about 80 per cent.‡ of the engine power. The friction of the piston in the tube amounted to 10 per cent.

The load of 264 pounds was made up as follows:—

		Pounds.	Per cent.	Per cent.
Dead Load	Piston	31·9	= 12·1	29·3
	Cage	37·4	= 14·2	
	Cars	7·9	= 3·0	
Live Load, or Coal		186·8	= 70·7*	70·7
Total		264·0	= 100·0	100·0

From these very encouraging figures the following estimate was made for the final plant, in which the tube was to be 63 inches diameter:—

Piston	2·25	gross tons	= 18·75	per cent.	Dead load.
Cage	3·00	"	= 25·00	"	
9 cars, at 0·25	2·25	"	= 18·75	"	
Coal	4·50	"	= 37·50	"	Live load.
Total	12·00	gross tons	= 100·00	per cent.	

The time required for the round trip at the greatest contemplated speed, 3,280 feet, was estimated at 7 minutes, as follows:—

	Minutes.	Seconds.
To load at bottom (3 deckings)	0	30
To hoist	3	00
Discharging at surface (3 deckings)	0	30
Descent	3	00
Total time for round trip	7	00

If this speed could be maintained, it would give a capacity of 33¾ gross tons per hour from a depth of 3280 feet with a single tube. With two tubes, the capacity would not alone be doubled, but a great advantage would be gained by operating them together, the exhaust engines alternately exhausting and discharging from one into the other, practically counterbalancing one piston with its cage, cars, etc., against the other. Accordingly, M. Blanchet designed the Epinac plant, to be operated with two tubes.

FINAL PLANT.

The tube or cylinder was made of sheet iron, 0·27 to 0·31 inch thick, in circular sections 4½ feet in length, having butt joints for the vertical seams, secured by countersunk rivets. The sections were bolted to one another by flanges made of angle iron, using rubber packing to keep the joints tight.

The alignment of the tube was preserved and its weight sustained by suitably connecting it to the shaft timbers, so that the tube stood vertical, within the inclosing special timbering, without bearing any excessive weights on its base.

Cast-iron doors, opening outward, were placed at the landings, it being arranged at Epinac to load three decks at once, in order not to lose too much time in handling the nine cars, as each deck only accommodated one car.

The chairs or catches for sustaining the cage at the landings passed through stuffing boxes, to prevent any leakage of air, and were operated in the usual manner.

The total weight of a single tube, 63 inches diameter and 1,979 feet high, with all its doors, valves, chairs, hanging rods, bolts, etc., was estimated at 342 gross tons, of which the tube alone amounted to 245½ gross tons.

The train, or moving members, consisted of an upper double piston, to which was hung the cage with its nine decks, and a lower or guiding piston, the whole having a vertical length of about 52 feet. The pistons were packed with leather, backed by springs, and the whole train was made as light as possible by using steel in its construction.

For indicating the position of the piston, push, or touch buttons were located along the tubes, which, on being touched by the piston in moving past them, made an electrical connection indicated on a series of tell-tale dials in the engine room. Barometers and second chronometers were also used as additional safeguards for indicating the position of the cage. The latter did so in a rough way, by the time usually required to make a trip, while the former were connected with the tube about

* Takiug the weight of a cast-steel hoisting rope of 1⅛ inches diameter at 2 pounds per running foot, and its breaking strength at 84,000 pounds, it should, theoretically, sustain itself until 42,000 feet long before breaking from its own weight. But taking the usual factor of safety of 7. then the safe working length of such a rope would be only 6,000 feet. If a weight of 3 tons is now hung to the rope, which is equivalent to that of a cage of moderate capacity with its loaded cars, the maximum length at which such a rope could be used, with the factor of safety of 7, is 3,000 feet or

$$2x \times 6000 = \frac{84{,}000}{7} \therefore x = 3000 \text{ feet.}$$

† To appreciate the rapid rate at which the mines in some of our older camps are growing deeper, it may be well to mention that the Comstock lode, of Nevada, was first worked in 1850, and had reached a depth of 3250 feet by 1886, when work was abandoned in the lower levels. The Lake Superior copper district, which has several very deep mines, was first worked in 1884, and the Tamarack Mine, though only started in 1882, has already attained the depth of 2820 feet. and is sinking two more shafts that are expected to cut the lode at a depth of 3700 feet within four years (a rate of over 1000 feet per year has been attained at this mine in shaft sinking). A new mine, called the Tamarack Junior, is likely to reach a depth of over 4000 feet within the next ten years, if a chute of copper is found that has thus far been very persistent.

‡ A subsequent statement gives 18 horse-power instead of 12, as above, for the vacuum pump; and only 50 per cent. instead of 70·7 per cent. of the gross load as live or coal load, while the gross efficiency is given as 40 per cent.; as the live load is only half of the gross load, 20 per cent. is the net or coal raising efficiency for the system, beginning with the vacuum pump as the source of power or 100 per cent.

every 100 yards, and so showed the progressive position of the cage. Suitable valves at the landings, connecting with the atmosphere and the exhaust engine, permitted the safe and easy landing of the cage, on their being operated by the lander, while safety valves were used at the top and bottom of the tube to check slowly the velocity of the cage, and prevent the piston from knocking out the tube heads, in case of inattention on the part of the lander.

After seven months spent in erection, a single tube, 63 inches diameter was ready for trial in 1876, it having been decided to first bnild only a single tube, and to subsequently add a second, making it a duplex plant, if found desirable.

A temporary exhaust engine was improvised from a former hoisting engine of 64 horse-power, which raised a gross weight of 6 tons in 20 minutes, with a vacuum of 9·45 to 9·85 inches of mercury, from a depth of 1,970 feet.

The piston was lubricated with very dilute soap-water, containing 0·27 per cent. soap, and 0·1 per cent. oil, and from 11 to 55 pounds were used per trip, depending on the dryness of the atmosphere.

Of the 64 horse-power developed by the exhaust engine, 75 per cent. was utilized during the period of ascent, but as no useful work is accomplished during the preliminary exhausting of the tube, in producing the vacuum by which the train is finally started, the average efficiency was 56 per cent.; and as 50 per cent. of the gross load was coal or net weight, this gives a net efficiency of 28 per cent. of the engine power, with a single non counterbalancing tube.

The final exhaust engine is a duplex, direct, horizontal engine of 739 horse-power, with 46 x 46 inches steam cylinders, 46 x 113½ inches air cylinders, and when making 23 1/6 revolutions per minute, with 75 pounds steam pressure, cutting off at ⅓ stroke, has a calculated efficiency of 70 per cent. With this powerful engine the time required to make a round trip, going a distance of 1979 feet, was as follows:—

	Minutes.	Seconds.
For the ascent	2	30
For the descent	6	00
For making the landings	3	00
Total time for round trip	11	30

The load raised was as follows:—

Weight of pistons, cage, etc	6,600 lbs.	= 54 per cent.
Weight of 9 cars @ 550 lbs	4,950 lbs.	
Weight of 9 car loads coal @ 1,100 lbs.	9,900 lbs.	= 46 per cent.
Total	21,450 lbs.	= 100 per cent.

The live load or coal amounts to 46 per cent. of the total weight raised.

With the conditions for hoisting at the other shafts at Epinac, using tapered manilla ropes, winding on reels, with one cage counterbalancing the other cage, M. Blanchet makes comparisons at different depths of rope and single tube pneumatic hoisting as shown in table on following page.

These figures are favourable to the pneumatic system, as with only a single tube the useful efficiency is greater in all cases, and decreases at a less rapid rate than with rope hoisting for increasing depth, while the coal consumed per ton of coal raised is in consequence very much less in the pneumatic than with the cable system of hoisting. With two tubes, where the dead loads of the pistons, cage, cars etc. (amounting to 54 per cent. of the total load), counterbalance one another, the efficiency would be correspondingly greater, and *very much higher* than in cable hoisting. This feature was unfortunately never developed at Epinac, as the second tube was not erected, and hence the minimum working cost of the system was not attained.

ADVANTAGES OF THE PNEUMATIC SYSTEM.

M. Blanchet sums up the advantages of the pneumatic system of hoisting as follows:

1. It permits the working of mines at all depths.
2. It gives, with a single tube, a higher efficiency than cables, which increases as the depth increases; with two tubes, the efficiency will be still greater.
3. It does away with ropes, and is therefore more economical.
4. It assists in the ventilation of the mine, with the lowering of the temperature resulting therefrom.
5. It permits, while the miners are absent, converting of the entire mine into a pneumatic receiver, and by the creation of an artificial barometric depression, facilitates the removal of the escaping fire-damp and so make the mine safer.
6. It leaves the shaft readily accessible for examination, repairs, and sinking, without interfering with the hoisting.
7. It removes the danger of accidents through the breaking of cables.
8. It gives greater security to the miners in ascending and descending.
9. It not only permits the lowering of the men, timber, filling, etc., without the expenditure of any power, but utilizes the work produced by the descending train in imparting a higher pressure to the air escaping from the bottom of the tube.

The only disadvantage, in M. Blanchet's opinion, is the greater cost of installation, which in his first estimate for the Hottinguer shaft he places at about 20 per cent. greater than that of the rope hoisting.

The statements made thus far concerning the Epinac plant have been quoted from the several brochures* by M. Blanchet, and as he was an enthusiastic advocate of the pneumatic system, his claims in its favour demand iuvestigation.

CRITICISM OF THE PNEUMATIC SYSTEM.

I. The statement that the pneumatic system has no limit in depth is certainly true theoretically, and there seems to be no practical difficulty in applying it to the greatest depth attainable. This is the salient and vital idea of the system, which would seem to entitle it to precedence over ropes after a certain depth has been attained.

II. That the efficiency of the pneumatic system is greater than that of cables must necessarily follow *if the depth is very great and the ropes are not* counterbalanced, as the principal part of the load is then the cable; but if the ropes are counterbalanced, especially if by an under rope, then the pneumatic system cannot be equal in efficiency to cables, if both systems are operated on the double or duplex plan, so as to counterbalance the dead weight of the cage, cars, etc. For if we start with equal amounts of energy in the delivery of the steam cylinders of the exhausting and winding engines, in the one case this must overcome the appreciable friction of the stuffing box, piston and valves of the vacuum cylinder, suffer the decided waste of energy due to the clearance of the valves, ports, etc., overcome the slight frictional resistence of the air travelling through the connecting pipes, valves, and tubes, do the useless and uncertain work of removing the air brought in by leakage at joints, valves, stuffing boxes and doorways of the tube, and overcome the fricton of the pistons in the tube before it begins to be usefully expended in raising load. In the other case a direct first motion hoisting engine must overcome the friction of the shafts of the drum and sheaves (well lubricated), expend the small amount of energy required to bend the rope about the drum and sheaves, and overcome the slight friction of the cage in its guides before it can be utilized in useful work. While these losses of energy can be expressed in an equation, the coefficients by which they should be modified have not all been satisfactorily determined. M. Blanchet puts the losses in the vacuum pump alone at 25 per cent. (and the makers say 30 per cent.), while the friction loss of the piston in the tube was 10 per cent. in the experimental tube, though undoubtedly it is much less in the large tube when well lubricated.

The entire loss of energy and rope practice usually range from 10 to 20 per cent. Leaving out of consideration the greater efficiency of a direct-acting hoisting-engine over a vacuum pump, and assuming that the friction of the air through the pipes, valves, and large tube do not consume more power than that required to bend the rope over the sheaves and drum, we still have the inappreciable friction of an ordinary cage in its vertical guides, which is almost *nil* with proper alignment as against the decided and unavoidable friction of the air-tight piston in the tube. So that while M. Blanchet's figures speak strongly for the greater efficiency of a single tube air system, when compared with a duplex cable hoist they will not bear investigation. His own broad and sanguine statement that the efficiency of the vacuum pump plant will be as great as 70 per cent. at once gives an effective or coal raising efficiency of only 32.2 per cent., when it is remembered that only $\frac{6900}{21450}$ of the load raised is coal, whereas he quotes about 42 per cent. for the pneumatic system and 36 per cent. for the cable system. As he does not give the details by which he obtained his figures, further errors cannot be specifically pointed out.

The actual fuel consumption, when the pneumatic plant was operated at Epinac, amounted to 10 tons per day in raising from 10 to 50 tons of coal; but as the fuel was inferior coal, and as hoisting in carrying on prospecting is very irregular as well as petty in amount, this excessive consumption cannot fairly be charged against the system, though it certainly does not encourage the hope of a marked economy in fuel.

III. That there will be no expenditure for ropes in the pneumatic system follows necesssarily, together with the avoidance of their renewal every six to eighteen months. But with proper size of drums and sheaves, feed screws to prevent side cutting of the rope as it winds on the drum where the engine is close to the shaft, and sprfngs at the capping, a first-class steel rope should, as it does in the best English practice, last from two to five years, or raise from 200,000 to 600,000 tons of ore or coal before it is worn out. But while the cables are dispensed with, the new feature is introduced of a thin wrought-iron cylinder, held by countersunk rivets, which deteriorates every time that the snugly-fitting piston passes through it. The piston packings, of which there are three sets, need frequent removal, as they must be kept tight to avoid leakage; while there is quite an appreciable daily outlay for lubricating the tube, as from ten to fifty-five pounds of 3 per cent. solution is used per trip. If the shaft is not so wet as to prevent the decay of the timber, the heavy timbering system required to sustain the tube will also need renewal, at no small cost, while the expense of maintaining a very large, fast running, expanding exhausting engine, with all its valves, will be greater than that of an equivalent direct hoisting engine. Unfortunately the Epinac plant was not operated loug enough to develope these maintenance expenses, but it is quite evident that the repairs and renewals of a cable plant will finally be decidedly less than those of the pneumatic system.

IV. The aid to ventilation is of some advantage, particularly in metal mining, where only natural ventilation is so largely depended on. With a tube 3,000 feet long and 63 inches diameter, there would be delivered into the workings during a round trip of twelve minutes, a volume of 5,425 cubic feet of air per minute, which *positive acquisition* would be no insignificant item; and the deeper the shaft the greater would be the volume of air expelled at each trip. In coal practice, however, this amount of air would be entirely too small to be entitled to much consideration.

Depth in Feet.	Cable Hoisting. Horse Power. Expended.	Utilized.	Efficiency Per Cent.	Pneumatic Hoisting. Horse Power. Expended.	Utilized.	Efficiency Per Cent.	Coal Consumed per ton Coal Extracted. Cables.	Pneumatic.
820	225	90	40	800	360	44	55 lbs.	16·5 lbs.
1,640	500	180	36	862	360	42	110 lbs.	33·0 lbs.
3,280	800	224	28	985	360	36	220 lbs.	66·0 lbs.

V. The novel application of the exhausting engines, through the medium of the tube, to the production of an artificial barometric depression throughout a tightly sealed mine, is at least attractive to miners troubled with gas, and undoubtedly would be advantageous in *some cases*. Where the gas is generated in the goaf or old rooms, and consequently its escape into the workings is facilitated by the lowering of the atmospheric pressure, a benefit will be derived in thus frequently forestalling nature and keeping the air safe. But where the gas is being given off by the slow continuous escape under great pressure from the coal (which is the case most frequently, though, fortunately, is usually not so dangerous), or where the gas results from blowers due to falls in the roof or breaks in the floor (the most dangerous instances), no good will result in thus turning the mine into a vacuum chamber. It is also obvious that in very extensive workings the time required to produce an appreciable lowering of the pressure of such a huge volume of air would exceed the period of an off-shift, while no repairing or other off-shift work could go on, on account of the danger of gas, with the ventilation at a standstill. Hence only Sundays or holidays could be used for this purpose during the regular working of the mine, which is not frequent enough to make it perfectly safe. If the proof is badly broken, especially if the breaks connect with the surface, the application will be useless, while in many cases it will be difficult to prevent excessive leakage into the mine at the shaft entrances. This novel feature, therefore, is capable of only a few applications in the gas troubled mines, and even then may not be valuable on account of the magnitude of the workings. Finally, in any mine troubled with gas from any source, the regular ventilating facilities should be on so large a scale that the gas is so diluted as to prelude any danger of explosion, except from sudden large blowers.

VI. The ease of repair of the shaft is greater in the pneumatic system, since it is possible from the capstan engine to make any inspections or repairs in the shaft,

short of renewing the tube, without in the least interfering with the hoisting.

VII. While accidents due to cable breakage disappear, a more serious danger arises in the much greater vigilance required on the part of the lander in keeping trace of the noiseless invisible cage, as the tell-tales, though ingenious, are hardly satisfactory. The unreliability of electric sounders or tell-tales in damp shafts are well-known, while barometers are very crude aids in making a landing, where the margin for dropping the cage on the chains is so small. Although a large safety-valve is placed at the top and bottom of the tube to slowly cushion the cage and prevent accidents arising from carelessness in over hoisting, it is evident that the momentum of a ten ton train will demolish any such device should it pass the terminal landing with its speed unchecked in spite of any reasonable margin for over-hoisting. Furthermore, while the breakage of the ropes has by no means ceased to occur, good devices can be used, at least on vertical shafts, that act promptly and arrests the cage in case the rope breaks, if *reasonable attention* is bestowed upon keeping the safety-catches in good condition.

VIII. That the pueumatic system will be more exempt from accident than the cable system seems hardly probable in view of the previously mentioned want of a reliable, continuous system of recording the positions of the cage in the tube. Overwinding or carelessness on the part of the landers or engineers, quite a frequent cause of accidents at present, seems likely to become even more dangerous in the pneumatic system. The trouble arising from the distortion of the shaft with consequent jamming of the cage in swelling or heaving ground, would be exaggerated in the pneumatic system, with its train fifty-two feet long; for while the tube stands free by itself away from the shaft lining, the displaced timbers supporting it would so distort and throw it out of line as to readily cause the jamming or sticking of the train in the tube.

The Epinac was not operated sufficiently long to develope reliable figures as to accidents with the pneumatic system. It created, however, a favorable opinion among the miners as being at least a very pleasant way of being raised and lowered.

IX. The want of merit in the last claim over rope hoisting, when properly operated, is self evident, and needs no comment.

How well these claims were realized at Epinac is most quickly appreciated upon finding a winding engine busy in the same shaft in carrying on the exploratory work, while the pneumatic plant along side of it, with one tube and its massive vacuum engine in complete running order, has been idle for several years, as it was too expensive in operation.

One item of excessive cost in the pneumatic system, to which M. Blanchet makes no allusion, is the greater labor expense per ton hoisted. If worked at full speed, the Epinac plant could raise about 250 tons in ten hours.

The force required was as follows: four firemen, one engineer, one runner, two landers, four cagers, one machinist; total, thirteen men, or $\frac{250}{13} = 20$ tons per man in the hoisting department.

Winding engines of even less power, hoisting from as great a depth, frequently raise from 1,000 to 1,500 tons in ten hours, with a force no greater than two more cagers, or hoisting from 60 to 100 tons per man, making the labor charge for hoisting $\frac{1}{3}$ to $\frac{1}{5}$ of that of the pneumatic system.

THE COST OF THE PNEUMATIC SYSTEM.

Before allnding to the outlay involved in the Hottinguer shaft, it is necessary to deal with the great difference between French and American practice in plant expenditure.

The French mining engineers, with usually an abundance of cheap money at their disposal, are characterized by their very heavy outlays in permanent plant. They make everything to last, and also, be it said to their credit, design, with regard to appearances and artistic effect. Hence there is a large outlay at the Hottinguer shaft for a masonry lining for the entire shaft, and a very large, substantial, brick shaft house, with a high brick chimney for the boilers which would be regarded as extravagant in America. Moreover, in executing their plans, they have recourse to a staff of trained engineers that is as yet far in advance of our so-called "practical" way of doing the same work. For these reasons, there has been a lavish outlay at the Hottinguer shaft, that is, by no means, to be all charged against the pneumatic system. The statement by one of the directors, that the experiment had cost them $500,000, refers to the entire outlay at the shaft. The expense of the pneumatic system proper, is given to me by M. Naugerode, the present superintendent, as follows:

Tube and connections	$ 70,000
Erection, including winch engine, etc.	74,000
Exhausting engine (or vacuum pump)	42,000
Total	$186,000

These figures show that the erection of the tube cost more than the tube itself, and that the tube (with its connection) cost about $35 per running foot. As there are 775 pounds metal per linear foot this shows a factory cost of the tube of about 4½ cents per pound, a figure that is about half what such work would usually cost in this country, when it is remembered that 72 per cent. of the metal required makes up the countersunk rivetted main tube. It is probably safe to say, that such a tube erected complete in this country would cost over $100 per linear foot. This does not include the vacuum engine, boilers, housing, and the primary cost of first sinking the shaft, So that a pneumatic plant, complete, would call for at least double the capital of a rope hoisting plant of equivalent grade, and when finished, aside from probably much greater operating expenses (fuel and repairs), would not have a fifth of the capacity of the cable system, as reckoned on the actual figures of the Epinac plant.

SUMMARY OF THE PNEUMATIC SYSTEM.

With a so much heavier investment of capital, with such a very small capacity compared with winding engines of equal power, and with the probability of a much greater daily operating expense, it is needless to say that the pneumatic system, as thus far developed, cannot compete at all with the rope system of hoisting in spite of the theoretical and the few practical advantages it possesses over the cable system.

It is, therefore, necessary to look deeper into our American winding practice, to search for opportunities for improvements, so that the requirements for increased depth in the not distant future may be met.

CONSIDERATIONS FOR THE FUTURE.

Theory indicates that tapered ropes have no limit in depth, and consequently, that by tapering and counterbalancing, ropes may be used in the deepest mines; but practically, in using flat ropes with reels as they are now made, there is great risk of the rope slipping off the top coils and jamming down in the narrow V space between the side of the reel and the coiled rope, with dangerous consequences, if the rope tapers to half of its extreme width. By using a guide sheave to wind the rope hard against one side of the reel, this danger may be overcome, though at the expense of more rapid wear of the rope, especially of the lacing. Flat ropes are now successfully and easily made of tapering section, and perhaps a better device can be used than the above guide roller, to avoid jamming in the reel.

Round ropes are made tapering, and if the drum is grooved to properly receive the rope, it gives no trouble in winding like the flat rope. But the American rope makers do not as yet advocate round tapering ropes on account of the difficulty of manufacturing with perfect reliability, though I understand that they are made in a satisfactory manner in Germany.

If tapered ropes are ignored on account of their greater cost and because of the objections of manufacturers, cylindrical ropes may still be used for unlimited depth by submitting to the low efficiency of the system adopted at the deepest shaft of the colliery of the "Societe des Produits," at Mons, Belgium, where a duplex, first motion engine hoists from 1000 meter (3280 feet) level to the surface. At the 1000 meter level another hoisting engine, run by compressed air supplied from the surface, hoists from the 1100 meter level, the lowest producing level at present, though the shaft is being sunk to the 1200 meter level (3937 feet). The surface engine is 27½ by 78¾ in. with a 25 foot reel, on which wind is a flat manilla rope that tapers from 11 inches down to 6½ inches, while the cage holds only 2 cars. The air is supplied by a duplex Dubois-Francois air compressor with 15½ inches by 59 inches air cylinders, run at 18 revolutions per minute and furnishing air at 45 to 50 pounds pressure.

While such a system of establishing new hoisting stations with engines run by compressed air whenever the rope becomes inconveiently long (it is not counterbalanced at the above pit) can be carried on indefinitely, the outlay for plant becomes so great, the extra labor and time involved in charging cages at the intermediate levels are so expensive and the efficiency of a compressor plant is so low, with its consequent heavy fuel consumption, that the cost of installation is almost as great as in the pneumatic system, while the operating expenses are probably greater.

IMPROVEMENTS IN AMERICAN HOISTING PRACTICE.

The simple, first motion, cylindrical rope hoist, constructed with the latest improvements, possesses a limit so far beyond our present practice, when properly designed, that there need be no anxiety for a very long time to come as to its range of application. It possesses the advantage of a minimum cost of installation, the cheapest operating plant and the greatest capacity of all known systems of hoisting. Thus far, in America, our hoisting practice with few exceptions, is anything but creditable. We are behind European practice. The following suggestions show how we can still very much exceed our present limits:—

(*a*) *By Counterbalancing the Dead Load.*—If the system is arranged duplex, or with a double compartment shaft, the dead loads of the cage and cars counterbalance one another, and if the ropes are counterbalanced, which is perfectly effected by an under-rope, then there remains only the work of raising the coal or live load plus the small effort necessary to overcome the friction due to the dead load (rope, cage, cars). Hence only a moderate sized engine is called for, instead of the large engines that are so frequently seen at our deep mines. Thus, in the Lake Superior copper district, where over 7000 tons of copper rock are raised per day from a depth of 1000 to 2500 feet, 60 to 75 per cent. of the engine power is wasted (except at two mines), by using single hoists in which a skip weighing from 1½ to 3 tons, and a rope weighing 1½ to 4 tons, are hoisted each trip in bringing up 1½ to 2 tons of rock: while the energy of the descending 3 to 7 tons of skip and rope adds to the expense by wearing out the brakes by which the speed is kept within a safe limit. Such a grossly extravagant system of hoisting not only calls for an excessively large hoisting engine, but the fuel consumption is about three times as great as it should be to do the above amount of work.

(*b*) *By Using a Smaller Factor of Safety for the Rope.*—For hoisting ropes the factor of safety should be made as low as possible, consistent with uncertainty in manufacture, abuse in use, sufficient margin to permit the reduction in section due to wear, and a working strain safely below the limit of elasticity. For the larger the factor of safety used, the greater is the section of the rope for a given load. This increases the dead load due to the rope's own weight, which even if counterbalanced augments the mass to be put in motion each trip, with the consequent strain in starting.

The increased size of the rope decreases its life, as the greater the diameter, other things being equal, the more severe are the bending strains and the quicker the rope destroys itself.

Now the factor of safety usually taken for steel ropes is 7, with 5 as a minimum and up to 10 as a maximum. For standard practice I would advise 4, provided: that the diameter of the sheaves and drums be *at least* 100 times the diameter of the rope for slow hoisting and *at least* 150 times for fast hoisting; that a spring* be interposed between the cage and the rope capping, to ease the sudden strain in starting; that the rope be kept properly oiled; and that the rope be inspected daily for its entire length, for careful observation of the condition of the wires and prompt rejection of the rope when a certain number are broken.

By thus easing the bending of the rope by the use of much larger sheaves and drums than is usual in American practice; by removing the shock due to starting; and by frequent oiling to prevent corrosion, they would last *at least as long* as they now average in American practice. By lagging the sheave with wood; by having the engine set far enough from the shaft to avoid side thrust and consequent lateral wear of the rope at the sheave and drum (carrying the rope on *wooden rollers* from the sheave to the engine if necessary); and by carefully maintaining the entire hoisting plant in proper alignment, the life of the rope would probably be found to be considerably greater than at present, in spite of the much smaller factor of safety used. By thus using a factor of safety of 4, the safe working length of the 1⅛ inch cast-steel rope, when sustaining a 3-ton cage load, will be increased from 3,000 feet to 7,500 feet.

By decreasing the speed of hoisting, the wear of a wire rope is diminished; but this necessitates increasing the load to maintain a given output in the same time. Aside from the other disadvantages of excessive load, the maximum size of the cars used is frequently fixed by conditions that it is not economical to change in order to use large cars. Hence the more rapid wearing out of the ropes due to high speed in deep hoisting is willingly tolerated, in order to secure the capacity and economy due to fast hoisting; and the tendency of the times is to use larger and more powerful engines in order to obtain higher speeds as the mines become deeper; so that this method of prolonging the life of a rope is not in favor at present.

(*c*) *By the Use of the Best Material for the Rope.*—Fiber and iron ropes are no longer used in deep hoisting in American practice, but the term "steel" covers a very broad range of material used in our present practice. The very soft steel ropes certainly possess the greatest flexibility, but they are deficient in strength, as the material has a breaking strength of about only 60,000 pouuds to the square inch. The best grade of plough steel, on the contrary, has a strength of 300,000 pounds per square inch, but does not always give satisfaction as used with sheaves only 50 to 100 times the diameter of the rope, since the wires break too readily under such sharp bending. But if used with sheaves and drums 150 to preferably 200 times the diameter of the rope, and if the wires are laid at an easy pitch with the "Lang lay," no such trouble should arise; with such a high grade plough-steel rope of 1⅛ inch diameter, the safe working length, using

*The intervention of an elastic connection, whether a spring or solid rubber, between the capping and the cage, need not in the least interfere with a chain connection of the rope to the cage, by which latter device the cappings have to be less frequently renewed.

a factor of safety of 4, would now be about 30,000 feet, or 12,500 with 10 as the factor of safety. While this represents the highest grade of the rope that is made to-day, we see that it is possible to hoist with perfect safety with a cylindrical rope from a depth that is vastly beyond any limit that we can reach, on account of the heat alone.

The price of aluminum has not yet permitted a thorough investigation of its use for hoisting ropes as the basis of trustworthy predictions. But the unprecedented progress made in the past year in lowering the price from $6 to $1.50 a pound, and the encouraging outlook for further material reduction of the present price, makes the possibility of using this metal or its alloys for hoisting ropes worthy of consideration.

The very low specific gravity of aluminum, 2·6, which is about one-third of that of steel, and its great strength, make it an ideal metal for a deep hoisting rope, where a *minimum* of *weight* and a maximum of strength are demanded. If this metal or its alloys should prove to have the requisite flexibility, toughness, and strength, to make a reliable, durable, hoisting rope, the question of deep hoisting with only cylindrical ropes is again settled beyond all cavil.

(*d*) *By Designing the Cage with a Minimum of Weight.*—As our mines get deeper, economy demands that we shall not only use at least 2-deck cages, but rather 3 or 4 or even 6-deckers, as used at some of the deep mines in Belgium. The prevalent objection to multiple deck cages is the time required in decking, even if the decking is carried on simultaneously from two landings or levels. To deck from more than two, or at most three, landings or levels at once, makes the stations very complicated underground and is not desirable, even should the surface plant be so arranged that there is no objection to having the ore or coal coming off on two or three levels. As our American plants are too frequently arranged, the time required to run off the loaded and run on the empty car seldom takes as little as 10 seconds, more frequently over 15 to 20, and sometimes even 30 seconds; and if this amount of time is multiplied by 4 or 6, for a 4 or 6-deck cage, it makes a serious inroad into the hoisting capacity of the plant.

But with ample facilities for accommodating both loaded and empty cars at the landings, with *sufficient help* to quickly handle the cars, there is no reason why we should not at least do as well as the Belgians, who load and unload a 6-deck cage in 30 seconds, or 5 seconds per deck† as their regular daily speed.

A multiple deck cage, with only one car on a deck, can be designed of steel, with a very light, and yet stiff strong frame, in which the ratio of the cage weight to that of its contents is decidedly less than with our much heavier single deck cages; so that the strain on the rope due to the weight of the cage (immaterial as to whether it is operated duplex so as to counterbalance) will be a very much less for a given carrying capacity, than with our usually strong, needlessly heavy single deck cages. Hence the rope can profit by this decrease of its load in sustaining its own weight for a still greater depth.

If two cars are run on a deck with the idea of saving the time that is supposed to result therefrom in decking, the cage weight per ton of carrying capacity will be increased over that of single decks, in consequence of the much stronger bracing required for a cage long enough to carry two cars.

The six-deck steel cage at the Sacre Madame pit weighs 3600 pounds, while the weight of the 6 loaded cars is about 9000 pounds, which gives a ratio of cage weight to carrying capacity of 1 : 2·5.

CONCLUSION.

The pneumatic system of Blanchet is practicable, quite safe, and unhampered by depth; but the installation is very much more expeusive than that of the cable system (approximately twice as great), while the operating expenses are greater for labor, repairs and fuel.

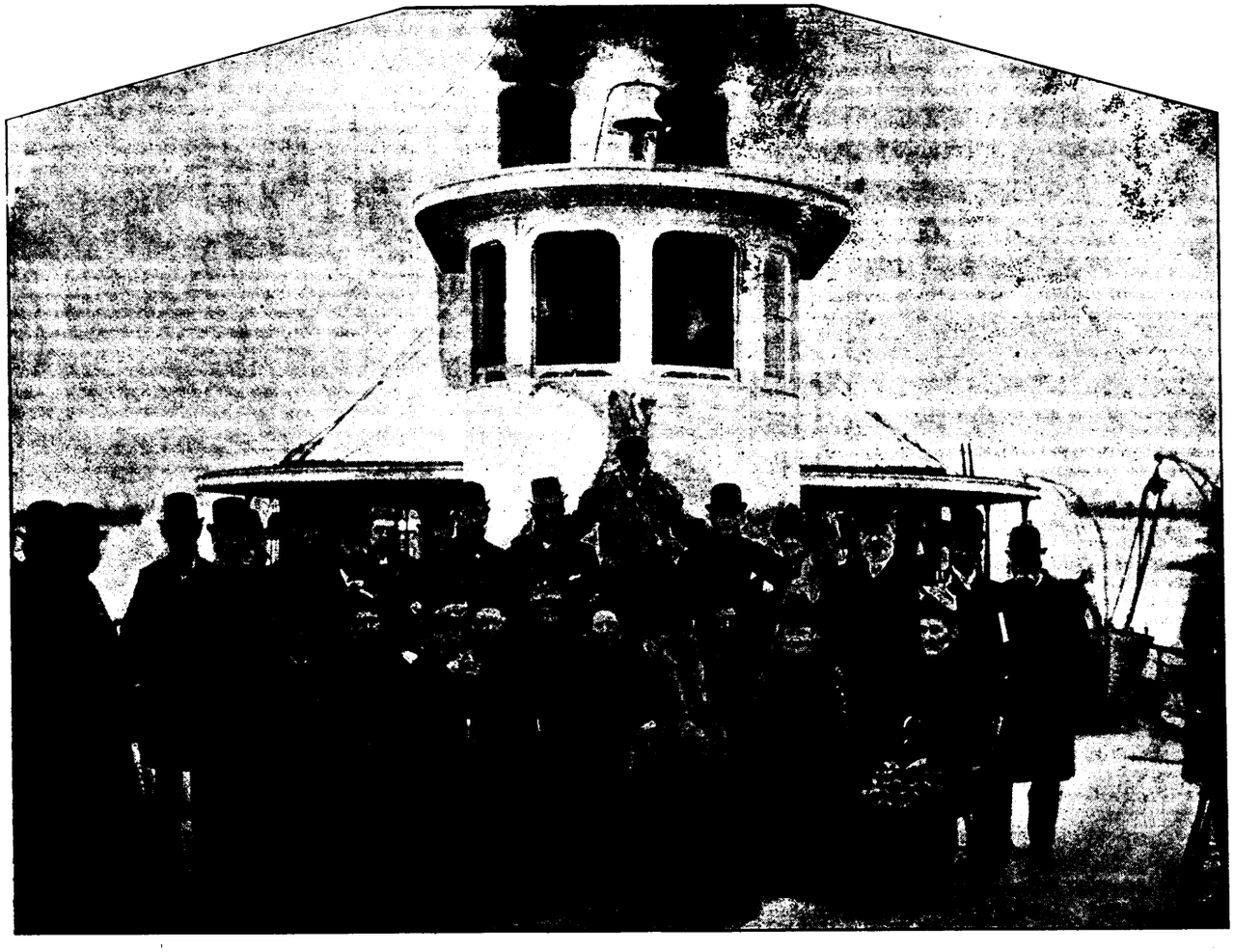
The cable system can be so improved by counterbalancing as to materially decrease the present expense of hoisting, while by more careful designing and operating, without materially increasing the plant outlay or the operating expenses, the present type of cylindrical ropes can be used for depths beyond what we are likely ever to attain by making the weight of the cage a minimum, by using a lower factor of safety, and by adopting the strongest rope obtainable.

The possibility of using aluminum may still further increase the range of the cylindrical rope.

When our manufacturers meet with sufficient demand to encourage them to perfect the round type of tapering rope, there will then be absolutely *no limit* to the range of cable hoists, although the best grades of cylindrical steel ropes will carry us, with the highest factor of safety ever used (10), to a greater depth than we will probably ever be able to attain.

†At the "Sacre Madame" Colliery at Charleroi two men and a girl pull off the loaded cars from one side of the cage, starting it off before the cage rests on the chairs, while two stout girls push on the empty car from the other side at the rate of 5 seconds per decking. The cars weigh 600 pounds each, and hold about 880 pounds, and 350 to 400 tons of coal are raised per day. The shaft is 2625 feet deep, and 80 to 90 seconds are required to make the trip, with a 600 horse-power engine (using a flat manilla rope made of 8 strands, that tapers from 12½ inches down to 7½ inches in width.)

A Remarkable Invention.—James Morgan, mechanical engineer, at present employed at the American Iron Works, Pittsburg, Pa., is the inventor of a remarkable labour-saving device in connection with the manufacture of steel rails and armour-plates. This invention is known as an overhead feeder, for use in blooming and finishing mills. It consists of an apparatus which can be worked by a boy with a lever, by which the ingot can be sent back and forth on the roll-table, and thence through the various grooves in the rolls without the aid of any of the skilled labourers at present employed for that purpose. A first-class mill-roller and a boy to work the levers is all that is required to operate the machine. The entire workings are controlled from a pulpit where three hydraulic levers are placed; one of these controls the blooming roll-table, the other the telegraph by which the piece is conveyed to the roll-table, attached to the finishing train of rolls, and with the third lever the entire workings of the latter train are managed. It is possible and practicable by this piece of mechanism to turn the ingots into rails without the assistance of any manual labour except that mentioned. The great labour-saving involved in this device can be imagined when it is known that many of the mills employ as high as seventy skilled labourers to do the work which Mr. Morgan claims can be done by the hydraulic levers.



VISIT OF THE IRON AND STEEL INSTITUTE. PHOTOGRAPH OF A SMALL PARTY, TAKEN ON STEAMER FILGATE DURING EXCURSION ON THE ST. LAWRENCE.

MINING NOTES.

Nova Scotia.

(From our own Correspondent.)

Pictou County.

The opening up of the Foord Pit continues satisfactorily, and from present appearances should be in working order by the New Year. 25 coke ovens, bee-hive pattern, will be ready to receive the coal, and others are to be built as the work progresses.

When the company are in a position to secure suitable engines, the "English slope" will be driven a further depth of from 1,600 to 1,800 feet, to connect with the Foord pit. This will make the slope some 3,600 feet in length.

At all the other mines work is steady. In our next issue we hope to review the season and publish returns of production and export.

It is rumoured that a new lift will be sunk this winter in the old slopes at the "Drummond." The sinking in the Scott pit is progressing favourably; the coal all the time said to be improving in quality.

A rumour has been current that the Nova Scotia Steel works at New Glasgow had been sold to English capitalists for $600,000. We are authorized to say that while an English syndicate did have an option at somewhat larger figures, the matter is now off.

Cumberland County.

The Springhill collieries continue to maintain an average output of 2,000 tons per diem.

The output from the Joggins has increased from 150 to 300 tons, and the colliery is rapidly coming to the front as a producer. Long-wall working has now been in operation for nearly three months, and has been found highly satisfactory to employers and employed.

We are glad to learn that a movement is on foot to unite the colliery owners, managers, engineers and officials into a strong association for the interchange of knowledge and ideas. This is a move in the right direction, and if carried into effect, should result beneficially to the owners, the men, and the industry.

(From Press Committee Gold Mines' Association.)

Waverley District.

Mining will be resumed upon the Gue and Wilson property (Chebucto Mining Co.) in January, and a small mill will be erected as soon as the weather will permit of breaking ground and laying foundations.

The Lake View Company have completed a crushing of a test lot of clean quartz from the Taylor lode, which yielded 5½ dwts. per ton, according to report. The mullock which has been going to the mill has yielded between two and three penny weights per ton, and has not contained more than from 30 to 60 per cent. of quartz.

Renfrew District.

Mining in Renfrew is almost at a standstill. The Free Claim owned by Mr. McDonell and others, is only working three men. The Empress Company are working only only a small force and employees report pay to be three months behind. It is greatly to be regretted that this district should be so dull; it was a magnificent producer years ago, and has had really no deep mining test made.

Central Rawdon.

Little or no news is reported from this once booming village. The Northrup Mining Company are doing nothing but sinking one shaft and prospecting winze, with a few men.

Killag District.

The Stuart property has been transferred to a syndicate known as the "Evans, Parker, McGuire and McKay." Mr. McKay will be the superintendent. The old mill is being rapidly renovated and will soon be crushing quartz from the rich lode cut in the swamp.

Lake Catcha.

The Oxford Co., under management of Mr. J. M. Reid, are putting in a fine air compressor and drill plant. The compressor is a duplex 10 x 16, of the latest Rand type and is a beautiful machine. Extensive changes and additions are also being made to the old surface plant, including a new 40 horse-power boiler, new mortars for the mill, &c., &c. All the machinery will be placed and in working order before spring, and the "Oxford" will be expected to report "fine work" during next summer.

Yarmouth.

The whole plant and property of the "Huntington Reef Mining Co." has been offered for sale. This property had a newspaper boom last spring, and over $14,000 was expended on machinery, &c.; now the owners are desirous of selling out at a fraction of the cost; the moral is beware of newspaper boomed mining properties.

Malaga District.

Reports from this district are not encouraging for the future. The mill and mine buildings of the Caledonia Company were destroyed by fire on Friday, the 12th inst., and the loss will not fall far short of $15,000. It is reported that the company will not rebuild this season.

The Malaga Mining Company are working out the reserves in the Rabbit and other lodes, and are not opening much if any new ground. On this work the mine is paying handsome dividends, but the policy is a shortsighted one.

Mr. Ballou, of the Boston Gold Mining Company, reports that the new mill is expected to start on the 19th or 20th inst. The mine has been opened during the last nine or ten months and a considerable amount of quartz of good quality awaits crushing.

Gay's River District.

The work iu the 50 stamp mill of the Coldstream Company is going rapidly ahead, and the completion of the mill is announced for February next. It is reported that all mining work has been discontinued for the present, thus following the lead of most of the other Evans-Parker mines, which have closed down this month.

Quebec.

The Jenckes Machine Co., of Sherbrooke, were, on 29th ulto., granted supplementary Letters Patent, whereby the total capital stock is increased from $75,000 to $150,000.

About 100 men and boys are employed at the Temiscamingue Galena mine, in the Temiscaningue district. Main shaft sunk 100 feet, and cross cuts driving to the west in rich galena ores. One-half of concentrating plant in place, consisting of Blake ore-breaker, two pair rolls, revolving screens, crushers and four jigs, rotary table, furnished by the Fort Scott Foundry Co., etc. Mill driven by Corliss engine, built by Laurie & Bros., Montreal. Ingersoll compressor furnishes air for hoist and drills. Mill turns out from 6 to 10 tons concentrates per day (24 hours) according to ore. Shipments to the extent of 100 tons have been made to date, mainly to Balbach & Son, Newark Smelting and Refining Works, Newark, N.J. Owners well pleased with result of their operations.

Mr. Obalski, Mining Inspector for the Province, has issued his annual report, which is published as usual, in conjunction with the Blue Book of the Commissioner of Crown Lands. A useful sketch of the progress of operations during the year is given. We are glad to see that the tabulated statement of individual outputs, which gave so much offence last year, has been dropped, for until sworn returns are compulsory, it is absolutely impossible to publish any correct statistics.

Most of the mines in the Eastern Townships and Ottawa valley have shut down during the holidays. In the main the season has been a prosperous one.

Ontario.

The Standard Oil and Gas Company of Ontario are seeking incorporrtion under the Companies' Act. Capital, $1.000,000; divided into 10,000 shares of $100 each. Alex. Dow, secretary, Stratford, Ont. This company has acquired some five thousand acres of land at, or near the Town of Stratford, and will commence drilling when fully organised.

The Collector of Customs at Buffalo, N.Y., recently submitted to the Treasury Department the question as to whether natural gas imported into that port from Canada is liable to duty under the tariff law. He says that the Buffalo Natural Gas and Fuel Company is engaged in laying a large eight-inch main pipe across the Niagara River for the transmission of natural gas produced in Canada to be used on this side for fuel purposes. In replying to the Collector, Assistant Secretary Spaulding says: "Under the circumstances mentioned the Department concurs with you in the opinion that illuminating gas is wholly different from electricity, and that as it is a merchantable commodity which can be measured as readily as liquids and other gases, it would be liable to duty on importation. The proper rate of duty would seem to be that prescribed for unenumerated unmanufactured articles, viz., 10 p. c. ad valorem."

British Columbia.

At the mines of the Revelstoke Mining and Smelting Co., at Hot Springs, development is being pushed with vigor, and by the spring there should be a large quantity of ore ready for smelting. At the United there are at present 1,100 tons ready to ship, and about 500 tons at No. 1.

The South Fork of Quesnelle, Hydraulic Co. has completed the survey of the fifteen mile ditch for their works, and excavating has begun. The 16 or 18 inch pipe, pipe, which it is proposed to put in, will give a dead fall of 350 feet, and be the biggest work in sluicing in the Province No returns are expected from the claim until next year, all that has been done being purely preliminary.

Mr. Hepden's claim, adjoining, also promises well, but the location of the ditch has not yet been completed. It will probably be 18 or 20 miles long, and a gang of men will be working at it all winter. Half a mile above is another good claim—at least the ground is promising, but as yet there is no prospect of water.

Placer mining continues to occupy the attention of the Chinese, one firm—the Chin Fan Co —reporting $8,000 or $9,000 for this year. In the last twelve or fourteen years they have alone taken out $50,000 or $60,000.

Reports of good finds in the Omineca district continue to be received. Mr. George Kenny, an experienced miner who has just returned from that district, reports that a certain portion of Tom's Creek is yielding richly, some $30,000 having been taken out this season by sixteen whites, together with Indians and Chinese.

The Black Jack quartz mill (water power), situated on William's Creek, opposite Stout's Gulch, shut down Nov. 6th for the winter. The managers have sent down to the Government test mill their concentrates to be worked by the chlorinating process. The company, at the 64-foot level of their incline shaft, drifted some twenty feet to the left and struck the surface formation of an eight-foot ledge, carrying a rich body of ore. Not being able to run their water mill in the winter the company held a meeting and decided to sink their incline shaft forty feet more to strike the ledge and will send the ore to the test mill to be worked this winter.

The Harkaway Gravel Diggings Company, in the same district (Barkerville), are hard at work drifting from their sixty-foot level under Broadway, the main street of Barkerville, and expect to strike it rich this winter.

Mr A. Dick, Inspector of Mines, has just returned from Tumbo Island where he states the Tumbo Island Coal Company has struck a seam of coal at a depth of 328 feet. The seam is said to be a thick one but as yet it is not known what quality it is. It burns well and makes gas freely, but until a shaft has been put down, its value will not be known.

Dr. Hendryx, who is so well known in connection with the development of the Kootnay district, was the subject of a dastardly assault a few Sundays ago. It appears that Dr. Hendryx, accompanied by Mrs. Hendryx, went out of the house after dark; Mrs. Hendryx carrying a lantern and walking ahead, the doctor slightly behind. When a short distance from the house, a shot was fired, evidently at the doctor, by some one concealed in the shrubbery near an outhouse in the vicinity of the dwelling. the shot passing close to Mrs. Hendryx and striking the ground near the doctor. An alarm was at once given to the men in the mine boarding-house close by, but no trace could be found of the miscreants. A boat was sent over to Ainsworth, but unfortunately the people there were not warned; and, although the men in the boat saw a boat land near the Siwash lodges, the occupants escaped to the timber before they could be recognized. So far there is no clue as to the identity of the would-be murderers. There appear to have been two men, as two tracks were discovered on the road or trail the following morning, leading away from the spot from whence the shots were fired.

It is announced to be the intention of the New Vancouver Coal Company to complete, as rapidly as possible, the second shaft which they have for some time been

engaged in sinking. As soon as they attain the required depth, which is expected to be by January 15, they will put on an extra force of at least 150 men, for whose accommodation they contemplate putting up additional buildings. The Nanaimo *Free Press* anticipates that the Company will further reduce the price of their product to $6, delivered in Victoria.

Mr. J. W. Jeusen, manager of the Laura Hydranlic Mining Co., at Rock Creek, gives the following description of recent workings on the claims owned by his Company:—"Two years ago, work was started, and the sawmill and hydraulic plant erected. The gold all lies in alluvial deposits on the banks—80 to 90 feet high—on each side of the Creek. The hydraulic power is taken from the Creek itself, and has a pressure of 85 feet fall. This throws a five-inch stream from the nozzle of the pipe, with a force which cannot be conceived without being seen. It washes away the gravel and rends the huge rocks from their beds with a mighty power, which shakes the solid earth. This stream has been digging and tearing away the banks continuously since April 24, and the amount of pay dirt washed into the flumes and boxes would seem incredible were it estimated in cart loads. Despite the fact that a vast deal of machinery and work, including 27 new boxes and a large amount of fluming, has been put in the mine this year, it has not only paid expenses but turned out an overplus. This means that next year—when no more work of this kind, to reduce the profits, will occur—a very handsome return will be realized. Even as it is, it is claimed that the output of gold from this claim has been larger during the past season, than that of any other in this Province.

Our old friend Dr. A. C. Lawson, who has been resident in Vancouver for several months, has gone to California to fill the position of assistant Professor of Geology in the University of California, a post which his abilities and knowledge will enable him to fill with success. The hearty good wishes of his friends in Ottawa, and his more recent acquaintances on the Pacific, follow him to his new vocation.

Local papers give very graphic descriptions of the new works of the Hamilton Powder Company at Northfield, in the Wellington district, Vancouver Island. The quality of the powder turned out by this company is, as everybody knows, first class.

A Retrogressive and Obnoxious Measure. — The Mining Tax Adopted

In the Quebec Legislature, 29th December:—

HON. MR. DUHAMEL moved the house into committee on a bill amending the law regarding mines.

MR. POUPORE said: I have an amendment to propose to the bill, but before doing so I wish to call the attention of the Government to the absurdity of the clause respecting prospectors. That class of persons complained of the want of security to them under the present law, but what would they think of the bill before them. Fancy a fee of $5 for permission to explore on fifty acres of private property. and $10 on fifty acres of public domain, which permit will only hold good for three months. This is an extraordinary condition. Take other countries where mining is carried on. No such fee is imposed. On the contrary every inducement is held out to a prospector to encourage him to go on with his onerous duty of making new finds. Without such work the most important dormant resource of our province would remain undeveloped for perhaps the next century. The bill in its entirety is a great mistake, and is certain to prevent foreign capital from coming in. The tax, after all, is small, but those who are already losing money in working mines will find it too much. Take the case of the Moulton Hill mine's iron pyrites, which is worked only for sulphur. In the shipment of the products of that mine to the United States quite recently the rate per ton realized was $5.40, and the cost of delivering it was $5.50, showing a loss of ten cents on each ton. Take another instance, the Bristol iron mines. The president of that company declared to me the other day that they lost $1 on every ton of ore sold so far; but they expected eventually to be recoupcd. Is it not a fact that in all countries when mining was in its infancy, and after attempting to raise a revenue by the imposition of a royalty or taxes, they were obliged to abandon that system as it retarded the development of mineral resources, and only after the business became established and paying was the tax imposed. Certain mines are alluded to as making large fortunes and should contribute to the cost of administration or state This may be true enough, but our province is too backward in its mineral development to attempt that system yet. If we want to encourage capitalists to come in with their money we must be able to show examples of paying mines and for one mining organization that is making money you will find ten that are not. The Commissioner points out that in England in coal mines large incomes are received by private companies every year, and that he wants to prevent that system here and secure that the Government should receive that income and not private individuals. The comparison is an unfair one and not at all to the point. If the private companies alluded to in England had not invested their money to develope those mines they, in all probability, would have been undeveloped still, and hundreds of thousands of men would be unemployed The effect of the proposed tax will retard the development of our mines. not, perhaps, on account of the tax itself, which, after all, is small, but because of the feeling of insecurity which it will create. The Commissioner says any predictions in this case will be like those made in relation to additional timber dues and ground rent charged by the Government three years and that the present law is so good that the lumbermen doubled their operations. If lumbermen doubled their operations last year they regret it now, because they cannot sell their timber, and the Commisioner will live to scratch a grey head before he realizes the same revenue again. In fact, I predict now that the revenue from woods and forests next year will not be two-thirds what it was last year, and every year it will become perceptibly less. Our mineral resources should be left perfectly free to develop, and when they are sufficiently advanced to bear a tax, that will be the time to raise a revenue from them and not before. I, therefore, move, seconded by Mr. Nantel:—That this House regrets that, instead of reducing the ordinary expenses of administration to its normal figure and thus saving over one and ahalf million dollars since their advent to power, the Government persists in imposing taxes upon our mines, the development of which is yet in its infancy, thus preventing capitalists from investing their money to assist in the development of our vast interests, and taking away from a large class of laborers a profitable and permanent source of employment. This House regrets also that instead of encouraging the prospector to make new discoveries the Government intends to impose new burdens upon that class of persons, the effect of which will be to stop further prospecting and the development of our mineral resources.

HON. MR. DUHAMEL said the measure was intended to prevent speculation in public lands. Lumber merchants were taxed, and why not miners. The law was not without precedent, as in many countries, even in the United States, such taxes were levied and still the mining industry flourished.

At the second sitting Mr. Duhamel continued for some time, but said little that was new.

HON. MR. BLANCHET followed, and dwelt upon intimate relations that existed between agriculture and the mining industry. The mines procured work for farmers in winter, and thus prevented emigration. So far the mining of phosphate and asbestos were practically the only kinds of mining that were really successful. Last year $600,000 from this source was paid out as wages, and since it first commenced three millions had been paid out. By imposing this tax the people might be deprived of a source of revenue and the Government would get nothing.

MR. LUSSIER also declared himself strongly against the measure.

MR. ROBERTSON said: I am opposed to taxation of particular industries or the selection of particular branches of trade or commerce and placing taxation on these. Every one should contribute if taxation is necessary. I opposed the tax on commercial corporations on this principle. I am particularly opposed to taxation of those industries engaged in developing the latent natural resources of the province. These ought to be encouraged by every means in our power.. To develop our mining industries, which have hardly begun yet, capital is absolutely necessary. Foreign capital is required and should be encouraged to seek our Province. To tax this capital would prevent its seeking investment. To prevent capital from coming here will have the effect of throwing thousands out of employment and obliging our labouring population to work for less wages or leave the country. In either case it will bring distress and suffering on the families of our miners. The tax proposed is unequal. To tax the net profits of any mine might be in some respects admissible, but to tax the gross output of a mine regardless of whether the product costs more to produce it than it is worth at the mines or whether there is a profit in mining, is totally unfair and unjust, upon any fair principle of justice. The ores of our country are mostly of a low grade. Copper often yields only 4 or 5 per cent. to the ton. If that is worth say $8 per ton at the mine the net profit when manufactured is only $1 per ton. A three per cent. tax on $8 is 24 cents and on the profit when manufactured 24 per cent., equal to about 25 per cent. on the net proceeds of a ton of crude ore. More valuable kinds of ore are worth say $20 a ton at the mine. The tax on this would be 60 cents. This ore when manufactured might be worth $10 a ton, making a six per cent. on the net proceed, whereas in the other case it would be 24 per cent. There is no kind of equality in this kind of taxation. It may be said that if mining does not pay people will abandon it; but mining operations are in all countries uncertain, and it is impossible at first to know what is underground and whether the kind of mineral sought for may not be found in greater quantity and richness when more developed. This encourages parties to go on working and gives labour to the miners and support to their families in the meant'me. The proposed tax will stop all preliminary examination and working and leave possibly valuable metals undiscovered, which it is in the interest of the country to aid in developing rather than in preventing their full development. He instanced a number of large mining companies which were shipping at a loss. They made large expenditures of capital, employ large numbers of men, pay large amounts in wages, but the quality of the copper is of low grade. It is sent to the United States for smelting purposes, and were it not for the sulphur in the ore used there to manufacture sulphuric acid the works must stop. He wanted the Government to fix the tax for ten years only, so parties would know what to expect, but they refused. The tax may be doubled next year. He wanted to show the House the true state of things and let the Government take the responsibility.

MR. MCSHANE made one of his usual vehement speeches justifying the tax. Speculators were making fortunes out of our mining lands, and could surely bear a little miserable tax. He was glad this tax had been imposed. Government land had been stolen In the past, though it should have been kept for the benefit of the people. These speculators should be made to pay a royalty.

The amendment was lost on a division of 40 to 20, Mr. Lovell voting for the amendment and Mr. Lussier absenting on the ground that he had paired with Mr. Bourbonnais. The bill was then adopted.

At six o'clock the House rose.

Annotated List of Canadian Minerals.*

G. C. HOFFMAN, F. INST. CHEM., ETC.

(Continued from page 165.)

135. IRON SAND—Occurs at St. Mary's Bay, Digby County, Province of Nova Scotia. Considerable deposits of the same are met with at Moisie, Portneuf, Bersimis, Mingan, and Natashquan, in Saguenay County, and at Batiscan, in Champlain County, and elsewhere in the Province of Quebec. It is also found on the shores and islands of Lakes Superior, Huron, Erie, Ontario, and many of the smaller lakes in the Province of Ontario. Mode of occurrence, examination and analyses, T. S. Hunt, Rep. Geol. Can., 1866-69, pp. 261-269.

136. ISERITE — Constitutes a certain portion of the black magnetic sands met with at St. Mary's Bay, Digby County, Province of Nova Scotia, on the north shore and gulf of the St. Lawrence, Province of Quebec, and on the shores and islands of Lakes Superior, Huron, Erie, and Ontario, etc., in the Province of Ontario.

137. JAMESONITE—Is stated to occur near Fredericton, New Brunswick. Prof. Bailey (of the University of New Brunswick) informs me that should such be the case, it would most probably be at the antimony mine in the parish of Prince William (about twenty-five miles from Fredericton), York County, Province of New Brunswick.

138. JASPER—A red and purple striped, and red and yellow striped jasper, is abundant at St. Mary's Bay (Digby Co.), and a red variety is found on Briar Island, in the same county, on Partridge Island (Cumberland Co.), Long Island, and at Woodworth's Cove (King's Co.), in the Province of Nova Scotia. A blood-red jasper, often finely clouded, occurs near Sherbrooke (Sherbrooke Co.), a small bed of dark green and reddish-brown jasper, traversed by small veins of white chalcedony, at River Ouelle (Kamouraska Co.), and a dark-red jasper in the township of Hull, Ottawa Co.), Province of Quebec. This mineral also enters largely into the composition of the beautiful jasper conglomerate—consisting of pebbles of red and reddish-brown jasper and smoky quartz, thickly imbedded in a white quartzite—which constitutes great beds on the north shore of Lake Huron, Province of Ontario.

139. KALINITE—Is mentioned by Prof. Chapman as occurring in considerable abundance on the exposed faces of some high bluffs of argillaceous shale on Slate River, a tributory of the Kaministiquia, about twelve miles west of Fort William, Lake Superior, Province of Ontario.

140. KAMMERERITE—Is mentioned by Dr. Hunt as occurring, with chromite, in serpentine in the townships of Bolton (Brome Co.), and Melbourne (Richmond Co.), in the Province of Quebec.

141. KAOLINITE—Is met with in masses, sometimes half an inch thick, in fissures in a sandstone of the

Sillery formation, just below the Chaudiere Falls (Lévis Co). The masses have a greenish or yellowish-white color and are composed of minute soft scales, very unctuous and slightly coherent. (Anal., T. S. Hunt, Geol. Can., 1863, 495). This mineral has also been found in the form of minute pearly scales of a yellowish white color, unctuous and plastic, lining cavities in a rock in the township of Acton (Bagot Co.), likewise in the Province of Quebec. Anal., G. C. Hoffmann, Rep. Geol. Can., 1874-75, p. 314.

142. KERMESITE—Occurs, in small crystalline tufts, with native antimony, stibnite, valentinite and senarmonite, in veins traversing argillite in the township of South Ham, Wolfe County, Province of Quebec.

143. LABRADORITE — Fine examples of this felspar occur in St. Jérôme, Morin—bluish, opalescent, cleavable —Abercrombie, and Mille Isles (Terrebonne Co.), also at Rawdon—as a bluish-white granular homogeneous rock—(Montcalm Co.), and Château Richer—as a pale bluish or greenish-grey rock, with red spots—(Montmorency Co.), in the Province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 478; G. C. Hoffman, Rep. Geol. Can., 1874-75, p. 316.

144. LAUMONTITE — Is very abundant at Port George, where occasionally veins of three inches thickness are seen intersecting the sides of the cliff, and is also found at Margaretville, where it occurs, colored green by copper, Annapolis County, Proviuce of Nova Scotia. Anal., H. How, Am. Journ, Sci, 2 ser., vol. xxvi., p. 30, 1858.

145. LAZULITE—Has been found—massive, of a deep azure-blue color, in narrow veins traversing a greyish-white, in parts milk-white, subtranslucent quartz—three quarters of a mile east of the mouth of the Churchill River, district of Keewatin. Anal., G. C. Hoffman, Rep. Geol. Can., 1878-79, p. 2 H.

146. LEAD—NATIVE—Was observed by Prof. Chapman to occur, in the form of thin strings, in a colorless quartz from the vicinity of Dog Lake of the Kaministiquia, Thunder Bay, Lake Superior, Province of Ontario.

147. LEPIDOMELANE — Has been met with, as an associate of arsenopyrite, in the township of Marmora, Hastings County, Province of Ontario. (See under Addenda.)

148. LIGNITE—Of varying composition, but for the most part of very superior quality, of Cretaceous and Laramie age, is found over very extensive areas throughout the North-West Territories; there are also extensive Tertiary deposits, supposed to be of Miocene age. both on the coast and interior of British Columbia, which in many places contain lignites. For reference to analyses, see under "Mineral coal."

149. LIMONITE—Important deposits of this mineral are met with in Pictou and Colchester Counties, Province of Nova Scotia. As there met with, it occurs in the form of lustrous botryoidal or mammillary and stalatitic masses, which exhibit a fibrous structure when broken; also compact and lustreless, and at other times earthy. Analyses, B. J. Harrington and G. C. Hoffman, Rep. Geol. Can., 1873-74, pp. 231-234.—See also notes to "Bog Iron-Ore," "Iron-ochre."

150. LOGANITE—Occurs, in the form of short thick oblique rhombic prisms of a clove or chocolate-brown color) in association with serpentine, phlogopite and apatite, in a white crystalline limestone at the Calumet Falls, Pontiac County, Province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 490.

151. LOUISITE—Honeyman, with analysis, Trans. N. S. Inst., vol. v., p. 15, 1879-82. (Needs further examination; free silicia is very probably present—Dana, Min., App. 3, p. 70, 1882).

152. MAGNESITE—Has, so far, only been met with in rock masses, forming, in association with serpentine, dolomite and steatite, beds in the townships of Sutton and Bolton, Brome County, Province of Quebec.

153. MAGNETITE—Is found, often beautifully crystallized, in veins in the Triassic trap of King's and Annapolis Counties, in the Province of Nova Scotia. Occurs massive, or disseminated in crystals in dolomite and chloritic slate (sometimes constituting fifty-six per cent. of the mass) in the metamorphic strata of the Eastern Townships of Sutton, Bolton, Ascot, Leeds and Orford; in the Laurentian, in the township of Hull, etc.,—also, in the form of black sand (see note to iron sand), on the north shore of the Gulf of St. Lawrence,—in the Province of Quebec. Forms deposits, frequently of very great extent, among the Laurentian rocks, in the Counties of Frontenac, Hastings, Haliburton, Lanark, Leeds, Peterborough, Renfrew, etc., and is also met with in certain localities on Lakes Superior and Huron, Province of Ontario. Further west, important deposits occur in crystalline rocks, supposed to be of Carboniferous age, in the vicinity of Gillies Bay, south side of Texada Island, Province of British Columbia. Crystals pseudomorph after pyrite, E. B. Kenrick, Ann. Rep. Geol. Can., vol. iii., p. 58 T, 1887. Mineral associations of magnetite, B. J. Harrington, Rep. Geol. Can., 1873-74, p. 194. Analyses, by various analysts, ib., pp. 208-211.

154. MALACHITE—Has, so far, not been met with in characteristic specimens, but merely as an incrustation on copper ores or in the form of stains and small earthy masses in copper-holding rocks. Of the numerous localities where it has been observed may be mentioned —Spanish River, where some of the quartz veins carrying chalcocite are stained throughout with green carbonate of copper; with galenite in a lode which crosses a long narrow island near the shore at Thunder Cape, Lake Superior, Province of Ontario. In the form of little fibrous masses, with sulphurets of copper, in a drusy calcite at the Black River mine, St. Flavien, Lotbinière County, Province of Quebec.

155. MALACOLITE (DIOPSIDE)—Large twin-crystals of white pyroxene, associated with cinnamon-colored garnets, are found in druses in a pale greenish pyroxene rock in the township of Orford (Sherbrooke Co.), and slender, pale greyish-green colored crystals, sometimes six inches in length, occur imbedded in limestone at the Calumet Falls (Pontiac Co.), Province of Quebec. Crystals of pale greyish-green pyroxene—often replaced on their acute literal edges, and occasionally several inches in diameter—associated with crystals of dark green pargasite, and black tourmaline, are found at the High Falls and at the Ragged Chute in the township of Blythfield, Renfrew County, Province of Ontario. Analyses, T. S. Hunt, Geol. Can., 1863, pp. 467-468.

156. MANGANITE — Is frequently found associated with pyrolusite at Tenny Cape (Hants Co.) and elsewhere —often crystallized on that ore. It is abundant at Walton and Cheverie, and is met with at Douglas and Rawdon, in Hants County, Province of Nova Scotia. Also occurs on Amherst Island, Magdalen Islands, Province of Quebec.

157. MARCASITE — Has been obtained, by Prof. Chapman, from the walls of a vein holding galenite and chalcopyrite, in the township of Neebing, a few miles east of the Kaministiqui River, north-west shore of Lake Superior, Province of Ontario.

158. MAREITE—Has been met with in the Triassic trap of North Mountain, Digby County, Province of Nova Scotia, and was also observed by Prof. Chapman in a gneissoid boulder from Bass Lake, a few miles north of Orillia, Simcoe County, Province of Ontario.

159. MELACONITE—Is recorded by Prof. Chapman as occurring, but in traces only, in some of the copper deposits of the Eastern Townships of the Province of Quebec.

160. MELANTERITE—Has been found in some heaps of shale and slack coal at the Glace Bay coal mines, in Cape Breton County, Province of Nova Scotia. Also occurs, in small quantities, in many of the ores from the mineral veins of Lake Superior, Lake Huron, and the Hastings region, Province of Ontario.

161. MENEGHINITE—Is found, apparently in a veinstone of quartz and dolomite, in the vicinity of Marble Lake, in the township of Barry, Frontenac County, Province of Ontario. Anal., B. J. Harrington, Trans. Roy. Soc. Can., vol. I., sec. iii., p. 79, 1882 and 1883.

162. MESOLE—Occurs, in association with mesolite, in trap rock in the neighborhood of Port George, Annapolis County, Province of Nova Scotia. Anal., H. How, Ed. N. Phil. Journ., new series, vol. viii., p. 207, 1858.

163. MESOLITE—Is found at Port George, and is also said to be very abundant in the North Mountains, Annapolis County, Province of Nova Scotia. Analyses, H. How, Am. Journ. Sci., 2 ser., vol. xxvi. p. 32, 1858.

164. METEORIC IRON—A specimen of meteoric iron, weighing 370 pounds, was found, in 1854, on the surface of the ground, in the township of Madoc, Hastings County, Province of Ontario. Its shape is rudely rectangular and flattened on one side. The surface is irregularly pitted, and coated with a film of dark oxide. The iron is malleable, and highly crystalline in texture. A polished surface when etched by an acid exhibits the so-called Widmannstadt's figures. It contains 6·35 per cent. of nickel; small amounts of the phosphide of iron and nickel (Schreibersite) are disseminated through it, and in making a section of it, rounded masses of magnetic sulphide of iron (troilite?) were met with. Results of its examination by Dr. T. S. Hunt, Geol. Can., 1863, p. 508.

165. MICACEOUS IRON-ORE—Is found in veins in the Cobequid Hills of Londonderry (Colchester Co.): constitutes an important deposit on the west side of the East River (Pictou Co.): is met with on Salmon River, at Melrose, Manchester, and Roman's Valley in Guysborough County, and at St. Peters, Richmond County, Province of Nova Scotia. Mingled with variable amounts of quartz and chlorite, it constitutes beds of a schistose rock in the townships of St. Armand (Missisquoi Co.), Brome and Sutton (Brome Co.); occurs in small beds in the township of Bristol (Pontiac Co.), and is also met with in the townships of Templeton and Hull (Ottawa Co.), and elsewhere in the Province of Quebec. Forms small beds in Potsdam sandstone in the townships of Bastard (Leeds Co.)., and Ramsay (Lanark Co.), in the Province of Ontario.

166. CHROMIFEROUS MICA — Is found in several localities in the Eastern Townships of the Province of Quebec. Minute scales of it occur in the magnesite of Sutton (Brome Co.), and it has also been observed, in larger plates and imperfect crystals, in a dolomite from Bolton, in the same county.

167. MICROCLINE — Is found in large cleavable masses, in association with quartz, muscovite, albite, etc., constituting a coarse pegmatite vein in the township of Villeneuve, Ottawa County, Province of Quebec.

168. MILLERITE—Is met with in small grains and prismatic crystals, together with minute grains and crystals of a bright green chromiferous garnet disseminated through a white cleavable calcite, in a vein on the east side of Brompton Lake, in the township of Orford (Sherbrooke Co.), Province of Quebec.

169. MINERAL COAL — See under "Anthracite," "Bituminous coal," "Cannel coal," "Lignite."

Analyses, E. Hartley, Rep. Geol. Canada., 1866-69, pp. 365-447—T. S. Hunt, ib., 1871-72, p. 98 B. J. Harrington, ib., 1872-73, pp. 76-81; ib., 1873-74, p. 63; ib., 1876-77, pp. 466-470—G. C. Hoffmann, ib., 1873-74, pp. 90-93 and 188-191; ib, 1875-76, p. 423; ib., 1879-80, pp. 8-14H.; ib., 1882-84, pp. 1-44 M.: Ann. Rep. Geol. Can., 1885, pp. I.11 M.; ib., 1887-88, pp. 5-20 T.

170. MINERAL RESIN — Is not unfrequently very freely disseminated through some of the coals and lignites of the North-West Territory, in the form of small flattened grains and nodules of a yellow, yellowish-brown or brown color. The nodules do not generally speaking, exceed a quarter of an inch in diameter, but occasionally some of much larger denomination are met with. One from a coal seam on the Middle Fork of the Old Man River, Rocky Mountains (North-West Territory) was found to be a little over an inch and a-half in diameter, and three quarters of an inch thick.

171. MINERAL TAR—Is often seen exuding from the deposits of bituminous sand rock occurring along the banks of the Athabasca River (see note to "Asphaltum"), and in numerons places on the ground at the foot of either bank, or on terraces lower than their summits, this tar collects in pools, or flows in sluggish streams to lower levels. It also occurs at several localities on the shores of the western part of Great Slave Lake; at one or two places on Peace River, and elsewhere in this part of the North-West Territory.

172. MIRABILITE — Occurs at the Clifton gypsum quarry, Windsor, Hants County, Province of Nova Scotia; and, associated with epsomite, as an incrustation upon the cliffs of shale at Fort St. John, Peace River, Province of British Columbia. Anal., G. C. Hoffmann, Rep. Geol., Can., 1875-76, p. 421.

173. MOLYBDENITE—Is somewhat widely distributed, being found, although in most instances only in small quantities, in nearly all the provinces of the Dominion. Some of the most noteworthy localities of its occurrence are those in the Province of Quebec, as —near the mouth of the Quetachoo River, in Manicougan Bay, on the north shore of the Gulf of the St. Lawrence, where it occurs disseminated in a bed of quartz six inches thick in the form of nodules from one to three inches in diameter, and in flakes which are sometimes twelve inches broad, by one-fourth of an inch in thickness; at Harvey Hill in the township of Leeds (Megantic Co.), occurring in small rounded masses of fine granular structure, in veins of quartz and bitter-spar; and the township of Aldfield (Pontiac Co.), where perfect and very handsome crystals have occasionally been found, and others, less perfect but of considerable dimensions are met with.

174. MOLYBDEITE—Has been met with in the form of an earthly yellow powder on molybdenite, in the township of Alleyn (Pontiac Co.), in the Province of Quebec, and in the township of Ross (Renfrew Co.), in the Province of Ontario.

175. MONAZITE—In the form of a nodular mass, was found at the Villeneuve mica mine, in the township of Villeneuve, Ottawa County, Province of Quebec (Ann. Rep. Geol. Can., vol ii., p. 11 T, 1886). Dr. F. A. Genth has recently made an analysis of a specimen from this locality, the results of which are given in Am. Journ. Sci., 3 ser., vol. xxxviii, p. 203, 1889.

176. MORDENITE—Occurs imbedded in trap, some two or three miles east of Morden or French Cross, in King's County, Province of Nova Scotia. Anal., H. How, Journ. Chem. Soc., new series, vol. ii., p. 100, 1864.

177. MORENOSITE—Is mentioned by Dr. Hunt as having been observed, as an efflorescence of minute acicular greenish-white crystals, on an ore of nickel from the Wallace mine, Lake Huron. Province of Ontario.

178. MUSCOVITE—Large plates and crystals of this species occur in a vein of graphic granite on Alumette Lake, at Montgomery's clearing, about five miles above Pembroke, Renfrew County, Province of Ontario. It is met with, in association with black tourmaline on Yeo's Island in the Upper St. Maurice (Portneuf Co.), and abundantly, and not unfrequently, in crystals of very large dimensions, in a coarse pegmatite vein (described in note to "Albite"), in the township of Villeneuve (Ottawa Co.), Province of Quebec. A rose-colored mica, closely resembling, if indeed not identical with,

the rose-colored muscovite of Goshen, Mass., has recently been met with by Mr. C. W. Willimott, in the township of Villeneuve (Ottawa Co., P. Que). It was associated with pale green muscovite, in a matrix composed of albite with a little white translucent quartz.

179. NAIL-HEAD-SPAR—Very fine specimens of nail-head-spar are found at Tenny Cape, Hants County, in the Province of Nova Scotia.

180. NATROLITE — Handsome specimens of this mineral are found at Swan Creek (Cumberland Co.), Cape Blomidon (King's Co.), and Gate's Mountain (Annapolis Co.), etc., in the Province of Nova Scotia. It occurs, associated with analcite, in some of the dykes cutting the Trenton limestone at the reservoir extension, Montreal (Hochelaga County.), Province of Quebec. Anal., B. J. Harrington, Rep. Geol. Can., 1874-75, p. 303.

181. NEPHELITE—Is stated, by Dr. Hunt, to occur in white crystals, with small grains of blue sodalite, in the nepheline syenite of Brome Mountain (Brome Co.), it also occurs, as a constituent of a similar rock, at Montreal (Hochelaga Co.), and Belœil (Rouville Co.), Province of Quebec. See also note to "Elaeolite."

182. NEPHRITE—This mineral has been found by Dr. G. M. Dawson, in the valley of the lower Fraser River (British Columbia), in the vicinity of Lytton, on the site of an abandoned Indian village, in small water-worn boulders, evidently derived from the beaches of the River, some having been merely more or less broken, whilst others had been or otherwise partly manufactured into implements (Can. Rec. Sci., vol. ii., p 364, 1886-87.)

* Fourth paper read before the Royal Society of Canada.

(To be continued.)

The Properties of Nickel Steel.

(Parisian Correspondence to the Ironmonger.)

The contemporaneous researches of English and French metallurgists—notably Mr. Riley, Glasgow, and M. Schneider, Creusot—upon the effect of nickel on steel have had results which seem likely to profoundly influence the future of steel-making, The extraordinary qualities of ferro-nickel have been brought prominently before the metallurgical world by the tests recently undergone in the United States by the Creusot nickel-steel armour-plates and as the outcome of that success it appears that the manufacture of nickel steel will at once be entered upon on an extensive scale. Now that the existence of enormous deposits of the metal has been demonstrated in Canada, the only difficulty is the economical and efficient reduction of the ores. This is claimed to be achieved by a French metallurgist, M. Garnier, who has elaborated a process by which sulphur is completely eliminated from the metal. M. Garnier has, it is stated, concluded a contract with the Canadian nickel mine owners to erect a large smelting works, in which this process will be practically carried on. In this aspect of the nickel-steel question, any information as to the actual composition and capacity of the alloy must be of interest. Such information has just been supplied by M. Charles Walrand, a well-known French steel-works engineer, who claims priority over M. Schneider for the idea of applying nickel to the constitution of armour-plates. The composition of M. Schneider's plates, as well as the special operations of tempering and annealing which are employed in their manufacture are, of course, a trade secret. But M. Walrand gives the composition of the material with which experiments were made, so far back as 1885, at the works of the Société des Forges de Montataire. These experiments were made with the idea that ferro-nickel might be used as a substitute for copper and "white metal" in nearly all its applications; and it was as the result of the information therein obtained that the employment of nickel steel in armour-plates, ordnance, &c., was suggested to the directors of the Ferro-nickel Company and the Creusot Works. The composition of the alloys from which specimens were rolled and tested at the Montataire Works was: carbon, ·15 and ·05 per cent.; phosphorus, ·02 and ·04; sulphur and silicon, traces; manganese, ·50 and ·04; nickel, 25·00; and iron, 74·00. From this metal results were obtained in the testing-machine which were quite foreign to the views up to then entertained upon the characteristics of steel. In round pieces of 6 inches, turned to 4¾ inches, a resistance of 197 lbs. and an elongation of 19 per cent. were obtained before tempering, while the results obtained after tempering were: resistance, 179 lbs.; elongation, 29·5 per cent. In flat pieces of 17 cm. by 6 cm. the resistance for both the tempered and non-tempered metal was less, but the elongation was 40 and 33 per cent. respectively. With round pieces of 10½ inches, turned to 4¾ inches, not tempered at all, the resistance was 196 lbs., and the elongation 43·5 per cent. Other round specimens of 4¾ inches, which were tested without being turned, showed resistance of 152 lbs. and 160 lbs., and elongation of 37 and 40 per cent. M. Walrand does not attempt to deprive M. Schneider of the merit of having pursued his own researches independently of those conducted by the Montataire Company. The main interest of his statement lies in the evidence which it gives of the peculiar properties of steel and nickel when combined in the proportions given above.

Mining Under the Sea in the North of England.—On the 23rd ult., in the presence of many directors and shareholders of the Hodbarrow Mining Company, the final and memorial block of a sea barrier was laid on the northern shore of the Duddon estuary, in the county of Cumberland, at a point where during the last twenty years an important mine, producing a large quantity of rich red hæmatite iron, has been worked. This mine is owned by the company, who are the proprietors of the land, the mineral rights being leased to them by the Earl of Lonsdale. The ore having been won as close to the sea margin as it has been possible to work without letting down the surface of the land and admitting the influx of the sea, thereby drowning the mine, the company have recently obtained a fresh lease from Lord Lonsdale, undertaking to construct a barrier to keep back the sea along that portion of the estuary in front of the mine, in order that they might win the ore from underneath some twenty-six acres of the sea bed. To effect this object a massive and substantial sea barrier has now been constructed. This great sea barrier is just two-thirds of a mile in length, and for about one-half of this length is fully 50 feet in height from the bottom of the foundation to the top of the parapet. The engineer of the work is Sir John Coode, and the contractors are the well-known firm of Messrs. Lucas and Aird. There is every reason to believe that the anticipation of the directors and shareholders of being able to contine the working of the iron ore over a further period of twenty-five years may be realized, thus giving employment during that time to about 1,500 men.

A Model Coal Shaft.—The new Standard shaft of the H. C. Frick Coke Company, which was visited by the members of the American Institute of Mining Engineers and their foreign guests, was built four years ago by Robert Ramsay, the present superintendent, and is considered the finest of its kind in the world. From its neat arches at the coal bottom to the self-acting tipple, more than 300 feet above, and from the five big batteries of boilers to the immense direct-acting engine there is an air solidity and strength about the whole thing that speaks louder than mere words about the ability of the designer and builder. In April last a test run was made at this shaft and the result was the breaking of the world's coal hoisting record that had been made some time before by the famous Nottingham shaft, near Wilkesbarre. This now famous hoist at the Standard began at 6 o'clock in the morning, and in eight and a half hours' actual running time 1,259 sixty-bushel waggons, or over 3,021 tons, were hoisted. These, more than 75,000 bushels, when turned into coke, would load 120 cars, allowing seventeen tons to the car. Throughout the entire mine the working of the men is systematized to the minutest degree, and every precaution is taken for the safety of the toilers. That Mr. Ramsay's efforts to have a safe mine have met with success is proved by the very small number of accidents that have occurred in it. The immensity of the work and its completeness of detail brought forth words of highest praise from the visiting party.

Sudbury Nickel Deposits

The January issue of the **Canadian Mining Review** will contain verbatim the report by COMMANDER WM. M. FOLGER and LIEUTENANT H. H. BUCKINGHAM to the Hon. B. F. TRACEY, Secretary to the United States Navy, Washington, on the Sudbury Mines and Nickel Deposits.

Parties desiring extra copies of this special number must order them in advance. **Price per copy, 15 cents.**

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For further information see OFFICIAL POSTAL GUIDE.

Post Office Department, Ottawa.
1st November 1889.

North-West Mounted Police.

RECRUITS.

APPLICANTS must be between the ages of Twenty-two and Forty, active, able-bodied men of thoroughly sound constitution, and must produce certificates of exemplary character and sobriety.

They must understand the care and management of horses, aud be able to ride well.

The minimum height is 5 feet 8 inches, the minimum chest measurement 35 inches, and the maximum weight 175 pounds.

The term of engagement is five years.

The rates of pay are as follows:—

Staff-Sergeants.....$1.00 to $1.50 per day
Other Non-Com. Officers.. 85c. to 1.00 "

	Service pay.	Good conduct pay.	Total.	
1st year's service,	50c.	——	50c.	per day
2nd "	50	5c.	55	"
3rd	50	10	60	"
4th	50	15	65	"
5th "	50	20	70	"

Extra pay is allowed to a limited number of blacksmiths, carpenters and other artizans.

Members of the force are supplied with free rations, a free kit on joining and periodical issues during the term of servce.

Applicants may be engaged at the Immigration office, Winnipeg, Manitoba; or at the Haad quarters of the Force, Regina, N.WT.

PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

— AND —

PRECIOUS STONES.

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 aid 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 ten areas the cost is 50 cents per area, for every area in addition in same application 25 cents. Cost of renewal one half the original fees. Leases of any number of areas are granted for a term of 21 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the ease 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 o 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 t hi 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 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

Commissioner Public Works and Mines,

HALIFAX

NOVA SCOTIA.

Mining Regulations
TO GOVERN THE DISPOSAL OF
Dominion Lands Containing Minerals other than Coal, 1890

THESE REGULATIONS shall be applicable to all Dominion Lands containing gold, silver cinnabar, lead, tin, copper, petroleum, iron or other mineral deposits of economic value, with the exception of coal.

Any person may explore vacant Dominion Lands not appropriated or reserved by Government for other purposes, and may search therein either by surface or subterranean prospecting for mineral deposits, with a view to obtaining under the Regulations a mining location for the same but no mining location or mining claim shall be granted until the discovery of the vein, lode or deposit of mineral or metal within the limits of the location or claim.

QUARTZ MINING.

A location for mining, except for iron or petroleum, on veins, lodes or ledges of quartz or other rock inplace, shall not exceed 1,500 ft. in length and 500 ft. in breadth. Its surface boundary shall be four straight lines, the opposite sides of which shall be parallel, except where prior locations would prevent, in which case it may be of such a shape as may be approved of by the Superintendent of Mining.

Any person having discovered a mineral deposit may obtain a mining location therefor, in the manner set forth in the Regulations which provides for the character of the survey and the marks necessary to designate the location on the ground.

When the location has been marked conformably to the requirements of the Regulations, the claimant shall within sixty days thereafter, file with the local agent in the Dominion Land Office for the district in which the location is situated, a declaration or oath setting forth the circumstances of his discovery, and describing, as nearly as may be, the locality and dimensions of the claim marked out by him as aforesaid; and shall, along with such declaration, pay to the said agent an entry fee of FIVE DOLLARS. The agent's receipt for such fee will be the claimant's authority to enter into possession of the location applied for.

At any time before the expiration of FIVE years from the date of his obtaining the agent's receipt it shall be open to the claimant to purchase the location on filing with the local agent proof that he has expended not less than FIVE HUNDRED DOLLARS in actual mining operations on the same; but the claimant is required, before the expiration of each of the five years, to prove that he has performed not less than ONE HUNDRED DOLLARS' worth of 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 AND PETROLEUM.

The Minister of the Interior may grant a location for the mining of iron or petroleum, not exceeding 160 acres in area which shall be bounded by north and south and east and west lines astronomically, and its breadth shall equal it in length. Provided that should any person making an application purporting to be for the purpose of mining iron or petroleum thus obtain, whether in good faith or fradulently, possession of a valuable mineral deposit other than iron or petroleum, his right in such deposit shall be restricted to the area prescribed by the Regulations for other minerals, and the rest of the location shall revert to the Crown for such disposition as the Minister may direct.

The regulations also provide for the manner in which stone quarries may be acquired.

PLACER MINING.

The Regulations laid down in respect to quarts 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.

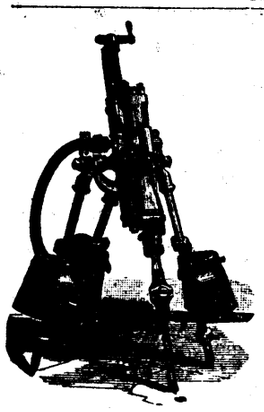
THE SCHEDULE OF MINING REGULATIONS

Contains the *forms* to be observed in the drawing up of all documents such as:—"Application and affidavit of discoverer of quarts 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 Dominian 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.

A. M. BURGESS,
Deputy Minister of the Interior



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BOILERS,

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Quarrying Machinery

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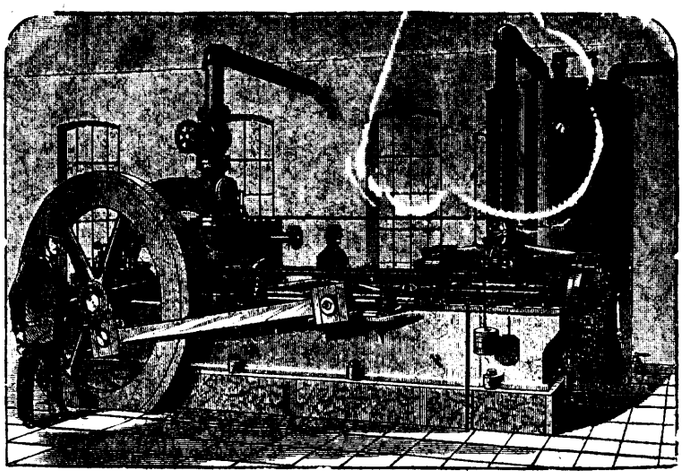
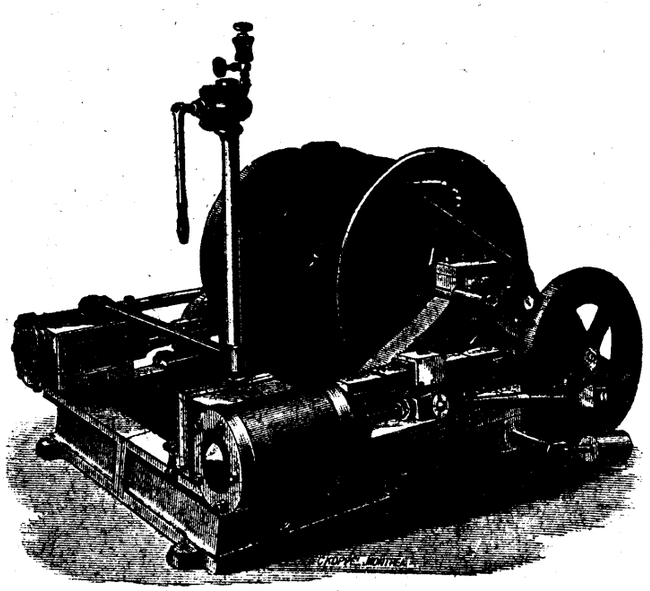


—ALSO—



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