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The Canadian Mining Review

Established 1882

Vol. XI.—No. 4. 1892—OTTAWA, ARPIL—1892. Vol. XI.—No. 4.

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1st November 1889.

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Synopsis of "The General Mining Act," Chapter 16, 54th Victoria.

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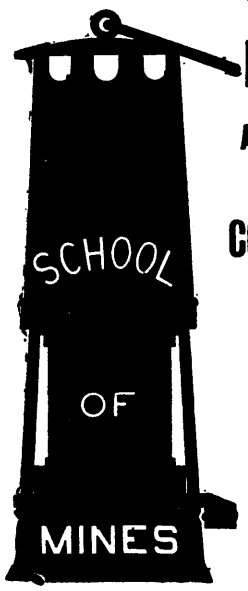

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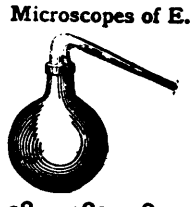

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CANADIAN MINING MECHANICAL REVIEW

CONDUCTED BY . . . . . E. T. A. BELL.

OFFICES:

Victoria Chambers, 140 Wellington Street,

OTTAWA.

Vol. XI. APRIL, 1892. No. 4.

The Mineral Revenue of Nova Scotia in 1891.

We are indebted to the courtesy of Mr. W. H. Brown, accountant of the Department of Works and Mines, Halifax, for the following returns, showing the revenue derived by the local government from its mines and minerals:—

Licenses to Search.

	1890.	1891.		
Cape Breton	$1,480	$1,470	$ 10	decrease.
Cumberland	1,340	570	770	"
Pictou	780	470	310	"
Inverness	750	420	330	"
Antigonish	350	120	230	"
Richmond	370	420	50	increase.
Hants, Lunenburg, Annapolis, Colchester, Digby, Victoria, Kings, Guysboro and Halifax	910	870	40	decrease.
	$5,980	$4,340		

Total decrease from Licenses to Search in 1891, as compared with 1890, $1,640.

Licenses to Work and Leases.

	1890.	1891.		
Cumberland	$ 900	$ 425	$475	decrease.
Cape Breton	800	450	350	"
Pictou	425	375	50	"
Inverness	325	125	200	"
Guysboro, Victoria, Antigonish, Colchester and Richmond	250	225	25	"
	$2,700	$1,600		

Total decrease of revenue from Licenses to Work and Leases in 1891 as compared with 1890, $1,100.

Rentals—Minerals other than Gold and Silver.

	1890.	1891.		
Pictou	$ 660	$ 570	$ 90	decrease.
Cumberland	390	840	450	increase.
Cape Breton	210	690	480	"
Colchester	30	60	30	"
Other counties	30	240	210	"
	$1,320	$2,400		

Total increase from rentals for minerals other than gold and silver in 1891 as compared with 1890, $1,080.

Coal Royalties.

	1890.	1891.		
Cape Breton	$ 63,833.29	$ 74,406.88	$10,573.59	in'cse.
Cumberland	37,595.39	43,042.17	5,446.78	"
Pictou	28,218.11	26,111.80	2,106.31	de'cse.
Other counties		11.25	11.25	inc'se.
	$129,646.76	$143,572.10		

Total increase from coal royalties in 1891 as compared with 1890, $13,925.31.

The following are the amounts received by the Department of Mines during year 1891, from various sources in connection with the gold product, from the under-named counties:

Prospecting Licenses.

Yarmouth	$ 127.50
Cumberland	179.00
Victoria	351.01
Kings	575.00
Queens	1,185.18
Guysboro	1,259.89
Hants	1,457.01
Lunenburg	1,534.62
Halifax	1,541.73
Colchester	1,633.05
Other counties	289.38
Total	$10,133.37

Rents—(Gold Leases).

Victoria	$ 48.00
Lunenburg	128.00
Colchester	142.00
Queens	142.00
Hants	196.00
Guysboro	380.00
Halifax	578.00
Other counties	8.00
Total	$1,622.00

Gold Rentals—(Yearly payments on Leases).

Yarmouth	33.00
Queens	189.00
Lunenburg	195.00
Colchester	202.50
Hants	206.50
Guysboro	236.50
Halifax	347.00
Total	$1,409.50

Royalty on Gold.

Colchester	$ 6.39
Lunenburg	9.87
Guysboro	527.42
Hants	1,239.72
Queens	2,195.69
Halifax	4,381.40
Total	$8,360.49

Head Him Off.

The Halifax *Critic*, whose reputation for blundering and misrepresentation in matters mining is notorious, eclipses all previous efforts by a profuse eulogy of—Great Scott!—Chas. M. Dobson. How Ontario mining men will smile when they read the following:

"The deep and intelligent interest in our mineral resources evinced by leading merchants and capitalists in St. John is in striking contrast with the apathy displayed by Halifax business men, who when they do invest generally lose, as they refuse to recognize native talent, but put up their money on the plausible tales of smooth-tongued outsiders who have absolutely no mining experience. There are of course numerous exceptions to this rule, but recent developments prove that it still holds good.

"Mr. Chas. M. Dobson, M. E. and C. E., of Chicago, has lately paid a visit to New Brunswick in the interests of Chicago capitalists, who contemplate the purchase of the Stockton manganese mines near Sussex. Mr. Dobson is a thorough metallurgist as well as mining engineer, and has had charge of some of the largest mines and reduction works in Arkansas and Colorado. He has held prominent positions in all parts of the world, and many large properties have been sold on his favourable reports. In his reports on the treatment of gold ores he always has a good word to say of the pattern of stamp mill manufactured in Nova Scotia, and on one occasion imported into the States a mill manufactured by the Truro Foundry and Machine Co. While in St. John Mr. Dobson received a large retainer from some gentlemen interested in gold mining at Isaac's Harbor and Country Harbor to visit and report on their property, and spent a short time in that part of the country. He was evidently most favorably impressed with both New Brunswick and Nova Scotia as favorable fields for the investment of capital in mining enterprise, and as he is now located in Chicago, where he has the best of connections, his visit here may result in important business."

It will perhaps be information to the *Critic* and to the "leading merchants and capitalists of St. John" to know that the subject of this flattering "puff" is a fraud, deadbeat and imposter of the very worst character. Dobson, who poses as an Associate of the Royal School of Mines and carries with him copies of credentials purporting to be from the eminent firm of London engineers, Messrs. John Taylor & Sons, all of which are fraudulent, is just one of these "smooth-tongued outsiders who have absolutely no mining experience," and against whose wiles the *Critic* so glibly warns its readers. His career in Ontario and Quebec during the years 1887, 1888 and 1889, when he posed as consulting engineer for the Vermilion Mining Co., special correspondent to the Toronto *Mail* from the Sudbury district, etc., etc., was notorious for the extent and audacity of his methods of swindling, and when he skipped to Chicago under a warrant for arrest on a criminal charge he left behind him many respectable citizens in Ottawa, Toronto and elsewhere to mourn his untimely departure. We have before us his *professional* card just as he presented it to us in 1887, and as it may be of some value to the *Critic* as a souvenir, we present it herewith:

CHAS. M. DOBSON, A.R.S.M., M.E.,
CONSULTING ENGINEER,
Mining & Reduction Works of all kinds Erected.
Reports on Mines and Mining Properties.
EXPERT OPINION.
OVER.

MR. DOBSON has had ten years PRACTICAL experience at the largest Galena mines in Great Britain, (Foxdale, Isle of Man), and on the South and West African Gold mines—Lisbon-Berlin, (Gold), Kimberley, (Diamond), and Gold Coast, (Gold) mines,—and on Canadian Phosphate and Mica Mines.
Special attention to the economical working of refractory auriferous ores.
MINING AND MINERAL LANDS BOUGHT AND SOLD.
LONDON, ENG., CORRESPONDENTS.
MINES WORKED AND DEVELOPED ON CONTRACT.
OFFICE: 23 Winton Chambers, Adelaide St., Toronto, Can.

The following is one of a series of letters utterly repudiating his claim to the A. R. S. M.:

ROYAL SCHOOL OF MINES,
South Kensington, S.W.
October 15th, 1891.

SIR,—On February 1st, 1889, you wrote to my father, Mr. J. S. Jeans, asking him if he could find out if Charles Miles Dobson was an associate of the Royal School of Mines. You said that Mr. Dobson had been concerned in some very questionable transactions. The council of the Royal School of Mines wish to get hold of a case of a man representing himself to be an A. R. S. M., in order that they may proceed against him. Could you oblige by writing and telling me if you know the whereabouts of Mr. Dobson, and if he still represents himself to be an associate of the R. S. M.

If you could give us any information that would lead us to finding him, you would greatly oblige

Yours, faithfully,
HAROLD JEANS.

We are sorely tempted to give a sketch at some length of the *modus operandi* of this blackguard, but as any such would necessarily involve the names of some respectable people whose feelings must be respected, we refrain. Suffice it to say that Charles Miles DeTracey Dobson is an unscrupulous and wholly unprincipled person, entirely devoid of any mining knowledge and ability, proved to be a liar and imposter almost without parallel; in fact, a dangerous character, whom our readers in the Maritime Provinces, in their own interests, will do well to have nothing whatever to do with.

With this number we present our readers with a very good portrait of our lamented friend the late Captain Tom Sheridan, manager of the Bell's Asbestos Company's mines at Thetford. Captain Sheridan was a miner of large and varied experience, and in the Eastern Townships, where he was so well known and so universally liked by his associates, his memory will be kept green for many a day.

EN PASSANT.

The interview of the Council of the General Mining Association of Quebec with the Hon. the Commissioner of Crown Lands, on 31st ulto., a full report of which will be found elsewhere, was the satisfactory outcome of the labors of the Association to have the mining law of the province placed on a satisfactory footing. The Hon. Mr. Flynn gave the impression of a minister who regarded the mineral development of the province as of the first importance and who would carefully consider any new legislation affecting its interests. He admitted that the confiscatory clauses of the Mercier Act had been repealed, and stated that in his opinion the industry had not arrived at that stage when it could be made a revenue-producing source to the government. He promised to submit the draft of any new Bill to the Council of the Association for suggestion.

The fee for powder licenses in Quebec is excessive and burdensome. Although not a provision of the Mining Act, it is a serious deterrent to the progress of the industry and the Council entertains hope that while it may perhaps not be abolished it will be very greatly reduced.

Through the courtesy of Mr. A. Blue, the recently appointed Director of Mines for the Province of Ontario, we are indebted for a glance at the advance sheets of his first annual report, from which the following summary of the mineral production for last year is taken: Nickel, 85,790 tons, of a value of $324,240, of which 4,536 tons, containing about 900 tons of nickel, were purchased by the United States Government for the manufacture of armour plate; silver, 14,925 tons, value $64,475; petroleum (crude), 894,647 barrels, value $1,209,558; mica, 240 tons, value $31,200; salt, 44,167 tons, value $157,000; gypsum, 5,350 tons, value $12.200; and phosphate, 4,900 tons, value $50,800. There were also produced building stone of a total value of $1,000,000; 48,221 bbls. of cement, valued at $44,501; lime, 2,350,000 bushels, of a value of $300,000; 160,000,000 common brick, value of $950,000; pressed brick, roofing tile and terra cotta, of a value of $156,699; drain tile, $90,000; sewer tile, $270,000; pottery, $45,000. The total value of the mineral production in Ontario for the year is thus computed to be of a value of $1,750,673 and the cost of labor employed therein, exclusive of the production of petroleum, salt and pottery, $1,659,141.

In order that our readers may be conversant with the subject of our article, "Head Him Off," we will publish in our next issue a cabinet portrait of the notorious Charles M. Dobson. Canadian and American papers need have no fear of libel suits in the reproduction of our article, as the REVIEW is in possession of ample evidence to bear out the charges in every particular—and a great deal more if necessary. Our only object is to put Canadian and American mining people thoroughly on their guard against this dangerous imposter.

At the Globe Works, Liverpool, there is in course of manufacture one of the largest steel wire cables that has been made in Great Britain. When completed it will be 3½ miles in one continuous length, without a joint or splice, and will weigh about 20 tons It is 3¾ inches in circumference, made from the finest quality of patent crucible steel wire, and having a tensile guaranteed strain of over 40 tons. Some idea may be formed of the immense amount of labor required for the manipulation of an order of this kind, when it is mentioned that the total length of the wire in the cable would measure something over 300 miles. The machinery employed for this heavy work is of special design.

In a report upon questions relating to the employment of explosives in presence of fire-damp, prepared by a special sub-commission appointed by the French Government, the following conclusions are arrived at :—

1. Even explosives under water can inflame fire-damp mixtures with air by means of the dust of the mine.

2. The greater number of known explosives are capable of igniting fire-damp mixtures when exploded freely in the atmosphere. Amongst these explosives are dynamite, gun-cotton (either military or mining, particularly the latter), gelatine dynamite and Paulille's ammonia dynamite.

3. It is, however, possible to find explosives which detonate at a temperature sufficiently low to avoid inflammation with fire-damp mixtures, at least in the great majority of cases, when freely exploded in the atmosphere. Among the explosives experimented on which approximately fulfil this condition are: (1) The intimate mixture of 50 parts dynamite with 50 parts of crystallized carbonate of soda, or sulphate of soda, with 10 eqs. water of crystallization, ammonia alum and ammonium chloride; (2) Moulin-Blanc pyroselin powder; (3) mixture of 20 parts dynamite, at 75 per 100, and 80 parts of nitrate of ammonia; (4) mixture of 20 parts of guncotton titrating 173 c.c. nitrogen dioxide and 80 parts nitrate of ammonia; (5) Bellite, of which the composition is not known with certainty, and the experiments have not been sufficiently numerous; (6) Favier's explosive, containing 90 parts of nitrate of ammonia, 10 parts mononitro-napthaline, which appears to equal Bellite in security. It requires, however, further experiment.

4. Because of the complexity and variability of the phenomena occurring during the detonation of explosives free to air, it will be prudent to avoid firing shots in the mine, even with charges considered the safest, at points where the mixture of air and fire damp is inflammable. The choice of explosives must be considered as diminishing danger, but not as absolutely suppressing it.

5. It is necessary to employ the explosives under conditions such as to develop from them the maximum useful work. Economy and security are in accordance to recommend this rule. To accomplish this the following conditions are necessary: The explosive must be rammed with care, and the hole must be sufficiently deep. No void space must be left either in front, behind or around the cartridge. The Bickford fuse must not be placed in contact with the explosive, if it is used, and the dangers of the fuse are sufficiently great to make it desirable to replace it by some more certain mode of ignition.

An enquiry, of great importance to colliery owners and miners, with regard to the use of explosives, was concluded at Atherton, near Wigan, in England, on March 1, in connection with the adjourned inquest upon the body of Edward Sandeland, collier. The deceased, after firing a roburite shot, in Messrs. Fletcher, Burrows & Co.'s colliery, complained of pains in his head, which he attributed to the explosive fumes. The pains brought on meningitis, which ended fatally on February 12, or three days after the inhalation of the noxious gas. The evidence of Dr. Martin was to the effect that the inhalation of noxious fumes, which brought about inflammation of the brain and membrane of the brane, was the primary cause of death. Dr. Paul, Professor of Medical Jurisprudence at the University College, Liverpool, said he had made an analytical examination, but with no positive result. He had discussed the matter with Dr. Martin, and thought the symptoms might be due to inflammation of the membranes of the brain, resulting from poisoning by substances like nitro-benzine or anilme, but there was no positive evidence to show that these ever did cause such inflammation, either directly or indirectly. So far as he could observe the man died from meningitis, and he thought the symptoms might be the result of poisoning by agents of the class named. In his opinion death from meningitis pure and simple in three days would be improbable. It might happen if there was some previous disease of the brain. Dr. Martin, recalled, said he was still of opinion that death resulted from the inhalation of noxious fumes. The jury, after ten minutes' consideration, found that death was due to the accidental inhalation of certain noxious gases liberated by the explosion of a roburite cartridge.

Conflicting reports reach us from Nova Scotia respecting the increased coal royalty. First we are told that the matter has been dropped for this session; then that the Premier says he will bring it on even if he is defeated; again we are informed that the lessees have played into the hands of the Government, have split among themselves, and are willing to compromise and pay an increasing rate of royalty for each successive term. Our readers, however, may rest assured that they did not form a mining society on the basis of the General Mining Association of the Province of Quebec to part company so soon. The lessees are unanimous. They have banded themselves together to see this question through. They rely on the justice of their case; at present they appeal to the moral justice of the Legislature, and if at first defeated they will not be discouraged, but fall back in good order to their lines before Public Opinion.

The organization of a strong and thoroughly representative union of the mining interests of Nova Scotia, noted elsewhere, marks an important epoch in the progress of mining in that province. The council and officers elected give confidence to the belief that, though the youngest, The Mining Society of Nova Scotia will soon take rank as the principal of our mining organizations. We heartily wish the association every success.

One of the first matters that will receive attention from the new organization will be the coal royalty. Informal discussions have been held with the Hon. Mr. Fielding, Provincial Secretary, touching what may be called a compromise between the claimants for moral justice on the one hand and the arbitrators of legislative power on the other. Secure to us, say the coal operators, fixity of tenure for the remainder of our leases and we will agree to pay, say, a royalty of ten cents "run of mine" for the whole period, although the consensus of legal opinion indicates that in a dispute between ordinary landlord and tenant, over the meaning of such an indenture as the coal lessees possess, the Supreme Court would decide in favour of the lessee. At these conferences, the Hon. Mr. Fielding has declared more than once that he did not propose to invoke the power of the Legislature but to exercise only the right held by the leases; yet at the same time he declined to allow the moral question of that right to be tested in the only satisfactory way it can be tested. He declined to allow a test case to go court. He declined to have it arbitrated on. He refuses to fix the rate of royalty except on an increasing scale on the full term.

Both sides are determined. The menace to the industry has become public, and as a result investments in the province have received a check. An instance before us is that of certain Boston capitalists who have written their Nova Scotia friends saying "they will not purchase, but will surrender their bond if the Government persist in the proposal to raise the present rate of royalty." Holders of gold and other mineral property are greatly annoyed at the doubt thus thrown on the title to mining lands in Nova Scotia, and fear that the difficulty of getting capital to develop mines will be largely increased unless the Legislature are roused to the seriousness of the question and at once pass a measure giving ample and unqualified security of title. Anent this deplorable measure, too much prominence cannot be given to Dr. Raymond's outspoken criticism of the policy, unfortunately too frequent these days, of squeezing Government revenue out of invested capital and industries. Dr. Raymond is, as all the world knows, secretary of the American Institute of Mining Engineers, and as a writer has given special study to the subject of mining legislation. In a recent contribution to the *Engineering and Mining Journal* he says:

"1. It will be useless to expect further investments of capital from abroad for the development of Nova Scotian resources if investors are given to understand that the conditions of their tenancy are liable to sudden change. The mere reservation, in some leases, of the power of the Province to make such change has been, to my personal knowledge, a hindrance to investments hitherto. Cautious capitalists have declined to put money into plant and mining work subject to the will of the Legislature as to their rights and obligations. Many have made investments, nevertheless, on the earnest assurance of promoters that, although the Legislature could alter the terms of leases, it would not do so, because it was heartily desirous to favour the development of the natural resources of the province. If this confidence is now proved fallacious, there will be no basis on which investment can safely be made here.

"2. It is highly demoralizing for any Government to make agreements with private citizens or corporations, in the terms of which an unlimited power of change is reserved to the Legislature. In the United States, coal and other mineral lands are sold outright, and the owners are taxed like other property-holders. This is one reason of the comparative ease with which capital can be secured here for such investments. It would be, in my judgment, better for Nova Scotia to adopt a similar policy. But if the coal lands are to be leased, then the Government should do as private owners do, namely, lease for a fixed period (25 or 30 years) at a specified royalty, and bind itself not to change that royalty until the end of that period. The effect of leaving the Legislature free to change it 'from time to time' is simply to make lessees dependent, not upon clearly defined rights of which they cannot be deprived, but upon the favorable or unfavorable action of a varying body of men, who have to be influenced, legitimately or illegitimately, to let the leases alone. This means, in the best case, considerable expense to the lessees for the proper representation of their case to successive legislatures. In the worst case, it means lobbying, bribery, and legislative black-mail. Canadian politics have furnished some recent instances, going to show that the worst may be apprehended in that latitude, as well as in this. I have no reason whatever to suspect the motives of the present Legislature of Nova Scotia. If I believed that body to be actuated by unworthy motives, I would waste no words in argument. On the contrary, I would simply say to my friends engaged in coal mining in Nova Scotia, 'These men want to be bribed to take their hands off your business. It is your duty to suffer the injury they threaten, rather than yield to their demands.' Perhaps my advice would not be followed; perhaps the crisis would be averted by secret means to the great injury of political morals, and a certain loss, besides, to the capitalists themselves, for nothing is more ruinous than to pay black-mail once, leaving to the next and the next and the next set of marauders not only the power to levy it again, but the encouragement of the established precedent.

"I would add here, that not merely the corruption of individual legislators, but also the changes of party control, are to be feared in such matters. A party in power, for instance, enthusiastically favours 'improvements' of all kinds; it offers bonuses, loans, cheap railroad rates, low taxes or no taxes, low royalties and large franchises, to attract and stimulate enterprise. It gets up a 'boom,' in short, and when the boom begins to decline, the business reaction from over-speculation extends to politics also, and the other party comes into power. Perhaps this alternation is a public benefit on the whole. No doubt the new administration is bound to overhaul the work of its predecessor, to correct abuses, to undo the result of actual fraud, and to adopt for the future whatever system it may deem better for the public welfare. But if it is to be understood that such 'reforms' are to include the revision of the terms of bona fide leases of land (even the right of such revision has been expressly reserved to the Government), the result will be to force the representatives of the capital invested in such leases, and in extensive operations connected therewith, to act, in pure self-defence, with one political party, to supply money for its expenses, and to influence employés in its favour. The corrupting influence of this situation cannot be over-rated.

"The net result of both the factors above described will certainly be, that the investment of capital for enterprises dependent for their profits upon the arbitrary action of the Legislature will be confined to parties who believe they have and can keep a 'pull' on the Legislature, either through alliance with the party in power, or through control of individual legislators. But such a 'pull' costs money, a great deal of money. Nobody who is willing to employ such means is fool enough to do so unless the profits of the business will be so large as to warrant this extra risk and expense. Such large profits cannot be made under free competition. Hence the industry itself is likely to be restricted, and the prices of the product are kept higher than they would be if capital were not thus handicapped. The total result, therefore, includes not only the demoralization of politics, but the retardation of industrial development.

"3. I doubt whether an increase of royalty upon coal could be borne by the collieries of Nova Scotia generally. Certainly the weaker enterprises would be seriously injured by it, and thus the business would be delivered into fewer hands, which is just what the public interest does not require. All taxes on gross product, without regard to cost of production, have this bad tenancy period. It is only when they are very small indeed that it may be overlooked. But whether the collieries can stand it or not, its future effect upon the Province would be disastrous, by introducing into the problems of industrial enterprise an element of unnecessary insecurity. There is insecurity enough, earth knows, in mining enterprise, without inventing new means of discouraging its promoters.

"There has never been, probably, more unemployed capital in London, Berlin, Paris and New York, than there is to-day. Yet it has seldom been so difficult to enlist it in promising enterprises. One principal reason is declared to be (and I believe the statement), the hostility shown by legislatures to capitalists and corporations. Granger laws, special tax-laws, laws dictating prices of commodities, and a host of other fanciful experiments in 'State Socialism,' are driving away capital from the places that need it most. Would it be wise for Nova Scotia to join this procession of folly, and give notice that she also 'from time to time,' intends to pluck and squeeze, and see how near she can come to killing, the goose that lays *her* golden eggs? If she does, even geese will shun her shores hereafter.

"4. 'But,' it may be asked, 'if it should be clear that the royalty now paid upon coal is smaller than, in fairness to the Province and without injustice to the industry, it ought to be, may not the Legislature, now or at any other time, at least wherever it has the expressly reserved right to change the royalty, exercise that right.

"My answer is that, as to future leases, there can be no question, and it would be a very good thing for the Legislature to try the experiment and see whether, under the higher royalty imposed, anybody would want to lease the lands. As to lands leased but not worked, there might be no special harm done by giving notice of a higher royalty to be exacted when work should be begun. But in both these cases I think assurance should be given that this new royalty would not be raised again for a period of years long enough to justify the investment of capital in extensive operations. Finally, as to enterprises now active upon leased lands, I think an immediate increase of royalty, whether lawful or not, would be in the highest degree unwise, and would inflict upon the Province an injury far greater than any benefit which could be expected from a temporary increase of revenue."

The Government of Nova Scotia has introduced their bill raising the royalty on coal 33⅓ per cent. Then, by separate Act, they propose to fix the date at which the increased royalty shall take effect. They name the 23rd of February, 1892! This is hardly credible. Casting to the winds all pretence of acting within their rights as lessors, they propose retroactive legislation. To demand additional royalty on quarterly returns for the period ending March 31st, already fyled, is indeed exercising the power of the Legislature with a vengeance.

How different to the honourable consideration for vested rights in Ontario by the Legislature of that province, which so lately carefully abstained from including in the rates of royalty leases granted prior to the passage of the Act imposing the new rates.

How different to the cautious regard for the rights of the lessees shown by this same House of Assembly in Nova Scotia in 1866, when, in furtherance of the interests of that province and the lessees whose capital had done so much to develop its resources, there was passed an Act which allowed renewals and gave, as was then supposed, a fixity of tenure, an Act which induced further expenditures of capital in that province.

The mineral lessees of Nova Scotia show legal opinion in writing, from prominent lawyers on both sides of politics, contending that the Legislature has not, as a matter of contract, the right to have, at the present time, a legislative revision of the royalty. The Government say they do not propose to exercise their power to over-ride contracts, and the Attorney-General declared he would blush were a breach of faith ever thought of in connection with this royalty measure. This is tantamount to saying the intention of the indentures should decide this difference of opinion. Why then is the offer of the lessees to have a test case go into court, not accepted?

An English company are making at Hartlepool, a new rope, which is called the anti-corrosive and self-lubricating strand wire rope. In

the process of its manufacture, the cores and all the wires in the strands are, we are informed, thoroughly coated with a preservative composition called glissantoline, which fills up the interstices of the rope, and makes it perfectly impervious against corrosion, as by bad water, steam, or other deleterious matter found in the workings of mines or elsewhere. It at the same time acts as a lubricant to the individual wires, and insures greater flexibility.

According to the trade and navigation returns, Canada imported for home consumption 1,598,855 tons of bituminous and 1,399,067 tons of anthracite coal during the fiscal year ending June 30, 1891. During that time there was exported 833,684 tons of bituminous coal, the product of Canadian mines. Of the total quantity of bituminous coal imported, 36,002 tons arrived from Great Britain and 1,562,753 tons from the United States. The total duty collected, at 60 cents per ton was $959,368. Of the total quantity imported 1,510,411 tons were taken by Ontario; 72,880 tons by Quebec; 28 tons by Nova Scotia; 4,491 tons by New Brunswick; 9,788 tons by Manitoba; 1,098 tons by British Columbia, and 159 tons by Northwest Territories. Turning now to anthracite coal which is imported duty free, the total quantity imported was 1,309,067 tons distributed as follows: Ontario, 931,463 tons; Quebec, 375,615 tons; Nova Scotia, 33,146 tons; New Brunswick, 50,375 tons; Manitoba, 6,224 tons; P. E. Island, 2,244 tons. Total value of anthracite coal imported into Canada during the year from the United States, $5,244,452. Turning now to exports, Canada shipped, as already shown, 833,68; tons of bituminous coal during the year ending June 30, 1891. Of this Nova Scotia mines exported 173,105 tons, Quebec 10,262 tons, and British Columbia 647,508 tons. The Northwest Territories sent out 223 tons. Of the products of the Canadian bituminous mines, Great Britain took 25,940 tons; Newfoundland, 73,397 tons; Sandwich Islands, 12,266 tons, and the United States 692,705 tons, the greater part of which was sent from British Columbia mines to Pacific ports in the United States.

The attention of Parliament was called the other day to the question of Civil Servants contravening the Civil Service Act by holding an interest in mineral lands and mines. This reminds us of a flagrant breach of the Act very apparent in the conduct of at least one member of the staff of the Geological Survey of Canada, and an Assistant Director at that, who makes a specialty of doing professional work, mainly on Sundays, for a consideration. This party has, to our knowledge, been employed reporting on mineral properties for certain corporations and individuals, and takes a fee—which from his salary he can very well afford to do—at less than half of the ordinary expert's tariff for such work. This is an injustice to the men who live solely by doing work of this kind, and we wish to see it put a stop to. In order that there may be no misconception as to who we refer to, we distinctly charge Dr. Robert Bell with being the offender referred to. We have in our mind at the present time his reports, written on the basis of a commercial negotiation, as follows: for Mr. George Stewart, on the High Falls phosphate properties, in 1889; for Mr. C. M. Pielsticker, London, Eng., on the McMillan property, in 1889; for the late Mr. Adamson, on the Victoria mine; on the Little Rapids property, for Mr. W. A. Allan. There are many other cases, but these are sufficient for our purpose.

The coal trade of Montreal is one that gives employment to a very large number of vessels during the season of navigation, and the prospects for the present year are therefore a matter of some interest. From present appearances there is not likely to be much increase in the volume of business, but it is even now evident that the trade is going to hold its own. Last year some 550,000 tons of Lower Port coal were brought to Montreal by water. This year purchasing has commenced about as usual, and most of the large orders have already been placed. The Gas Company, however, is not going to use as much coal this year. Last year the Gas Company purchased 55,000 tons of coal. It takes 25,000 tons less this year, but as the company has a stock of 10,000 tons left over, its total consumption this year will be in the neighborhood of 15,000 tons less than last year. The railroads have made their arrangements for their purchases. The Grand Trunk takes about 95,000 tons of Lower Port coal, and some 40,000 tons of American coal. The Canadian Pacific Railway takes about 125,000 tons of Nova Scotia coal. The big manufacturers are now placing their orders. This is the usual time for them, for if they do not purchase now the mines cannot make arrangement for tonnage to supply the orders. There are some 25,000 ton orders yet to come in, however. The sugar refineries, which usually take that amount each, are expected to place their orders at once. Steamship freights opened higher than last year, but as more tonnage came upon the market there was a decline, and the later boats were chartered at about last year's figures. There are still a couple of more boats to be fixed, however.

London advices of March 9th say: "As to the phosphate market, its position may almost be called an absurd one. People are trying hard to sell Florida phosphate, 75 per cent., at 8½d. A few cargoes have come over 80 per cent., but have not been sold at the price of 80 per cent., but at the price of 75 or 78 per cent., with rise, as the mine owners can never depend on 80 per cent. Florida 70 per cent. is unsaleable, but Bull River 60 per cent. can be placed at about 8½d. the reason for its preference being that manufacturers are in the habit of using it with low Belgian stuff, and it does not pay them to make any alteration in their plant, at least until Florida shall have thoroughly established itself in the market. The manufacturers' position appears to be one of great soreness. They have over-stocked themselves at what they thought bottom prices, and the bottom has fallen out, and now they find remunerative sales difficult. By May or June we may have a different state of things, but just at present two or three of our leading brokers are selling against one another for the purpose of realisation and finance. The market is simply in an impossible state."

The appearance of Mr. Sando in Canada, together with the . signation of Mr. Wills, the manager, and the abrupt termination of the Stewart contract, would seem to indicate an entire reconstruction on the part of the General Phosphate Corporation, Ltd. The company is unquestionably in a very bad way, and its dissolution seems not very far distant. From the very start its affairs have been grossly mismanaged. Money has been thrown away wholesale on the purchase of properties whose values were entirely unproved and whose subsequent working has equally failed to justify a fraction of the expenditure upon them. The balance sheet printed in a recent issue of this paper records an outlay for the purchase of some 2,660 acres of virgin lands, together with £7,798 10s. 6d., paid on option, for the North Star mine, at no less than £106,662 1s. 7d., while the expenses in London and at the mines have amounted to nearly £42,000. The quantity of phosphate produced in eighteen months' working only amounted to 1,000 tons, realising £3,339. When we compare this miserable result with the glowing statements set forth in the prospectus, estimating "an annual output of from 80,000 to 100,000 tons, realising an average net profit of from £1 to £1 10s. per ton," we are disposed to smile. It is obvious that these statements were made either without knowledge, or with the deliberate intent to mislead the public. It is indisputable that the directors went to allotment upon an absurdly insufficient capital; the promises of the prospectus have not been performed; the properties which were acquired by raising debentures, and thus mortgaging the credit of the company, have resulted in a loss, while the promoters and vendors are the only persons who have obtained any benefit from the promotion. The whole concern is but one more monument to English capital ill-applied and grossly mismanaged.

The Financial *Critic*, in an outspoken article handles the company without gloves. This is what it says: "Had the over-sanguine expectations of the promoters been realised in regard to the half of the £1,000,000 which was offered for subscription, doubtless some of these properties *would* have been acquired. But fortunately for themselves the public for once in a way were not slow to perceive some of the many weak points which abounded in the prospectus, and consequently stood pretty generally aloof. Notwithstanding that every will-o'-the-wisp dodge known to promoters was practised to abstract subscriptions, and hundreds of

pounds expended in advertisements, *only about 4,000 shares were subscribed by bona fide investors*, so that the founders, the majority of whom expected to be relieved of their guarantee of the subscription of fifty ordinary shares for every founder's share they accepted, were compelled to keep the full amount of ordinary shares guaranteed to be taken up. This represents about 15,000 shares, or a total in all of about £19,000, upon which ostensibly £2 has been called up, yielding, or rather that should have yielded, a capital to the company of £38,000. We think, however, it would puzzle the directors to prove that these calls have been paid, inasmuch as such a proceeding would affect very seriously some of these so-called founders, who never had the least contemplation of being saddled with any liability. The list of founders that was issued with the prospectus included a galaxy of high-standing and distinguished members of the Peerage, and of gentlemen whose names are known throughout the United Kingdom. The directorate, too, was a strong and faultless array, and the only wonder is that investors at large were not more dazzled and carried away by their imagination than they appear to have been. There is little doubt, however, that many of those who subscribed for shares did so in the belief that the prominent gentlemen whose names appear on the list had subscribed for ordinary and founders' shares, but we have reason to know that the said list was nothing more than what we may expressively name a 'bogy,' and fit only to rank with such beautiful specimens of the Dandoic, irresponsible compilation art as were exposed in the cases of the Metropolitan Coal Consumers' Association, and the Whole Meal Bread Company. If proof of this were needed, it is to be found in comparison of this list with the register of members of the company, which reveals the fact that a large proportion of the names appearing upon it as founders, do not, and actually never have held a single share, founder's or otherwise. With regard to the directors, Sir James Whitehead and Mr. Sampson S. Lloyd, who practically composed the business element of the board, were not slow to grasp the true state of affairs, and without prevarication resigned their seats forthwith. As to the wisdom of the step, there can be no question, and if the truth were known, Lord Stalbridge himself must regret the hesitation he displayed in following their lead."

One of the features of the ensuing meeting of the General Mining Association of Quebec will be a paper on "The Present Status of the Canadian Asbestos Industry," by our genial friend, Mr. L. A. Klein, of the American Asbestos Company.

The union of Mr. E. D. Ingall, of the Division of Mineral Statistics and Mines, with Miss Rand, of New York, is reported. The REVIEW hastens to express its congratulations and good wishes for the happy couple. The event is another outcome of the Ottawa meeting of the American Institute of Mining Engineers in 1889.

The "Bulletin" of the British Iron Trade Association, just issued, gives the total production of pig in the United Kingdom in 1891 as 7,228,496 tons, or a decrease of 646,634 tons as compared with 1890. There was a production of 1,642,005 tons of Bessemer steel ingots, or a reduction of 372,838 tons, the production of acid and basic steel ingots being 1,306,229 acid, 355,756 basic.

The district mine inspectors appointed by the late Mercier Administration have been dismissed. This is an economy which will save the Government several thousand dollars and which will rid the industry of a class of men who were of no earthly use to it.

Reports from Florida contain the statement that the phosphate boom in that country is at an end, and with the reaction a number of failures are announced. Many of the works are shut down and others are soon to follow. An English authority states that a very large proportion of the quantity exported as high test phosphate has proved of inferior quality.

The next quarterly general meeting of the Mining Society of Nova Scotia will be held at Halifax on or about the 15th June next. This date, following as it will close upon the meeting of the General Mining Association of Quebec, at *Black Lake, will give an opportunity to the* Upper Province men to visit and interchange ideas with their Nova Scotia brethren, which we trust will be liberally taken advantage of.

There has lately been issued an important bulletin on the forest and mineral wealth of Brazil by the Bureau of the American Republics, which states that scientific explorers have found great deposits of coal and iron, and have also proved that the country possesses copper, manganese, and argentiferous lead ore. There are also mines of gold and diamonds. Diamonds are co-extensive with the gold deposits, and like that metal, are most abundant in Minas Gereas, where they have been found since 1879. The most important locality known for the production of these gems is the district of Diamantina, in the above-named State. They are found in Parana, in the gravels of the river Tibagy, and in the beds of streams dry during the summer. Since the discovery of diamonds at the Cape of Good Hope, the Brazilian production has greatly diminished. As regards iron, the State of Minas Garaes abounds with it. It is not found in veins or strata, buried deep in the earth, but in enormous beds, often lying at the surface, or in mountain masses. These vast deposits are worked only by small scattered furnaces, charcoal being used in the reduction of the ore. Of these small furnaces there are five groups, producing about 3,000 tons annually, the product being used in the surrounding districts in the manufacture of articles of home consumption, such as hoes, shovels, picks, drills, nails, horse shoes, &c. In the State of San Paulo are found deposits similar to the best Norwegian ore, and one of the mines is worked by the Government establishment near the village of Soracaba. This establishment has two furnaces, and produced in one year about 790 tons of pig iron. The ore has about 67 per cent. of iron. In Santa Catarina, not far from a harbour accessible to the largest vessels, are vast deposits of hematite, containing, on an average, 30 per cent. of manganese and 20 to 30 per cent. of iron. In the State of Goyaz, as in Minas Geraes, are found enormous masses of the ore itaberite.

Summaries of the statistical portion of the reports of her Majesty's Inspectors of Mines for the year 1891 have just been issued as a Blue Book. These summaries show that during the year 1891 the total number of persons employed in and about all the mines in the United Kingdom of Great Britain and Ireland, together with the Isle of Man, and inclusive of those employed on private branch railways and tramways, and in washing and coking coal on premises adjacent to or belonging to the mines, amounted to 707,411, of whom 6,112 were females above ground. The number of persons employed in and about all the mines, exclusive of those employed on private branch railways and tramways, and in washing and coking coal, was 687,878, of whom 5,819 were females, the aggregate increase being 32,581. The total number of fatal accidents was 961, and the total number of deaths occasioned thereby 1,030, being an increase of 62 in the number of fatal accidents, and a decrease of 176 in the number of lives lost, compared with the totals of the preceding year. There was one death for every 668 persons employed, which is more favorable than the ratio one in 543, of the preceding year. In the mines classed under the Coal Mines Regulation Act, the total quantity of mineral wrought in the different districts was 197,693,592 tons, of which 185,479,146 was coal, and 29,150 ironstone, the rest being fireclay, oil shale, and other minerals, making a total increase of 3,087,705 tons, compared with the preceding year, there beng an increase of 3,864,838 tons of coal, but a decrease of 888.326 tons of ironstone. One of the summaries shows the ratios of the fatal accidents and the deaths to the number of persons in and about mines under the present and former Coal Mines Acts, given in averages for the periods covered by the first three Acts, and in detail with the averages since 1878, from which it appears that the occupation of the miner is now very much safer than at the commencement of the Mining Acts, the average ratio under the first Act being one death in every 233 persons employed, under the second Act one death in 258, under the third Act one death in 312, under the fourth Act one death in 466, whilst for the present year it is one in 662, a much more favourable ratio. The ratios of accidents and deaths to the number of persons employed, and tons of mineral wrought in each of the districts shows a general average of 217,007 tons of mineral wrought for every fatal accident, and 201,934 tons for every death, as compared with the more favourable quantity

of 226,023 tons per fatal accident and the less favourable quantity of 167,763 tons per death in the preceding year. The number of persons employed on private branch rail ways and tramways, and in washing and coking coal on premises adjacent to or belonging to the mines, was 19,533, of whom 293 were females. The number of fatal accidents was 26, the number of deaths resulting therefrom was 26, and there was one fatal accident for every 751, and one death for every 751 persons employed, which are more favourable ratios than in the preceding year. During the year 1891 the total number of persons employed in and about the mines under the Metalliferous Mines Regulation Act was 38,418, of whom 1,363 were females employed above ground. There were 50 fatal accidents and 51 deaths, the number of accidents being 12 more and the number of deaths 5 more than in the preceding year. There was one fatal accident for every 788 persons employed, and one death for every 773 persons employed, which are less favourable ratios than in the preceding year.

CORRESPONDENCE.

The Quebec Mining Inspectors.

SIR,—The Government of Quebec being about to appoint a Mining Inspector for that Province, it is highly important to the future welfare of our Mining Industries that a suitable man should be chosen and entrusted with this position.

We have heard a great deal lately from electioneering platforms about the pernicious effect of the incompetence of men holding this authority, obtained by no other recommendation than political bias and favour, and we surmise that the DeBoucherville Cabinet will steadfastly avoid such influence in making their choice.

This Government has already expressed its determination to very carefully revise the Mining Act, through the Hon Commissioner of Crown Lands, as communicated to the Council of the General Mining Association of Quebec on the 31st of March last, and everyone interested in the successful development of the natural resources of the Province, look to this new measure with eagerness and confidence.

Its practical effect, however, will depend to a very large extent on the abilities of the officers who have to put it into execution, and all practical mining men will agree that the Inspector to be appointed cannot be too efficient in the profession which he is called upon to exercise.

It is publicly known that several of the candidates for the position are neither graduates of any school, nor have they received any technical education whatever which is required to fit them for their duties, and such men could never render any benefit or honour to the position which they would thus usurp.

It cannot be ignored that a Mining Inspector should possess at least an elementary acquaintance with (in addition to the three R's) physics, inorganic chemistry and analysis, surveying, mineralogy, metallurgy, geology, mechanics, steam, etc., and *practical mining*. Would it not, therefore, be desirable to make a competitive examination the basis of the selection of this Inspector?

Another point which should be rigorously enforced is the inadmissibility of any candidate for this inspectorship who may hold or possess any personal or pecuniary interest whatever in any mining or metallurgical enterprise carried on within the territory of his jurisdiction, or who may be a speculator in undeveloped properties or mineral lands. (Vide Quebec Statutes, sections 46, 114 Victoria, chap. XII.)

We hope to see that our legislators and those interested in the development of our mineral resources will take this matter up in the most serious manner and correct the mistakes of past experience, and thus assist an industry and natural wealth which only needs their wisdom and attention in order to revive it.

JOS. LAINSON WILLS, M.E.

OTTAWA, April 26th, 1892.

The Cost of a Small Blast Furnace Plant.

SIR,—Would you be so kind as to furnish me, through your columns, with some idea of the cost of the equipment of a 50, 80 and 100 ton furnace?

Yours, etc.,

T. B.

KINGSTON, 29th April, 1892.

[We will attempt to reply to this question, which is far from being an easy one, for the cost of a blast furnace depends, first, on its location, second, upon its equipment, and, third, upon the general character and finish of the work.

The capacity or output of a blast furnace is also dependent upon the ores used, the fuel available, the character of the equipment, and, more than anything else, upon the management. Therefore, what would be a 50 ton furnace in one location might with different ores and fuel, and even different management, be an 80 and even a 100 ton furnace.

Basing cost upon a good substantial construction, where building material does not command excessive prices, where machinery can be purchased cheaply and where labour is not above normal conditions, a blast furnace substantially constructed, free from unnecessary ornamentation and equipped with good machinery, which could under efficient management, using easily smelting ores high in iron and satisfactory coke, produce the quantities named, would cost about as follows: A 50 ton furnace, $80,000 to $100,000, an 80 ton furnace, $100,000 to $125,000; and a 100 ton furnace $125,000 to $150,000. There would be little difference between the cost of a 50 and 60 ton furnace.

The above estimates are intended to cover a complete plant, ready for operation, which can produce continuously the quantity of iron named, and are not plants of smaller capacity which can periodically be spurred up to the outputs you require. Of course, furnaces can be constructed much cheaper than the figures given, or can be embellished to add largely to the cost. These figures are only approximations, for unless we knew the location, the character of the material to be used, the kind of product to be made, we would be unwilling to be quoted as giving the estimate.—EDITOR.]

Impressions of Kootenay.

SIR,—In response to your request to give you my impressions of the Kootenay District of British Columbia, I have pleasure in sending you a brief report. At the time of my visit the snow was on the mountains and was not expected to disappear from the most noted mineral locations until the middle of May. I can, therefore, do little more than give you a general description of the country and a report of the talk of the region, and this can be done in one word for each topic—mountains and boom. The hills make a sheer ascent from the magnificent waterways, and from the centre of Kootenay Lake more than fifty peaks are visible, with the assurance of a limitless sea of mountains beyond. The best mineral prospects yet found are at an elevation of from 4,000 to 6,000 feet, and at present there are no electric railways or cable cars to afford easy access. The hills, however, are not as heavily timbered as in some other regions, and I have seen fully as difficult places to prospect in the County of Ottawa. There being no hardwood, the undergrowth is not so thick as with us, though the fallen trees are a serious obstacle. I was surprised to find that there are as yet no productive mines in that district; the great number of the so-called mines being unexplored locations—sometimes made in the snow. There are, however, a few properties on which enough development work has been done to determine their value. The most notable, and in fact the only "bonanza," is the "Silver King," on Toad Mountain, near Nelson, which by a tunnel of 850 feet, is said to have proved ore "in sight" to the value of $1,600,000, and which is estimated to have at least $100,000 in the dump. This is a "dry ore" containing copper, and is said to give from 30 to 1,000 oz. of silver to the ton. No one is allowed to visit the mine and the reports of values are so conflicting that it is difficult to form an opinion. One person, who had good sources of information, told me that the ore would average 50 ounces of silver to the ton, and that the vein in the end of the tunnel just now was only 14 inches in width. Other reports make the vein the whole size of the tunnel with more beyond. As the mine is merely being exploited for the English stock market, no dependence can be placed on the rumours.

At Ainsworth half a dozen properties have been tested by shafts to the extent, in one case, of 120 feet. The ores are chiefly of argentiferous galena, and the seams vary from a few inches to several feet. Some streaks of ore containing ruby, silver and wire silver are found, giving very high assays, but I judge that an average of 30 to 50 ounces to the ton is a representative value for this region. I asked the foreman at one mine what his ore would assay and his reply was, "Anything you like to make it;" an answer which explains the wide variation in assays. I visited one prospect showing two feet of galena ore, which at the end of a tunnel of 30 feet had narrowed to two inches, and so it goes in and out as minerals have a way of doing in other localities.

Near the Slocan Lake, some 20 miles north west of Ainsworth, rich samples of ore were picked up last fall asssaying from 100 to 2,000 ounces of silver to the ton. The principal finds were at an elevation of 6,000 feet, and as yet no development work has been done that can afford any idea of the extent of the deposits. A large number of men are going in with tents, camping at the edge of the snow, and prospecting up the mountains as the thaw progresses. Some claims have been sold to parties who will provide funds for development, and this season's work will show what the ground is made of.

The mining laws are very liberal, and Capt. Napoleon Fitz Stubbs, the Gold Commissioner, exercises an equitable control over the region. A smelter is being built at Pilot Bay, 8 miles from Ainsworth, on the east side of the lake, under the direction of Dr. Hendryx, and there are numerous proposed railways. The construction of a finishing connection with the existing road from Little Dalles to Spokane, Washington, has been opposed by the Canadian Pacific Railway, which naturally wishes to control transportation; but as nearly all the work is being done by United States capital, the establishment of a railroad to the south is a foregone conclusion.

The chief difficulty with regard to the development of the region is the political commercial restriction. The bulk of the supplies must come from the United States, and their cost is greatly enhanced by the Canadian tariff, while on the other hand the export of products is met by the United States duty of $30 a ton on lead. The country is thus between two fires, and must suffer from these embarrassments. It may be, however, that the ores may prove rich enough to bear the burden of these imposts and of the efforts made to make commerce conform to national lines rather than to geographical laws; but every one feels that the country is politically in an unfortunate position.

The town of Nelson is thriving, and a corner lot, 50 x 120 feet, has been sold for $4,000. Lots in the "new and thriving City of Kaslo" are selling at $400 each, although at the time of my visit the city consisted of two houses and a prospective store. A new town, Eldorado City, near Slocan Lake, is starting this spring, and some twenty edifices have already been put up. There will be a great rush of people to the region this summer, and doubtless some very rich finds will be made, and some still richer ones will be reported. Although there will necessarily be much disappointment, the air of the region is charged with hopefulness, and as a miner remarked to me, "A downhearted man in this country is a curiosity." I can perhaps give you the best summary of my impressions by saying that while realising the risks and difficulties so keenly that my enthusiasm is not of a booming nature, I am going to send out my own prospectors to try their skill and more especially their luck in the Slocan region.

ROBERT C. ADAMS.

MONTREAL, April 25th, 1892.

The Quebec Mining Act—Satisfactory Interview with the Hon. E. J. Flynn, Commissioner of Crown Lands—A Liberal Measure Promised.

On Thursday, 31st ulto., the following deputation, representing the General Mining Association, of the Province of Quebec, had the honor of an interview with the Commissioner of Crown Lands at Quebec, with reference to the mining law of the Province:—Hon. George Irvine, Q. C., (Johnson's Company,) Quebec, *President*; James King, M.P.P., (King Bros.,) Quebec, *Vice-President*; L. A. Klein, (American Asbestos Co.,) Black Lake Que.; John J. Penhale (United Asbestos Co.,) Black Lake, Que.; Capt. Mathew Penhale, (Glasgow and Montreal Asbestos Co.,) Black Lake, Que.; Col. Lucke, (Beaver Asbestos Co.,) Sherbrooke; A. M. Evans, M. E., (King Bros.,) Black Lake, Que.; O. M. Harris (Canadian Phosphate Co.,) Montreal; J. Lainson-Wills, F. C. S., (General Phosphate Corporation) Ottawa; J. B. Peters, (Peters' Asbestos Mine,) Quebec; J. Burley Smith, M. E., (Anglo-Continental Guano Works Co.,) Glenalmond, Que.; R. T. Hopper, (Anglo-Canadian Asbestos Co.,) Montreal; W. H. Jeffrey, (Jeffrey Asbestos Mine) Richmond, Que., B. T. A. Bell, Editor CANADIAN MINING REVIEW, Ottawa, *Secretary*. The deputation was received by the Hon. Mr. Flynn and the Hon. Mr. Pelletier, Attorney-General.

HON. GEORGE IRVINE, Q.C., having explained the object of the interview, stated that he believed the Government had repealed the confiscatory clauses of the Mercier Act. Is that so?

HON. E. J. FLYNN—Yes, I believe so.

HON. MR. IRVINE, resuming, dwelt upon the extent and importance of the mineral resources and the benefits to be derived by the province from its fullest growth and prosperity. That portion of the country on the line of

the Quebec Central Railway where his mines were situated was, until the establishment of the asbestos industry, a barren and uninhabitable wilderness, but with the opening of the asbestos mines there had grown up large settlements and a prosperous community. Mining was certainly an industry worthy of being encouraged by the most liberal legislation. Two years ago the Dominion Government, with a view to its extension throughout the country, had admitted free of duty all machinery of a kind or class not already manufactured in the country. This has proved a great benefit to the producer, inasmuch as it permitted him to import certain classes of machinery, indispensable to his work, not to be had in Canada. The Mercier Act was probably not intended to be unjust, as some of its provisions assuredly were. It was framed and passed without obtaining the views of the persons engaged in mining, who were the only competent parties to be consulted, or who could give information on a matter of so vital importance to them. The bill was passed through the House, he thought, in one day's sitting —certainly in two—and the following day was printed. The miners were given no time to object or suggest amendments. The royalty on the gross product, which he was glad to hear had been repealed—at all events on mining lands sold by the Crown prior to 1880—was most unjust. Many of the companies made very large expenditures in labor and machinery, and the returns often were small, in some cases none at all. This royalty, if carried out, would have diminished or annulled these small profits, while the loss of the companies not making any profits would be greater. The mining community, he thought, contributed already, by their corporation taxes, imposts on powder magazines, municipally and otherwise, more than their fair share of the public revenue. They certainly did not object to contribute their fair share of taxation, but it must be just and equitable. Royalty on the output of mines was a pernicious system that was generally condemned by miners all the world over. He was sure the Government would gain more—at all events the producer would—by the total abolition of any royalties on the product of the mines. It would be better to sell the mineral properties of the Crown at a good price outright. The old practice of placing them up at public auction had worked acceptably. He pointed out that the Mercier Act gave extraordinary powers to inspectors; such as determining boundaries—which he claimed should be settled by the courts by action *en bornage*. One good inspector was quite sufficient. The men appointed were people who knew nothing about mining—in the Thetford district, the official was a lawyer—a very respectable gentleman, no doubt, but not in any way qualified to deal with mining questions from a practical or theoretical standpoint; in the County of Ottawa, the inspector, Mr. Viau, he understood was a shoemaker. There was also a good deal of complaint about the infringement of the law respecting the sale of liquor in mining districts. The men could buy the liquor by the bottle from stores, and a good deal of trouble and annoyance had been created. The inspector might be given powers to deal with such cases. Mr. Irvine then made a strong case against the tax on powder magazines. The amount, $150, for a minimum storage of 25 lbs. of powder or explosives of any kind was felt to be excessive and uncalled for. The amount should be minimised. He called attention to the serious menace mining companies had in the case of bush fires. Much loss had been inflicted by the careless and wanton destruction of valuable timber by settlers clearing their bush land. He asked for a more stringent application of the law in this regard.

JAS. KING, M.P.P.—I do not think I can add anything to what Mr. Irvine has said. I take it as the policy of the Government to do everything in their power that will tend to develop the industries of this province, and to do so means to draw capital and capitalists. You must do something to bid for this capital; you cannot do better in the interest of this province than to bid for the capital to develop its mines and minerals. He commended the Act of 1880, the main features of which were fair and equitable to the investor and the producer.

MR. PELLETIER—I think the Province of Onterio has charged a royalty.

MR. B. T. A. BELL—Yes; but Ontario lands are to be granted on the lease system, and royalty is not to be collected for some years after the entry has been made. At all events the law is not retroactive like Mr. Mercier's. The imposition of the tax under the Act of 1891 had created a feeling of insecurity, and capitalists were chary of investing until some assurance had been given that it would be annulled. Every inducement should be given for the investment of capital, and the fewer restrictions the better.

MR. J. BURLEY SMITH said he never in all his experience heard of an inspector collecting taxes. Their duties ordinarily were largely to see that the laws concerning the health of the employés were observed. His company had a good deal of money invested in works at the mine. Last fall the farmers set fire to their bushland, and started a conflagration which was within an ace of completely destroying the buildings. The Government should not only make laws to take money from the miner, but should also legislate to protect and promote their interests. He would suggest that some power be given to the mine inspector to enforce the law already in existence with regard to these bush fires. He should have power to compel the Forest Ranger to carry out the laws. This official had never been at his place, and had paid no attention whatever to his letters calling attention to the wilful destruction of the forest and the danger caused to his buildings thereby.

HON. MR. IRVINE asked that any new legislation might be submitted to the Association for suggestion.

HON. E. J. FLYNN—I am much pleased to meet this delegation and to hear the opinions thus expressed on a question which I have given much thought and study. While of course I cannot voice the views of the Government, or say what it will do, I may say that personally I do not think the mining industries have advanced to that stage when they can be made a source of revenue. Some years ago when framing the Act of 1880, I went very carefully into the matter, and I did not think we could adopt a revenue policy then. I have seen no reason to change that opinion. I am in favor of as liberal a measure as possible to protect both the interests of the mining industry and the revenue of the country. When all is reckoned, very little revenue has been derived from this source in the past. The law I intend to introduce must of course have the concurrence of my colleagues. I will be very pleased to have suggestions from your Association. I am in favor of a measure which will give satisfaction to all.

The Hon. Mr. Irvine having thanked the commissioner and Mr. Pelletier for their very courteous hearing, the deputation withdrew well pleased with the result of the interview.

The Mining Society of Nova Scotia—A Strong Union of the Mining Interests Formed.

Pursuant to the call issued on the 16th of March there gathered in the Halifax Hotel, Halifax, on Wednesday, March 30th, a large number of gentlemen representing the varied mining interests of the Province. Among others present were: Mr. John E. Hardman (Oldham Gold Co.), Oldham; H. S. Poole, F. G. S. (Acadia Coal Co.), Stellarton; Chas. Archibald (Gowrie Coal Co.), Cow Bay; D. J. Kennelly (Sydney and Louisburg Coal and Rail Co.), Sydney, C.B.; J. S. McLennan (International Coal Co.), Sydney, C. B.; A. A. Hayward (Lake View Mining Co.), Waverley; J. D. Austen (South Uniacke Gold Co.), Halifax; R. H. Brown (General Mining Association of London, Eng.), Sydney; Wm Lithgow and J. R. Lithgow (Glace Bay Mining Co.), Halifax; Chas. Fergie (Intercolonial Coal Co.), Westville, N. S.; G. W. Stuart, Truro, N. S.; H. T. Harding, Truro; B. G. Gray, Halifax; B. C. Wilson, Waverley; T. R. Gue, Halifax; Geo. MacDuff, (Palgrave Gold Co.), Waverley; Harvey Graham (New Glasgow Coal and Iron Co., New Glasgow; R. G. Leckie (Londonderry Iron Co.), Londonderry, N. S; H. M. Wylde, Halifax.

The meeting was called to order by Mr. J. E. Hardman, Chairman of the Provisional Committee, who briefly explained the objects of the call and the purposes for which it was proposed to unite the different mining interests of Nova Scotia. The outline proposed was similar to that followed by the Gold Miners' Association, which had had four years' successful experience.

Upon motion, it was resolved that it was expedient to form "The Mining Society of Nova Scotia," and the society proceeded at once to organize. The constitution and by-laws were taken up clause by clause, debated and passed, as follows:—

I. Name.

The organization will be called "The Mining Society of Nova Scotia."

II. Objects.

The object of the Society shall be to mutually benefit and protect its members, by facilitating the interchange of knowledge and ideas and by taking concerted action upon all matters affecting or relating to the Mining Industries of the Province of Nova Scotia, and generally to promote the said industries by all lawful and honourable means.

III. Members.

The Society shall consist of Members, Associate and Honorary Members.

Members shall be persons engaged in the direction and operation of mines and quarries in the Province of Nova Scotia, more particularly mine and mill owners, parties interested in the ownership of mines, mine managers, superintendents and metallurgists.

Associate Members shall be persons not eligible in the foregoing clause, but such persons whom the Society shall deem worthy of admission for membership.

Honorary Members shall be persons eminent in the profession or in the mineral history of the Province.

IV. Officers.

The Officers of the Society shall consist, 1st—of a President; 2nd—Three Vice-Presidents; 3rd—a Secretary; 4th—a Treasurer; 5th—nine members in good standing, who shall act with the other officers as a General Council, five of whom shall constitute a quorum for the transaction of business.

BY-LAWS.

I. Election of Members.

Application for admission to membership shall be signed by not less than three members in good standing and sent to the Secretary. At least three weeks previous to the date of ballot the Secretary shall provide each member with a ballot slip stating the names of the candidates and their endorsers. A member voting shall sign the ballot slip and return it to the Secretary, erasing "aye" or "no" opposite the name of each candidate. At least fifteen votes in favour of any candidate must be cast to elect, and five negative votes to exclude. Members in good standing only shall be allowed to ballot.

II. Fees.

The Membership Fee shall be ten dollars, payable annually in advance at the Annual Meeting of the Society.

III. Election of Officers.

Nominations for officers shall be sent to the Secretary at least one month previous to the date of the Annual Meeting, and election shall be by ballot, as in the case for membership, on a form prescribed by the Council.

Vacancies occurring in the officers or Council of the Society shall be filled by the Council until the next Annual Meeting.

IV. Duties of Officers.

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

The Treasurer shall hold in trust the invested funds of the Society, which shall be deposited in the name of the Society at a bank approved by the Council, and shall present, from time to time, a statement of the Society's accounts. All cheques shall be signed by the Treasurer and countersigned by the Secretary.

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

The Council shall have the general control and direction of the affairs of the Society.

V. Meetings.

The Annual General Meeting for the election of Officers, the transaction of the business of the Society and the reading and discussion of papers shall be held in the City of Halifax, N.S., on the second Wednesday in March of each year.

General Meetings for the reading and discussion of papers and for the transaction of business shall be held quarterly at such time and place as the Council may determine.

Special Meetings may be called by the President at any time, or by the Secretary, on the requisition of five members, notice of which shall be mailed by the Secretary to members of the Society. Any special business or subject for discussion shall be specified in the notice convening such meetings, and the Secretary shall give not less than fourteen days' notice thereof to all members of the Society.

No resolution shall be recorded on the minutes for which less than ten votes are cast. No measure shall pass or action be taken in the name of "The Mining Society of Nova Scotia" at any special meeting without the previous sanction of the Council.

VI. Consulting Officers.

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

VII. Amendments.

Amendments to the by-laws can be made at any regular meeting of the Society, provided a month's notice of the amendment shall have been previously mailed by the Secretary to the members of the Society.

The election of officers was then proceeded with, when the following were chosen for the ensuing year:

President:

Henry S. Poole, F. G. S. (General Manager Acadia Coal Co.), Stellarton, N. S.

Vice-Presidents:

John E. Hardman, S. B. (Oldham Gold Co.), Oldham, N. S.; R. G. Leckie (Manager Londonderry Iron Co.), Londonderry, N. S.; David McKeen, M. P. (Managing Director Caledonia Coal and Railway Co.), Glace Bay, C. B.

Treasurer:

J. R. Lithgow (Sec. Glace Bay Mining Co.), Halifax.

Secretary:

H. M. Wylde, Halifax.

General Council:

Charles Fergie, M.E. (Intercolonial Coal Co.), Westville, N. S.; Charles Archibald (Gowrie Coal Co.), Cow Bay, C. B; R. H. Brown (General Mining Association of London), Sydney, C. B.; J. R. Cowans (Cumberland Railway and Coal Co.), Springhill; B. C. Wilson, Waverley; George W. Stuart, Truro; Harvey Graham (New Glasgow Coal and Iron Co.), New Glasgow; A. E. Sjöstedt (Pictou Charcoal-Iron Co.), New Glasgow; Clarence Dimock (Wentworth Gypsum Co.), Windsor, N. S.

Mr. Poole, upon taking the chair, made a short speech bearing upon the aims and objects of the Society, which was warmly applauded.

Upon motion, the following gentlemen were made

honorary members of the society: Sir Wm. Dawson, Prof H. Y Hind, Hugh Fletcher, B.A.; E. R. Fairbault, C. E., and F. Gilpin, jr, Inspector of Mines.

Several matters of detail were then referred to the Council, and it was then announced that the afternoon session would be devoted to the discussion of the question of the increase of the coal royalty.

In the afternoon a goodly number of those interested in coal mining met at 2.30, and after preliminary discussion a sub-committee consisting of Messrs. Poole, McLennan and Franklyn were appointed to confer with the Government and report at the evening session

The evening session assembled at 8 p.m., and after doing justice to an ample bill of fare, Mr. J. S. McLennan gave a report of the sub-committee on royalties. Speeches were made by Messrs. Archibald, Kennelly, Wade, MacDuff and others, and the first meeting of The Mining Society of Nova Scotia adjourned until June next, after scoring an unqualified success.

Ontario's Mining Laws. The Director of Mines Defends the Government's Policy in Relation to Royalties.

The following excerpts from the advanced sheets of Mr. Blue's report, just issued, will be of interest as explaining the local Government's attitude towards its mining lands:

The price of mining lands under the old Act in the districts north of Lake Nipissing and the French and Mattawa rivers was uniformly $2 per acre, and in districts south it was $1 per acre.

Under the amended Act prices are graduated according to the situation of lands with respect to railway lines and surveyed territory, ranging from $3 to $4 50 per acre in the districts north, and from $2 to $3 in the districts south of Lake Nipissing and the French and Mattawa rivers.

But the new Act also contains a provision which enabled parties who had made application under the terms of the old Act and paid in money thereon, or who as prospectors or explorers had applied for and expended money or labor in proving locations, to acquire lands at the old price and free from royalties and working conditions, upon renewal of application and payment of the purchase money.

The following table shows by districts the area for which patents in fee simple were issued and the amount paid therefor into the treasury of the province for the year ending December 31, 1891:

District.	No. of patents.	Acres.	$
Rainy River	46	6,812	14,020
Thunder Bay	72	17,172	34,936
Algoma	130	29,580	59,519
Nipissing	20	3,364	6,349
Parry Sound and Muskoka	4	365	365
Elsewhere	17	2,096	2,325
Total	289	59,389	$117,514

Under the leasing clause parties may acquire mining lands in the districts north of Lake Nipissing and the French and Mattawa rivers at the rate of one dollar per acre for the first year, and twenty-five cents per year thereafter, and in districts south of those waters at sixty cents per acre for the first year and fifteen cents per year thereafter.

This feature of the Mining Act is a novel one in this province, and in view of the tenure which so generally obtains in Canada and the United States leasehold from the Crown can only be regarded as on trial. So far it has been favorably received by all classes of mining men, as a large proportion of the applications for lands now being received are made under the terms of the leasing clause. Should it for any reason prove unsatisfactory to the holders they are free to change the tenure into fee simple, in which case the payment of the first year's rent would be applied on the purchase money.

In the State of Minnesota the leasing system was adopted three years ago, and is reported as working very satisfactorily alike to leaseholders and the state. In the Australian colonies and New Zealand all mining lands are leased, and the rental is a fixed one, ranging from five shillings to twenty shillings sterling per acre for each year of the term.

The following table shows by districts the area of mining lands for which leases were granted last year under the terms of the new Act, and the amount paid into the treasury for the first year's rent:

District.	No. of leases.	Acres.	$
Rainy River	2	129	129
Thunder Bay	11	1,267	1,267
Algoma	14	1,793	1,793
Nipissing	17	1,529	1,529
Parry Sound	2	205	123
Elsewhere	1	75	45
Total	47	4,998	$4,886

At the present date (March 15, 1892) thirty more leases are ready for execution covering an area of 3,500 acres.

ROYALTY ON ORES AND MINERALS.

The royalty provision has been more severely criticised than any other of the amended Act. It is, indeed, the only one to which strong objection has been taken, and many sins have been laid at its door by the opponents of the clause. But the subject has more than one side, and there has been much misrepresentation.

It has been charged, for instance, that the royalty has destroyed mining operations in the North Shore districts and driven capitalists and miners out of the country.

This assumes that the clause is already in force, and that it affects alike all mining lands, whether the title is in or out of the Crown. The facts are that it does not apply at all to any lands patented previous to the 4th of May, 1891, saving lands patented under the Free Grants and Homesteads Act; and it cannot apply to any lands sold or leased after that date until seven years from the issue of the patent or lease except in the case of mines known to be rich in nickel, and as to these it cannot apply for four years.

It is true that mining has been comparatively slack during the past year, but not in Ontario or Canada alone. In the United States and Great Britain there was a serious depression as an immediate consequence of the failure of large banking houses in both countries in the latter part of 1890 and the beginning of 1891. The falling off in the tonnage of Lake Superior iron ore in 1891, compared with the output of 1890, was greater than the tonnage of all the iron ore ever raised in the Province of Ontario, if not in the whole of Canada.

In Great Britain inactivity continued throughout the year, but in the United States the industry revived in the last six months as a result of the good harvest in that country.

In Canada, and especially in the province of Ontario, we are dependent on foreign capital to open up and work our mines of iron, nickel, gold, silver, phosphate, etc. Our own capitalists are shy of such investments. Except in rare instances they cannot be persuaded to put their money into mines, or blast furnaces, or reduction works, or refining works, or rolling mills. Enterprise of this sort is a thing of growth and education, and inasmuch as hitherto we have had to rely upon British and American capital to buy and develop our mining lands it can readily be perceived how the financial failures of 1890-91 would affect mining operations in our country.

For more than twenty years miners were free from the payment of royalties to the Crown in Ontario, yet during that period the industry did not prosper. Silver mining was stirred into activity at one time, as an indirect consequence of the policy of putting a provincial tax on mining lands, but the iron, copper and gold mines were idle, and the phosphate and gypsum mines were worked intermittently, in a half-hearted way. We had neither capital nor skill to operate them, and the abolition of the royalties does not appear to have offered a new inducement to one or the other.

The discovery of nickel ore in vast quantities in the North Shore districts a few years ago, and the more recent discovery of the value of nickel as an alloy with steel, have done more than anything else to attract attention to the mineral resources of our province, and there is no evidence to show that the royalty clause of the amended Act has kept out skill or capital in so far as this ore is concerned. It probably did interfere with the plans of dealers, some of whom made fortunes by the sale or lease of undeveloped properties acquired under the terms of the old Act, and all of whom were sanguine of making larger fortunes had the Legislature not seen fit to consider the share of the public interests in that portion of the Crown domain as something apart from the interests of individuals.

A boom has been arrested, but not a mining boom. The men who complain most persistently of the Crown royalty are not miners or mining companies; they are persons who lived in expectation of becoming "kings" themselves, with miners and mining companies paying royalty dues to them.

I have in mind one case in which an option sale of three small locations of nickel ore, situated eight or ten miles from a railway, was made to an English syndicate for a consideration of about $120,000 and a royalty of twenty-five cents per ton on a daily minimum of 200 tons of ore. A payment of several thousand dollars was made on the purchase and as much more was spent in exploring the property last summer, when the representative of the syndicate came to the conclusion that the price agreed upon was far too high in view of the terms upon which locations might be procured from other parties or from the Government. An effort was then made to buy the locations from the owners free from royalty terms, but the price demanded (a quarter of a million dollars) led the syndicate to abandon its option, and meantime they have withdrawn from the country.

Numerous instances of this kind might be cited, and there is no doubt but that the system of private royalties is in great favor with mineral land owners of speculative tendencies.

The iron locations on the Atik-Okan river, fifty miles from the nearest railway station, are understood to have been optioned to a Belgian syndicate subject to royalties ranging from twenty to twenty-five cents per ton; another location in Hastings county has been leased subject to a royalty of forty cents; a barytes mine in Lake Superior is leased at twenty-five cents, and a phosphate mine in the eastern part of the province at two dollars per ton, with a fixed minimum output in each case.

It would be easy to lengthen out the list if it was necessary, for the plan of making mineral land a source of revenue to the owner suggests itself naturally; it is the all but universal practice in Great Britain and the United States, as I shall show presently.

Now the rates of royalty provided for in our Act are on a more moderate scale, being three per cent. on silver and copper and nickel, not exceeding two per cent. on iron, and not exceeding three per cent. on all other ores of metals, calculated upon their value at the pit's mouth.

We do not know exactly what this value would be upon the several kinds of ores in Ontario, but in the case of iron ore we have the data furnished by Bulletin 113 of the United States census for 1890, showing the cost of production in the various states and of the value put upon the ore at the mines, based on the output of 1889. The following table gives the figures for a few states and and the whole country, computed for the long ton:

States.	Cost per ton.	Value per ton.
Alabama	$0.82	$0.96
Michigan	2.07	2.70
Minnesota	1.80	2.87
New Jersey	.74	3.23
New York	1.64	2.49
Pennsylvania	1.10	1.96
Wisconsin	1.78	2.20
United States	1.71	2.30

For the short ton these averages of cost and value would be about one-ninth less, so that the value of ore at the mines of the United States in 1889 was $2.05 per short ton, in Michigan $2.40, in Minnesota $2.55, in New York $2.21, and elsewhere in the same proportion.

On this basis the royalty payable to the province would not exceed five cents per ton as against the royalties of twenty, twenty-five and forty cents per ton which by the terms of contracts are payable to private parties for iron ore.

For the ores of nickel and copper and of silver we have the returns of values made by mining companies to the Minister of Agriculture for the years 1890 and 1891, as required by the Mining Operations Act. These give averages of $7.60 per ton for nickel and copper and $15 for silver per ton, which at the rate provided for in the Act would yield a royalty of about twenty-three cents on the former and forty-five cents on the latter.

In the light of these figures it is perhaps not surprising if the private owners of mining locations should view with a jealous eye the conduct of the Government in reserving a small royalty on ores or minerals taken from lands sold or leased under the amended Act, at the low price fixed in the Act.

On Accidents in Mines.*

By Mr. James Tonge, F.G.S.

The present paper is a very brief one, and has been written simply to reply to a few remarks and comments that have been made as to recent progress in mining; and to questions that have been asked as to whether certain so-called improvements are REALLY such or only *alterations* by which one danger is avoided to some extent by bringing on another.

Dealing with the question of safety lamps, it is said that the safety lamp is a very doubtful improvement. It is pointed out, in the first place, that there never were in former times, when candles only were used, such violent explosions and fearful loss of life. These objectors forget that the conditions of coal mining are so different. They do not allow for increased depths and temperatures, and for greater quantities and higher pessures of fire-damp; nor do they take into account the more extensive workings and proportionately larger bodies of men down the pit at one time. They forget too, or have never learned, the long series of experiments which may be said to have commenced so far back as 1737.

The old type of safety lamp has served the miners well for more than half a century. But now, with greater quantities of air and increased velocities, they are being replaced by lamps better adapted to existing circumstances. And it seems utterly unreasonable and indefensible to say that explosions are due to their *use*, instead of saying they are due to their *misuse or abuse*. If too much reliance is placed upon them; if they are made to do duty where they never were intended; if they are not kept in good order and perfect condition; this should not be charged against the lamp any more than the failure of any other machine should be charged to the machine rather than to the user. But another objection is taken to the safety lamp. It is said that the roof cannot be examined so well with a lamp as with a candle, and that the deaths from falls of roof and sides have not decreased in number in the same proportion as the deaths from other causes. If we examine carefully the report of H.M. Inspector of Mines we find that whilst the deaths from *all causes* have been reduced during the past 40 years from 1 in 219 to 1 in 530 persons employed, the deaths from *falls of roof and sides* have during the same period been reduced from 1 in 661 to 1 in 1,135 of the persons employed; in other words, whilst the proportion of *total deaths* has been reduced to ⅓ of what it was in 1851, that from *falls* has been reduced to ½, so that though the saving of life from *falls of roof* has not exactly kept pace with the *whole*, there has been a very substantial gain; such a gain as I think ought to dispel the theory that the use of lamps is objectionable in any direction. It appears to the writer that we are within measurable distance of a time when those who have to earn their bread by the sweat of the brow close to such a terrible foe as fire-damp, shall be enabled to do so without fear of any such terrible explosions as the past history of mining has witnessed; and *this* is the great province of the safety

*Read before Manchester Geological Society.

lamp: not the attempt to save only here and there a single life, for that we look to other sources; but to guard against that terrible sacrifice of life which, though it may but seldom become a reality, is at all times a possibility in the absence of a good and perfect lamp.

Mining Explosives.

In one of our recent issues we published an excellent paper on this subject by Mr. Cockson, read before a meeting of the Manchester Geological Society. This was followed up by a discussion at a subsequent meeting, to facilitate which the members had been previously invited to witness a series of "blown out" shot experiments at the works of the Roburite Explosive Company. The object of these were to show the effect of various explosives when the shot was fired into coal dust, in suspension, and air without the admixture of gas, to show the effect of gunpowder shots and shots fired with several explosives of the water cartridge, or safety tamping class, when used without their safety adjunct, and finally to exhibit roburite as an explosive containing in its composition its own safety element, requiring only a small quantity of ordinary pit stemming to bring this element into play. The subject is of so much importance to our Canadian coal producers, that we take the liberty of quoting the following discussion in full from the printed report of the Society's *Transactions*:—

MR. MAWSON gave particulars of the experiments and the results, with different explosives, as follows:

Series No. 1—Coal Dust and Air.

In this series, 4 oz of each explosive was used, tamped with 4 inches of dry coal dust. About 4 lbs. of fine coal dust was then sifted into the tank, and whilst the dust was in suspension the shot was fired by electricity.

Series No. 2—Coal Gas and Air.

In this series the same quantity of explosive and the same length and quality of stemming was used. Instead of coal dust, coal gas was allowed to issue into the tank for 90 seconds, given approximately at 10 per cent. mixture. The shot was then fired by electricity, the gas meanwhile remaining on to represent a feeder.

Series No. 1.—COAL DUST AND AIR.

No. of Experiment.	Name of Explosive.	Weight used.	Length of Stemming. Coal dust.	Coal Dust used. Quantity.	Coal Dust used. Quality.	Flame. Length of 1st.	Flame. Duration of 2nd.	Remarks.
		oz.	inches.	lbs.		ft.	sec'ds.	Temp. Wet. Dry.
1..	Gunpowder (loose)	4	4	4	Wigan 9ft. Sovereign Pit.	12	2	55° 58°. Large volume of flame, bright and then red.
13 .	Gunpowder	4	nil	nil	Ditto	10	nil	Fired after No. 12, without any fresh dust. Sparks projected.
2..	Gelignite.....	4	4	4	Ditto	6	nil	53° 55°. Bright forked flame. Coal dust floating in the air.
6 .	Gelignite.....	4	4	4	Ditto	12	nil	55° 56°. Enormous volume of bright white flame. No coal dust floating in the air. Evidently a bona fide *explosion* of coal dust.
9..	Gelignite.....	4	4	4	Ditto	9	nil	54° 57°. Partial *explosion*, but not so marked. Some coal dust floating in air.
10..	Gelignite.....	4	4	4	Ditto	9	nil	54° 57°. Bright flame, but not such a broad sheet.
3..	Roburite	4	4	4	Ditto	nil	nil	54° 57°. Cloud of black dust.
7..	Roburite	4	4	4	Ditto	nil	nil	51° 52°. Ditto
11..	Roburite	4	4	4	Ditto	nil	nil	53° 55°. Ditto
4..	Securite No. 2 (coal)	4	4	4	Ditto	8	1½	56° 58°. Dull flame.
5..	Tonite.....	4	4	4	Ditto	5	nil	56° 58°. Dull red flame pointed. Coal dust not fired.
8..	Tonite.....	4	4	4	Ditto	nil	nil	55° 57°. Cloud of black dust.
12 .	Tonite.....	4	4	4	Ditto	5	nil	50° 54°. Dull red flame, pointed. Coal dust not fired.
14 .	Tonite.....	4	4	4	Ditto	5	nil	Ditto. Ditto.

Series No. 2.—COAL GAS AND AIR.

No. of Experiment.	Name of Explosive.	Weight used.	Length of Stemming. Coal dust.	Duration of Gas issue.	Gas exploded or not.	Length of Flame.	Feeder Ignited or not.	Remarks.
		ounces	inches.	sec'ds.		feet.	. .	
1...	Gunpowder.....	4	4	90	yes	..	yes	Undoubted explosion; difficult to estimate length of flame.
2...	Gelignite.....	4	4	90	yes	..	yes	Ditto ditto
3...	Roburite	4	4	90	no	..	no	Cloud of black dust.
6..	Roburite	4	4	90	no	..	no	Ditto
8...	Roburite	4	4	90	no	..	no	Ditto
4...	Securite No. 2 (coal)	4	4	90	yes	4	yes	Undoubted explosion; difficult to estimate height of flame.
5...	Tonite.....	4	4	90	no	4	no	Dull red flame seen above tank, but no explosion of gas.
7...	Tonite.....	4	4	90	no	..	no	No flame. No explosion of gas.
9...	Tonite.....	4	4	90	yes	..	yes	Undoubted explosion. Large bright flame.

The tank containing the explosive mixture measures 56 cubic feet, and is 3'10 high.

In answer to questions by the President,

MR. MAWSON said the charges were fired with a cannon enclosed in an iron cylinder, with a scale up the side marked in feet to show the height of the flame.

THE PRESIDENT—Were the charges stemmed in the usual way?

MR. MAWSON—We stemmed with four inches of coal dust.

MR. WATTS—Were these experiments conducted solely by the Roburite company, or were they conducted by independent persons?

MR. COCKSON—They were conducted at the Roburite company's works, under the supervision of Mr. Bigg-Wither, the company's general manager. But there were in attendance at the experiments two of H. M. Inspectors of Mines, and it was put to the vote whether further experiments, or what experiments, should be made, in every case, so that all the gentlemen present could ask to have the experiments carried out as they wished. I do not, however, think that any question should be raised as to how they were made, the presence of the gentlemen who where there being quite enough to ensure their being made absolutely without any shadow of prejudice either one way or the other. I see Mr. Saint, who witnessed the experiments, is here.

MR. WATTS—I asked the question in order that the point might be clearly stated, because in experiments of this kind, in which a company is interested, it is necessary that they should be conducted without any show of favouritism. I have no interest in any one particular explosive over another, only I think it desirable that when such experiments as these are made they should be conducted by independent persons.

MR. BIGG-WITHER—I, as general manager of the Roburite company, was asked to carry out the experiments, and no one present raised the slightest question as to their fairness. I asked Mr. Saint, who was there, if he would be kind enough to watch each charge, and Mr. Saint's reply was that he would trust to us.

THE PRESIDENT—I do not think Mr. Watts means to cast any suspicions upon the *bona fide* character of the experiments, but what he means and is perfectly right in saying, is this. Here is a paper read before the Society, and the experiments are, so to speak, got up by some of the members of the Society, and it behoves us as a Society not to put our stamp upon anything that is not absolutely above suspicion. It is only a matter of precaution. There is no suggestion that anything was done that would not have been done whoever was there; it is only to prevent the Society being made use of by a trading concern for its own interest.

MR. WATTS—I am glad the president has put it in that way. That was precisely my view in asking the question.

MR. BIGG-WITHER—And it was in that view I replied to you. I may add that it was our desire that the tests should be absolutely impartial, and for that reason I asked Mr. Saint, one of H. M. Inspectors of Mines—who was present—to see how each shot was charged, and to see that the tests were conducted in conformity with the programme.

MR. DONALD MUNRO—I think there are conditions in connection with blasting which are better known to mining men than they are to Mr. Bigg-Wither.

MR. BIGG-WITHER—It is quite possible.

MR. MUNRO—And it would perhaps have been better if the experiments had actually been conducted by such men as those. I may say I have had some practical experience with regard to blasting with the different explosives that have been mentioned, and I am glad to hear to-day that so many experiments have been conducted without any sign of flame from roburite. I have tried some experiments myself in different parts of the country with that substance, and I am sorry to say I have not been so fortunate. I have seen flame repeatedly from roburite. There is no one who would be more pleased than I should to see and hear of roburite being absolutely flameless, but in some experiments with roburite at the works where it was manufactured in Germany—I do not know whether they are connected with the works in this country.

MR. BIGG-WITHER—No.

MR. MUNRO—In those experiments I distinctly saw flame. I would like to ask whether in the experiments of Saturday last at Gathurst, there was any made without any stemming being used. I think the putting in of stemming rather delusive. Experiments should be conducted without it. I know that in a mine you do not usually fire shots without stemming, but when you are testing explosives it is not an unfair test, to try them without any stemming. The stemming has a tendency always to prevent flame from being seen.

A MEMBER—The Roburite Company do not claim that it shows no flame without stemming.

MR. MUNRO—All I want is to make it clear that in the roburite experiments which I saw, and had something to do with, and which were conducted in the dark, flame was seen, though there was stemming used.

MR. DEAN—I have had some little experience with explosives during the time I have been connected with the Wigan Coal and Iron Company, and have seen many experiments with roburite, water cartridge, &c, From roburite I have seen flame, or, to speak more correctly, a flash, for it could hardly be called flame. I saw some experiments which Mr. Hilton gave at the Saw Mills, where with a light tamping the flash was visible, but it did not fire the gas in any instance. I have seen the same light underground, but I do not think that in any case it would have fired gas. Our experiments were carried out on a very dark night. With regard to

tamping, I may say we did try a shot that night at the Saw Mills, with roburite without any tamping, and of course it fired the gas; but I do not think that any one down a pit would attempt to fire a shot without first putting some tamping in. Roburite if tamped with only four inches of coal dust (and that is one of the most inflammable substances you can have in a mine) will not light the gas or the dust. We have used tonite at one of our pits, on the Haigh side, to get down coal, and we were troubled with it not exploding at times. The charge lighted and simply fizzed in the hole; it did not explode and did not blow the rock or coal. One case I remember well, in the Wigan Four-foot; they were using a nine-ounce charge, made up of two portions, 6oz. and 3oz., which were fired simultaneously. The 6oz. charge exploded, bringing down the coal. Afterwards the fireman on visiting the place saw a big light, and found that the smaller charge had not exploded, but was simply burning. The heat was so great that it burnt the coal into a cinder. That of course is a very serious matter in a coal pit. So with roburite; when two charges of this have been put in I have known one not to fire, but to be left in the hole unexploded. I have never known it to burn the coal, however. That shows the necessity of gauging the strength of your shot and putting one charge in. It makes it safer for the men to handle. Electrical firing is another very important matter. I may say that at our pits at Standish we fire on an average 80 or 90 shots per night by electricity, and since March 21st we have not had a single missed shot. That, I think, will compare very favourably with the ordinary fuse or anything else. We have had 4,256 shots within that time, and not one has missed.

THE PRESIDENT asked why, at the experiments, on Saturday, carbonite was not among the explosives tested? The testing of tonite and securite was like flogging a dead horse the practical use of the former for a short time having convinced him that it was a most undesirable thing to introduce into a mine. After an unexploded shot we found the coal absolutely red hot, and had it been left alone we should have had the whole place on fire. He thought, however, that carbonite would hold its own with roburite, and these two should be tested side by side.

MR. MUNRO—I would like to be perfectly fair. I have tried, I think, all the explosives that have been mentioned to-day, and with regard to roburite it is only fair I should state that I have seen less flame from it when used than from any other explosive. I could not go further than that. I cannot as a mining man myself, say that roburite is absolutely flameless, or perfectly safe, though I should like very much to find it so.

MR. SAINT—I attended the experiments at Gathurst. They were conducted about the middle of the day. In the first series there was a cannon sunk vertically in the ground, and surrounding it was a part of a boiler flue, to a height of about 5 feet above the muzzle, the coal dust being shielded from the wind. The explosives were stemmed with coal dust, and coal dust was passed through a sieve into the flue, and then the wires having been connected, at a signal from Mr. Bigg-Wither, the shot was fired. Both tonite and roburite failed to fire the coal dust. The former gave a flame in two or three instances, but I certainly think roburite behaved the best of all, as there was not any flame seen from its explosion. In the gas tests, again, which were conducted in another part of the works, roburite gave off no visible flame nor did it light the gas which was kept on during the time of the experiments. From what I could see I have no hesitation in saying that roburite was certainly the safest explosive tried on that day.

THE PRESIDENT—No doubt.

MR. SAINT—But there is another question in connection with roburite—that is, its effect upon the health of the miners. Mr. Bramall, at a former meeting of this society, gave instances of men having been poisoned, and he attributed the mischief to the use of roburite.

MR. STIRRUP—To the inhaling of roburite fumes.

MR. SAINT—It was a question what did poison the men? Some people said it was the fumes, but others were of opinion that it arose from the men handling the stuff. It was stated in a case of arbitration in which Professor Dixon and one or two other medical gentlemen were deputed to test the fumes arising from the explosion of roburite, that those fumes were less noxious than the fumes of gunpowder. Then the question arises, how were the men poisoned? Did they handle the roburite? Some people say that they did and others that they did not; but I have a theory on the subject. I have been told that in some shots the whole of the roburite charge has not been exploded, and in such cases it is possible that a portion of the charge may have been thrown into the atmosphere and the men may have inhaled it, and thus have become poisoned. I believe it was stated by Professor Dixon that the atmosphere, after a shot of roburite, had been filtered through spun glass, and that a yellow substance had been deposited on the web. I have a great curiosity to know what that yellow substance was. Was it roburite, or could it have been something else? Possibly Mr. Cockson or Mr. Bigg-Wither may be able to throw some light upon the question.

MR. WATTS—With reference to roburite affecting the health of the men using it, I may say that I have had some experience. About two years ago, when this explosive was being introduced, I obtained about 1½ cwt. of it for the purpose of testing it side by side with tonite and gunpowder, in a tunnel which I was engaged in constructing. As an explosive I find roburite about equal to tonite, and the same labour in stemming, &c., is required for the two. In our case we used a double tape fuse—of course this being a tunnel in rock, and not a colliery, we proceeded in a different way to what the colliery people do where fiery gases exist—we used a double tape fuse all through the work; therefore the firing was the same. After a few days' use of the roburite my men began to complain very seriously of a want of energy in their legs, and a peculiar sensation in the roof of their mouths. I asked them if they had put their fingers in their mouths before washing them after using this stuff, and they all declared that they had not; I therefore concluded that the sickness they complained of was due entirely to the fumes given off by roburite. I do not know of anything else that could account for it. I was extremely anxious that roburite should be used because at that time it was 3d. or 4d. per lb. cheaper than tonite, and it was to our interest to use it, as well as to that of the men, because we purchased it in the first instance and sold it to them. The men, too, were equally anxious to use it. There is one little drawback, however, in reference to roburite, that is to say, if they would serve the cartridge in the same way as the tonite is served, the men would have less handling of it, and I think it would encourage its use, if the gentlemen present, representing the Roburite Company, could see their way to do this. It would meet a complaint which I know is made amongst miners. I am speaking, of course, of the men we employ and not of colliers. Doubtless where fumes deleterious to health are generated much will depend upon the ventilation. The ventilation in the case I have referred to was good. It was the same precisely with tonite as with roburite. As an explosive for facilitating and cheapening work I believe there is nothing cheaper than blasting powder. I have taken note of all the explosives we have used in our tunnel, and I know to a shilling the cost per yard; and I have no hesitation in saying that in driving an ordinary sized heading you will drive it with powder and roburite or tonite mixed several shillings a yard cheaper than all tonite, but the cheapest of all is powder. With powder, however, you require to have good ventilation.

MR. COCKSON, replying upon the discussion, said. With regard to the experiments on Saturday, I hope nobody misconstrued my meaning, when I said that I was sure that all the gentlemen present understood that those experiments were so conducted as to be beyond suspicion. I took that for granted, and I am sure the members of this society will grant it at once; but with regard to the point that it would have been better if the experiments had been conducted by mining men, I think that is sufficiently covered by my saying that the actual charging—the actual work—was done by a couple of under ground workmen who have been sufficiently trained, and who have fired thousands upon thousands of shots of all the different explosives, and they naturally were very much more suited for the work than any of our own members would be. They knew the precautions to take and the nature of the explosives, and we could not have got through the experiments in three times the time we did if they had been made in any other way than they actually were. As to the fairness of testing explosives without stemming, I am afraid I cannot agree with the gentlemen who spoke. I think that any test as to an explosive should be made as much as possible under the conditions in which you use that explosive in a mine; but I would modify that to this extent. I would make the conditions more onerous in the test than would actually be the case in the mine, so that if you get it proved to be safe with conditions more onerous than you actually can have in actual use, then you may take it for granted that what is proved to be safe in your experiment must be absolutely safe under more favourable conditions. Some experiments were made in South Wales a few months ago with the idea of showing that Carbonite, though unstemmed, would not fire an explosive mixture of gas and air. I was not present at those experiments, but Mr. Bigg-Wither was, and he protested against the experiments being made with the explosive unstemmed. I may say that that opinion is held by myself and nearly all the mining people with whom I have spoken on the subject. These experiments in South Wales simply proved that in an unworkable test—a test which, to my mind, was of no possible value—all the explosives at present on the market, that is, the English market, will fire an inflammable mixture of gas and air if untamped. They proved that undoubtedly; and as far as it goes it is a fact I have myself known for the last three years, and there is nothing new in it. It, I am afraid, proved rather too much for some of the gentlemen who were interested in the experiments because they had hoped that carbonite would not fire gas if untamped; but it did, and we may take it that all the explosives at present known will fire an explosive mixture of gas and air if untamped. I have been asked why the experiments were not made with carbonite, on Saturday. The simple reason for that is stated in my paper. I said I only proposed treating on explosives made and manufactured in England. I did not propose to go through the list of German and French explosives which may be counted by the score, but I confined the details of my paper to explosives really made and manufactured in England. For the president's information, and that of the Society, I may say that my experience of carbonite leads me to think that it may be—I do not say that it is—an explosive that will not inflame gas in actual practice. But it has, to my mind, some very serious drawbacks, which possibly might be shown with the testing machine better than can be described. But though I do not say that carbonite is not a safety explosive, we did not make experiments with it because we have had difficulties in the use of it through its freezing, which caused me personally to decide not to have anything to do with it. There is also the fact of its extreme inflammability. It appears to my mind that these disadvantages will prevent its being largely introduced for underground work. Taking the question raised by Mr. Watts as to the fumes of roburite (and it was also raised by Mr. Saint) the most recent information was given us in the report of the meeting of the Institute of Mining Engineers, held in London, about ten days ago. At the close of a very voluminous report there is a statement of "conclusions and recommendations," and it is stated amongst other things "that the products of the explosions of roburite and tonite are not more deleterious than the products of the explosion of gunpowder," and "with regard to the production of carbon monoxide, the average quantity found is so much dissipated by the air around as to be detected only in traces after an interval of five minutes after the firing of the shot." Upon this is based the recommendation that an interval of at least five minutes should be allowed after the firing of the shot before the hewers re-enter the place. This would preclude any complaint on the question of fumes. Through careless handling poisoning undoubtedly may ensue, but apart from this and the possibility of getting the poison into one's system through cuts, etc., there can be no question that roburite is perfectly safe. I see in this same report they give the proportion of carbon monoxide to tonite, gunpowder, and roburite fumes as follows:—

	Parts.
Tonite	0·55
Gunpowder	0·4
Roburite	0·38

With these facts before us I think we may allow the fumes objection to sink into oblivion. I am glad to find that since my paper was read one of H. M. Inspectors in the South Wales District (Mr. Robson) almost repeats some of the words I used; saying in his annual report to the Home Secretary: "That in the interests of safety, blasting with gunpowder should be abolished in all coal mines known to produce fire-damp, or which are naturally dry and dusty." Mr. Hall, too remarks: "It is perfectly clear that explosives which, although tamped with clay, give off flame, must be discarded altogether." I am glad to find that throughout Lancashire the practice is really in advance of the requirements of legislation in the use of an explosive which will not inflame an explosive mixture of gas and air or a mixture of coal dust and air; and such explosive is being used with the extra precaution that firing is carried on between the shifts, when risk to life and limb is so very much less. I am glad to think that in this district mine owners and managers are doing their best in this respect to keep in advance of legislation, and to minimise the risk of accidents occurring.

THE PRESIDENT—I am much obliged personally to Mr. Cockson for his explanation, and I perfectly see the justice of it. I agree with his paper entirely—everything he says in it—and all I should like him to do is to say that possibly (I am speaking now as an independent member of the Society) there may be another explosive besides roburite which fulfils a good many of the requirements which he lays down as a *sine qua non*, but which he may think has compensating drawbacks, lest it should seem that this Society is recommending roburite as the best explosive.

MR. COCKSON In the course of the discussion I think we have all been alive to the fact that there is such an explosive as carbonite. I have given you my objections to the use of it. My objections mainly are that it is a most inflammable substance, and that if you get a cartridge and put a fuse into it and light it, it burns for a considerable time like a small tar barrel. I cannot think that an explosive which is so inflammable can be called safe. If what Mr. Dean has described happened to a tonite cartridge it would, I submit, be as likely to happen to a carbonite cartridge; and for that reason alone I prefer not to have anything to do with carbonite.

MR. MUNRO reiterated his belief that a trial without stemming was the only true test of safety. In colliery operations, he said, they met with a good many fissures in the seams, and the stemming was only on one side, whereas the sides and back end might be exposed to one or more of such fissures, and if it was not a safety explosive gas might be fired. He had no faith in the so-called safety envelope. What he would like to see was a self-contained safety explosive, and he hoped that Mr. Bigg-Wither, or some one else, would soon give it them.

MR. COCKSON said he could not agree with the views as to stemming expressed by Mr. Munro. He could not believe that roburite could cause an explosion. The composition of the gas in any cavity or fissure would not allow that. If they bored through into a feeder the workman would certainly hear the issue of the gas, and he would not be so foolish as to fire a shot in a hole where gas was issuing; and if there was the least thickness of coal between the shot hole and such fissure, it would be a sufficient protection to ensure the quenching out of the small flame that was caused by the explosion of a roburite shot.

A New Alloy.—Professor Austin gives the Royal Society of Great Britain an account of his discovery of a new alloy of gold and aluminum, which is said to be the most brilliantly colored combination yet made. It has a fine purple color, with ruby tints, where the light is reflected from one surface of the alloy to the other.

The Spontaneous Ignition of Coal, and its Prevention.*

By Vivian B. Lewes, F.I.C., F.C.S.

Last autumn I had the honour of bringing before the chemical section of the British Association certain views, which are now widely gaining ground, as to the cause of the phenomenon of spontaneous ignition in masses of stored coal; and, in the discussion which ensued, Sir Frederick Bramwell expressed the hope that the paper would be followed by a second, in which methods for the prevention of this too often disastrous action might be discussed; and it is at the invitation of your secretary that I propose to bring my views on the subject before you to-night. Ever since the general adoption of coal as a fuel, the storing and shipment of masses exceeding 2,000 tons has been recognized as requiring great care; and if much small coal has been present, or if it has been stored wet, firing, or at any rate heating, of the mass, has frequently taken place. On shore this has led to much inconvenience and loss, but it is during shipment that the real danger has occurred; and many a fine vessel, with all hands, has been lost from this cause, without even a record of the calamity reaching the land. In 1875, the loss of life and property from this cause became so serious, that a royal commission was appointed to report upon the possibility of preventing these appalling disasters; but the recommendations contained in the report, although of the greatest possible value, seem to have had but little effect in checking the loss from spontaneous ignition; and, in the nine years following the publication of the report (1873 to 1883), no less than 57 coal-laden vessels are known to have been lost from this cause, whilst 328 others were missing. In coal stores, and in gas works, heating frequently takes place, but is so much more easily dealt with than at sea, that cases of absolute ignition are much rarer; and it is from the evidence obtained in the case of coal cargoes, that we can learn most as to the cause and prevention of this most dire plague of the coal trade.

In treating the subject to-night, I will first bring to your notice the explanation of the action which eventually results in combustion, and which is founded upon the work of Richters and myself, and will consider how the incipient action can be best prevented, or at least retarded, and the steps which should be taken in case ignition should result. Coal is a substance of purely vegetable origin, formed out of contact with air by long exposure to heat and pressure from the woody fibre and resinous constituents of a monster vegetation, which flourished long before the earth was inhabited by man; and coal may be therefore looked upon as a form of charcoal, which, having been formed at a temperature lower than that of the charcoal burner's heap, and under great pressure, is very dense, and still retains a quantity of those constituents which, in the latter case, are driven off as tar, wood naphtha, &c. These bodies consist essentially of compounds containing carbon and hydrogen, together with a little oxygen and nitrogen, and form the volatile matter and hydrocarbons of the coal. Besides the carbon and hydrocarbons, coal also contains certain mineral bodies, which were mostly present in the sap and fibre of the original vegetation, and which gives the ash which is left behind when the coal is burnt. These substances consist chiefly of sulphate of lime or gypsum, silica, and alumina, whilst in nearly all kinds of coal is to be found a substance called disulphide of iron, coal brasses, or pyrites, which has been formed by the gradual reduction of the sulphates by carbonaceous matter in the presence of iron salts, and which during the combustion of the coal, is decomposed, giving off sulphur compounds, and leaving behind oxide of iron, which gives the reddish brown colour to the ash of many kinds of coal. Of these constituents of coal, the only ones which play no part in the phenomena attending heating and spontaneous ignition, are the mineral constituents other than the pyrites, and we have, therefore, to deal with the chemical actions which take place when the carbon, hydrocarbons, and brasses contained in newly-won coal come in contact with air and moisture.

A.—The Influence of Carbon in Producing Heating.

Carbon is one of those substances which possess to an extraordinary degree the power of attracting and condensing gases upon their surface, this power varying with the state of division of the particular form of carbon used. The charcoal obtained from dense forms of wood, such as box, exhibits this property to a high degree, 1 cubic inch of such charcoal absorbing—†

Ammonia gas	90	cubic inches.
Sulphuretted hydrogen	55	"
Carbon dioxide	35	"
Ethylene (olefiant gas)	35	"
Oxygen	9·25	"
Nitrogen	6·5	"

while certain kinds of coal also exhibit the same power, although to a less degree. The absorptive power of newly won coal due to this surface attraction varies, but the least absorbent will take up one and a quarter times its own volume of oxygen, while in some coals more than three times their volume of the gas is absorbed. This absorption is very rapid at first but gradually decreases, and is, moreover, influenced very much by temperature, for reasons which will be explained later. The absorption is at first purely mechanical, and itself causes a rise of temperature, which, in the case of charcoal formed in closed retorts, as in preparing alder, willow, and dog-wood charcoal for powdermaking, would produce spontaneous ignition if it were not placed in sealed cooling vessels for some days before exposure to air.

The rate of absorption varies with the amount of surface exposed, and therefore able to take part in this condensing action, so that, when coal or charcoal is finely powdered, the exposed surface being much greater, absorption becomes more rapid, and rise of temperature at once takes place. If, after it has been made, charcoal is kept for a day out of contact with air, and is then ground down into a powder, *it will frequently fire after* exposure to the air for thirty-six hours, whilst a heap of charcoal powder, of 100 bushels or more, will always ignite. It is for this reason that in making charcoal for powder, it is always kept, after burning, for three or four days in air-tight cylinders before picking over, and ten days to a fortnight before it is ground. In the case of coal, this rise in temperature tends to increase the rate of the action which is going on, *but is rarely sufficient to* bring about spontaneous ignition, only about one-third the amount of oxygen being absorbed by coal that is taken up by charcoal; the action also being much slower, tends to prevent the temperature reaching the high ignition point of the coal. Air-dry coal absorbs oxygen more quickly than wet coal.

B.—The Action of the Bituminous Constituents of the Coal in Spontaneous Ignition.

All coal contains a certain percentage of hydrogen, which is in combination with some of the carbon and also with the nitrogen and oxygen, and forms with them the volatile matter in the coal. The amount present in this condition varies greatly, being very small in anthracite and very great in cannel and shale. When the carbon of the coal absorbs oxogen, the compressed gas becomes chemically very active and soon commences to combine with the carbon and hydrogen of the bituminous portions, converting them into dioxide and water vapour. This chemical activity increases rapidly with rise of temperature, so that the heat generated by the absorption of the oxygen causes it to rapidly enter into chemical combination. Chemical combination of this kind—*i.e.*, oxidation—is always accompanied by evolution of heat, and this *further rise of temperature again increases* rapidity of oxidation, so that a steady rise of temperature is set up, and this taking place in the centre of a heap of small coal, which, from the air and other gases enclosed in its interstices, is an admirable non-conductor of heat, will often cause such heating of the mass that, if air percolate slowly into the heap, in sufficient quantity to supply the necessary per*centage of oxygen for the continuance of the action, the* igniting point of the coal will soon be reached. The effect of rise of temperature in increasing the rapidity of chemical actions of this kind can be realized from the effect which it has in the spontaneous ignition of oily waste or rag.

If a substance like cotton waste be rendered oily with anything except the mineral oils, it acquires the power of taking up oxygen *from the air; and this oxidising the* oil gives rise to heat. At ordinary temperatures this oxidation is slow, and, consequently it may be days before the rise in temperature becomes sensible, but when this point is reached the oxidation proceeds with remarkable rapidity, and in a few hours the point of ignition is reached, and the mass bursts into flame, whilst if the oily waste be placed in a warm place at first, spontaneous ignition is only a question of hours, or sometimes even minutes. Galletley found that oily cotton at ordinary temperatures took some days to heat and ignite, whilst, if placed in a chamber warmed to 130° to 170° Fahr. (54° to 76° C.), the cotton, greasy with boiled linseed, ignited in one hour and fifteen minutes, and olive oil on cotton in five hours; and in a chamber heated to 180° to 200° Fahr. (82° to 93° C.) olive oil on cotton ignited in two hours. It has been suggested that very bituminous coal, such as cannel, shale, and coals containing schist, is liable to spontaneous ignition, from the fact that a rise in temperature would cause heavy oils to exude from them, which, by undergoing oxidation, might cause rapid heating. But experiment not only shows that this is not the case, but that the heavy mineral oils have a remarkable influence in retarding heating; cotton waste, oily with easily oxidisable oils mixed with 20 per cent. of heavy mineral oil, being exempt from heating.

C.—The Action of Iron Disulphide, Pyrites, or Coal Brasses in Promoting Spontaneous Ignition.

The earliest theory as to the cause of spontaneous ignition in coal was, that it was due to the heat given out during the oxidation of pyrites (the disulphide of iron) into sulphates, and this idea has been adopted, and has held its own, in this country up to the present time, although the researches of Dr. Richters, some twenty years ago, clearly prove that the explanation was an erroneous one, and the late Dr. Percy, as early as 1864, pointed out that probably oxidation of the coal had a great deal to do with the action. This disulphide of iron is found in coal in several different forms, sometimes as a dark powder distributed throughout the mass of the coal, and scarcely to be distinguished from coal itself. In larger quantities, it is often found forming thin golden-looking layers in the cleavage of the coal, while it sometimes occurs as masses and veins, often an inch or two inches in thickness, but inasmuch as these masses of pyrites are very heavy, they rarely find their way into the screened coal for shipment, many hundreds of tons of these "brasses" being annually picked out from the coal at the pit's mouth, and utilized in various manufacturing processes. The yellow pyrites which form the *large masses in the coal, and even the dark varieties* when in the crystaline form, remain practically unaltered, even after long exposure to moist air, but the amorphous and finely divided portions, which probably contain lower sulphides mixed with the disulphide, will oxidise and effloresce with considerable rapidity when exposed to moisture and air, forming mixtures of ferrous sulphate and basic sulphates of iron, and it is during this *process of oxidation that the heat supposed to bring* about the ignition of the coal is generated.

In some of the coals most prone to spontaneous ignition there is only 0.8 per cent. of pyrites, and if we imagined the whole of this to be easily oxidisable, and to be concentrated in one spot instead of being spread throughout the mass, and to be entirely oxidised in a few hours, the rise of temperature would only be a few degrees; whereas, under existing circumstances, it is manifest that practically no determinable increase can be generated by the action. Under certain conditions the oxidation of masses of pyrites first gives rise to the formation of ferrous sulphate, and sulphur dioxide with liberation of sulphur, and my early experiments led me to believe that, inasmuch as sulphur has an igniting point of 250° C., this free sulphur might play an important part in the action, by lowering the point of ignition; later experiments, however, show that this could only take place with large masses of pyrites undergoing oxidation, and that with the amounts present in coal, if the air were present in sufficient quantity to oxidise the pyrites, the small trace of sulphur liberated would be oxidised to sulphur dioxide at temperatures as low as 60° C. This oxidation of sulphur at low temperatures is not a generally known action, but my experiments show that it takes place with considerable rapidity. The only way in which pyrites can assist spontaneous ignition is that when they oxidise they swell, and cause disintegration of the lumps of coal, so exposing fresh surfaces to absorb oxygen and afterwards carry on chemical action. I have carefully determined the igniting point of various kinds of coal, and find that—

Cannel coal	ignites at 698° Fahr.	=	370° C
Hartlepool coal	" 766	=	408
Lignite "	" 842	=	450
Welsh steam coal	" 870·5	=	477

So that no stretch of imagination could endow the small trace of pyrites scattered through a large mass of coal, and undergoing slow oxidation, with the power of reaching the needful temperature. When coal is heating, it gives out a distinctive and penetrating odour, which is the same as that noticed when wood is scorched. The gases evolved by the heating coal consist of nitrogen, water-vapour, carbon dioxide, carbon monoxide, hydrocarbons of the paraffin series, and sulphuretted hydrogen, the presence of the latter gas showing beyond doubt that oxidation of sulphur had nothing to do with the action.

We can now trace the actions which cumulate in ignition. The newly-won coal is brought to the mouth or the pit, and at once commences, by virtue of its surface action, to absorb oxygen from the air; but unless piled in unusually large heaps and a great deal broken, it does not, as a rule, show signs of heating, as the exposed surface is comparatively small, and the air finding its way freely between the lumps keeps down the temperature. The coal is now screened, and the obtrusively large lumps of brasses picked out; it is then put in the trucks, and enjoys the disintegrating processes of joltings and shuntings innumerable, every jar adding to the percentage of small coal present, and a corresponding increase in the size of the surface exposed to the air. Arrived at the docks, it has to be transferred from the truck to the ship, which is done by one of the numerous forms of tips, shoots, or spouts employed for the purpose, and it *is during this operation that more harm is done than at* any other period. The coal first shot into the vessel, by reason of the distance which it has to fall, is broken down into small lumps, and having to bear the impact of the succeeding load falling upon it from a height, rapidly becomes powdered into slack, whilst the succeeding loads falling in on the cone so formed get more or less broken down, so that, by the time the *cargo is all taken in, a dense mass of small coal is found* under the hatchway, and it is invariably at this point that heating takes place, as the large surface exposed fresh to the air by the breaking down of the coal causes rapid absorption of oxygen, and consequent rise of temperature. This sets up chemical combination between the oxygen absorbed by the coal and the hydro-carbons and coal brasses. On examining the evidence to be obtained as to the *conditions under which spontaneous* ignition of coal in ships usually takes place, it is found that liability to ignition increases with :—

1. *The Increase in Mass of Coal.*—Thus in cargoes of under 500 tons the cases reported amount to a little under ¾ per cent. for shipments out of Europe; from 500 to 1,000 tons, to over 1 per cent.; from 1,000 to 1,500 tons, to 3·5 per cent.; 1,500 to 2,000 tons to 4·5 per cent.; and over 2,000 tons to no less than 9 per cent. The evidence demonstrating this very remarkable result is to be found in the Report of the Royal Commission for 1875, p. 8, and clearly shows the influence of mass upon this action, which acts in two ways:—(*a*) The larger the mass, the more non-conducting material will there be between the spot at which heating is taking place and the cooling influence of the outer air. (*b*) The larger the

* Paper read before the Society of Arts, March 2, 1885.

† Sat. w.

mass the greater will be the breaking-down action of the impact of coal coming down the shoot upon the portions first loaded into the ship, and the larger, therefore, the fresh surface exposed to the action of the air.

2. *The Ports to which Shipments are Made.*—Of 26,631 shipments to European ports in 1873, only ten resulted in casualties, while 4,485 shipments to Asia, Africa, and America gave no less than sixty. This startling result is partly due to the length of time the cargo is in the vessel, the absorption and oxidation being a comparatively long action; but a far more active cause is the increase in the action brought about by the increase of temperature in the tropics, which converts a slow action into a rapid one, and if statistics had been taken, most of the ships would have been found to have developed active combustion somewhere about the neighborhood of the Cape, the action developed in the tropics having raised the temperature to the igniting point of the coal by that time.

3. *The Kind of Coal*, some coals being specially liable to spontaneous heating and ignition. This is a point on which great diversity of opinion exists, but I think it will be pretty generally admitted that cases of heating and ignition are more frequent in coals from East Coast ports than in shipments of the South Wales coals. The idea that the percentage of pyrites present is any indication of the liability to spontaneous combustion must be entirely discarded, as experiment shows that many coals poor in pyrites frequently ignite, while others rich in them are perfectly safe. A much surer guide is to be found in the quantity of moisture present in an air-dried sample of coal, which is a sure index to the absorptive power. The higher the amount of moisture held by the coal, after exposure for some time to dry air, the greater will be its power of absorption for oxygen, and the greater therefore its liability to spontaneous heating and ignition. This is beautifully shown by the following table, in which the percentage of pyrites and moisture present in some coals is contrasted with their liability to self-ignition :—

Liability to Spontaneous Ignition.	Pyrites.	Moisture.
	Per cent.	Per cent.
Very slight.....	1·13	2·54
	1·01 to 3·04	2·75
	1·51	3·9
Medium	1·2	4·5
	1·08	4·55
	1·15	4·75
Great.....	1·12	4·85
	0·83	5·3
	0·84	5·52
	1	9·01

The percentage of moisture shown in this table is not due to external wetting, but is moisture absorbed from the air and held by the coal, so that the amount of it present is an indication of the power of absorption possessed by the coal, and which will give it the power of taking up oxygen as well as water vapour.

4. *The Size of the Coal*, small coal being much more liable to spontaneous ignition than large. This, as has been pointed out, being entirely due to the increase in active absorbent surface exposed to the air, a fact which is verified by the experience of large consumers of coal on land; gas managers recognizing the fact that coal which has been stamped down or shaken down during storage being more liable to heat than if it has been more tenderly handled, the extra breakage causing the extra risk.

5. *Shipping or Storing Coals while wet.*—The effect of moisture upon coals is very remarkable. At first external wetting retards the absorption of oxygen by the coal, but the presence of moisture afterwards increases the action of the already absorbed oxygen upon the hydrocarbons of the coal, and so causes a serious increase in the heating. Of late years the researches of Cowper, Baker, Dixon and others have shown so fully the important part which moisture plays in chemical combination, that it is now fully recognized as a factor of importance in actions of this time. During last autumn, a very marked case of the influence of moisture in the action taking place came under my notice :—A ship took in a cargo of coal at a South Welsh port, the weather being fine and dry whilst she was loading at the main hatch, and wet whilst taking in the coal at the after hatch, with the result that the temperature after the first few days was uniformly about 10° higher in the coal that had been loaded wet than in the dry portion of the cargo, spontaneous ignition being the ultimate result.

6. *Ventilation of the Mass of Coal.*—The so-called ventilation, which has from time to time been introduced into coal ships, is undoubtedly one of the most prolific causes of spontaneous ignition. For ventilation to do any good, cool air would have to sweep continuously and freely through every part of the cargo, a condition impossible to attain, whilst anything short of that only increases the danger, the ordinary methods of ventilation supplying just about the right amount of air to create the maximum amount of heating. The reason of this is clear. A steam coal absorbs about twice its own volume of oxygen, and takes about ten days to do it under favorable conditions, and it is this oxygen which, in the next phase of the action, enters into chemical combination, and causes the serious heating. A ton of steam coal occupies 42 to 43 cubic feet, and if properly loaded contains between the lumps, as nearly as possible, 12 cubic feet of air space, that is to say, of the 42 cubit feet 12 cubic feet is air, and 30 cubit feet is coal. Thirty cubic feet of coal, with its fresh absorbing surfaces laid bare by the crushing incidenial to loading, will, in the first ten days after being taken on board, absorb 60 cubic feet of oxygen, if it can get it. Now, air contains, only, roughly, one-fifth of its volume of oxygen,, so that 60 cubic feet represent 300 cubic feet of air, or twenty-five times as much as is present. It is therefore evident that if air could be excluded, there would be only one twenty-fifth the quantity of oxygen present that is needed for complete action, and any heating would, in consequence, be very slight ; whilst to produce the greatest heating it would be necessary to change the entire air in the cargo twenty-five times in the first ten days, and this is just about what the old method of taking a box shaft along the keelson with venetian lattice upshafts from it would give. The most forcible illustration of the evil of such ventilation is to be found in the case of the four colliers *Euxine*, *Oliver Cromwell*, *Calcutta* and *Corah*, which were loaded at Newcastle under the same tips at the same time, with the same coal from the same seam. The first three were bound for Aden, and were all ventilated. The *Corah* was bound for Bombay, and was not ventilated. The three thoroughly ventilated ships were totally lost from spontaneous ignition of their cargo, whilst the *Corah* reached Bombay in perfect safety.

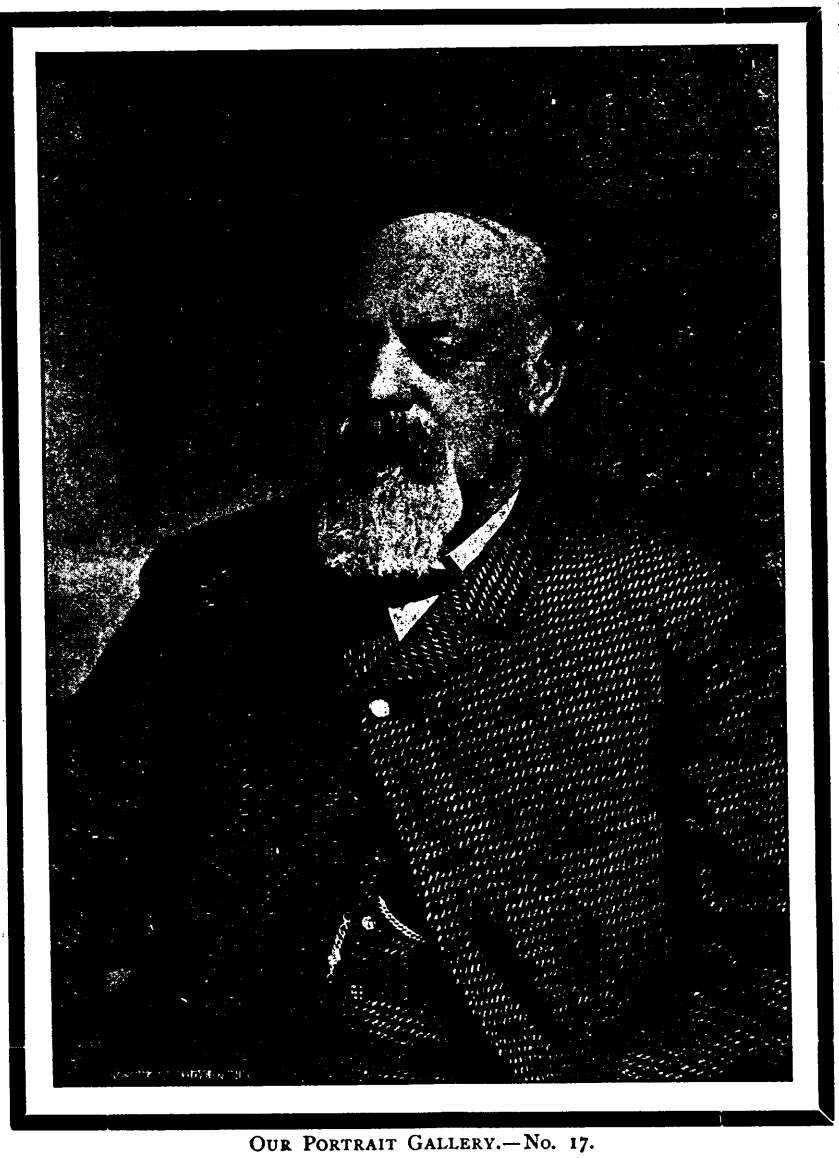
7. *Rise in Temperature.*—It has been fully pointed out that anything which tends to increase of initial temperature increases the rapidity of chemical action ; and in most cases of spontaneous combustion of coal stored in this country, the cause can be traced to a steam pipe or boiler-flue in contact with the mass of coal, or even fixed to a wall against which, on the other side, the coal is heaped. Sometimes the coal store is close to the benches of retorts in a gas-works, or even against the wall of the benches, and in such cases, with certain classes of coals, ignition would be almost certain to take place. In a paper read at the last meeting of the Gas Institute, it was proposed to lead the flues from the benches under the coal store in order to dry the coal, a device which would infallibly lead to spontaneous ignition. On colliers there are many causes for increased temperature, amongst them being the introduction of triple-expansion engines and high-pressure boilers. Steam at 80 lb. boiler pressure has a temperature of 324° Fahr. (162° C.), and a common stoke-hold temperature, with boilers worked at this pressure, is 100° to 130° Fahr. (or 38° to 54° C.). Steam at a boiler pressure of 155 lb. has a temperature of 368° Fahr. or 186° C., and gives a corresponding increase of temperature in the stoke-hold and other adjacent portions of the vessel, the temperature in the stoke-hold under these conditions being from 110° Fahr. (43.5° C.) to 140° Fahr. (60° C.), an increase of about 10° Fahr. Then, again, donkey boilers will often be found recessed into bunker bulkheads, and steam pipes led alongside the bulkheads, with the cargo close up against them on the other side. The effect of temperature due to climatic influences has already been dealt with under the influence on ignition of ports to which shipments are made.

Having now discussed the chemical and physical conditions which lead to the phenomenon known as "spontaneous ignition," we can formulate precautions which will tend to prevent such disasters.

1. *The Choice of Coal for Storage or Shipment.*—The coal should be as large as possible, free from dust, and with as little "smalls" as can be helped. It is better as free from pyrites as possible, and it should contain, when air-dried, not more than 3 per cent. of moisture.

2. *Precautions to be taken in Storing or Loading.*—The coal store should be well roofed in, and have an iron floor bedded in cement, all supports passing through and in contact with the coal should be of iron or brick ; if hollow iron supports are used, they should be cast solid with cement. The coal must never be loaded or stored during wet weather, and the depth of coal in the store should not exceed eight feet, and should only be six where possible. Under no condition must a steam or exhaust pipe or flue be allowed in or near any wall of the store, nor must the store be within twenty feet of any boiler, furnace, or bench of retorts. No coal should be stored or shipped to distant ports until at least a month has elapsed since it was brought to the surface. Every care should be taken during loading or storing to prevent breaking or crushing of the coal, and on no account must a large accumulation of small coal be allowed. These precautions, if properly carried out, would amply suffice to entirely do away with spontaneous ignition in stored coal on land, and we have now to consider a far more important phase of the question.

3. *Precautions to be taken on board Coal-laden Ships.*—This phase of the question is undoubtedly the most important, and in order to ensure any successful treatment of the coal cargo at sea, to prevent undue heating and ignition, the means adopted must be as nearly automatic in their working as possible, as it is useless to expect the master or any officer on board a collier during rough weather, &c., to comply with any instructions, such as daily taking the temperatures in various parts of the cargo, and so on. The iron bulkheads dividing the coal storage from the other parts of the vessel should be made double, and spaced six inches to a foot apart, with openings (which could be closed water-tight) every few feet, to allow of the interior being from time to time coated with protective compositions. Through this double casing sea-water would be allowed to circulate, and would not only effectually prevent any penetration of heat from the stoke-hold, boilers, or engine-room to the coal, but also to do away with any chance of leakage of gases from the coal cargo into other portions of the vessel, and so would minimise the danger of explosions. A similar double partition should run down the centre of that portion of the vessel in which the coal was stored, and it would be sufficient if this were packed with silicate wool ; this partition would serve to prevent any heating which might take place in one part of the cargo being communicated to the other half, whilst it would also perform the important function of helping to prevent shifting of the cargo during heavy rolling. When the coal has all been taken in, it should be battened down, and the hatches should not be again opened until the vessel reaches her destination, the only ventilation allowable being a 2-inch pipe just inserted into the crown of each coal compartment, and led twelve feet up the nearest mast, the top being left open. This would be quite sufficient to allow free egress to any gases



OUR PORTRAIT GALLERY.—No. 17.

THE LATE CAPT. TOM SHERIDAN,

Manager Bell's Asbestos Co., Thetford, Que.

DIED, 12th FEBRUARY, 1892.

evolved by the coal, but would not allow undue excess of air. Into the body of the coal cargo itself would be screwed, at regular intervals of about ten feet, iron pipes, closed at the bottom, and containing alarm thermostats, so arranged that when a rise of temperature causes expansion of the mercury in rising in the tube, it makes a contact; and the wires from these tubes are in connection with an electric bell, index-board, and battery in the captain's room; so that the moment the temperature is reached to which the thermometers have been set the bell rings, and will continue to ring, until the temperature again sinks, the spot in which heating is taking place being indicated by the index-board.

In the evidence given before the commissioners in 1875, Mr. J. Glover strongly advocated the use of carbon dioxide, or carbonic acid gas, as it is more usually termed, for extinguishing ignition when it had broken out in a coal cargo, and for stopping heating when it had reached a dangerous pitch. His proposal was to generate the gas by the action of hydrochloric acid upon chalk, and to lead it by gas pipes to the compartment affected; and this gas, being heavier than air, and a non-supporter of combustion, was to displace the air and its contained oxygen, and so to prevent further action by surrounding the coal with an atmosphere which could not carry on combustion. The idea was a good one, but there were many difficulties in the way of carrying it out, one being that for every 1,000 tons of coal carried, 80 cwt. of hydrochloric acid would have had to be shipped; also the gas could not have been driven down into the hold if any serious heating had taken place, as an up-current would have been formed, and would have carried it away; whilst in the state of gas, it fails to give any great cooling effect, and so would have exercised but little influence upon the mass of red-hot fuel. These objections weighed so strongly with the commissioners, that, in their final report, we find the following sentences:—

"Several methods for generating carbonic acid gas, and applying it to the ignited portion of a coal cargo, have been proposed for our consideration. We consider, however, that although this gas might be useful for excluding atmospheric air (which is essential to support combustion), yet it will not, as water does, exert any very sensible cooling effect, *which is a point of vital importance in the case of a mass of ignited coal.* We are of opinion that water and steam are the only agents practically available for the purpose of extinguishing fire in coal cargoes."

Applied in the way which was suggested, there is no doubt but that the carbonic acid gas would have been practically useless; but there is another way in which it could be used, which would make it a most powerful cooling agent, an instantaneous quencher of fire, and would prevent *any further tendency to heat on the part of the* coal treated with it. If carbonic acid gas is compressed under a pressure of 36 atmospheres at a temperature of 32° Fahr. (0° C.), it is condensed to the liquid state, and can be obtained in steel vessels closed with screw valves. On opening the valve some of the liquid is ejected into the air, and in coming into the ordinary atmospheric pressure, is in a moment converted into a large volume of gas. Conversion from the liquid to the gaseous state means the absorption of a large amount of heat; and so great is this, that everything near the stream of new born gas is cooled down, and some of the escaping liquid is frozen to a solid, having a temperature of -78 C., or -108·4 Fahr. This liquid carbonic acid gas is now extensively manufactured, and is used abroad to a large extent for aerating waters, driving torpedoes, and for freezing machines; and I should suggest its use in the following way for the checking of ignition in the coal cargo. The nozzle attached to the screw-valve on the bottle of condensed gas should have a short metal nose-piece screwed on to it, the tube in which should be cast in solid, with an alloy of tin, lead, bismuth and cadmium, which can be so made as to melt at exactly 200° Fahr. (93° C.). The valve should then be opened, and the steel bottle buried in the coal during the process of loading. The temperature at which the fusible metal plug will melt is well above the temperature which could be reached by any legitimate cause, and would mean that active heating was going on in the coal; and under these conditions the pressure in the steel cylinder would have reached something like 1,700 lbs., and the moment the plug melted, the whole contents of the bottle would be blown out of it into the surrounding coal, producing a large zone of intense cold, and cooling the surrounding mass to a comparatively low temperature. The action, moreover, would not stop here, as the cold, heavy gas would remain for some time in contact with the coal, diffusion taking place but slowly through the small exit pipe.

When the coal has absorbed as much oxygen as it can, *it still retains the* power of absorbing a considerable volume of carbonic acid gas; and when coal has heated, and then been rapidly quenched, the amount of gas so absorbed is very large indeed, and the inert gas so taken up remains in the pores of the coal, and prevents any further tendency to heating; indeed, a coal which has once heated, if only to a slight degree, and has then cooled down, is perfectly harmless, and will not heat a second time. It is not by any means necessary to replace the whole of the air in the interstices of the coal with the gas, as a long series of experiments show that 60 per cent. of carbonic acid gas prevents the ignition of the most pyrophoric substances. One hundred cubic feet of gas can be condensed in the liquid state in a steel cylinder one foot long and three inches diameter, and it has been shown that a ton of coal contains air spaces equal to about 12 cubic feet, therefore one of these cylinders would have to be put in for every eight tons of coal, as, although the gas formed at the first moment would only occupy a small space, on account of its low temperature, it would rapidly expand in contact with the hot coal. These cylinders should be distributed evenly throughout the cargo, and near the alarm thermometers, which should be set to ring a degree or two below the point at which the fusible plug would melt. The bell ringing in the captain's room would warn him that heating was taking place, and the bell would continue to ring until the cylinder had discharged its contents, and had cooled the cargo down to a safe degree, so that the whole arrangement would be partly automatic, and yet the officers would know if everything was safe. This liquid is now being made at a comparatively cheap rate, and, with any demand for it, machinery could be put up at the principal coaling ports, to charge empty cylinders at a very low rate, so that the initial cost of the steel cylinders once got over, the expenses would not be worth considering, more especially as one, or two at most, of the cylinders in use, would be likely to go off. If the precautions advocated were taken, no danger could arise until the arrival of the ship at her destination, and the commonest precautions would then suffice. On removing the hatches, no naked light must be allowed near them, and no one must be allowed to descend into the hold until all the gases have had time to diffuse out into the air. If the cylinders have gone off, there will be but little fear of explosion, as a high percentage of the carbonic acid gas lowers the explosive power which the mixture of marsh gas (given off from some coal) and air possess; but the carbonic acid gas would overcome and suffocate a man descending into an atmosphere containing any considerable percentage of it. When a safety lamp, lowered into the hold, continues to burn as brightly as it did in the open air, then it is perfectly safe to descend.

When once coal in a cargo has fired, pumping in water is practically of no use, as the fire is as a rule, near the bottom of the mass of coal, and the flow of water is so impeded by the caking of the heated mass above the fire, that in percolating through the interstices of the heated coal, it is converted into steam before it can reach the seat of combustion. The most effective way to apply water would be to have three inch pipes laid along the floor of the coal compartments, about six feet apart, these tubes having a quarter inch bored in the upper side every foot or so, and each pair of pipes coming through the bulk head, and connecting on to two six-inch pipes passing through the side of the vessel, the sea water being prevented from entering by means of screw valves. As soon as the alarm thermometer gave notice that heating had reached a dangerous point, these valves could be *opened and the lower portion of the cargo drenched with* salt water. This, evaporating rapidly, would give large volumes of water vapour, which, passing up through the heated coal, would lower its temperature, but would not be nearly as effective as the method before advocated. It might, however, be used in conjunction with that method, and would, in many cases, save the carbonic acid gas. In the case of coal bunkers in modern steamers and warships, the conditions under which the coal is placed are so totally different from those existing in a collier, that no comparison can be drawn between them. In the coal bunker, the question of mass, which which plays so important a part in a hold laden with coal, is almost entirely eliminated, as 50 to 400 tons would be about the capacity of any ordinary bunker, and it has been before shown that the cases of spontaneous ignition in masses of coal less than 500 tons does not amount to more than quarter per cent., and the question of initial temperature becomes the most important factor.

To be Concluded.

Cast Iron.

The fourth of a series of lectures on this subject was delivered recently by Mr. Thomas Turner at the Mason College, Birmingham. The lecturer stated that castings were sometimes made from iron taken directly from the blast-furnace, in the fluid condition. But this method was only used to a very limited extent, and was becoming relatively of less and less importance as irregular results were obtained, owing to the variations in the character of the iron made in a blast-furnace from day to day, or even from hour to hour. So that even when founders are also ironmakers it is the custom to remelt the pig-iron after its uniformity has been checked by fracture, or by analysis if necessary. On the small scale, for special purposes, gas-furnaces are convenient for melting cast iron, but their use is limited, as the cost of gas is generally too high to allow of the application of gas on any considerable scale. Wind furnaces with fireclay crucibles and coke for fuel are in use in many cases where small castings are made, and where great uniformity is necessary a reverberatory or air furnace is employed. But in the vast majority of cases a small blast-furnace, called a cupola, is used, as it is cheap, rapid, and easily managed. The coke should be hard, and as free from sulphur and ash as possible. The amount of coke used will depend on the quantity of iron melted in a given time, and on the construction of the cupola. It may be reduced to as little as 1 cwt. of coke per ton of iron melted. Usually, however, from 2 to 3 cwt. is employed. In addition to the simple form of cupola so long in favour, a number of improved varieties have been introduced during the last few years. In Germany the Herbertz cupola has met with much favour, but has not succeeded in making its way in this country. It is worked with a steam exhaust instead of with a forced blast, as is usual. Where large quantities of metal of uniform quality are needed, a cupola with a receiver or mixer is to be preferred, and Siemens' "Rapid" answers very well. As the applications of cast iron are numerous, and, despite the competition of steel, appear to increase rather than diminish, the difference in form and variety of moulds is very great. The most general material used for moulding is green sand, a black mixture to be found in every foundry, and which gets its name from the fact that it is used in the raw or unbaked condition. For special purposes dry sand, loam, or cast iron moulds are needed. Moulding machines are now being introduced into many branches of the trade where there is much repetition of simple forms, and it is stated that by this means the cost of moulding can, in some cases, be reduced to about one-sixth of what it formerly cost. The effect of re-melting cast iron varies with the character of the metal, and with the method of melting. It has been frequently supposed that iron was improved by being melted and kept in the fluid condition, but Mr. Turner's analyses of the test-pieces prepared by Sir W. Fairbairn have shown that the effects obtained can be fully explained by the chemical changes that took place, and that the metal loses silicon and absorbs sulphur when it is remelted in the cupola or air-furnace. This makes the iron harder, and, if it were originally too soft, it improves it, while, if the metal were too hard at first, every melting only makes it worse. The properties of cast iron are not altered when it is melted in a closed vessel so as to prevent chemical change. The various kinds of cupolas, moulds, &c., were illustrated by the aid of lantern views.

In the fifth lecture of the series Mr. Turner, in referring to the production of large castings, said that it sometimes happened that some special work was needed heavier than could be produced with the ordinary methods of working in the foundry, at the same time it is out of the question to put down sufficient cupolas to meet such a case. To overcome the difficulty, it is the custom to melt a few tons of metal, or as much as the cupola will take, and collect the fluid metal in a covered ladle. another charge is then melted and added to the first, and the operation repeated as often as may be necessary, the metal in the ladle keeping quite fluid until it is required. With large castings special care is needed in weighting the top of the mould, or the liquid pressure will lift the top off and spoil the cast. It is also necessary to use a harder iron with large work, as the metal cools so slowly. Where special strength is needed care must be taken to have not only the right chemical composition, but also the size and shape of the casting *suitable to the iron employed. Some iron is stronger in* small castings than in large, while in exceptional instances the opposite is the case. In some forms of patterns, too, with abrupt changes of shape, planes of crystallization are developed, and there are causes of weakness. Where great crushing strength is required the iron should be hard and white, or nearly so. For transverse strength, a very close-grained grey iron gives the best result; but where tensile strength is most wanted the iron should be soft and a good working metal, but still close and dense. When iron is too soft it runs easily and fills every line of the mould, but it is weak. The malleable cast iron trade is a very important industry in the midlands, this variety of work being employed where a softness like that of wrought iron is required, but where the pattern is so complicated as to make a forging costly, and where only a moderate strength is needed. The metal used is a hard iron, usually white, which is specially free from silicon, manganese, and phosphorus. The castings are made in green sand in the ordinary way, except that in many cases a crucible is used for melting the iron. The castings so obtained are quite hard and brittle, and in their present state of no particular use; but after they have been heated in closed boxes filled with hematite the character of the material is completely changed. The castings can be readily cut or filed, and the fracture presents a characteristic grey appearance; the material has actually become so soft and malleable that it can be bent without fracture, like wrought iron. This remarkable change of properties is connected with the fact that during the so-called annealing, part of the carbon has been removed, and that which remains is converted into the graphite form. The large and extending use of malleable cast-iron bears testimony to its usefulness, though its introduction by unscrupulous persons instead of wrought iron has, doubtless, helped to give a bad name to some of the productions of the South Staffordshire district.

Separation of Iron, Cobalt, and Nickel.—From *Les Comptes Rendus de l'Academie des Sciences* we learn that G. A. LeRoy uses an electrolytic method for the separation of iron, manganese, nickel, and cobalt. To the solution in sulpuric acid a small quantity of citric acid and an excess of common sulphate and ammonia is added. With a current from two Bunsen cells the manganese deposits at the positive pole, iron, cobalt, and nickel at the other pole. The deposit of these three metals is rapidly washed and is then placed in a strongly ammoniacal solution of ammonium sulphate. With a weak and reversed current the metals dissolve. The nickel and cobalt re-deposit at the negative pole, and the iron remains in the solution as a precipitate of ferric hydrate, as citric acid is now absent.

On Natural Phosphates.*

By J. Lawson Wills, F.C.S.

When your President and Treasurer did me the honor to request me to read a paper on "Phosphates" before the Ottawa Field Naturalists' Club I hesitated in complying.

"Phosphates" in a general way, as we employ the word in this locality, implies the crystallized Mineral Apatite so abundant in certain parts of our Laurentian formation. The good work done by the Geological Survey, has from time to time, through its officers, kept us well informed of the localities and peculiarities of occurence of the Canadian apatite, by valuable contributions from the pens of Sir Wm. Logan, Sterry Hunt, Vennor, Dr. Geo. Dawson, Torrance, Dr. Robt. Bell and others. At the present time, I understand that Mr. Ingalls also, who has been in charge of a special study of our Canadian apatite fields, is about to terminate and publish his preliminary report, so with deference to his opportunities and approaching publication, I could not presume to undertake a paper purely on Canadian phosphates or apatites as was proposed, but thought it might be acceptable to our members here to give their attention to a more extended and general consideration of natural mineral phosphates, and hence the title of my paper this evening, instead of being "Canadian Apatite" is "Natural Phosphates" in a more general way. My present occupations prevent me from giving much time and study to the preparation of this work, but if by some generalizations of facts we can awaken a healthy discussion and exchange of ideas, my humble attempt will not have been useless.

Natural phosphates owe their commercial value to the proportion of phosphoric element contained in them, and are employed as raw material for the manufacture of phosphatic fertilizers, being also sometimes applied in the natural and raw state direct to the soil by the farmer. They are also in demand for the manufacture of phosphorus, baking powders, and some other chemical products. By far the greatest demand for them, however, is made by the manufacturers for agricultural requirements, and this demand is yearly increasing at a very rapid rate. The occurence of natural phosphates presents the most varied and interesting modes of formation, as may be surmised by finding their deposits not only in nearly every geological system but in many different groups of the same system: Now in beds, which may be, have a fresh water or marine origin; now appearing as hardened conglomerate or rocks; and sometimes as sand and loose gravel: then again in vein formation or pockets, sometimes amorphous, at other times crystalised.

In the matter of texture, color and other physical characters, we find the same endless variation.

The origin of the demand for these phosphatized products is comparatively of recent date. It was only in the commencement of the present century that crushed bones were employed as a fertilizer in agriculture, and, strange to say, only then on account of the gelatine or organic matter they might contain!

The following curious statement, which appeared in a scientific journal in the year 1830, apropos of the employment of crushed bones in England, exposed the ignorance on the subject at that day, and read as follows: "As to the earthy matter or phosphate of lime contained in the bones, we may disregared it. It is insoluble and indestructible, and *cannot serve as a manure*, even in a damp soil, and in immediate contact with the rootlets of the plant."

The suggestion of Liebig, to treat the bones with sulphuric acid, opened a new era to the utilisation of phosphatic materials in agriculture, and the manufacture of artificial manure was soon established.

The illustrious Elie de Beaumont thus expressed himself with regard to the commencement of the mining of mineral phosphates. "Colbert has said that France would be lost for want of forests, and everyone perceives that without coal, his prediction would soon be accomplished.† In his day, one would have failed to comprehend how a great country might disappear."

Natural Phosphatic Deposits.

These valuable provisions of nature are the result of various causes and agencies familiar to the geological observer, and their contained phosphoric acid is mostly due to animal life; and when we say "due" to animal life we wish to imply that animal life is the assimilating and concentrative medium of *pre-existing* phosphoric acid. Whether as sea and fresh water shells, as fish and animal bones, as excreta of birds and saurians, etc., animal organisms have been from the beginning of life, and still are, the silent but mighty laboratory of nature, never resting to collect and store up the dispersed molecules of phosphoric acid. Among such are the guano beds of recent epochs, coprolitic deposits, bone beds, shell beds, etc.

Nature's operations of bringing these materials or their debris together to form whole geological areas are equally varied, but the esturaries and depressions of the sea bottoms of the different and respective geological periods are recognized to have been the receptacles or store houses of these wonderful supplies. A curious deposition to concretionary action, displayed by nuclei of certain organisms to absorb and accumulate phosphatic matter, with which the ancient seas abounded, is more easily seen in its effects than explain'd.

Such is the origin of many odd species of nodules, some varities of which exist in immense quantities.

The abrupt or imperceptible, but never ceasing operations of geological rearrangement, follow the aforementioned accumulations, and we then have new forms of mineralized phosphatic matter, giving rise to conglomerates, breccias, phosphatic limestone, shells and marls, sandy and ablation deposits, etc., and most of the known natural deposits of mineralized phosphate display examples of two or more of these products. For instance, the perplexities experienced just now with some of the exploratory workings of the lately discovered Florida deposits, are chiefly occasioned by the character of these beds containing boulders, and nodules from pea size to masses of several hundred pounds in weight, fish bones, shark teeth and fossil bones, in fact *debris* from several geological epochs, each of these materials naturally varying in their purity, and therefore their commercial value, so that the more successful enterprises may be looked for where regular and homogeneous deposits occur, or some cheap and efficient mechanical means are applied for the separation of the marketable products from the less valuable or worthless intermixtures.

The classification of natural phophates of lime is, as remarked by Dr. Penrose in Bulletin No. 46 of the U.S. Geological Survey, "a matter attended with many difficulties, not only on account of the great variety of forms in which phosphate of lime occurs, but also because many varieties blend into one another, thus often rendering it uncertain to which class a special deposit should be referred;" and he adopts the following classification, based mainly on the chemical composition of the deposits, and grouped under the headings thus:—

MINERAL PHOSPHATES.. { *Apatites.* { *Fluor-Apatites.* / *Chlor-Apatites.* / *Phosphorites.*

ROCK PHOSPHATES .... { *Amorphous Nodules.* { *Loose Nodules* / *cemented (conglomerates).* / *Phosphoric Limestone Beds.* / *Guanos.....* { *Soluble Guanos.* / *Leached Guanos.* / *Bone Beds.*

We shall recognize, as we proceed with the study of the various phosphatic deposits formed during the different geologic periods, that by far the greater part owe their origin to animal or organic remains, and we shall see that as soon as the organic compounds of a guano, for example, are dissipated and resolved into their elements, we may consider that the residual products, to all intents and purposes, revert to the mineral state, in accordance with the familiar expression "earth to earth."

We pass over, for the present, the guano of various localities, which however, will be observed to lie mostly within 10 to 20 degrees of the Equator.

We should remember, however, that this product has probably obtained its zenith, both as to quality and quantity, and must cede its commercial importance ultimately to the mineral resources of phosphoric acid, which are before us for our more particular consideration.

We shall find the diagram on the wall, which shows the approximate geological position or age of the different phosphate deposits, very useful to our present purpose, and we will commence with the more recently formed or mineralized products:—

Occurrence of Natural Phosphates in the Geological Epochs.

Post Tertiary or Quarternary System.

True guanos.
Crushed or "leached" guanos.
West Indian and Pacific phosphates.

Tertiary System:

West Indian Rock Phosphates.
Nassau or Lahn nodular concretions.
Suffolk Coprolites in the Red crag and Coralline crag; (reposing on Lower Eocene).
South Carolina beds, resting upon Eocene.
Deposition of Florida phosphate, *debris* and organic remains.
North Carolina, overlying Eocene marl.
Fundamental rock of Florida phosphate deposits.
Clays and *debris* of Bordeaux phosphates.

Cretaceous System:

Belgian (Liege) Heshaye nodules.
American Alabama amorphous nodules.
New Jersey marls.
Belgian (Mons) Ciply nodules (Maestricht beds).
Somme deposits, arenaceous and nodules.
Russian "Samorod" nodules Desna-Don.
Cambridgeshire and Bedfordshire Coprolites.
French nodules of Ardennes, Meuse.
French nodules of Montpellier and Bellegrade.

Oolitic or Jurassic System.

Bordeaux Phosphorites and nodules overlain by Tertiary (Eocene) clays and *debris*.
Algerian Phosphates.

Triassic System.

Highly phosphatic beds, (between Trias and below Lias), containing exuvie of huge reptiles as well as remains of fish and crustaceans.

Permian System:

(Appearance of Reptilia.)

Carboniferous System:

(Appearance of Amphibia.)

Devonian or Old Red Sandstone:

Highly phosphatic beds in junction with Lower Carboniferous.
Highly phosphatized bed in Shropshire, containing oldest known remains of vertebrate life associated with crustaceans.

Silurian System:

(Appearance of Vertebrata.)
Welsh Bala beds; Berwyn Phosphate mine.
Lingula flags (Quebec), 40% Tribasic.
Angers slates (France).
Phosphate limestone of Kentucky.
Logrosan (Spain) Phosphorites. (Apatites?)
Caceres (Spain) Phosphorites.
Portugal Phosphorites.

Cambrian System:

(Appearance of Protozoa, Mollusca, Annulolida and Crustacea.)

Laurentian System:

Canadian Apatite.
Norwegian Apatite.

Thus at the present time, we have mineral phosphates of lime in process of formation, and principally known in commerce as "Grust Guano."

Looking at the chemical composition of average bird guano, we find it to be composed of the following constituents:—

Moisture	15.8
Organic matter and Ammoniacal Salts	52.5
Phosphates of Lime	19.5
Phosphates of Iron and Alumina	3.1
Alkaline Salts	7.6
Silica and Sand	1.5
	100.0

This typical analysis is from the average of 15 samples, made by Nesbit on the Chinchas inland guano.

An elementary knowledge of chemistry will assist us to perceive what a large proportion of the above constituents will be leached out by water, or dissipated by prolonged exposure to ordinary atmospheric influences, especially when we remember that the organic matter above mentioned comprises uric, oxalic and phosphoric salts of alkalis and ammonia, and even about one-third of the phosphate of lime is found to be soluble in water. Given a deposit of guano on a limestone soil or rock, and it is readily perceived that every shower will contribute to the steady but continual process of the transmutation of the carbonate of lime into phosphate of lime in consequence of the discharge of the weaker carbonic acid by the stronger phosphoric acid.

The exhausted guano then becomes phosphatic in distinction to being nitrogenous and ammoniacal ("leached"), and the subjacent limestone undergoes a metamorphosis, by a double decomposition, into phosphate of lime. If the absorbing limestone is pure, the phosphate of lime thereby formed will be correspondingly pure; and on the other hand, if the calcareous base is intermixed with clay or sand, or ferruginous material, the newly formed product will contain alumina, silica, oxide of iron, etc., in like proportions.

Such has been the undoubted origin of the deposits of Aruba rock phosphates, samples of which are on the table, and which are typical of this kind of metamorphosis, and will serve to illustrate many similarly formed deposits, notably those of Curacao, Sombrera, Navassa and Redondo, (in which latter case the subsoil must have been aluminous, since the mineral is a phosphate of alumina).

In some cases, the phosphatic principle may have been derived from animal *debris*, such as bones.

The composition of animal bones varies somewhat, according to the animal furnishing them, and even with the particular part of the same animal, but the following analysis, expressed in 100 parts, may be taken as an average:—

	Green Bones.	Bone Ash.
Moisture		
Organic matter	33 (gelatine)	
Phosphate of Lime	56	70/75%
Phosphate of Magnesia	3	
Carbonate of Calcium	3	
Alkaline Salts	4	
Silica	—	

The bones of birds are even richer in phosphoric acid than those of mammals, but bones of the *Amphibia* and fish contain less than those of birds and mammals.

Amongst other animal organisms rich in phosphoric acid or phosphate of lime, may be mentioned certain shell fish, or rather their shell remains, notably the shells of *Lingula* and *Orbicula*, which consist for the greater part of phosphate of lime, and are found in accumulated beds in the Lower Silurian rocks, being thus described by Sir Wm. Logan (Geology of Canada, 1863). Those coming from the Chary formation at Alumette Island left after calcination, 61% of fixed residue, consisting of:—

Phosphate of Lime	85.7
Carbonate of Lime	11.7
Magnesia	2.6
	100.0

* Paper read before the Ottawa Field Naturalists' Club.

† Jean Baptiste Colbert, born 1619, Minister of Finance to Louis XIV.

And analysis of the original material gave as follows:—

	Alumette.	Hawkesbury.	River Ouelle.
Phosphate of Lime....	36.38	44.70	40.34
Carbonate of Lime, some Fluorine.....	5.00	6.60	5.14
Carbonate of Magnesia.	....	4.76	9.70
Oxide of Iron and Alumina.....	7.02	8.60	12.62
Magnesia	....	....	....
Insoluble.....	49.90	27.90	25.44
Volatile by heat.....	1.70	5.00	2.13
	100.00	97.56	95.37

We here observe an average of 40% of phosphate of lime. It would appear that our knowledge of the proportion of phosphatic element in similar animal remains is very imperfect, so that upon further investigations we may expect to meet with many other similar accumulated supplies of phosphoric acid.

Some authorities attribute a large portion of the phosphate of lime in the Charleston fields to such mollusks and principally *Lingula, pyramidata*, which are found abundantly on the present coast.

Classification of Natural Phosphates.

I prefer for all practical purposes, and from rational observation, to modify the classification proposed by Dr. Penrose, thus:—

- APATITES..... *Fluor-Apatites.* / *Chlor-Apatites.*
- MINERAL AND ROCK PHOSPHATES..... *Phosphorites.* / *Nodules, Coprolites.* / *Concretions.* / *Conglomerates.* / *Phosphatic Limestone.* / *Phosphatic Marls.* / *Crust Guanos.*
- GUANOS. ..... *Nitrogenous.* / *Phosphatic, or "leached."* / *Bat Guano.*
- ANIMAL REMAINS..... *Bone Beds.* / *Shell Beds.* / *Animal exuviæ.*

We will now proceed to trace in a cursory way the commercially known deposits, commencing with the most recent and passing stratagraphically in descending order to the more ancient formations.

Classification of Natural Phosphates.

Guanos.

Guanos are of two kinds: Nitrogenous, or those containing their original manurial qualities, and phosphatic or "leached," the latter being in a more or less mineralized condition by exposure to weathering.

Among the nitrogenous guanos we have the Peruvian, Ichaboe, Patagonian and Falkland Islands.

The phosphatic or weathered guanos include those of the Pacific or Polynesian Islands, Sidney, Phœnix, Starbruck, Baker, Howland, Jarvis, Enderbury, Malden, Lacepede and Arbrolos Islands.

Some of these deposits are more or less exhausted, and new islands furnishing similar products are from time to time worked.

The West Indian guanos are from Aves, Mona, Tortola.

Other South American are Patos Islands, Megillones, Rata.

From Africa, Saldanta Bay and Kuria Muria Islands.

Bat guano, the products from the floors of caverns inhabited by bats, have sometimes been sent to market as a rich fertilizer. It is found notably in Cuba (W.I.) and in North Borneo. It possesses a characteristic dark brown color and exhibiting the undigested parts of beetles' wings and insect *debris*.

Bone Beds.

These are found in nearly all sedimentary strata, from the Devonian up to the present time, but with the appearance of those remarkable *Reptilia* in the Permian age, we find that these kind of phosphatic provisions of nature took enormous developments, augmenting the resources previously furnished by the *Amphibia* of the Carboniferous epoch.

Bone beds however in their original state, have furnished little to commercial supplies of phosphatic products, excepting those found in the Tertiary and Quarternary ages, such as Bordeaux, Carolina, Florida and Sombrero (breccia).

Shell Beds.

Since these must have existed from a time well into the Palæozoic periods, or that is to say, from the Cambrian age, we may expect and do find these molluscs remains through a wide range of systems and strata and up to recent times.

The Silurian Lingula beds are remarkable, and have been already particularized as a probable abundant source of phosphoric acid.

The Welsh Silurian beds, and the French Bellegrade and Ardennes deposits in the lower Greensand (Cretaceous), exhibit evidence of this origin, while the Tertiary and Quarternary phosphates contain very frequently these marine and fluvatile remains as a contribution to their value in phosphate of lime.

Some very interesting specimens are on the table from the Dutch West Indies, containing from 75 to 80% of tribasic phosphate of lime, and exhibiting in some cases one mass of shells belonging to recent times.

Coprolites

Owe their name to Professor Henslow, and should be applied only to the fossil *exuviæ* of animals. The appellation has extended itself to many rolled or gravelly products, chiefly found in the Cretaceous formation. In England they have been worked to a large extent in Bedfordshire and Cambridgeshire, where they appear in the (Neocomian) strata, between the chalk and the subjacent Jurassic system, in nodules and pebbles of size from a pea to a hen's egg, and sometimes cemented by ferruginous sand into a hard conglomerate; organic remains are present, and casts and fragments of fossils with abundance of *Ammonites*, vegetable remains and other *debris* of the Jurassic epoch (Iguanodon and Megalosaurus, etc.)

The commercial products contain from 45 to 55% phosphate of lime.

The Coprolites of Suffolk occur in the Tertiary, being in the older Pliocene (the Red crag and Coralline crag). They are poorer in phosphate of lime, more ferruginous and harder in texture.

France also possesses some deposits of this character at Bellegrade, near the Swiss frontier, and also at Montpelier and Avignon, yielding 54% tribasic of lime.

Nodular, Concretionary and Arenaceous Phosphates.

These, by far the most important of nature's phosphatic reserves, comprising as they do the South Carolina deposits, the French deposits of the Somme, Ardennes and Meuse, the Belgian fields of Mons and those more lately opened up at Liege (Hesbaye). The so called "Bordeaux Phosphates," because being formerly shipped from that port, but having their real origin in the region of Quercy, comprising portions of the departments of the Lot, Tarn and Garonne and Aveyron, also furnish a considerable quantity of nodular or phosphatic concretions of kidney shape of great purity (85%) and curious geological interest. These are well represented by specimens on the table, and coming from the crevices in the Oolitic limestones, accompanied by *debris* of Tertiary age (Eocene), the walls of the crevices or fissures being at the same time incrusted with phosphorite of a high degree of purity, attaining 80% of tribasic phosphate of lime.

We must not omit here the Florida nodular beds of land and river formation, which are now enjoying such a glorious boom.

As a peculiarity of this Bordeaux phosphorite, we may mention that it contains a very appreciable proportion of iodine.

The Russian deposits, situated between the rivers Desna and Don, occur in the Cretaceous system, at about the same horizon as the Cambridgeshire coprolites and may be described as nodular.

The Nassau or Lahn concretions in clay are of Tertiary age, and although not exhibiting signs of organic remains are generally believed to be of animal origin; they attain 60 to 75% phosphate of lime, but are too ferruginous to be much in request for superphosphate manufacture.

The Belgian (Ciply) deposits, which have furnished over 150,000 tons per annum of a 40 to 50% product, is of a nodular character, although the grains are often so fine as to be considered more correctly arenaceous.

The same may be said of the very remarkable French deposits, discovered near Amiens in 1886, and known as the Somme phosphates. These are granular or arenaceous, and to this feature as well as to their richness (65/80%) may be attributed the enormous development which they have enjoyed in such a short period, attaining the annual production of 200,000 tons.

Conglomerates and Breccias.

Phosphatic beds may also assume these characters, sometimes with the cementing material as the phosphatic element, and at others with the enclosed pebbles or angular fragments as the valuable portion for commercial supplies.

Thus the Cambridgeshire coprolite fields furnish a conglomerate of phosphatic pebbles, cemented by ferruginous sand, while at the Ardennes district (France) is found a peculiar agglomeration of granules of chlorite in a phosphatic cement, the whole yielding 40 to 45% phosphate of lime.

The Belgian (Ciply) deposits yield abundant supplies of a mass of phosphatic nodules, shells, casts and fossils, cemented in a calcareous matrix, to utilize which has puzzled the mechanical ingenuity of many an "*exploitant.*"

Phosphatic Limestone and Marls.

These are found in most strata from the Silurian epoch down to more recent times.

The metamorphosis or transmutation of earthy carbonates into phosphates is a very simple and comparatively rapid process, and the evidence of Dr. R. Ledoux in the following description is instructive. He says in a recent article on phosphates: "Some clients of mine sent a ship to a coral island in the Southern Pacific to bring away a cargo of bird guano. The birds were still in countless thousands. The captain had been there for a load 20 years before, and since that time no guano had been removed. At his first visit the crew had cleaned off a space and made a house of coral rock, covering it with a sail and had used it for a shelter and store-house while at work. On leaving, the sail was taken away and the walls and board floor left. On the return, 20 years after, there was an average depth of 20 inches over the floor—an inch a year. The underlying limestone was altered into phosphate for a depth of several feet, but the conversion of carbonate into phosphate gradually became less perfect as depth from surface was attained."

I have observed the same effect myself taking place in the West Indies, where the surface of the coral rock is speedily converted into phosphate of lime, wherever the sea birds are in the habit of congregating.

Such indeed is the simple origin of some of the most important deposits of phosphate in that part of the world: i.e., Curacao, Sombrero and Aruba, etc.

The prospecting and first development of the latter named island having fallen to my own care and experience, I am able to produce some interesting specimens here, illustrating very clearly the history of their formation by examination of their fossil organisms, originally carbonate of lime (coral rock), and now seen to be, by analysis, phosphate of lime of over 80%.

The deposits of Florida and South Carolina would appear to owe much of their phosphatic wealth to *debris* of phosphatized limestones and marls.

One of nature's operations which is a factor in enriching already formed phosphate beds, may be here alluded to, namely the property of spring waters (which often contain considerable proportions of bicarbonates and free carbonic acid gas) to dissolve neutral carbonate of lime, even when presented to them in apparently the most compact and impervious material. Such has been the origin of the many remarkable caves existing in the limestone rock formation (Cheddar, Derby, Kentucky, etc.)

This property, applied to a calcareous phosphated material, will in course of time, ablate as it were, more carbonate than phosphate, and to this action is attributed the value of many thousand tons of material in such extensive beds as those of the Somme, Ciply, Liege and probably at Florida.

While speaking of these beds of the Cretaceous period, I may mention the recent opening up of another similar field in France. I refer to that in the department of the Pas de Calais, which would appear to be of the same nature as that of the Somme.

Apatites

Although crystallized phosphate of lime is found as a component of rock masses in more recent strata, yet we do not yet know of any workable deposits of this mineral before passing to the oldest of fossiliferous systems, the Laurentian.

The rocks of this formation are among the most ancient on the North American Continent and probably correspond to the oldest gneiss of Scandinavia. The modes of occurrence are so varied in the Canadian Apatite field, that the subject would require to be treated by itself in order to do it justice here.

We are all here familiar with how it is found both in Ontario and Quebec provinces.

Dr. Hunt thus describes in 1884 the main features of its mode of occurrence: "The deposits of Apatite are in part bedded or interstratified in the pyroxenic rock of the region, and in part are true veins of posterior origin. The gneissic rock, with their interstratified quartzose and pyroxenic layers, and an included band of crystalline limestone, have a general northwest and southwest strike, and are much folded, exhibiting pretty symmetrical anticlinals and synclinals, in which the strata are seen to dip at various angles, sometimes as low as 25 degrees or 30 degrees, but more often approaching the vertical. The bedded deposits of apatite, which are found running and dipping with these, I am disposed to look upon as true beds, deposited at the same time with the enclosing rocks. The veins, on the contrary, cut across all these strata, and, in some noticeable instances, include broken angular masses of the enclosing rocks. They are for the most part nearly at right angles to the strike of the strata, and generally vertical, though to both of these conditions there are exceptions. One vein, which had yielded many hundred tons of apatite, I found to intersect, in a nearly horizontal attitude, vertical strata of gneiss, and in rare cases what appear, from their structure and composition, to be veins, are found coinciding in dip and in strike with the enclosing strata."

The apatites of Norway are known since 1854, and occur on the southern coast in similar rocks to our own, (Canadian) and many of the associated minerals are similar to those observed in the Laurentian rocks, the vein matter differing chiefly in freedom from carbonate of lime.

Rutile may be mentioned as an exception, which in some mines is so abundant as to form a considerable revenue to a working mine, since it is worth about 1/6d. per lb., say $800 per ton. These are fluor-apatites, although they contain also some chlorine

Continental geologists, (Brogger and Rensch) who have studied these formations, have supposed them to be of eruptive origin, in consequence of the absence of phosphoric acid in the surrounding rocks, but the question seems to be most doubtful, as well here as in the case of the same opinion held on the Canadian apatite deposits.

The Situation of Canadian Phosphate Trade.

Although this Canadian industry has not progressed on the same scale as many other phosphate fields, Somme, Ciply, Liege, Carolina and Florida, yet there are some facts offering an explanation for this. The peculiarity of the occurrence of the mineral, in vein-like formation in hard rock, calls for a scientific and economic system of mining, which has been little applied to the development of our deposits, and the cost of production is thereby more considerable than that attained in other fields of supply.

Certain centres of manufacture still require our high-testing products to complete their standard types of

concentrated *supers*, and the rapidly increasing demand for fertilizers by all the civilized world, both the new and the old, will tend to maintain a fair value for natural phosphates. We are getting into the era in which steam does not work fast enough, and on every hand we are seeking to accomplish our ends by electricity with lightning speed. Some one has said that the man who could make two blades of grass grow where one only grew before, was a benefactor to his race, but the rush and struggle for existence imposes that every cultivator shall be a benfactor in this regard, and carry on agricultural science at the highest possible tension for his very existence.

With increasing populations, with better means of transport, and lastly, but not least, advanced scientific education, fertilizers and all other artificial means of stimulating our exhausted soils will continue to be in increasing demand.

We see no reason therefore to suppose that the mineral phosphate industry or phosphate mining has attained its zenith, and so far as we can see at present, the future demands of the world for phosphoric acid are destined to increase with time and agricultural progress.

Resume.

We may now shortly generalize the foregoing facts and observations.

Of the sixty-four elementary substances at present known to compose the material of our original globe, phosphorus is found to be among the twenty more abundant elements, and is recognized to have been widely disseminated in all the original and ancient rock masses. With the exception of the segregations of crystallised apatite in the Laurentian rocks, we do not find any marked local accumulation of phosphatic bases in any of the azoic formations, or intrusive rocks.

The existence of the Eozoon Canadense is still debatable, and it is problematical whether the apatite of these older metamorphosed strata is not the mineralised product of organic remains, but passing from the Laurentian epoch to the succeeding and less altered rocks, we are immediately in presence of abundant evidence of organised life, and cannot fail to remark how much more frequent are the accumulations of phosphatised beds.

The function of organised life to assimulate and concentrate the disseminated phosphoric element is strikingly apparent. The natural forces which are ever restless and continual in building up the varied geological strata of succeeding epochs (attrition, deposition, cementation, ablation etc.) may alter and vary the manner of presentation of the phosphatic deposits which we have been considering, but the silently working power of assimilation by the organised cell would appear to triumph over the mighty disruptive and more violent operations of nature, for the latter forces fail to redisseminate the work accomplished by the former, but rather complete the task required to secure to man the providential supplies of phosphatic deposits with which we may satisfy our present demands, and therefore these economic supplies are seen to be chiefly in the more recent geological formations.

"A New Use For Old Ropes."*

By Robert M'Laren.

It has long been a source of anxiety with mining managers what to do with winding ropes which have been thrown off, as they can be used for few purposes about a colliery; and the price received when disposed of is so small that, rather than sell them, they allow them to lie about as so much useless material, probably with the hope that a use will be found for them some future day.

Owing to the difficulty in disposing of some old iron winding ropes, taken from No. 1 Pit, Gilmerton, at a remunerative price, the manager, Mr. Hutchison Burt, determined to utilize them on an incline, or "cran brae," in place of iron rails and wooden guides in use on the other inclines.

The colliery is situated to the south-east of Edinburgh, and is owned by the Gilmerton Gas Coal Co., Ltd.

The shaft (No. 1) is sunk to the Stairhead coal, at a depth of 88 fathoms.

From the shaft crosscut mines are driven east and west. On the west side the following seams are intersected in their order: Gillespie coal, Blackchapel coal, Coalpatty coal, Stinky coal, Glass coal, North Parrot coal, Corbiecraig coal, Peacocktail coal. The mine to the east side cuts through the Great coal seam. Six of these seams are presently being worked. The measures are in the carboniferous limestone series, and are highly inclined, the inclination varying from 65 deg. to 78 deg. The coal from the various seams is lowered to levels by inclines in cages or carriages. There are five inclines in operation—three with wooden guides and cages, one with iron rails and carriages, and one (Corbiecraig) with wire ropes and carriages.

Corbiecraig incline is 96 yards long, with eight stopping places, 11 yards apart, worked by a drum at the top, 6 ft. diameter, with brake attached, and steel haulage rope ⅝ in. diameter. The signalling is the usual method adopted in the steep measures. The inclination is 72 deg., except 30 yards or so at the top, which is 65 deg. On this incline the Corbiecraig coal and the North Parrot coal, about 8 yards back, are lowered. The latter is reached by back mining.

The Corbiecraig coal is worked stoop and room, stoops 20 yds. on level by 8 yds. to rise, with openings 9 ft. wide; and the North Parrot coal is worked long-wall.

Roadway.—The road is 12 feet wide by 4 ft. 6 in. high (average), and has a carriage and back balance way. Sleepers, 9 ft. by 8 in. by 3 in., are laid across every 4 ft., and on these are fixed planks 6 in. broad by 2 in. thick, laid longitudinally. Again, on the longitudinal planks the ropes, 3 in. circumference, are laid, and to make them rigid the following method is adopted:—At the foot of the incline a beam, 9 in. square, is fixed. Into this a hole is bored, and the rope is passed through, and is glanded on the under side of the beam. At the top the rope is fixed to a screw by means of a hose and muzzle, and as the screw is turned the rope tightens. As soon as the rope is stretched spikes or large nails are driven through its centre to fix it to the plank. The spikes are 8ft. apart.

The gauge for the carriage way is 4 ft. 6 in., and for the back balance way 1 ft. 10 in.

Carriage.—The carriage is 10 ft. long by 4 ft. 3 in. broad by 3 ft. high, is of angle steel, 2 in. by ¼ in., and carries one tub. The wheels are made with a groove 1 in. deep to fit into the rope, and are 5 ft. apart.

The speed of the carriage is twenty seconds for the journey from top to bottom, equal to 9·75 miles per hour; but the average is about half that speed. The weight of the carriage when loaded is 13 cwts.

Back Balance.—The back balance consists of a plank fixed to two axles, on which are wheels, same as on the carriage, and loaded up to the required weight. This back balance is insufficient for the part of the roadway which has the reduced gradient, and in consequence a second back balance is in use, which rests on a block, and is raised by the main back balance when ascending, and stops at the block when descending.

The second back balance is similar to the main back balance, except that is fixed a projecting piece of wood each side, 6 in. square, which come against the block, and the back balance is brought to rest. The block consists of two planks, 9 in. by 3 in, placed upright and firmly fixed between roof and floor.

To prevent the back balance when at rest from going over the block and tumbling down the incline, there is fixed a small pulley over which the haulage rope passes. The pressure of the rope on the pulley is sufficient to keep the back balance in its place, but, in case the rope should rise, two glands, raised in the centre are fixed close to the pulley, and the rope runs through them.

The incline has been in operation about six months, and has worked very satisfactorily, having given no trouble, neither carriage nor back balance having once left the ropes.

The advantages claimed for this rope road are:—(1) It is much cheaper, as the ropes are of little value; (2nd) It is easier fitted up, and, when compared with a similar incline fitted with iron rails, the cost is about one-sixth.

Discussion.

The PRESIDENT remarked that this was a paper describing another source of economy in coal mining, which seemed to work satisfactorily.

Mr. FAULDS asked if Mr. M'Laren would tell them if the ropes he described had many broken wires projecting out, or were they just slightly worn?

Mr. M'LAREN said he had not travelled the incline, but the manager, Mr. Burt, was there, and could doubtless answer the question.

Mr. BURT said he did not think the ropes contained any broken wires. They were ropes that had been at the colliery for four years.

Mr. MENZIES, former manager, said he was under the impression that the ropes had not worked for six months. They were good ropes, but got cut on a pulley and were put aside, and he had no doubt these were the same ropes.

Mr. M'LAREN.—In that case they were useless for winding, and therefore old ropes.

Mr. MENZIES.—Most certainly.

Mr. FAULDS said he would like to know how long the ropes had been in use, and whether the wheel was malleable iron, cast iron, or steel, grooved or otherwise.

Mr. M'LAREN said the wheels were grooved wheels, and similar to the ordinary winding pulley.

Mr. GEORGE THOMSON said, as one who had had some experience of steep workings, he thought Mr. Burt had great credit for the idea he had brought out. Especially where the inclination varied, he knew that it was scarcely possible to keep ordinary rails in their position unless they used a heavy rail, which was very expensive. Mr. Burt's idea was a new one, and he thought, a correct one, even though new ropes should require to be applied. He thought that a spike every 4 feet would be better than one every 8 feet. However, they would find that out by experience.

Mr. FAULDS said with grooved pulleys he did not suppose it would matter whether it was 4 or 8 feet.

Mr. HUGH JOHNSTONE said he thought it was a good idea to have practically continuous rails. This arrangement got over a difficulty which he had experienced when at Niddrie. He had no doubt if their wire rope friends took up the matter they would get over the difficulty of the broken wires by substituting a rope for the purpose.

The PRESIDENT said the use of old wire ropes in this way would depend on whether the price they got for them was more or less than the price of rails.

Mr. M'LAREN said the price of old wire rope was 20s. per ton.

The PRESIDENT proposed a hearty vote of thanks to Mr. M'Laren for his paper, which was agreed to.

*Transactions Mining Institute of Scotland.

The Speakman Water Cartridge.

In a paper read before a recent meeting of the Federated Institute of Colliery Managers, Mr. J. J. Speakman said:—

There was no direction in which improvements had been greater or attention more fixed than in that of explosives. After carefully examining the results of the many tests that had been made, it seemed not too much to say that amongst them the water cartridge, as used with gunpowder, might be fairly classed amongst the safest types. The comparative ease and safety with which colliers could handle gunpowder (which for so long a time was almost the only explosive), its freedom from gases injurious to health, the completeness with which the water extinguished the flame when the cartridge was properly made and placed in the hole, and, above all, the generally correct estimate a collier could form of the quantity required in a shot so as to yield the largest quantity of round coal, seemed to point to gunpowder being reinstated in the estimation of mining engineers and becoming again almost the sole explosive used in mines. Many and various experiments had been made for the prevention of flame as produced from ordinary charges for bringing down coal to that of the blown-out shot, and to avoid its coming into contact with fire-damp and coal dust. The greatest advance towards safety in coal mining was due to the discovery made by Sir Frederick Abel of using explosives enclosed in a water shield, now known more particularly as the water cartridge. The lecturer was inclined to give Mr. Tonge, who read a paper on the subject before the Manchester Geological Society in 1880, the credit of the invention and use of tin cartridges, and although at first they were not successful, they were used successfully afterwards. Captain M'Nab took out his patent in 1876 for the paper-bag cartridge, which, when used in a proper manner did good work, but did not supply the long-felt want. Mr. Miles Settle designed a tin cartridge, but it was rather cumbersome, and the difficulty of manipulating it militated against general adoption. Mr. Speakman now submitted a tin cartridge, which, he said, answered every purpose, and was probably the best water cartridge which had yet been before the notice of the public. It was simply worked, and thus enabled every miner to be in the position at any time to use it himself, without the assistance of the shot-firer. A series of tests were recently made at the Bedford Leigh Collieries, near Manchester, in the presence of a number of mining engineers connected with the neighbouring pits, as well as Mr. Saint, Her Majesty's inspector of mines. In these tests the explosive charge used in the cartridge was tonite, and four shots of four ounces each were fired in coal. The experiments were satisfactory, as there was an entire absence of flame, and the coal was brought down in excellent condition. The charge of explosive when in the cartridge lay in such a position as to be almost completely surrounded by water, and by thus placing the charge in the bottom of the cartridge it was claimed that there was a greater head of water for extinguishing any flame that might arise when the charge exploded.

In the discussion which followed, several gentlemen pointed out that it had been proved that under no circumstances could the flame from gunpowder be prevented by water.

Foreign Coal Used at the Government Cartridge Factory, Quebec.

(*Proceedings House of Commons.*)

Mr. McMULLEN—I see that 290 tons of coal are charged for the cartridge factory at $6 a ton, with so much for duty. Is this American coal?

Mr. BOWELL.—I do not know. All the coal was purchased by tender. I do not know whether it is American or Scotch coal.

Mr. McMULLEN.—Is it American coal or Scotch coal? There is $196 duty paid, and we would like to know whether it is coal from Nova Scotia or coal from the United States?

Mr. BOWELL.—Does not the hon. gentleman think that question a little captious? If it were Canadian or Nova Scotia coal, certainly the duty would not be there. It must be either English or American coal.

Mr. FORBES.—Where is this coal delivered?

Mr. BOWELL.—In Quebec for the cartridge factory.

Mr. FORBES.—Then it is not Nova Scotia coal?

Mr. BOWELL.—Certainly not.

Mr. FORBES.—Why is it that the department does not use Nova Scotia coal?

Mr. BOWELL.—Since I have been at the head of that department I have always instructed the deputy to accept the lowest tender.

Mr. FORBES.—Then I am to presume that American coal, with the duty, costs less than Nova Scotia coal?

Mr. BOWELL.—You may presume what you like.

The Quebec Asbestos Mines Re-open.—Advices from the Eastern Townships report that the asbestos mines at Thetford and Black Lake, which have been closed since November last, resumed working during the month.

MINING NOTES.

[From Our Own Correspondents.]

Nova Scotia.

Killag.

Mr. D. S. Turnbull, formerly of Renfrew, has resigned his connection there and has accepted the management of the Old Provincial Co. at Killag. Mr. Turnbull will have entire charge of both mines and mills.

Salmon River.

Mr. Lucius J. Boyd has been engaged by the Dufferin Co. the past month in making an extensive series of surveys and maps of the surface and underground works of the company. The reports from the mine are unchanged.

Mount Uniacke.

The McCallums, representing the Alpha Company, have made arrangements with Prince et al., owning the ground immediately north, into which the rich lode is dipping, and work on the extension has been begun.

Messrs. Madill and Archibald are prosecuting their search for the big roll, but have not yet reported success.

South Uniacke.

The Thompson-Quirk people are going on in the even tenor of their way. The pay chute has over 160 feet yet to run before reaching the boundary line.

Montague.

The English syndicate have not yet bought the Annand mine, though it is rumoured that a further extension of *time has been given. Meanwhile Manager McQuaine* has begun to sink again, and will soon have plenty of stoping ground available.

Molega.

It is rumoured that the Molega Co. are entertaining a proposition for a sale. Mr. John McGuire, formerly manager of the company, has been in Molega again, and is said to be engineering the sale.

Oldham.

The Rhode Island Co. have abandoned their western workings and have gone close to their eastern boundary, where they are sinking a vertical shaft to strike the Dunbrack lode. The shaft will be about 75 feet deep before it cuts the lode.

Messrs. Isner and Vandegrift have found a cross lode showing coarse gold some two miles westerly from Oldham District. No regular lodes have been found of any value. There is some local excitement, but it is yet too early to say anything favourable of the new find.

Waverley.

The West Waverley Co. have been running their mill steadily, one shift, during April. The double shift went on on the 18th inst., and the management hope to keep double shift as a permanent thing. The mill is not yet completed, a concentrating plant being in course of erection.

The Lake View Co. have advertised for twenty-five miners, and it is rumoured that more extensive workings will soon be commenced.

Pictou County.

With reference to the progress of the works of the New Glasgow Iron, Coal and Railway Co. at Ferrona, our correspondent writes:

The railway is completed and in operation from Eureka Junction on the Intercolonial Railway to the Black Rock Mine, a distance of 10½ miles. Besides this, about two miles of sidings are laid. Freight for all parties is being carried over the line, but passengers are not yet taken.

The furnace and accompanying plant at Ferrona are nearing completion. The stock house, iron cast house, engine house, boiler shed, buildings for coal washing and storing are all completed. The blowing engines, built by the Philadelphia Engineering Co., are on the ground and in course of erection.

The coke plant consists of a coal washing and separating plant and improved Belgian coke ovens, both of which are new to this country. The boilers, which are also all in place, will be fired by the waste gases from the coke ovens. The coke will be discharged from the ovens by a steam engine and pusher, at a very trifling expense compared with the usual style of discharge from the bee-hive oven. The company expect to manufacture coke in the course of a few weeks, and to commence the production of pig iron shortly after.

At the mines, the slope at Bridgeville has been unwatered and for the past month or two has been producing about 50 tons of ore per day. This will be increased as soon as the furnace goes in full blast. At this mine there are over 5,000 tons of ore on the dump. The Black Rock Mine has been working steadily since its discovery two years ago, and during the winter has produced 50 tons per day in development work. There is a fine face of ore, nearly 50 feet in height, to quarry from by open cut as soon as the furnace goes in blast, and also a very large ore dump.

Two new shafts are being sunk at Bridgeville upon veins which have not been opened, but which have been located by the drill.

In the Blanchard district a bed of red hematite has been traced for nearly half a mile across the lands of the company.

The following new discoveries have been recently made and not yet reported in print: A continuation of the limonite vein at Bridgeville at some distance from the present workings; a vein of brown ore upon the lands of the company, purchased from Grant Bros., situated near the main road; at a distance of several hundred feet from the last mentioned an ore body of limonite, which here attains a thickness of 18 feet as penetrated by the drill; a small vein of red hematite, comparing favourably in quality with the other red hematites of the district, upon the Blanchard area of this company.

Coal Trade in Pictou County.

Present demand very dull. Although the port of Pictou has been open from the 1st April shipping has not ventured in. A stray cargo or two only has been loaded. The Drummond Mine has been busy banking preparatory to filling their large contracts up the St. Lawrence. The Acadia Co., so far as known, have made no contracts in Quebec.

Quebec.

It is reported that Mr. George R. Smith, late of the Ingersoll Rock Drill Co. of Canada, has been appointed manager of the Bell's Asbestos Company's mines at Thetford.

The annual general meeting of the Asbestos Club was held in the club house, Black Lake, on the 28th inst., when the officers for the ensuing year were elected and other business was transacted. A report of this meeting will appear in our next issue.

Mr. J. Lainson Wills, F.C.S., has severed his connection with the General Phosphate Corporation.

Templeton Notes.

The Templeton Asbestos Co. are now grinding their short fibre asbestos at Buckingham through the Frisbee Lucop mill. The cost of separating by this process is much cheaper than by the fibreizing plant process. Mr. Circkel, the manager, has reduced the gang to about 18 men.

The East Templeton and District Mining Syndicate *intend increasing their staff by 70 men, which will give* them a force of about 130, including cobbing boys. The winter output, now at the river front awaiting shipment, is about 500 tons 80% and 900 tons 70%.

The Electric Mining Co. has been working 22 men since the fall. Their monthly output has been from 100 to 125 tons.

The Haycock mica property, comprising 1,000 acres, together with a stock of cut and rough material, was sold this month to Watters & Co., Ottawa; consideration, $38,000. Operations have been commenced by the new purchasers.

The Canada Industrial Co. are working 12 men on their property on the 8th concession of Templeton. *Considerable high grade phosphate has been taken out* and delivered at the station through the winter.

The latest offers from Hamburg for 80% range from 10¼ to 10¾. Several straight offers have been made this month at 10½, without takers.

Portland West.

Messrs. Allan & Fleming have opened up several new shows on their property on the 4th range. The quality of the phosphate is very high grade, averaging from 84% to 86% and almost free from impurities.

Ontario.

Hastings County.

Mining operations in this section promise to be brisk this season. President Campbell, of the Standard Asbestos Co., owning the Bull Actinolite Mines, writes under recent date that they will begin active operations soon.

The Peebles Actinolite Mines are also expected to be operated this season.

It is said that the new management of the Central Ontario Railway will take steps early this spring to operate in iron mines at Coe Hill, and that large shipments of ore will be sent to Cleveland.

Sudbury District.

The Reduction Works Co. at Nickel City will go into *liquidation in a few days.* It has expended some $12,000 in hard cash here and are over $4,000 in debt. "Such an awful bungle of mining work was never seen before in this world," says a correspondent of the Sudbury *Journal.*

Mr. J. Robinson has sold Lot 1, in the 5th Concession of Hallam, to the Duluth Nickel Mining Co. for $5,000 cash.

Port Arthur District.

Arrangements, we understand, are now in progress for the active development of the deposits of native copper upon Lots 4 in the 2nd and 3rd Concessions, and the silver bearing lode traversing diagonally throughout mining location 52B and 54B in the 3rd and 4th Concessions of Crooks. These properties have been examined and favourably reported on by outside experts, and as *their yield in silver and copper is considered* satisfactory the deal may be regarded as closed.

The Gunflint Lake Iron Co. will be incorporated immediately by John Paulson, O. D. Kinney and Marcus Johnson. The capital stock will be $100,000. This company owns property in Township 65, Range 4, and is located about two miles from the boundary line and 11 miles from the present terminus of the Port Arthur, Duluth and Western Railway, which line will be extended across the border this summer. There is a fine out-cropping of magnetic ore, and developments will be pushed at once. Paulson is an experienced Minneapolis mining man, and has been all over the Gunflint country.

Kingston District.

A large deposit of "asbestine" or fibrous talc in *Addington is attracting considerable attention from paper* manufacturers and others. The mineral is similar to that of Gouverneur, N.Y., but the deposit is much larger and will be very easily worked.

An American firm is negotiating for the Effingham mica mine. If it obtains the property, it will equip it with steam plant, etc., and work it energetically. It consists of two large feldspathic dykes, carrying a fine quality of tough white mineral. The feldspar is suitable for pottery purposes. On the same property is a large quartz vein, carrying free gold, which they also intend to prove, and if ore exists in paying quantities, erect a mill. A 45-ton shipment of amber mica went from here last week.

The Amey mica mines, near Wilbur, are now operated under the management of S. Cordick.

British Columbia.

Nanaimo District.

The No 1 Shaft, back of Departure Bay, in the big bend, which was closed down some time ago, owing to the influx of water, is to be reopened. New and improved machinery has been obtained and placed in position, so that the inrush of water will be kept in control.

Owing to the slackness of the coal trade, it is stated that the Dunsmuirs intend reducing the number of men employed in the mines at Wellington. It is expected that about 150 men will be laid off; if this is not done the mines will be worked only half-time during the dull *period.*

Some Nanaimo parties are at work near the old Douglas shaft at South Westminster, prospecting for coal. They are sinking a shaft directly through the croppings of lignite which were first discovered, and are confident of striking good coal. Being practical miners, they are familiar with all the indications which are to be found in the vicinity of coal deposits, and those interested in the discovery of coal on the south side of the river are more hopeful than ever since these men have started prospecting. The shaft of the South Westminster Coal Company is now down a considerable distance, but the hardpan has not been got through yet.

The pay days for the employés of the East Wellington Coal Co. have been altered. In the future instead of *semi-monthly pays, wages will only be paid on the 15th* of every month.

The new Vancouver Coal Company has struck the lower seam on Protection Island, and found it four (4)

feet thick of superb quality—roof and floor excellent. The value of this discovery to the Company can not be over-estimated.

The Company will make preparations for working both seams. The top seam will be worked to a certain distance first, and then the lower seam will be started on. Both seams will be worked right along in this way.

The coal exports for March, were:

	Tons.
New Vancouver Coal Company.....	25,539
Wellington Colliery	19,037
East Wellington Colliery.....	2,832
Union Colliery.....	8,660
	56,068

The transfer of the Tumbo Island Coal Co. to Messrs. Green & Watelet was announced some time ago. On the 21st January last, Mr. P. Watelet arrived in Victoria, and at once proceeded to the property and commenced development work. He has continued his arduous labors ever since, and a few days ago was rewarded by discovering a seam of coal at a depth of 60 feet, and running a considerable distance from south-east to north.

The works for the sinking of the shaft, etc, are on the south side of the island, about 50 feet from high water mark, with ample harbor accommodation, so that the shipment of the black diamond will be comparatively inexpensive. Operations have been progressing wonderfully, more than 50,000 square feet of rock having been blasted, and a shaft of 10x12 sunk to a depth of 60 feet. The machinery is all in position, and Mr. Watelet is delighted with the prospects, and hopes soon to commence the shipment of coal From the position of the mine and the quantity of the coal, it is safe to predict a large output and a cheap article.

Nelson.

(From The Miner)

Two shifts of men continue development work on the main tunnel of the Silver King, which is now in 854 ft. The character of the ore remains unchanged. John McDonald, the secretary, has gone to Spokane Falls to receive instructions as to the contemplated increase of the working force.

Next to the Hall mine group of claims on Toad mountain there is no property in the district that presents a better showing for the amount of development work that has been done on it than the Umatilla, Lizzie C, and Uncle Sam on Mineral Mountain, about two miles behind Nelson. Tom Collins and his partners have been working all winter driving a tunnel on the Lizzie C., about 300 feet below the old shaft. The tunnel, which will be 220 feet in length when completed, is now in 120 feet, and will tap the shaft at a depth of 150 feet. The rock in the face at present is diabase schist heavily mineralized with iron and fine-gram galena. The tunnel will be finished in about 75 days, and provided the character of the gangue remains the same, it will establish the group as a first-class concentrating proposition. The bottom of the shaft is in solid mineral, averaging $42 per ton in silver, lead and gold.

John Macdonald, secretary for the Hall mine-owners, has returned from Spokane Falls where he met Mr. Croasdaile. Although the property has not changed hands, there will yet be a considerable increase in the number of men employed in development work as soon as the season opens. The rule of forbidding visitors to inspect the property will be enforced as vigorously this year as last, and absolutely no outsider will be admitted to the mine.

William Lynch, one of the prospectors who discovered the first mineral in the Slocan district, has given a working bond to a syndicate of Spokane Falls moneyed men, represented by S. K. Green, on a sixth interest in the Don Juan, and a quarter interest in the far-famed Washington claim, for 90 days. The price mentioned in the bond is $1 and other valuable considerations—the "other valuable considerations" being currently reported to be $20,000. W. E. Murray has sold a bonding interest in the latter claim to T. J. Jefferson, of Spokane, for $250.

Although the Dandy may not have the same fabulous amount of mineral wealth conspicuous to the naked eye that is to be seen on its neighbor to the southeast, it has nevertheless been at last developed to a stage that makes it a matter of absolute certainty that it will become in the near future one of the greatest ore-producing mines in the Kootenay Lake country. Ever since the middle of January last, when the first faint streak of gray copper was struck in the crosscut to the west of the main tunnel, every blow of the hammer has shown the property up better than it ever was before. The character of the ore has been gradually changing—gradually becoming more and more similar to Silver King rock each week, thus giving color to the supposition that the two claims would soon be blazing identical ore. That this theory was correct is at last proved by the fact that peacock-copper is continuous in the face of the south drift, dipping towards the Silver King The strike was made at a depth of 200 feet, about 40 feet east of the old shaft—indicating that the vast body of high grade bornite on the Silver King is continuous on the Dandy, but further down. The ordinary country rock through which the drift has been run, assayed 43 ounces in silver and 7 per cent. in copper. A. M. Esler who has employed the shift working there all winter, was in Nelson this week, but was unable to get up the hill on account of the snow. He had, however, specimens from the face brought down, and left on Friday's train more fully convinced than ever that the Dandy will be a great mine Mr Esler expects to be back in Nelson about the first of next month, to make arrangements for increasing the working force, and says that just as soon as the mine is sufficiently developed a concentrator will be running on Giveout Creek.

The Lendrum-Retallack-Watson interest in the now famous Washington claim in Slocan district—five-twelfths—has been bonded by A. E. Jefferson, of Spokane Falls, for $20,000

J. R. Tool, of Anaconda, Montana, came in, last Sunday, to inspect the Skyline on behalf of the Montana company, to report before the final payment for the property is made. He shipped three sacks of ore for test.

Development work is going on steadily on the Silver Queen, and the results are of a very encouraging nature. The shaft has been sunk about ten feet, and at the bottom the ledge is between six and seven feet wide. "Jim" Mack is the acting superintendent.

Ed. Croft, superintendent of the Neosho, reports having closed down the mine on account of water. The shaft is down 100 feet with the bottom in rich black-sulphurets. An effort will probably be made to keep the water in check by means of a windlass mill until the mine is thoroughly opened up.

A syndicate of English and Victoria capitalists have procured a working bond on the Whitewater gold mine on Rover creek, about 10 miles from Nelson. The purchase price is $90,000. It is the intention to place a stamp mill on the ground as soon as sufficient work has been done to warrant the outlay.

The tunnel on the Grizzly is in about 300 feet. The rock is not as good as it has been, but still it is good enough.

The Hanna and Denver City mineral claims in the vicinity of the Queen, have been sold, through R. G. Tatlow, to coast speculators.

W. W. Sprague, the tenderfoot who sold the Tenderfoot last year for $7,500, brings good news from Tacoma. He says that the Tacoma smelter has proved a great success, and that W. R. Rust, the manager, has expressed the opinion that the ore from the Kootenay lake country—being a shipment from the Neosho and No. 1 in Hot Springs district—was among the best he had ever handled. A mining exchange has been established there, and specimens from this part of the continent are solicited. The exchange is located on A street in the neighborhood of the Hotel Tacoma. Mr. Sprague says that a number of mining men with money are there waiting for the season to open, they being under the impression that this section is under two feet of snow. They will not believe there is no snow in Nelson.

CANADIAN COMPANIES.

Hamilton Natural Gas and Mining Co. (Ltd.) Gives notice that application will be made under the Ontario Act for incorporation to hold, work and sell land containing natural gas, oil, mineral waters, and to lay pipe lines for natural gas, oil, &c., in the County of Wentworth. Head office, Hamilton, Ont Capital stock, $50,000 in 5,000 shares of $10 each. The applicants are: Thomas H. Pratt, merchant; John H Tilden, iron founder; Lewis Springer, County Registrar; Charles E. Newberry, farmer; Henry Carscallen, barrister; John Milne, iron founder; John E. Parker, manufacturer; Edwin D. Cahill, solicitor; Chas R Smith, secretary of the Board of Trade; Joseph Heron, merchant; Alex. Gartshore, manufacturer; George H Bixby, merchant; Edgar P. Wingate, civil engineer, and William Male, veterinary surgeon; all of the City of Hamilton, Ont.

The West York Natural Gas and Mining Co. (Ltd.)—Will apply for incorporation under the Ontario Acts. The object of the company is to hold, work and operate land containing natural gas, oil and mineral waters, and to lay pipe lines for natural gas, oil, &c, and to produce electricity for light, heat or power, in the Township of York, Ont. Head office, Toronto. Capital, $500,000 in 5,000 shares of $100 each. Those applying are: Joseph E. Stonage, of Weston; John P. Jackson, agent, Weston; Frank Andrew Fleming, agent, Toronto; Edward Eagle, Weston; and Ernest Heaton, barrister, Toronto Junction.

The Saint Nicholas Nickel Mining Co. of Ontario (Ltd.)—Gives notice that application will be made under the Ontario Acts for incorporation to explore for, mine, smelt, treat and refine, sell and export copper, gold, silver, iron, nickel, lead and other ores in the Province of Ontario. Head office, Toronto. Capital stock, $500,000 in 50,000 shares of $10 each. The following are the names and addresses of the applicants: Isaac F. Toms, judge, Goderich; Henry W. C. Meyer, Q.C., Wingham; Henry Lowndes, wholesale merchant, Toronto; John Segsworth, wholesale merchant, Toronto, Richard Caddick, barrister-at-law, Toronto; Arthur Wyndham Harrison, stock broker, Toronto.

Black Jack Quartz Mining Co. (Ltd.)—There is delinquent upon the following described stock, on account of assessment levied on 8th February and assessments levied thereto, the several amounts set opposite the names of the respective shareholders, as follows:

G. A. Veith,	200 shares.....		$45 00
C. Hageman,	1,500	"	31 38
C. Paulsen,	600	"	13 37
A. Barlow,	400	"	3 00
Thos. Robb,	200	"	4 40
Wm. Forrest,	400	"	9 00

And in accordance with law, so many shares of each parcel of said stock as may be necessary will be sold at Barkerville, on Saturday, the 7th day of May, at 2 o'clock p.m., to pay said delinquent assessments thereon, together with the costs of advertising and the expenses of the sale.

West Kootenay Mining Development Syndicate (Ltd.)—This syndicate has been formed in London for the purpose of leasing, purchasing or otherwise acquiring mineral properties in British Columbia, Canada, or elsewhere, and to develop these properties with a view of re-selling them to existing companies or forming other companies to work the same. Authorized capital, £10,000 sterling, divided into 9,800 ordinary shares of £1 each and 100 founders' shares of £2 each; payable 2s. 6d. on application, 2s. 6d. on allotment, and the balance in calls not exceeding 5s. per share, at intervals of not less than two months. In a division of profits the ordinary shares will receive a preferential dividend of 8 per cent., and, subject to provision for a reserve fund, the balance will be equally divided between the ordinary and founders' shares. Directors: W. Pellew-Harvey, Golden, B.C.; Peter McCarthy, Q.C., Calgary, Alta.; Alfred Mowbray-Waite, London, Eng. London Office: A. M. Waite & Co., 16 St. Helen's Place, London. Canadian Office W Pellew Harvey, Golden, B.C. The company has obtained a concession to an argentiferous galena property known as the Gladstone location, situate about three miles from the town of Illecillewaet. Four samples of ore taken from the "Gladstone" give the following returns:

"No. 1 Galena. Out of tunnel.	Silver, 93 ozs. per ton. Gold, $9. Lead, 70·31½.
"No. 2 Galena. Out of shaft at bottom.	Silver, 293·95 ozs. per ton. Gold, nil. Lead, 68·72%.
"No. 3 Galena. From Main Lode.	Silver, 70 ozs. per ton. Gold, $3. Lead, 70%.
"No. 4. Grey Copper. Forming stringer to lode in shaft.	Silver, 58·7 ozs. per ton. Gold, $2.50. Lead, 11·54½.

A contract has been entered into, dated the 14th day of April, 1892, and made between Alfred Mowbray-Waite of the one part, and William Littaur, on behalf of the Syndicate, of the other part, and the same, together with the concession above referred to, dated 12th March, 1892; the report of Mr. W. Pellew-Harvey, dated July 7th, 1891, and the Memorandum and Articles of Association can be inspected at the registered offices of the Syndicate.

British Phosphate Co (Ltd.) This company (practically an offshoot of the Anglo-Continental Guano Works Co.) has been registered at London on the 18th ulto., with a capital of £20,000 sig, divided into 4,000 shares of £5 each. The objects for which the company is established are: To purchase or otherwise acquire, either absolutely or conditionally, and on such terms and conditions as may be deemed expedient, any phosphates, ores, coal or other mines, lands, hereditaments and premises and real and personal estate situate in Canada and elsewhere, and all or any mining and other rights and privileges in any way appertaining to or connected with all or any such mines, lands, hereditaments and premises, or any part thereof respectively, etc. The first subscribers are,

Ad. Horney,	merchant, 15 Leadenhall Street, London.....	20 shares
Hermann Voss,	merchant, Holstein House, Beckenham, Kent.....	20 "
W. H. Hutchinson,	merchant, Fordwych Road, Brondesbury, London.....	20 "
E. Watts,	accountant, Ivy Dene, Durnton Road, South Croydon.....	1 "
Max Hirsch,	cashier, 29 Ickburgh Road, Upper Clapton.....	1 "
Otto Trubenbach,	merchant, 56 Ferdinand Strass, Hamburg.....	20 "
Gustav Martens,	merchant, 25 Rue du Robinet, Antwerp.....	20 "

The company has taken over the Squaw Hill and Etna phosphate properties, formerly operated by the Anglo-Continental Co., in the Township of Buckingham, County of Ottawa, Que. The Canadian manager is Mr. J. Burley-Smith, Glenalmond, Que.

The Buckingham and Lievres River Railway Co.—Messrs. Hatton & McLennan, solicitors for the appli-

cants, give notice of an application to Parliament for an Act with power to build, construct and operate a railway from a point at or near the Village of Buckingham, in the County of Ottawa, extending along the River Lievres, upon either side, northerly to White Fish Lake, and thence along the River Lievres to its source; with power to make and enter into running arrangements with other railway companies. This line, when constructed, will be a great stimulus to the development of the mineral industries on the banks of the Lievres River.

A Safety Brake for Hoists.

Mr. Robert Middleton, of Leeds England, has favoured us with particulars of his patent "grip" safety apparatus for hoists and suspended lifts or cages. The method of action of the apparatus will be readily understood. It is fixed at the top of the well over the hoist, and the rope which passes over the grooved pulley is fastened, after passing through the grip, to the top of the cage. The other end, after passing under a pulley fixed on the bottom of the hoist well, is fastened to the *underside of the cage or in some* cases to a balance weight. The speed of the cage, therefore, regulates the number of revolutions of the grooved pulley. This pulley in its turn drives the regulator. When the latter exceeds the desired speed the strikers compress the springs, and flying out come in contact with the lever and shaft. This shaft and levers are held in position by the simple contrivance of passing a piece of copper wire through the lever and into the casting. The force of the blow from the striker shears the wire, and the "grip" comes at once into action. When once the rope is in contact with this, the greater the pull, and the heavier the weight, the more securely is the cage held. On reversing the hoist the "grip" at once relaxes its hold and sets the rope free. A new piece of wire inserted in the hole resets the apparatus, and the hoist is ready for work in a few minutes after the action has taken place. The rope, it is stated, is undamaged in any way. At a test trial, we are informed this apparatus gave most satisfactory results. The cage of the hoist was disconnected from its hoisting ropes, and propped up from below. Forty 56 lb. weights were then put into the cage, the props struck, and the cage was stopped and held fast in the space of 14 inches. The same result practically took place with the cage empty. This apparatus can be connected direct to the cage itself, or can be used as a certain means of bringing into action any other kind of safety apparatus fixed on the cage and acting on the slides of the hoist well. No hoist cage can, it is asserted, fall with or without occupants with this apparatus, and its action takes place without waiting for a breakage of parts before being put into motion.

The Lechesne Nickel-Steel Process.

A foreign exchange states that the Ferro-Nickel Company, of France, has succeeded in obtaining nickel iron and steel containing a large percentage of nickel, and participating in the remarkable properties of this metal (non-oxidizability, brightness, &c.), and susceptible of being substituted for it in a large number of uses from which it has hitherto been excluded by the high price of pure nickel.

In continuing the series of ferro-nickels, the lowering the percentage of nickel below 25 per cent. forms a category of metals, the new properties of which constitute a special class of altogether peculiar interest. We have here no longer alloys of a somewhat high price, capable, on account of their richness in nickel, of replacing the pure metal, but metals comparable to iron and steel, and in which the intervention of even a small proportion of nickel modifies the constitution of the metal without (in low percentages) materially increasing its cost, and gives to the iron and steel employed an improvement of quality which is very remarkable.

The process consists in the simultaneous employment of manganese and aluminum with or without addition of carbon, under the form of charcoal, or metallic or ferro-cyanides. In the case of manganese, either pure manganese is used or oxides mixed with a reducer, or ferro-manganese. In like manner for aluminum, either the pure aluminum is used or a mixture of iron and aluminum. The nickel itself is introduced either in the form of pure metal or in the form of malleabilized metal, or crude metal more or less rich in nickel, proceeding either from the treatment of nickel ore up to the point of elimination of the iron, or from previous fusions of cast iron, wrought iron or steel with nickel.

With regard to the carrying out of the process, current experience has indicated the following method as the most suitable for obtaining a good result. It is preferable to take the pure nickel or mixed with iron at the outset of the operation. The manganese, under whatever form it is employed, mixed or not with the chosen carbonizer, is added in one or two additions in the course of fusion. The quantity of aluminum necessary is projected at the close of the operation in the bath of metal or in the casting ladle.

With regard to fusing apparatus use is made of that which is ordinarily employed in metallurgy—crucibles, reverberatory furnaces, converters, Siemens furnaces, cupolas, &c. Experience has shown that in the quantities of the intermediary agents the best results are obtained, with proportions of aluminum varying from a ten-thousandth to about one-thousandth, and of manganese varying from one-thousandth to about two hundredths per kilogramme of alloy to be produced according to the quantity of nickel and the quality of the metal to be attained.

From the point of view of the carbonizing agents it has been ascertained that according as it is wished to obtain metal soft or hard, carburetted or not, with the same percentage of nickel, carbon or cyanide must be used in variable proportions. In this way it is possible, by the employment of ferro-cyanide with manganese and aluminum, without even the addition of nickel, to transform the iron into a tempered steel naturally susceptible of furnishing turning tools without tempering and by direct forging.

We shall give for instance the best quantities for obtaining on the hearth a ferro-nickel with 5 per cent. of nickel, starting with a nickeliferous pig. The work is proceeded with as for the manufacture of steel, and after partial or complete decarbonization, according to the quality of the metal to be obtained, metallic manganese or ferro-cyanide of manganese is added, and at the moment of tapping the aluminum is added, either in furnace or in the casting ladle. For 500 kilogrammes of alloy the proportions are as follows:—

	Kilos.
Pig, with 25% nickel	100
Soft Iron or Steel	400
Ferro-manganese, with 75% of manganese	3
Aluminum	0.25
Total	503.25

The character of these various alloys is as follows: These metals possess a much more perfect homogeneity than that of iron or steel obtained by the usual processes, and consequently they have the qualities of malleability, *ductility, tenacity, elasticity, etc., to an altogether superior* degree. The coagulation of the ingots is very rapid and bubbles are avoided. Ferro-nickel, with 25 per cent. of nickel, whatever the quantity of carbon, does not take tempering, but according as the proportion of nickel diminishes, the property of being tempered reappears and goes on asserting itself until, with proportions of 7, 5 and 3 per cent. below, we obtain alloys capable of being tempered according to laws analogous to those which govern the tempering of ordinary kinds of steel. The proportion of carbon, the distribution and special forms of the carbon in the cement and the metallic core (*modification due to the presence of the nickel*), the fall of the temperature between the heating and the cooling, and the rapidity of the cooling, combine to produce various degrees of hardness, as could be predicted by the complete analysis made according to the very exact methods recently discovered, and by the remarkable investigations into the constitution of steel which have appeared of recent years.

The influence of the agents of malleabilization in the application of these processes is demonstrated by the fact that, when these agents are employed without the intervention of nickel, the products obtained present much *superior qualities to those of iron and steel treated by the* ordinary processes.

Hauling Coal by Electricity.

Following close upon the experiments of the Delaware, Lackawanna and Western Company, in Scranton, comes news of the successful experiments that have been made with electricity for hauling purposes by the Hillside Coal and Iron Company. At the Erie colliery of this company an electrical hauling plant is in operation. It consists of a 60 horse-power Thomson-Houston generator. The engine and dynamo room are in charge of the engineer and assistant who operate the other mining machinery. The electric locomotive is run by one man, who is assisted by a boy in making up the trains and turning the switches. This locomotive displaces 7 mules and 3 drivers. During a period of 112 days the average number of cars delivered at the shaft bottom by the locomotive was 559, against 526 per day delivered by mule haulage, much time being consumed by waiting at the bottom of one shaft for empty cars. Thus far it has shown that it will increase the daily output to 700 cars per day. To deliver 700 cars per day of ten hours, the time of running the locomotive is 5 hours and 30 minutes, leaving 4 hours and 30 minutes for contingencies. The total distance run is 21.28 miles, and the locomotive is reversed 232 times. Besides this hauling power the current is used for lighting purposes, so that in every department of the work there is abundant light. Altogether the company managers have found the new system a great improvement over the old, and they intend in the near future to extend it to their other works.

INSTEAD of the suggested one pound notes, Sir Henry Bessemer proposes an aluminium coin. He points out that the new metal may be slightly alloyed so as to harden and increase its durability, and at the same time raise its fusing point, and thus render the casting of it in plaster moulds quite impossible. The specific gravity of aluminium is 2·56, while that of silver is 10.47, so that an aluminium coin of the exact size and thickness of a common florin would weigh a minute fraction less than a silver sixpence; hence, if taken from the pocket in the dark it would be instantly recognised by its extreme lightness, and could never be mistaken for any coin made of gold or silver, while the great weight of all lead or pewter alloys, which are capable of being cast in plaster moulds, could never be passed off as aluminium coins, however their external surface might be coated or coloured in imitation of that metal.

The Value of Bore-Hole Records.

The State Geologist of Missouri, in his preliminary report on the coal deposits of that State, appreciates the value of all these local records as a means of assisting him formulating a State geological map, and we cannot do better than present his own words on this point. He says: Of especial value in this report are the records of the various deep shafts and drill holes which are included. They are furnished by many different individuals, and, in each case where the results are quoted, recognition of this assistance is expressed. With a few exceptions, the individuals and corporations of the State have generously contributed such results in a free, public-spirited manner. The importance of furnishing such records to the survey, where they may be kept on file for ready reference, cannot be too strongly emphasized. Hundreds of such holes have been put down in the State for various purposes, and from comparatively few of such are reliable results now available. Such holes are generally sunk for a definite purpose, and when that end is reached it occurs to few that the results may still be valuable for other purposes. But this is almost always the case. Whether a thick coal be encountered or not a good record establishes a series of facts concerning the geology of the locality, and is, hence, valuable. For instance, the record though *apparently* barren of results of economic value, may show that the drilling stopped in a certain limestone, which, by comparison with a record obtained elsewhere, we know is 20 or 50 feet, as the case may be, above a certain valuable coal bed. Hence, from the study and comparison of these two records we are able to predict the probable existence of workable coal within a short distance of the bottom of the hole. Again, the hole may *have penetrated rocks which we recognize as below any* coal in the State; and in this case the result is of general value in preventing further exploration below this depth. Only from the results of such deep drilling can the area of available coal in the State be exactly determined and the limits of the individual beds be defined, especially in those parts of the State where the coal beds are deep beneath the surface. The reason why records of value are not always attainable is, however, not only because of negligence on the part of those immediately interested to preserve them, nor yet because of refusal to contribute them. It is unfortunately the case that many holes have *been put down by incompetent men, or by men who* know merely how to handle a drill without having sufficient knowledge of lithology or geology to be able to accurately describe and record the descriptions of the rocks they encounter, or to interpret the meaning of all they pass through. In cases it is even worse than this, and the history of many a deep and expensive drill hole in the State shows evidence of trickery and bad faith on the part of the driller towards those in whose service he was supposed to be working. The uncertainty attending such work has thus brought disfavour in many localities upon deep drilling as a public enterprise, many having acquired *the impression that only indefinite results of small practi*cal value could be reached. This impression is wrong and unfortunate, for such work can and should be prosecuted by every progressive community in the coal regions which is anxious to determine the existence of coal beds and is anxious to have them developed. In view of these facts the survey suggests a possible plan of co-operation which, if adopted, would ensure a well conducted drill hole, a reliable record and an official report on the same, and would, at the same time, secure for the State complete results of the drilling in such condition that they can be unhesitatatingly used and will be entirely comparable. *To any private individual or community desiring to have a deep* drill hole sunk the survey could arrange to recommend reliable men whom the the individual or community can employ to do the work of drilling; second, it could supervise this work, and last, it could furnish an official statement of the results of the drilling. In return for this service it would be required that the survey be allowed full and free use of the results for the benefit of the State. That this would be in every way a liberal offer, cannot be disputed. In addition to securing reliable results, the individual would, by this means, be put in possession of a report, which would be, as it were, negotiable. Being of an official nature, *from an impartial source, others will place faith in it and will* invest money on its authority, for purposes of actual development, where they would not do so were the report of a private nature, emanating from an interested source. If such a plan of co-operation were generally adopted, the State would soon have accumulated an invaluable mass of material from which it would be possible to outline, with a high degree of accuracy, the general limits of each and every coal bed in the State. From this the prospects of finding coal at any one point could be predicted, as well as its probable depth and thickness when found. Surely the attainment of such a condition of exact knowledge is worthy of our serious efforts.

The Copper Combine.—The latest information at hand concerning the new combination of the copper producers, is to the effect that the agreement has been perfected; that all the American companies have assented to it, and that all that is now needed is to get certain foreign properties in. The allotment of annual production as finally decided upon is said to be as follows: Anaconda, 75,000,000 pounds; Calumet and Hecla, 60,000,000; Quincy, 12,000,000; Parrott, 14,000,000, and the Clark-Bigelow properties—the Tamarack, Osceola, Kearsage, Montana, Butte and Boston, and others, 65,000,000, making an aggregate of 225,000,000. These figures represent a considerable increase over last year's total production.

A Remarkable Entombment.

In Geikie's *Geological Sketches at Home and Abroad*, we have the following remarkable instance of an entombment in a mine in the year 1825. The story runs somewhat as follows :

A creep (cave-in) came over the mine and scared the men out, but a miner named Brown happening to leave his jacket (a new one by-the-by) in his room, returned by himself to fetch it. During the time he was gone, a heavy fall occurred which shut him off from the only outlet there was left. It was 23 days before the rescuing party reached the man, but he was still alive and able to speak, and, after a few hours, to give some account of his terrible experience, without a particle of food and only mine water to drink. It seems that he never lost consciousness or belief that he would be rescued, as he could hear the workers approaching his place day by day. But in the end, as he grew weaker, he had stumbled across the road way and fallen in the position in which he was found. On bringing him into daylight, a sight never seen before, and never to be forgotten, presented itself. The coal-mine fungus had spread over the poor fellow's body as it would have done over a rotting log. His beard had grown bristly during his confinement, and all through the hairs the white fungus had taken root. On a friend pulling off the fungus threads, he pushed the hand aside saying, "Na, noo wad ye kittle (tickle) me ?" A more ghastly figure than he was could hardly be pictured. His face wore a strange sallow hue *like that of a mummy*. His flesh seemed entirely gone, nothing left but the bones, under a thin covering of leather-like skin. The doctor said he could distinctly feel the inner surface of the backbone on putting his hand over the pit of the stomach, so completely wasted away was he. However, the shock had been too much for him ; he only lived a few days. This poor miner's lower extremities were not human at all—for he was cloven-footed ; and this fact was calculated to make the traditional and superstitious Scottish miner not so sure whether this man, who might be said to have *risen from the dead*, was not the "deil" in disguise after all.

A tombstone bearing the following inscription marks John Brown's grave in the quiet churchyard of Dailly :

"In memory of
John Brown, collier,
Kilgrammie coal pit, by a portion of it having fallen in,
Oct. 8th, 1835,
and was taken out alive,
and in full possession of all his mental faculties,
but in a very exhausted state,
Oct. 31st,
having been twenty-three days in utter seclusion
from the world, and without a particle of food.
He lived for three days after,
having quietly expired on the evening of
Nov. 3rd,
aged 66 years."

Funding the Natural Gas Debt.—The Board of Natural Gas Trustees, of Toledo, O., in suggesting the funding of the natural gas debt of that city, made the following statement : "The immense drain upon the gas fields for the last 4 years has seriously affected the gas produced in the territory where most of the wells belonging to the city are located, and the rock pressure of the gas wells (which is the force by which the gas is driven into the pipe line), has diminished from 370 to 120 pounds, thereby very seriously diminishing the quantity which the pipe will carry, and we are now confronted with a shortage of gas for the supply of people who rely on us for a supply of that fuel, and without which there will be failure, not only to supply the needs of our people, but also of an income to increase the supply, and at the same time pay the debt incurred by the city in building the works. The trustees have territory comprising some 2,000 acres where the rock pressure is still undiminished, and where a reasonable expectation may be entertained of providing for the wants of the city, and there is more that is offered, and can be purchased, if the trustees were so situated financially as to obtain it."

Mining Laws Affirmed.—The Supreme Court of West Virginia handed down its decision on March 22nd, affirming the constitutionality of the act recently passed by the legislature, regarding certain additions to the mining laws of that state. In accordance with the decision rendered by the court, employers are forbidden to issue scrip or checks to employes, such scrip or checks to be exchanged for goods at the store of the employer. The operators are likewise required to pay the miners according to the weight of coal mined, but before it is screened. This presumably settles these points once for all in the little Mountain State.

Another Mode of Making Briquettes.—The conversion of coal dust into fuel has for a long time been accomplished by various simple methods, differing but slightly in their details ; but it has recently been proposed, instead of the usual plan of using pitch to cement coal dust together to form briquettes, to resort to substances of a glutinous or a farinaceous character, these including those obtained from wheat, barley, rye or other cereal or vegetables, 5 per cent. to 95 per cent. of coal dust being found to constitute a suitable proportion. The mixture may be kneaded by hand and sets in a short time, so that moulding under pressure is not really essential, though moulding may be resorted to for securing rapid manufacture. The product is said to burn with less smoke than the ordinary briquettes, and it is claimed that, in the matter of cost, the new article is the more economical. Ashes, or refuse matter from coal fires, with or without fresh coal, may also be utilized.

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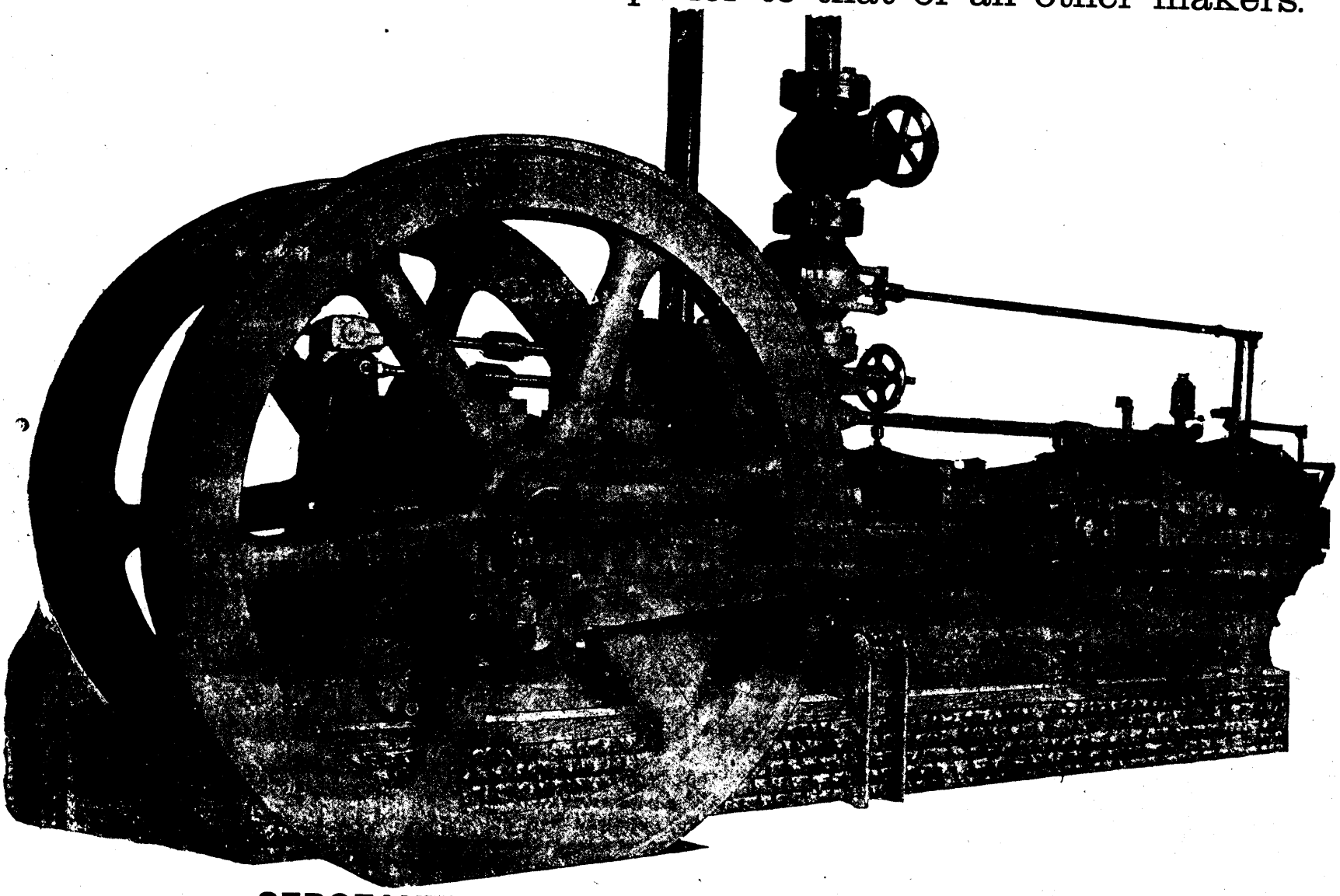

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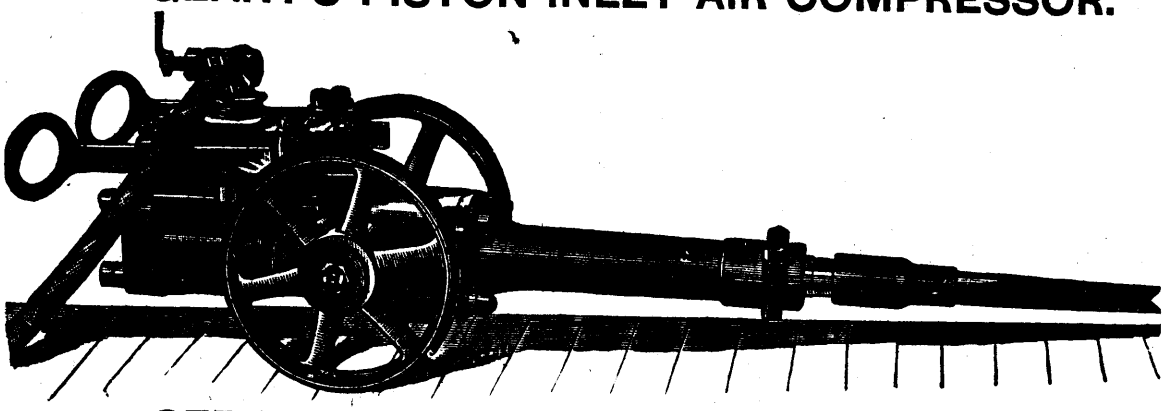

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