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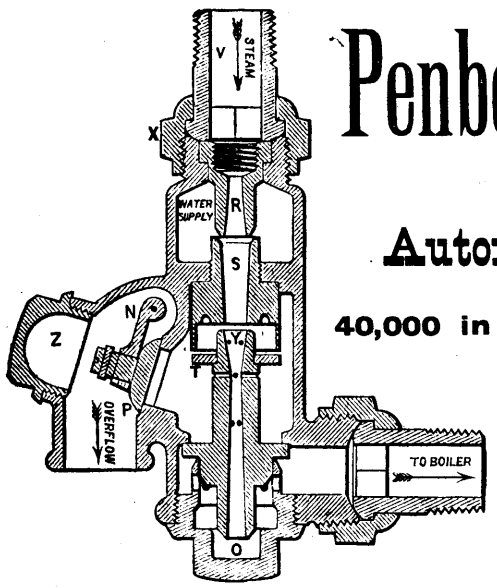
The Canadian Mining Review

Established 1882

Vol. X.—No. 6. 1891—OTTAWA, JUNE—1891. Vol. X.—No. 6.



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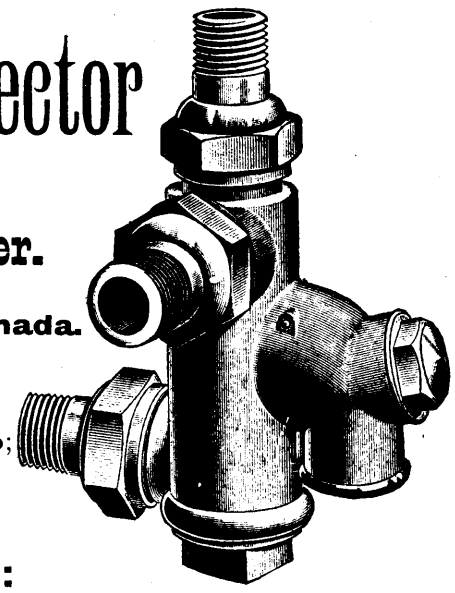

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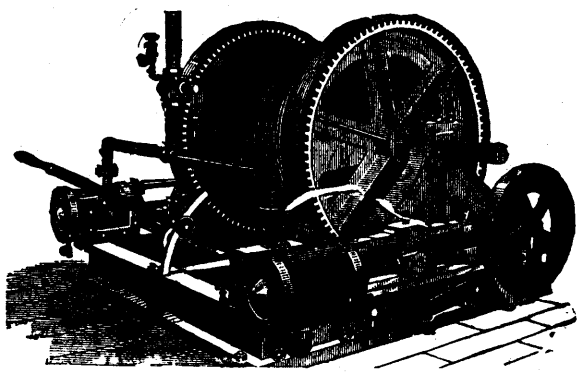


Double Cylinder Reversible Mine Engine.

Ontario Mining Laws.

The following is a summary of the chief provisions of the amendments to the Mining Laws of Ontario, passed during the Session of 1891:

1. In Algoma, Thunder Bay, Rainy River and that part of Nipissing north of Lake Nipissing and the French and Mattawa Rivers, the price per acre of mining lands sold after the 4th day of May, 1891, is $4.50 in a surveyed township, and $4 in an unsurveyed territory, if within 12 miles of a railway, and if beyond that limit $3.50 in surveyed and $3 in unsurveyed territory. Elsewhere the price is $3 in a surveyed township any part of which lies within 12 miles of a railway, and $2 if at a greater distance.

2. Instead of by grant in fee simple, mining land may be obtained under a ten years' lease at a per acre rental, unless otherwise fixed by regulation, of $1 for the first year and 25 cents yearly thereafter if north of Lake Nipissing and the French and Mattawa Rivers, or of 60 cents for the first year and 15 cents yearly thereafter, if situated elsewhere, with right of renewal at the expiration for an additional ten years at the same rentals, and with a right of renewal thereafter every twenty years, subject to payment of the yearly rent charge in advance and to such conditions as may be provided by regulation. But the lessee may at any time purchase the land so held, in which case the first year's rent shall be treated as part of the purchase money.

3. The owner or lessee of mining land sold or leased by the Crown after the 4th day of May, 1891, is required during the first seven years to expend in actual mining operations $4 per acre if the location exceeds 160 acres, and $5 per acre if it is 160 acres or less.

4. After the 4th day of May, 1891, all ores or minerals of silver, nickel, or nickel and copper, taken from lands sold or leased by the Crown, are subject to a royalty of 3 per cent., and all other ores or minerals to such royalties as shall from time to time be fixed by Order-in-Council, not exceeding in the case of iron 2 per cent., and as to any other ores or minerals not exceeding 3 per cent.; and such royalties shall be calculated upon the value of the ores at the pit's mouth. But royalties shall not be imposed or collected upon any ores until after seven years from date of the patent or lease, except as to mines known to be rich in nickel, and as to these not until after four years.

5. Hereafter in all lands sold under the Public Lands Act, or for agricultural purposes, all minerals and mining rights are reserved to the Crown, unless otherwise provided in the patent or grant.

6. In the case of mining lands for which bona fide application was made in writing to the Department prior to the 24th April, 1891, grants may be made where the application is received within three months from the 4th day of May, 1891, and otherwise at the price and upon the conditions heretofore applicable in accordance with the terms of section 1, sub-section 5, of the Act of 1891.

ARCHIBALD BLUE,
Director.

OFFICE OF THE BUREAU OF MINES,
Toronto, May 21, 1891.

This advertisement will not be paid for if published without authority.

PROVINCE OF NOVA SCOTIA.

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

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of chap. 7, Revised Statutes of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of six months, which can be extended by renewal for another six months. Mines of ld and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. Up to ten areas the cost is 50 cts. per area, for every area in addition in same application 25 cents. Cost of renewal one half the original fees. Leases of any number of areas are granted for a term of 21 years at $2-00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and in smelted gold valued at $18.00 an ounce.

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

MINES OTHER THAN GOLD AND SILVER.

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

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

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

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

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 7½ cents on every ton sold.

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

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

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

CANADIAN MINING & MECHANICAL REVIEW

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

OFFICES:

Victoria Chambers, 140 Wellington Street,

OTTAWA.

Vol. X. JUNE, 1891. No. 6.

Applied Science at McGill University.

The announcement of McGill University for next session gives evidence that the governors fully understand that the advance of applied science calls for additions to the teaching staff and increased laboratory equipment, and are prepared to meet the demand to the utmost of their ability. Industrial chemistry, metallurgy, electrical science, and the constructive arts daily enter upon the occupation of new fields, and are daily fruitful in new problems. Canadian graduates must successfully grapple with these problems or give place to men who are fitted for such tasks by the education provided by other communities. The importation of many millions of dollars worth of metals every year, for the manufacture of which this country possesses ores and fuel in abundance, may be viewed as a political problem from different standpoints, but it offers only one practical question to the instructed manufacturer, for the solution of which he is dependent upon the revelations of the chemist and the devices of the engineer. The laboratory is an indispensable adjunct to every metallurgical works, and its operator must acquire his training in the class-rooms and laboratories of the modern school of applied science An institution of this sort, with well-equipped laboratories for physical and chemical demonstration, and the foundation of a professorship of electrical engineering, have been given to McGill University by Mr. W. C. McDonald. Large gains for Canadian mining enterprise may be hoped to follow Mr. McDonald's wise gift. Electrical science has but recently given much aid to miners by the incandescent light and the transmission of motive power to points difficult of access. Still more recently we have the concentration of lean iron ores and the depuration of rich ores from phosphorus by the magnetic separator. In fact the more or less successful operation of 26 concentrating mills in the United States raise some expectation that this preparation of ore for the furnace may prevent the basic process for purifying steel from obtaining a place in American manufacture. Be this as it may, it is beyond doubt that the value of lean ores has been immensely increased and the purification of rich ores from phosphorus made practicable by a process which had its first application in the invention of Dr. LaRue of Quebec, for depurating the iron sands of the Lower St. Lawrence.

Mr. McDonald's munificent gift has evidently been prompted as much, if not more, by a hearty love of scientific research as by a spirit of generosity; for he has provided for students desiring to engage in original research a special laboratory.

Of the other laboratories it is worthy of note that the hydraulic presents special features in the motive power of a 200 feet head of water afforded by the Montreal Water Works, and in the equipment with various turbines and water-wheels. The applications of hydraulic pressure touch many arts, such as the manufacture of the finest brick, the compression of steel ingots, the operation of cranes of enormous power. The mountain streamlet, though slender in volume, if it be only of high fall, when married to a dynamo sends its energy along a wire to some remote peak and lights the miner's pathway, works his drill and lifts his ore to the mouth of the shaft. The immense power of our own mighty rivers is second to none in the world in capacity for aid to industrial enterprise. These considerations indicate somewhat the great value of the aid offered to students of engineering by the hydraulic laboratory of the McGill University.

If in the equipment of the cement-testing laboratory we may discern the recognition of the value of Canadian cements and the importance of testing their efficiency, as well as of guarding the engineer from the many worthless cements put on the market, the remark may be permitted that the addition of a small milling plant and muffle and would enable students to do serviceable work in the preparation of cements. Synthesis as well as analysis should have its place in experimental enquiry. Recent discoveries point to our rock silicates as materials for cements deserving of investigation, and this remark leads up to the suggestion that the firing of Siemens' furnaces with Lima oil and super-heated steam instead of with coal, now in successful operation at Bethlehem, Pa., presents to the Faculty of McGill University means of providing for metallurgical research a small manageable furnace of great efficiency, easily constructed, occupying little space, and maintainable at moderate cost. There are some knotty points in thermo-dynamics which the use of this oil and water-gas fuel presents, and if to these were added the problems presented by the greatest steam-generator of the day, the Babcock & Wilcox boiler, the students of McGill who would be brought to the study of these questions might make while going through their curriculum very profitable use of the instruction the thermo-dynamic laboratory is otherwise so well fitted to impart.

The workshops on the endowment of Thomas Workman, are fully equipped for practical instruction under the professor of Practical Engineering. A special lecturer or professor will, next year, undertake the course of lectures on mining and metallurgy. The university requires aid for this purpose, and it is intimated that funds are necessary to place the Mining School on a secure basis. A permanent endowment of $2,000 is asked for, and the REVIEW hopes it may be doubled for the purpose of intimating to the governors that the public need demands that McGill University, otherwise so well equipped to instruct in every auxiliary science, shall take a foremost place in teaching metallurgical science. It is stated that no special mining laboratory has yet been provided for instruction in practical ore-dressing. This want should be supplied ere another session and nothing left undone to equip with all methods of practical research this great Canadian institution of learning.

Bush Fires.—A More Stringent Application of the Law Demanded.

The recent destruction of the Asbestos Club House, along with other valuable property at Black Lake, reminds us of the urgent necessity that exists for some more stringent application of the law respecting bush fires which will diminish, if not altogether eliminate this constant and harassing menace to the miner in various of our mining camps. Until quite recently no organized effort was made in the Province of Quebec to prevent the annual recurrence of these bush-fires — indeed the Crown Lands Department seemed to be animated by an insane desire to destroy every trace of verdure on the hills, leaving nothing but the rocks. Not only were lands which were totally unfit for settlement disposed of to ignorant pioneers, attracted to such remote places by the timber and the fishing rather than the quality of the soil, but purchasers were bound under pain of forfeiture of their homes and improvements, to destroy a certain percentage of the timber upon their lands before being granted their patents. Recently a disposition has been manifested to check this criminal waste of a rapidly diminishing source of revenue, but so far with little practical effect. In the sale of mining lands, for instance, the government reserves the right to the timber for three years. During that time the lumberman who owns the limit in which the lands are situate, has the privilege of removing such timber as he may want. Very frequently this timber would be of considerable value to the miner in the construction of his works and buildings, but having no direct interest in the timber, and having every interest in learning the character of the rocks beneath, his first step after taking possession is usually to start a forest fire to burn the moss, forest growth and debris from the rocks. But with them goes valuable timber. Unfortunately it is seldom limited to the locality of its origin, but, as in the instances before us, it extends into neighbouring properties, sweeping large areas of timber, and destroying much valuable property. We hope that the Commissioner of Crown Lands will see to it that his large retinue of so-called "Mining Inspectors" are given full instructions to look closely into this matter, and that the law will be made stringent enough to suppress the evil altogether.

The subject of our next portrait sketch will be Dr. George M. Dawson, Assistant Director of the Geological Survey of Canada.

To Our Readers.

In May, 1886, when the REVIEW was assumed by its present management, it consisted of eight pages of reading matter and four of advertisements, twelve in all, with a circulation of 431 copies; in May, 1891, it had increased to fifty pages, twenty-nine being reading matter and twenty-one advertisements, with a circulation of *four thousand* copies. The wide distribution of our last issue, not only throughout the various provinces of Canada, but among capitalists and others interested in Canadian mining in different parts of the world, may be gathered from the following authentic returns taken from our books :—

	Copies.
Province of Ontario	1,338
" Quebec	624
" Nova Scotia.....	748
" New Brunswick....	72
" British Columbia ..	273
Province of Manitoba and N. W. T.....	28
United States.....	564
Great Britain.....	207
France.....	57
Germany.....	53
South America.....	18
British West Indies	5
Australia..	5
South Africa.....	2
Japan.....	5
Italy	1
Total circulation for May..	4,000

Any 'doubting Thomases' who may be disposed to question the veracity of these figures, are invited to examine our mailing sheets for themselves, when they will be thoroughly convinced of the truth of these statements.

We notice that the *Trades Journal* and several other Nova Scotian papers have been complaining of the noxious fumes produced by the explosive roburite. On what slight grounds they do so may be judged from the report of a committee appointed by the Durham Coal Owners' Association and the Durham Miner's Association, to investigate the question, which found: That the products of the explosion of roburite and tonite are not more deleterious than those of gunpowder; that no chemical evidence was obtained of the presence of nitro-benzine, and throughout the enquiry no case of nitro-benzine poisoning was met with; that with regard to the production from roburite, tonite and gunpowder of carbon-monoxide, the quantity found in average samples taken is small, and is so quickly dissipated by the air current as to have been detected only in traces, five minutes after the firing of the shot. It was recommended that an interval of five minutes be allowed to elapse after the firing of a shot before the hewers be allowed to re-enter the place, and also that cartridges be fired by electricity, owing to the fumes given off by the burning fuse.

EN PASSANT.

We are indebted to the *Colliery Engineer* Co. of Scranton, Pa., for a copy of their valuable little hand-book, the "Colliery Engineer Pocket Book." It is replete with information on every point connected with the subject and will be of great assistance, especially, to miners who are preparing themselves to take a certificate; we cordially recommend it to their notice.

Elsewhere in our columns will be found an excellent article on "The Nickel and Copper Deposits of Sudbury," from the pen of Mr. Alfred E. Barlow, M.A., of the Geological Survey. Mr. Barlow has been for several years engaged in the exploration of this region, associated with Dr. Robert Bell, and there is, perhaps, no one better qualified to deal with the subject, both from a scientific and practical standpoint, than himself.

The next quarterly meeting of the General Mining Association of the Province of Quebec, will partake of a holiday nature—a trip to the phosphate region being contemplated by the Council. A steamer will be engaged to carry the members and their friends up the Lievres as far probably as High Falls; here they will camp out for a couple of days, which, if the weather prove propitious, will be a pleasant change from the customary routine of similar excursions. Trips to the various mines in the vicinity will be arranged, and everything be done to make the visit serve a practical purpose, while maintaining the character of an outing.

Among the curiosities that occasionally crop out among the reports of mining companies, is that of a great French company which was to perform wonders in the gold fields of the Transvaal. Ten crushing mills produced in twelve days 300 oz. of gold, while in the preceding thirty days only 600 oz. were obtained, from which the shareholders are led to infer that the company is making very rapid strides in the direction of big dividends. In order to facilitate this desirable result the company has resolved to procure thirty more mills, ten of which have been already bought. It is expected that by means of these "the monthly yield of 56,000 francs will be very rapidly doubled." Their ideas on the subject of plant are certainly not limited by any notions of economy.

The following communication from Mr. H. P. McIntosh, Secretary of the Canadian Copper Company, will be of interest, as showing that this company has found mining in Sudbury to be profitable:—

TO THE EDITOR OF THE CANADIAN MINING REVIEW:
SIR,—If it is sufficiently interesting, you might announce that this company has purchased about thirteen acres of land, on the Valley Railway, near Brooklyn Station, O., on which it will immediately erect a copper-nickel alloy plant.
Yours truly,
THE CANADIAN COPPER CO.,
By H. P. McINTOSH, Sec.-Treas.
CLEVELAND, O., June 2nd, 1891.

It is understood that the works will be in operation by August. We trust that the result of their enterprise will be such as to induce some Canadian companies to follow their example on *this side* of the line.

On another page will be found some interesting communications from Mr. H. S. Poole, General Manager of the Acadia Coal Company, and Mr. T. Shaw, M.E., of Philadelphia, respecting the latter's gas testing machine, together with copies of a unique correspondence between Mr. Poole and Mr. Wilson. The dispute on Mr. Shaw's side is waxing acrimonious, and the REVIEW comes in for a share of his withering sarcasm. Ordinarily, we believe him to be moderate and equable in his views, but on the subject of his pet instrument he becomes rampant and unmanageable, and ready to assail any and all who do not profess entire belief in its almost supernatural powers. We are quite willing to admit some of its virtues, but must decline to agree to its infallibility when the contrary has been proved. Our editorial tester was applied to the letter under consideration and showed a very large percentage of "gas," which Mr. Shaw with a workshop full of his machines was unable to perceive. But Mr. Shaw contrives, though perhaps with difficulty, to keep within the bounds of courtesy, which is more than can be said of his agent, J. R. Wilson. In his case impudence rises to a height almost sublime, and certainly unique. Under the guise of friendship, and with a patronizing verbosity not often equalled by other members of the "patent cure-all" fraternity, he undertook to read a lesson to his correspondent on the error of his ways, ignorantly imagining that by professing to see a danger which none but he could cure—a very stale trick of the Ancient Order of Quacks—he might contrive to sell his "universal panacea" of a machine. The culminating point was reached in his letter of March 16, when he asks: "Would you live to regret, like Cowans, that you were ever a mine superintendent?" which for gross impudence and heartlessness stands unrivalled. The Shaw machine, as we have said, undoubtedly has some merits, but if these are to be hidden under a bushel of wordy insolence, it will be difficult to dispose of at any price, far less five hundred dollars.

The Pictou *Journal* indulges itself in a long and laborious criticism of the letter from "Manager," which appeared in the April issue of the REVIEW. Intended to be mildly sarcastic, it falls decidedly short of this expectation, being only inane in some parts and in others rather rude. It is not our province to defend our correspondent—we suspect, in any case, that he is more than able to hold his own in a discussion with the *Journal*—but exception must be taken to certain remarks in respect to Nova Scotian colliery managers as a class. Commenting on their conduct in general, after a diatribe on those of a past generation, their surliness and vulgarity, it goes on to say: "They—the managers—have improved wonderfully of recent years, and if they continue as they have begun, it will not be a matter of surprise that they act like gentlemen, but the wonder will be that it was possible for them ever to have acted otherwise." This is most uncalled for, and is a gross libel on these gentlemen. By what standard the *Journal* judges

them it is hard to conceive; Chesterfield himself would hardly come up to it, and this paragraph alone would preclude the idea that even the most outrageous egotism could allow our contemporary to have any personal reference. It seems, however, that this captious critic, having no arguments to advance, adopted the cuttlefish or skunk mode of retreat as the safest, and having ejected a cloud of inky dirt, retired, leaving his opponents with a vague sense of having been in contact with something nasty.

We observe that a certain Rev. Mr. Pringle, of Port Arthur, having left the consideration of things spiritual for those temporal and of the earth earthy, has been airing his opinions, or what he believes to be such, on the new Ontario Mining laws. We suspect, however, that the worthy parson, with a simple faith characteristic of his kind, has been imbibing too freely of the doctrines propounded by some wily speculator in his flock—though mayhap there might be some thought of the acquisition of certain glebe-lands, rich in minerals, the development of which might materially advance the interests of a "Society for the Distribution of Top-boots and Neck-ties among the Cannibals." The clauses that especially appeal to his sympathies —or pocket—are those relating to the increase in the price of mining lands and the imposition of a royalty. "Fortunes," according to Mr. Pringle, "have been made by booming mineral lands in the Port Arthur-Sudbury sections, but fortunes have also been lost by men who have paid inflated prices for mining property." Exactly! But the proportion of fortunes made to those lost is so very small that it was a wise step to put an end to "booming," and substitute practical for speculative mining. With lands at $1 an acre there were far too many instances of speculators buying up large areas, and holding them at enormous and ridiculous prices, but they will not be so ready to do so now, when their hands have to dip so much deeper into their pockets. As for the plea that poor men will be unable to buy lands that they have prospected, we cannot see that their condition is altered to any appreciable extent; capital can always be obtained to assist in a legitimate enterprise, and to capital they must go to develop a property, whether the price be $3 or 50 cents an acre. Without sharing in Mr. Pringle's exalted notions as to the preliminary outlay in mining operations, "the making of roads and *streets*," etc., the cost is certainly beyond the means of the ordinary prospector in any case. Thus the wisdom of the Government's policy is evident, tending as it does to eliminate the speculative element, without bearing unduly hard upon the poorer classes of miners. As for the royalty clause, the church is proverbially behind the times in secular affairs, and the holy miner is strictly in keeping with the tradition, his opinion being based upon the situation of affairs two months ago, since when they have radically changed. Altogether we should imagine that this worthy apostle of mis-information has quite enough on his hands in looking after the spiritual welfare of his lambs—who, by-the-by, as outside capitalists have not infrequently found to their cost, are much more liable to fleece than to be fleeced.

The first annual report of Mr. A. Slaght, Inspector of mines for the Province of Ontario, has been received, and we must confess, is an agreeable surprise. It is concise yet sufficiently voluminous to afford a very fair idea of the extent and nature of the mining operations carried on in the Province, and is well written and tastefully gotten up.

The last occasion upon which the late lamented Premier of the Dominion came in touch with mining matters was only a couple of months ago, just after the Springhill disaster. He was one of the first to respond to the appeal for help, and in one of the collection books now in possession of the REVIEW, stands his signature, thus:—

John A Macdonald $10.

We notice that the number of "remarkable discoveries" of minerals throughout the length and breadth of the land keeps fairly up to the average. The gentlemen who find these extraordinary deposits seem to be of a venturous nature as a rule, and blessed with a good luck that might make a forture even on the Stock Exchange, for they appear invariably to come upon mineral, any sort that pays, in some inaccessible spot in the wilds, where no one ever supposed it to exist, and where verification of their reports is practically impossible. Their discoveries serve as baits, however, for the traps so continually laid for that gullible portion of the investing public, the "old maids and clergymen," who, by-the-by, keep coming forward in a steady stream that defies all the efforts of the company-promoters to exhaust. Anything out of the way, or that savors of the improbable, more especially if a remote possibility exists of distributing a few tracts among the "misguided Indian brethren" while working these colossal veins, is always snapped up if put before the right parties and in the right way. Some day these mistaken investors will learn that a moderate interest that you *do* get, is much better than a very large one that you *don't;* but in the meantime they are furnishing a golden harvest to those who do not scruple to reap it.

The efforts of the Pennsylvania Legislature to frame a new and more satisfactory Bituminous Mine law, have unfortunately ended in failure. Early in the year a commission was appointed by the Governor to report upon the question, but after sitting for thirty days, such radical differences of opinion were developed that both a majority and minority report was presented. The former, while excellent in many respects, yet contained portions both unjust and unwise, and on these points the minority differed; but their report, on the other hand, showed such evidences of crudeness and hasty preparation, that the Senate Committee, after listening to the arguments of both sides, reported negatively on each. In consequence, the present law, which is in many ways faulty and inefficient, will remain in force for another two years.

That "a prophet is not without honor save in his own country," is sometimes due to his insignificance at home, and sometimes to the fact that the source of his inspiration is there too common and well known. A consciousness of this doubtless induced a Mr. Herbert C. Jones, of Toronto, — whoever he may be — to favor an American journal with certain statistics ingeniously culled from the REVIEW and government blue-books, trusting, we suppose, that distance would imprint the stamp of originality upon them. But the "rage for scribbling" appears to have blinded Mr. Jones to the fact that our friends across the line are, as a rule, fairly well acquainted with the state of mining affairs in the Dominion, or he would have certainly restrained his fanciful comments on them, and not have exposed his ignorance to the eyes of men in remarks such as "asbestos has not yet received any attention, though it abounds in rare quantities." If authors of his calibre would be content to remain in the modest retirement intended by nature, or at least expend their talents in the writing of prospectuses, for which their style is much more suited, they would materially advance the interests of and increase the interest in mining journals.

It is understood that in the course of a few days enquiry will be made by one of the Nova Scotian members of the House of Commons as to the size on which it is intended to publish the geological maps of Nova Scotia. We shall possibly arrive then at the true inwardness of the "masterly inactivity" so long shown by the worthy Deputy Head. His explanations, if he makes any, will be interesting.

The Antigonish *Casket* of May 28th, after quoting the article from the REVIEW of January, on the geological map of Nova Scotia, adds:—

"A good deal of public money has been expended on a geological survey in Nova Scotia. The expenditure is a proper one, as the mineral resources of the country are thus ascertained. To make the knowledge thus gained of practical service, it is necessary to publish maps showing the results of the survey. This has been done satisfactorily for Cape Breton, the scale of the maps being one inch to the mile. But now that maps of the counties of Antigonish and Pictou are being prepared, Director Selwyn has made the mistake of reducing the scale to a quarter of an inch to the mile. The publication of the maps is but a small part of the total cost, the survey itself being the chief item, and it is false economy to restrict the means of indicating the result of the survey. It is like putting down an expensive foundation for a house and then building a shanty upon it."

The death is announced of Capt. F. P. Warren, R.N. He was a prolific inventor, his patents including a new form of lifeboat, cooking stoves and pots, lubricants for engines, dog biscuits, horse-harness, etc. Further eulogy is needless!

The report of an alleged discovery of asbestos on the Annapolis River has afforded an opportunity for the *Gold Hunter* of Queen's Co., N.S., to surprise the world with some remarkable information regarding the Quebec mines, in these words: "There are two asbestos mines in the Province of Quebec. They are worked by hand drills, and the seams are from one to four inches wide." 'It is well to be first in one's own line,' and certainly for crass stupidity and marvellous mis-information, the *Gold Hunter* can easily keep the lead against any competitor that we have yet seen, formidable as some of them are. It would not have been so surprising in an ordinary provincial newspaper, which at times will display a profundity of ignorance really astonishing, but there is no palliation for such a gross blunder when committed by a paper, ostensibly, at least, identified with a section of the mining industry. The following list of companies mining asbestos may enlighten it somewhat as to the status of the industry in Quebec:

American Asbestos Co.,	Black Lake,
Anglo-Canadian Asbestos Co.,	Black Lake,
Allan & Fleming,	Portland,
Beaver Asbestos Co.,	Thetford,
Bell's Asbestos Co.,	Thetford,
Brompton Lake Asbestos Co.,	Brompton Lake,
Bowie Mine,	Portland,
Johnson's Asbestos Co.,	Thetford,
Jeffrey Mine,	Richmond,
King Bros.,	Thetford,
Laurier Mining Co.,	Black Lake,
Megantic Mining Co.,	Coleraine,
Scottish-Canadian Asbestos Co.,	Black Lake,
Templeton Asbestos Co.,	Templeton,
Thetford Mining Co.,	Thetford,
United Asbestos Co.,	Black Lake,
Ward Bros.,	Thetford,
Wolfestown Asbestos Co.,	Wolfestown.

The value of last year's output from these mines was $1,039,661. As to the "working by hand drills," these were discarded years ago, and plants are now installed in their place that might well be taken as an example by some mines in the *Gold Hunter's* neighborhood.

The Massachusetts Institute of Technology affords to persons desirous to acquire a knowledge of mineralogy the advantage of a very cheap and practical course. A few minerals and question papers are mailed to the student, who is expected to study for himself their obvious properties and mail his answers to the professor. The work is corrected and more specimens and questions sent with a blowpipe, and the student referred to some elementary text book for help in his simple assays. The question papers are corrected as the work proceeds, and at the end of a course through some seventy specimens a sufficient knowledge of mineralogy is acquired to enable a prospector to know the ores he may find. The fee for the course is $2.50. Could not such work be done by a Canadian university?

That remarkable journal the Halifax *Critic*, whose avowed object it is to be a sort of "omnium gatherum" of political, financial, commercial, mining and general news, edited by the aid of paste pot and scissors, has once more been seduced from the "straight and narrow path" to revel in fanciful imaginings on the subject of asbestos mining. The last number of the REVIEW having apparently been all cut up and, as much as possible, inserted in previous issues, in an unfortunate moment the editorial shears fell upon the *Gold Hunter* and excerpted therefrom that extraordinary paragraph on the "two asbestos mines in Quebec, worked by hand drills," that has excited our surprise and drawn forth our comment in another place. An utter want of originality, even in such extraordinary perversions of the truth as this, has always been the *Critic's* bane, and until it attempts to write its own articles it will never attain that rank in Nova Scotian journalism to which we suppose it aspires. If it will accept our advice it will not lend so ready an ear to the opinions of other small provincial papers, but will endeavor to do a little amateur collecting of mining notes itself, whereby it may, perhaps, improve somewhat—it cannot possibly become worse or more unreliable.

The last meeting of the Asbestos Club was held at Thetford on May 23rd. The attendance was large, and the membership roll was further added to by the election of sixteen gentlemen to the Club. An interesting paper on "The Electric Drill" was read by Mr. H. J. Williams, of the Beaver Asbestos Company, being his impressions regarding the future of electricity in mining operations.

We much regret to learn that since then the Club House has been burnt together with all its contents. This is a serious blow, but we trust that, like the Phœnix, the Asbestos Club will rise from its ashes to a renewed period of activity and prosperity.

The editor of a certain would-be financial, mining, commercial, *olla podrida* sort of a journal styled the *Lighthouse*, published in London, Eng., is amusing himself in the manner of a small dog barking at a big one, by writing a series of letters in his most valuable publication, ostensibly addressed to, and viciously attacking, Bell's Asbestos Company. We have a hazy idea that they are meant to be in the style of the famous Letters of Junius—we apologize to the Shade of the latter for hinting at the comparison—but if so, they are woefully below the mark, containing no true satire but much vulgar innuendo. One question in particular attracts our attention: "Is it true that Canadian Government geologists have reported unfavorably upon the Bellmina property and express an opinion that as an asbestos mine its value is nil?" It is well known that the members of the Geological Survey of Canada are absolutely forbidden to report upon any property whatsoever, so that the sting of this editorial wasp loses its power altogether. By the way, we wonder what prompted this valiant but puny onslaught? Did the *Lighthouse* fail to receive an advertisement, or, like the gypsies, was its hand not crossed with a silver coin? Furthermore, how much would it cost to effect a change of tune and produce an outburst of adulation?

Having seen the impulse given to mining matters in Ontario through the report of the Royal Commission, the Alberta press have now commenced an agitation for a similar enquiry to be made respecting the mineral resources of their Territory. They urge that if Ontario with its large population and with a considerable section already engaged in mining, needed a public commission to attract public attention to its natural wealth, much more does Alberta, a sparsely inhabited Territory, require such a commission to make known to the world the nature and extent of its minerals. These are many and varied. Iron, copper, galena and other ores are to be found in the Rockies, but the great products of the Territory are coal and petroleum, which are found over a very wide extent of country and apparently in paying quantities every where. Whether a commission would be granted is another thing. The reports of the Geological Survey have made evident the vast resources of that part of the country, but the economic value of the coal, for instance, is as yet very small, on account of the absence of any market. Altogether we should not think that the time is yet ripe for an enquiry of this sort, though perhaps the Geological Survey might be directed to prepare a special report on the subject.

We regret to learn that the Cumberland Coal-Owners' and Miners' Conciliatory Board has broken up, the miners having refused to abide by Rule 14, which says that questions of a general adjustment of district wages shall be brought before the full Board, and, in case no agreement can be arrived at, a single arbiter shall be appointed, and his decision shall be final and binding on all parties. The difficulty arose in connection with the proposed reduction of 10 per cent. in miners' wages, and the rupture took place at a meeting of the Joint Committee at Workington. It is a very great pity that this should have occurred, for the Board has been the means of smoothing over many of the little differences between the coal-masters and men, which may now cause serious friction.

A six-foot vein of coal, of very good quality has been struck in No. 3 level of No. 1 shaft of the New Vancouver Coal Company's collieries, at Nanaimo, B.C. The company has for many years been working in a very faulty field, but it is thought that they have at last struck the great deposit they have searched for so long—a deposit which is believed to extend under the Nanaimo harbor, Protection Island and under the channel connecting the gulf with the harbor. If all that is said of it be true, this find will be of immense importance to the surrounding country, while it will very materially enhance the interests of the company, who well deserve their good fortune after such a long struggle against difficulties.

The production of Bluestone is the subject of the latest bulletin issued by the United States Census Office, under the supervision of Dr. David T. Day. This stone, which is a variety of sandstone, is, on account of its great hardness and durability, largely used for paving as well as for building purposes.

Our Portrait Gallery.

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

No. 12.

Mr. John Rutherford, Stellarton, N.S., the first Government Inspector of Mines for the Province of Nova Scotia.

One of the most widely known of the men engaged in the mining industry of Nova Scotia is Mr. John Rutherford, the first Inspector of Mines, whose genial, cordial disposition has gained for him the high esteem of all his acquaintances, and whose intelligence, keen observation, and conscientious, ardent advocacy of reforms in mining procedure have been invaluable to that province.

Mr. Rutherford is a native of the County of Durham, England. He was educated at a private school, and at the age of sixteen was placed with a civil engineer of considerable repute, who was then superintending dock and other works at Hartlepool. As a fitting preparation for the mechanical knowledge so essential in practice, two years were spent in the engine building shops of the now well known Hartlepool engine works of Thomas Richardson & Sons, which were then in course of formation. Mr. Rutherford had charge in rotation of all the screwing, turning, planing and boring machines, and thus gained a practical knowledge of machinery that was of much value in after life.

A dullness of trade and other circumstances led to the abandonment of the profession of civil engineering and to his being articled to Mr. George (now Sir George) Elliot, the eminent mining engineer and coal owner, whose first pupil Mr. Rutherford was. On the completion of his term, he was placed in a position that enabled him to gain an intimate knowledge of the difficulties in sinking through the the Magnesian limestone and beds of quicksand, and the mode of overcoming them, at the Seaham and Seaton collieries, then being opened by the Marquis of Londonderry and others.

About this time the railway mania was in full force, and engineering help was in great demand. Mr. Rutherford accordingly entered the office at Newcastle-on-Tyne of the late Mr. Sopwith, who, with his partner Mr. Scott, had a large amount of surveying and planning in hand, and he spent several months in that first-class establishment. A mining assistant being required by the manager of Lord Durham's extensive collieries, he applied for and obtained the appointment, which he held for some years. Subsequently, he conducted the operations at the Shirecliffe colliery, in the County of Durham, and at a colliery in Northumberland, at which the production of coke for iron smelting was an important part of the business.

In 1865 a delegation to England from Nova Scotia made inquiry, among other matters for which it was sent, for a competent person to act as Inspector of Mines for that province, in which the development of the mineral resources had begun to assume an important aspect, and mining operations were in consequence receiving general attention, and Mr. Rutherford being strongly recommended, was engaged in that capacity, and entered on his duties in the latter part of that year. With the exception of the Sydney and Albion mines, few of the collieries then in operation were of any extent as regards their production, and gold had only lately been discovered. At the close of the year 1866 upwards of sixty gold mines were being actively prosecuted; 3,000 tons of bar iron of a very superior quality had been produced during this and the previous year; twenty-seven collieries had yielded in the same period 1,397,341 tons of coal, and several others were being rapidly brought into a position to augment this produce. Mr. Rutherford has thus witnessed the growth and development of the mining industry of Nova Scotia for a quarter of a century. He entered upon the duties of his office full of faith in the destiny of a country so rich in mineral wealth as he more and more learned Nova Scotia to be. Believing that to this source the province must look for its progress and prosperity, he strove to establish scientific mining; "to attract foreign capital to the mines, to give greater safeguards to native capital flowing in the same direction, and to find lucrative employment for a growing mining population." His reports to the Chief Commissioner of Mines contain detailed descriptions of the works at the several mines and collieries, with tables shewing the mines worked, the number of men employed, the expenditure on machinery and development, the yield and destination of the products. Practical suggestions are given for the prevention of accidents, for the keeping of mining records, for more systematic working, for the proper ventilation and drainage of the mines and for the storage of coal. By his industry and energy, his uncompromising opposition to unscientific mining, Mr. Rutherford laid a good foundation for his successors, and led to the general diffusion of accurate information regarding the mineral resources of Nova Scotia and the right modes of reaching and working them He earnestly advocated the value of properly constructed plans and carefully drawn up descriptions of mining districts, observing that, in the words of Werner, it is "an obligation—a duty—for us to collect and leave to future generations as much instruction and knowledge as possible on the labors carried on in our mines, whether it be in those that are still worked or in those which have been given up," and a special report of his on the importance of mining records was printed in 1867.

After holding the important position of inspector for six years, he resigned it to become the general manager of the General Mining Association of London, the oldest and at one time the only coal company in operation in Nova Scotia. Respecting this change, the Hon. Wm. Garvie, in his report in 1872, remarked: "The recent resignation of the Inspectorship of Mines by Mr. Rutherford, who enters on a new career in connection with one of our foremost coal mining companies, has deprived the department of a highly efficient, active and valuable officer." The position of general manager he held for five years, during which time the company disposed of much of their mineral property, and subsequently confined their operations to the Sydney and Lingan mines.

After the termination of his engagement with the General Mining Association, Mr. Rutherford followed a private professional practice, and was consulted and employed in important mining questions. In 1881 he made a minute examination of the Albert mines in New Brunswick, and his report being confirmatory of the assumed exhausted condition of that wonderful mineral albertite, the works were in consequence brought to a close. Mr. Rutherford also visited professionally and reported on silver and lead mines in Utah and in Spain.

In 1880, when the sad explosion occurred at the Albion mines, Mr. Rutherford, who was then in the north of England, was summoned to London from the sick bed of his son, by Sir George Elliot, and received instructions to come out to Nova Scotia and assist in replacing the mines in a productive condition. He was subsequently appointed manager, in which position he remained until the Vale and Halifax companies were amalgamated with the Acadia Coal Company.

In the course of his long connection with the coal trade of Nova Scotia Mr. Rutherford has filled various duties in relation to that trade and to mining generally. In 1876 he was examined by the committee on the depression of trade, and again in 1877 by the committee on the coal trade. He was appointed by the Dominion government a member of the advisory board for the Philadelphia Exhibition in 1876, and superintended, conjointly with the late Dr. Honeyman, the collection of minerals sent to that exhibition. For some years he was examiner in mining at King's College, Windsor, N.S., and in that capacity read a paper on the mining profession at one of the Encœnias.

On the establishment by the Nova Scotia government of a board of examiners for granting certificates to candidates for the grades of mine officials, Mr. Rutherford was elected chairman of the board. This position, and his connection with the board, he resigned in consequence of the indifference with which his representations of the inadequacy of the means of instruction open to the miners was received by the Commissioner of Mines. He strongly urged in 1883 the adoption of some system by which the candidates for certificates might have that preparatory knowledge which they lacked; and although no attention was at the time given to his communication, happily a more liberal disposition has prevailed of late, and steps have been taken which will materially contribute to the object Mr. Rutherford has in view, viz., the fitting of the candidates for a higher class of examination.

Mr. Rutherford has been a member of the North of England Institute of Mining Engineers since its formation in 1852, and contributed to the Transactions a lengthy paper on the coal fields of Nova Scotia, which was also published separately in book form. He wrote an article on the minerals of Nova Scotia for Messrs. Selon & Co's Handbook to Canada, 1881, which is printed as an appendix to that publication. Being a great reader, with a good memory, his intelligence, combined with the accuracy with which he can recall incidents in the history of mining during the time in which he has been associated with it, makes him an agreeable companion. He lives at Stellarton, in Picton County, where his son is assistant manager of one of the collieries under the control of the Acadia Coal Company.

A Compound-Plunger Hydraulic Pump.*

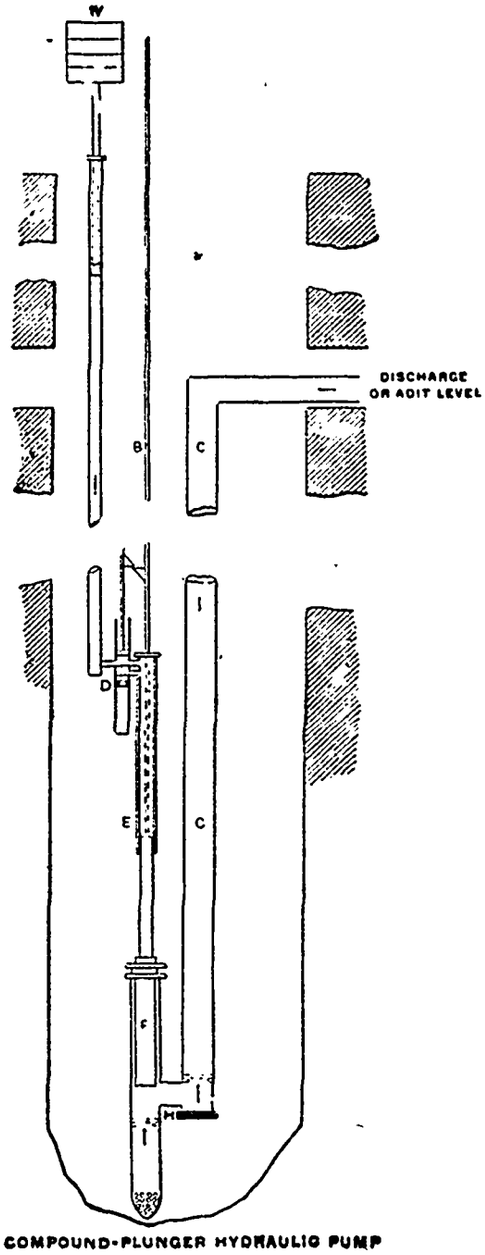
By Ernest R. Woakes, Tolima Mines, Republic of Colombia.

Those engaged in pumping from shafts, or other mining works, may be interested in the following suggestion of what is believed to be a novel method of raising moderate quantities of water against a considerable head.

It is admitted that the ordinary Cornish pump, as generally used in mines, is hard to beat on account both of its extreme simplicity and its easy adaptation to the requirements of mining; its great drawback, however, being the enormous weight of heavy rods and successive plungers that have to be kept in motion, not to mention the necessary "balance-" and "angle-bobs" with all thin accompanying friction and wear and tear.

It is contended that the following method would, to a great extent, overcome these drawbacks; though no doubt many old miners may say it would also introduce new ones. Possibly this may be the case. It is only desired that this pump may be judged upon its merits.

The chief novelty of the method consists in employing the almost unlimited pressure obtainable from a high column of water augmented, if necessary, by a hydraulic ram or press at the top, to work a small diameter piston or plunger at the bottom of a shaft or well. This high-pressure, indicated at E in Fig. 1, transmits power direct to a larger diameter plunger, F, constituting, together with the ordinary higher pieces, valves, and wind-bore, the actual pump which raises the water, by column C, to the adit-level or other discharge placed as far as possible below the head of the high-pressure column A and ram W.



COMPOUND-PLUNGER HYDRAULIC PUMP

It will thus be seen that it is only necessary to maintain a pressure on the small piston E, equal to that on the larger one, F, by means of the small but high column of water A in order to cause F to descend, and thus force the water up through C. The up-stroke is accomplished by a small water-wheel, or other engine, connected to the light rod or wire rope B, this having only to raise the weight of the actual plungers and fill the H-piece with water from the tank or sump. The equilibrium-valve, shown at D, for regulating the admission and the cut-off of the water from the column A to the cylinder E, is also worked by this rod. Of course the amount of water used in E is lost at each stroke, and has to be taken into account in the amount raised by F. This quantity, however, is small, as will be subsequently shown. Thus it will be seen, that instead of a large engine and heavy working parts, a small one with light connections can be used; the weight of the plunger, &c., only being balanced by a small "bob" in the ordinary way. The difficulties encountered in shafts, and especially in inclines, would thus be minimized. As a set-off to this it may be necessary in most cases to keep the ram running at the surface in order to maintain the pressure on the small piston by a closed and continually descending column of water, the waste from which is maintained at the top by the ram and which after doing its work in the high-pressure cylinder at the bottom of the shaft, is pumped up again as far as the discharge by the large plunger which it actuates.

If desirable, two or more sets of plungers can be worked at different stations in the same shaft or well from the same high-pressure column, the sizes of the various plungers being varied to suit the pressures to be overcome and the quantity of water to be raised.

In order to demonstrate more clearly the working of the pump, the following example may be taken:—

A shaft 700 feet deep with the adit or discharge-level 100 feet below the surface so that the water, say 100 English gallons per minute, has to be raised against a head of 600 feet.

High-pressure plunger, 3 inches diameter.

Low-pressure plunger, 10 inches diameter.

Working at 6-feet stroke, and 6 strokes per minute.

Capacity of high-pressure cylinder, 10.5 gallons per minute.

Capacity of low-pressure cylinder, 121.5 gallons per minute.

Difference 111 gallons per minute, which is the amount of water to be raised.

The pressure on the 10-inch plunger is 260 pounds per square inch, making the total pressure on its area 20,400 pounds.

In order to produce an equal pressure on the 3-inch piston a pressure of 2,900 pounds per square inch must be maintained, which will give 20,470 pounds for the total pressure on the area of the 3-inch piston.

This pressure can be supplied by a 19 horse-power ram at the top of the column.

The power required to raise the plungers and work the valves could not be more than 5 to 6 horse-power, so that the whole system would be worked for an expenditure of 25 horse-power.

To do the same work with a Cornish pump, consisting of three plungers and one lift, would require about 30 horse-power, so that there is a slight gain in this respect with the method under discussion.

It may be said that the above pressures would be an obstacle to the successful and economical working of the system, but it is believed that by using cast-steel instead of cast-iron, in the parts subjected to high pressures, this objection would be removed. It is certain that the present tendency in all machinery is to the use of high initial pressures.

The above example could, of course, be modified to almost any extent to suit individual cases, and is only *quoted to illustrate the practical application of the* principle. The duplication of plungers, as before mentioned, would reduce the actual pressure on any one system.

In situations where there is a sufficient difference in altitude between the highest convenient point near the pit's mouth and the adit- or discharge-level, and where the amount of water to be raised is small, the ram at the surface could be dispensed with, the excess of natural pressure in one column overcoming that in the other.

In conclusion, it may be added that th same principle could be employed to compress air in the bottom of a shaft, the air-cylinder replacing the large plunger and casing, in which case the initial pressure required would be much less than for the pump, though, of course, the work of the mine-pump would be augmented by the amount of water used in the high-pressure cylinder.

*Trans. Am. Inst. Mining Engineers.

The extravagant expectations which many respectable metallurgical authorities have based upon the extraordinary reductions recently effected in the cost of producing aluminum have been contradicted by actual experience of the metal's capabilities; but there is no doubt that aluminum and its alloys will take an important place in the metallurgy of the future. With the price reduced only a very little from present rates, there is a strong probability of aluminum-bronze very largely displacing brass. It is as an alloy with other metals that the greatest extension in the use of aluminum is at present promised, researches in that direction being now industriously pursued.

CORRESPONDENCE.

The Shaw Gas-Testing Machine--Some Unique Correspondence.

SIR,—I notice in the May number of the *Colliery Engineer*, a quotation from your paper, in reference to the report of the coroner's jury on the Springhill disaster, which would imply that I had misquoted the jury's report. I can only say in answer that the report in question referring to Shaw's Test Instrument was copied from the *Colliery Engineer* of April number, page 202.

It further appears that my son-in-law Mr. Jos. R. Wilson, while representing me in Canada last summer, made the acquaintance of Mr. H. S. Poole at Stellarton, agent for the Acadia Coal Co., and visited that gentleman's mines, the MacGregor, and while there found the gases in a very bad condition, so much so that pure C. H_4, or carburetted hydrogen was found rushing into the mine to such an extent that the condition of affairs called forth from him an exclamation of surprise.

That night Mr. Wilson exhibited my Test Instrument at Stellarton and tested with it the gases from the MacGregor pit before H. S. Poole, Chas. Fergie, Mr. Rutherford, and about twenty other mine officials from that district, and found that the outgoing current or return air contained two and eight-tenths of fire damp, *which will speak for itself.* He tested many other gases and proved the instrument sensitive to the presence of $\frac{1}{1000}$ part of ignitible gas in the air, or the one-tenth of one per cent. All parties present were unanimous in their endorsement of the apparatus, and Mr. Poole was particularly impressed.

The enclosed extract from a letter will show his real sentiments.

STELLARTON, NOVA SCOTIA,
THE ACADIA COAL COMPANY,
September 3rd, 1890.

Joseph R. Wilson, Esq.,
Queen Hotel, Halifax.

DEAR SIR,—I was much interested in your exhibition of Shaw's Apparatus for Detecting Mine Gases, and I have much pleasure in stating that so far as such an exhibition enabled me to judge of its merits, it analyzed percentages with greater accuracy than any ready appliance with which I am familiar.

I am, Dear Sir, yours truly,
HENRY S. POOLE.

In view of the dangerous condition of the MacGregor mine Mr. Wilson urged Mr. Poole to equip himself with the Shaw Inspector's instrument, and Mr. Poole promised to ask Mr. Clendinning, his president, as soon as possible for permission to order one. There the matter rested. Mr. Wilson then exhibited the instrument at Westville, and it received the following endorsement:

OFFICIAL ENDORSEMENT OF THE SHAW MACHINE IN CANADA.

WESTVILLE, N.S., Sept. 19, 1890.

We, the undersigned, are satisfied, after the most crucial tests, that Shaw's Instrument for detecting the presence and percentage of explosive gases is the only instrument extant by which a superintendent can know the true condition of his mine, and we recommend its introduction to use at all mines.

ROBERT SIMPSON,
Civil and Mining Engineer.
CHARLES FERGIE,
General Superintendent Intercolonial Coal Co.
WILLIAM MADDEN,
Deputy Inspector of Mines for Nova Scotia.

After which Mr. Wilson returned to the States and left the instrument in charge of Mr. Chas. Fergie, manager of Drummond Colliery, Westville.

On December 1st, 1890, Mr. Wilson wrote to Mr. Poole advising him urgently to buy a Shaw machine on account of the dangerous condition of his mines. Mr. Poole replied on December 6th, 1890, as follows:—

[COPY].
STELLARTON, NOVA SCOTIA, DEC. 6th, 1890.

To Joseph R. Wilson, Esq.,
915 Ridge Avenue, Philadelphia, Pa.

DEAR SIR: The receipt of your letter of the 1st inst., has gratified me exceedingly, and as I understand Mr. Fergie to say he declines to buy the machine you left with him, I shall be pleased to give $250 cash for it with lags, &c.

Yours very truly,
(Signed) H. S. POOLE, Agent.

This we declined, as the price of the instrument is $500 and cannot be sold for less.

All of this goes to show that the instrument was well received in Canada, and it is surprising to me that Mr. Poole should turn round and belittle himself in the eyes of the scientific public, after once having been quoted as an authority on the same subject. Mr. Poole's action under these circumstances is unaccountable to me.

The action of this gentleman on the Springhill verdict with reference to the Shaw machine, is to be regretted for his own sake. He knew in his heart that the instrument was invaluable and has testified to its merits over his own signature. I personally know nothing of the jury's report except what was published in the papers.

With reference to your editorial on the subject of Shaw's Gas Testing Machines, the tirade of abuse and undue comparison proceeds from a lack of knowledge on the subject and the influence of prejudiced opinions of others. Could you have seen the instrument in operation you would have had nothing but praise for it, both from a scientific and a practical standpoint. Its precision and accuracy are beyond question, and its use must become universal.

I enclose you a few endorsements of the several thousands received, and I trust, since you have published an article against my instrument and method of introduction, that you will insert my reply.

Very truly yours,
T. SHAW, M.E.

PHILADELPHIA, May 19th, 1891.

SIR: I thank you for yours of the 21st with the enclosed papers. Personally I have not the slightest objection to my statements and letters respecting the Shaw machine on the Shaw system being published at any time Mr. Shaw cares to do so, provided they are not garbled, but published with those of Mr. Wilson, his representative, showing the context.

My letter in your March issue expressed views identical with my letter to Mr. Wilson, of September 3rd, 1890, and I will again with pleasure repeat what I have said already, that for occasional and special tests the Shaw machine presents great advantages; that I would gladly see one in the hands of the deputy inspectors, and gladly have the use of one myself; but at the same time I must continue to most emphatically protest against blatant assumptions that the use of this machine in connection with the Shaw system will make fiery mines safe. Mr. Shaw is pleased to speak of "the dangerous condition of his mines," and "the gases in a very bad condition," whatever that may mean, and in a way to have your readers believe the use of the machine would change the condition. Does Mr. Shaw wish it to be understood that I had a hand in putting the gas into the coal? I can assure him I was not present at the making of the coal seams. I have only to deal with them as I find them. The gas, which I did not make, but naturally issuing into the McGregor workings, was shown to Mr. Wilson, who, totally unfamiliar with fiery mines, may have been surprised, as Mr. Shaw says, but because of his surprise does Mr. Shaw wish it to be thought that the gas could be frightened to keep back, or that he could blow hard enough to effect that purpose? Mr. Shaw must know that the gas is pent up in the coal under a pressure of many pounds to the square inch, even in some cases of hundreds of pounds, and that when the coal is cut out it has to come, and no silly little ¼ inch pipes can catch it, issuing as it does from every crack and crevice, and carry it away. This is the more evident when the quantity to deal with is considered. Mr. Shaw says Mr. Wilson found in the return air $2\frac{1}{10}$ per cent. of fire damp. Now, as the total air current is about 90,000 cubic feet a minute, this means that the mine is generating 2,500 cubic feet of gas per minute, and if Mr. Shaw were to ask any gas engineer if he approved of ¼ inch pipes for each half a mile long for drawing off that quantity of gas *diluted* with air, he doubtless would get an "unprejudiced opinion." But Mr. Wilson did *not* find the quantity named; what he did do was to confirm the percentage in one return of the mine only to be less than half that percentage, and $\frac{1}{10}$ less than I assumed. And I would here add that with Liveing's gas indicator, which we use, small percentages can be approximately found, and further, that machine is portable, which Shaw's is not, and it is safe to be used in the pit, which Shaw's in its present form is not.

Mr. Shaw says my article was "against his instrument." You will be able to say whether this is so better than I can, but my objections were intended to apply to his *system*, and to the "cure all" power claimed for the machine so applied.

I suppose in taxing me with having "turned round and belittled myself in the eyes of the scientific public," Mr. Shaw hopes to find a tender spot in my anatomy for my venturing to freely express my views in response to your enquiry respecting his machine and system. If by "turning round" he implies a change of respect for the character of men who could invent so clever an instrument on finding they could descend to the methods they adopt for forcing the system on the mining public, he is quite right. I regret exceedingly to see such evident ability so prostituted. Mr. Shaw chides me for referring to the Springhill verdict. In his desire to make capital out of the deplorable explosion, he published a circular giving the verdict and an alleged recommendation from the jury that the government should purchase one of his machines. My offence consists in showing on the authority of the mayor of Springhill, who was the foreman, that the jury *never* made this recommendation If he is annoyed at the exposure of this untruth, he has to thank the tone and style of letter adopted by his representative, Mr. Wilson. You published in your March issue an extract that is sufficient to show the offensive character of his correspondence, and yet most amusingly Mr. Shaw complains of "abuse and undue comparison, from lack of knowledge," &c., objecting evidently to others descending to his own tactics! In this respect he is doubtless right, but even poor worms will attempt to turn when trodden on.

H. S. POOLE.

STELLARTON, N.S., May 28th.

The precise meaning of several expressions in Mr. Poole's letter, such as "garbling, etc.," not being very apparent, he writes us to say that he referred to the "persistent twist" given to commendations, making them more general and sweeping than intended; as, for instance, his own praise of the machine was limited in application, and yet he is taxed with turning round, when he protests, not against the machine *per se*, but the Shaw system. Regarding the offer of half price for the machine quoted by Mr. Shaw, Mr. Poole says that by taking that part of his letter alone it would appear as though he were only trying to beat Mr. Shaw down in price, but his real intention was to imply that he did not put nearly such a value on the instrument as its inventor, and taken in connection with Mr. Wilson's two previous letters, and his short reply, it was a quiet rebuke of the tone adopted by the latter. Furthermore, he had in anticipation other possible quotations, and if Mr. Shaw wanted to quote further, he should have also shown the Wilson letters, to which he, Mr. Poole, takes exception. With these explanatory remarks, we present the full text of the correspondence between Mr. Wilson and Mr. Poole.

Copy of Correspondence Between Mr. Wilson and Mr. Poole, Referred To.

PHILADELPHIA, Oct. 22nd, 1890.

To Henry S. Poole, Esq.,
Stellarton, N.S.

MY DEAR SIR,—I trust the good impression made on you by the Shaw machine will be the means of making you one of the pioneer superintendents in its introduction and use in Canada. It would be strange if Sir George Elliott were to adopt them in England before you had quite made up your mind as to its utility for the Foord, MacGregor and Vale pits; but this would not be very surprising, as the English Government has already appointed its senior mining inspector, Joseph Dickinson, F.G.S., to report on same to the Home Office, and we believe his report so far has been most favorable. There can be no doubt, Mr. Poole, of the urgent necessity of the adoption of the Shaw machine at your three mines as early as possible—and I feel convinced that you share this opinion—therefore I trust, in the interest of yourself and company, you will bring the matter before Mr. Clendinning as soon as he arrives at Stellarton, or if he has been and gone again, send it after him. The Shaw machine is a means of insurance of the highest and most reliable order, and the time is not far distant when the wonder will be—however did we do without it. I see by the papers that Mr. Wills is getting the Foord pit into good shape. An instrument would be very useful to him at present. Give him my regards. I have heard about him from the other side; also kindly convey my regards to Messrs. Rutherford, Jr. and Sen., and with kindest regards to yourself and Mrs. Poole, and thanks for kind assistance when with you.

Very truly yours,
JOSEPH R. WILSON.

STELLARTON, N.S., Nov. 12th, 1890.

J. R. Wilson, Esq.,
Philadelphia.

MY DEAR SIR,—Special matters having come up lately, I have had my attention diverted from correspondence not requiring immediate attention; and I regret to find I have left your letter of October 22nd so long unanswered.

I thank you for it and for recalling to my recollection the very attractive experiments you showed here with the Shaw machine. The machine had a strong fascination for me, not only because of its practical value in connection with my profession, but also because of the interest awakened in me in physical research when years ago I studied in the Roy. Coll. of Chemistry, and attended the lectures of Prof. Tyndall.

You are kind enough to suppose that a desire for *kudos* still is in me; what little I may have had in my salad days is well nigh dead, and is at any rate very difficult to arouse. I find it so much easier to wait for others to work out details and adopt improvements that I am no longer eager to be first. I shall be pleased to see Mr. Fergie acquire one of the Shaw machines and find it practically useful for constant application; for as I remarked to you I only see use in occasional tests, and then not to an extent that would warrant the purchase of so high-priced an instrument.

With kind regards, believe me
Yours faithfully,
HENRY S. POOLE.

PHILADELPHIA, Dec. 1st, 1890.

Henry S. Poole, Esq.,
Stellarton, N.S.

DEAR SIR,—I am in receipt of your kind favor of 12th ulto., and note your remarks on the Shaw machine with great pleasure, notwithstanding the fact that you consider it an expensive protection. If you are not a man to be credited with a desire for *kudos*, I should like to know

where to look in Nova Scotia or Hochelaga for one better calculated to wear the honor with greater dignity than yourself. In this case, I value that very *kudos* which you profess to be indifferent to now, as only fitting for *opanu*. You are entirely mistaken inasmuch that you only see a use in occasional tests with the Shaw machine, nor can I understand how a man so thoroughly practical, could possibly arrive at such a divergent opinion from the greatest mining engineers and experts in the world, and with all due respect to your professed opinion, if I were called upon to point out a mine in which I considered continuous tests absolutely necessary throughout the day for the safety of life and property, I should immediately refer to the MacGregor, Vale, and Foord Pits, in the vicinity of Stellarton, Nova Scotia. Providence, rather than protective measures, has granted you immunity from serious disaster, but you cannot always expect Providence to avert catastrophe, and I urge you now as I have done before, to avail yourself of the apparatus known as the Shaw machine, and not trust to the treacherous lamp to warn you of danger, when too late; but with diaphragm hand-pump and rubber bags test the dangerous pockets and disused ramifications around your mines, so that you can direct your air currents that way and carry off the highly explosive accumulations by means of ordinary ventilation. Without the Shaw machine, it is impossible for you to know what per cent. of gas you are carrying, and were you to apply the lamp to test the pockets in question, if a high per cent. of gas was present, an explosion would be almost unavoidable. Then again the $C O_2$ tests connected with the Shaw machine are of the highest importance for the health of the miner and animals, $\frac{6}{10}$ of a foot in a thousand being the extreme permissible amount for health, while in the Foord pit at present I should say you are carrying as high as 2 and 3 per cent. This can also be corrected when its presence is known, by means of increased ventilation. With all these facts in view, your disposition resolves itself into an incongruity in my eyes, for not having availed yourself of this invaluable invention long ago; however, since you do not care to be first, I know that the time is not far distant when you will endeavor to analyze in vain the motives that prevented you from adopting it at sight. As to the matter of cost, $500; what is that paltry sum that at 5% means only $25 a year, compared to the protection it now offers over life and property? I do not think logarithms are necessary to work out this calculation.

With kind regards to yourself and Mrs. Poole.

Very truly yours,

JOSEPH R. WILSON.

STELLARTON, NOVA SCOTIA,
December 6th, 1890.

J. R. Wilson, Esq.,
915 Ridge Avenue, Philadelphia.

DEAR SIR,—The receipt of your letter of the 1st inst. has gratified me exceedingly, and as I understand Mr. Fergie to say he declines to buy the machine you left with him I shall be pleased to give $250 cash for it with bags, etc.

Yours very truly,
H. S. POOLE, Agent.

PHILADELPHIA, DEC. 9th, 1890.

To Henry S. Poole, Esq.,
Agent Acadia Coal Co., Stellarton, Nova Scotia.

DEAR SIR: Your kind favor of the 6th inst. to hand, and am much pleased to receive your offer of $250 for Shaw machine left with Mr. Fergie, together with bags, etc. Outside of any business consideration, it affords me deep pleasure to see your true nature awakening to the call of science, and I regard the motives which prompt you to make me this offer as a triumph of intellectual manliness and a desire to do that which is right, over a conservative business policy, which although highly commended while everything is going on all right by those who are saved from a modest outlay, yet severely condemned by those self-same people when they realize that to save a few dollars a whole mine and many human lives have been sacrificed and their own financial ruin brought about. It is only then that the blame of a short-sighted policy is thrust upon the management, on the plea that they were not urged sufficiently on the matter, and thus exonerating themselves from any participation, they hold the management answerable to themselves and God for the unnecessary loss of life and property. This is plain language, but so surely as two and two make four, so sure is the foregoing true. I regret that I am unable to accept an offer which I appreciate so much, but the price has been set for the whole world at $500, and this being a fair price, we cannot establish a precedent for any other sales by lowering it, excepting in the cases of colleges and public institutions, in which latter cases, it is our desire to help scientific research all in our power, and our prices will be in accordance therewith. The machine is most expensive to construct, special machinery having been made for the purpose. The cylinders have to be drawn over steel mandrils by hydraulic machinery, and are correct to the $\frac{1}{1000}$ of an inch. The most skilful mechanics and mathematicians have to be employed; in fact $500 is a reasonable price.

I will not dilate farther on the uses of the Shaw machine, for their name is legion. You have a proper sense of its merits, and I shall be glad to send you a new one, with all extras for $568, exclusive of duty, which is $150 at present, but we have every reason to believe that the Minister of Justice will decide in our favor and admit the instrument free as mining machinery, in which case the cost complete will only be $568. I sincerely trust that you will consider the great importance of our instruments for your mines, and get your board of directors to take this matter up at the earliest possible date. Just think how useful it will be to you, and how you will be able to know the condition of your mines; why it seems to me strange that knowing of the existence of such a machine a coal operator would be without one any longer than was absolutely necessary to obtain the same. I enclose you a list of what we will furnish you for $568, f.o.b., Philadelphia; also application blanks.

You will perceive that *you cannot use* ONE instrument for all your mines, but must have ONE for EACH, but we shall be glad to equip one mine at a time, which will be a step in the right direction for your company; a step which I sincerely hope for your sake will be taken soon. With kindest regards, again thanking you for your offer,

I am, dear sir,
Yours very truly,
JOSEPH R. WILSON.

PHILADELPHIA, March 16th 1891.

Henry S. Poole, Esq.,
Agent Acadia Coal Co., Stellarton, N.S.

MY DEAR SIR,—The late disaster at Springhill is a prophetic warning to the mining community of Nova Scotia. The total absence of any definite means of ascertaining the gaseous condition of your mines, urges me to make one more effort to introduce the *only known* appliance for this purpose into the mines of the Acadia Coal Co., and as I have already in former letters, made all the necessary arguments why you should avail yourself of what science offers, I have nothing left to add but this: Unless you avail yourself—and soon too—you may live, like Cowans, to regret that it was ever your misfortune to be a mine superintendent. You know your responsibility—I know the condition of your mines. *Deliberate!*

With kindest regards to yourself and Mrs. Poole.

Very truly yours,
JOSEPH R. WILSON.

MARCH 19TH, 1891.

Mr. Joseph R. Wilson,
915 Ridge Avenue, Philadelphia.

SIR,—I can hardly believe that through your continuous advocacy of the so called Shaw system of signalling in mines, you are already so lost to all sense of decency as not to know your letter of the 16th inst. is grossly insulting: it is cruel, heartless, devilish. The pursuit of the "almighty dollar" must have indeed deprived you of every dreg of manhood before you could write as you have. You would have me die would you, with the wails of widows and the fatherless in my ears unless I buy your rights! Take care, curses sometimes come home to roost.

Yours, etc.,
HENRY S. POOLE.

PHILADELPHIA, March 24th, 1891.

Henry S. Poole, Esq.,
Agent Acadia Coal Co., Stellarton, N.S.

MY DEAR SIR: In reviewing my letter to you of the 16th inst. I fail to see any such objectionable references as you make note of in said letter, and you are not warranted in drawing unfriendly inferences or charging improper motives from a communication from any party that has had no other than friendly intercourse with yourself.

If I see impending danger to yourself, and a remedy against the same, I would appear in my own eyes a most ungrateful party if I failed to use the strongest possible language against the real or supposed impending danger.

Very truly yours,
JOSEPH R. WILSON.

The Nickel and Copper Deposits of Sudbury.*

BY ALFRED E. BARLOW, M.A., GEOLOGICAL SURVEY OF CANADA, OTTAWA.

The presence of large deposits of nickel and copper in the District of Algoma, Ontario, has of late years attracted world-wide attention, in the first place on account of their immense and apparently inexhaustible character, but latterly because of the proposed application of nickel in alloy with steel to improve the quality of the latter. The existence of workable deposits of copper in this region was a fact that had long been known, and as far back as 1770 a company had been formed and attempts made to mine this metal, but the difficulty of procuring and maintaining miners at so great a distance from any centre of civilization, the remoteness of any market for the ore, as well as the absence of facilities for transportation, rendered these first attempts abortive. However, in 1846, owing to the activity in prospecting and locating mineral lands on the southern shore of Lake Superior, and a favorable report by Mr. W. E. Logan, then newly appointed Provincial Geologist, some enterprising Canadians banded themselves together into two associations called "The Montreal Mining Co'y," and the "Upper Canada Mining Co'y." The former company having purchased, amongst others, what was then known as "The Bruce Mines" location, and on account of the richness of the deposit decided to commence active work at this locality, while the Upper Canada Co'y proceeded to develop and work what was known as the "Wallace Mine," at the mouth of the Whitefish River. The Montreal Mining Co'y continued their operations from 1846 to 1865, when, from a variety of causes, the work proving unremunerative, they sold out the whole of their claim to the "West Canada Mining Co'y," who had previously leased and worked the western half of the location under the name of the Wellington Mine. This company continued working till 1876 when, owing to unsatisfactory results, work was suspended and has not been resumed since. The Wallace Mine was chosen on account of its promising character and proximity to civilization, and is chiefly remarkable as having been the first place in Canada in which the presence of nickel had been detected.

*Read before the Logan Club, Ottawa, March 6th, 1891.

According to Mr. Alex. Murray, of the Geological Survey of Canada, who made an examination of the location in 1848, "No true vein can be discovered, but the ore occurs at the contact of quartzose and chloritic slates with diorite, as bunches and strings of pyritous matter, interlaminated irregularly with the slates, and distributed in specks and patches in the diorite. Abundant evidence of disturbance is displayed in irregularities of dip and intrusion of the diorite. The material collected for assay was chosen as free as possible from copper pyrites, but nearly two-fifths of the specimen consisted of earthy materials which might readily be separated by dressing," (See Report Geological Survey of Canada, 1848-49, pp. 42—45.) Dr. T. Sterry Hunt, in his report on this ore, says that "the specimen is a steel grey arseniuret, the species not determined, with white iron pyrites and probably some arsenical sulphuret of iron. The mass, weighing 45 oz., was reduced to powder and submitted to analysis, with the following results:—

Iron	24.78
Nickel, with trace of cobalt	8.26
Arsenic	3.57
Sulphur	22.63
Copper	06
Earthy materials	40.01
	99.31

In the process of washing the ore, the earthy parts being removed by washing, the composition of the ore in 100 parts, as deduced by calculation from the above, would be—

Iron	41.79
Nickel and cobalt	13.93
Arsenic	6.02
Sulphur	38.16
Copper	.10

From the small proportion of arsenic the nickel must in part at least, be present in a state of sulphuret, a fact which is, indeed, made evident by the spontaneous oxidation of the ore. The nickel from this source contained about three parts in a thousand of cobalt. In conclusion, he remarks that in the same bands of rocks we may detect the presence of nickel and cobalt, a prophecy which has since been amply verified.

A mass of copper pyrites from the same mine weighing 9½ lbs. was also assayed, which yielded 11.6 per cent. of metallic copper. Acting on these and other favorable reports, the company began to sink shafts to test the extent and the quality of the ore, and one of these shafts at least attained a depth of 10 or 15 fathoms. Work was carried on energetically for some years, but the enterprise was finally abandoned, as the quantity of ore did not seem sufficient to justify further expenditure.

In his report for 1856, Mr. Alex. Murray (see Report Geological Survey of Canada, 1853-56, p. 180,) mentions the occurrence of a "dingy green magnetic trap" associated with red syenite in the northwest corner of the Township of Waters on Salter's meridian line. Specimens of this trap were given to Dr. Hunt for analysis, and the result of his investigation showed that it contained magnetic iron ore and magnetic iron pyrites, generally distributed through the rock, the former in very small grains; titaniferous iron was found associated with the magnetic ore and a small quantity of nickel and copper. The variation of the magnetic needle near this mass was from ten to fifteen degrees west of the true meridian. It can thus be seen that even at this early period of its history the officers of the Geological Survey were aware of the existence of nickel in this region, and had pointed out the probability that workable deposits would be found. Years passed by and the inaccessible nature of the country deterred prospectors from making very detailed exploration or examination, so that it was not till 1883, when the Canadian Pacific Railway was in course of construction, that the first discoveries of any consequence were made, since which time the whole belt of the Huronian district has been overrun with eager prospectors and miners. A not infrequent accident in newly settled districts led to the first important discovery. Judge McNaughton, stipendiary magistrate at Sudbury, had been lost in the woods to the west of that village, and diligent search was at once instituted for him. A party consisting of Dr. Howey and two others found the judge seated on the small eminence which then marked the site of what is now known as the "Murray Mine." Early in 1884 the Canadian Pacific Railway made a cutting for their main line through this small hill, about 3½ miles northwest of Sudbury, and on July 12th of the same year Dr. Selwyn made a careful examination of the location and pronounced the lode to be one of the most promising he had yet seen in Canada. Other discoveries soon followed, and the McConnell, Lady Macdonald, Stobie, Blezard, Copper Cliff and Evans Mines were all located. At first the wildest notions were entertained as to the extent of these deposits, and the most exaggerated reports circulated as to their value. It was even confidently asserted that these were immensely important

discoveries, and would revolutionize the whole copper trade and render other mines then in operation quite unremunerative. Rounded hills of gossan, indicating the presence of the more solid and unaltered ore beneath, occur at intervals for miles in a southwesterly direction, conforming rudely to the strike of the rocks in the vicinity. This circumstance is all that seems to have justified the early discoverers in describing the deposits as veritable mountains of solid ore, many miles in extent and hundreds of feet thick. Closer investigation revealed the fact that these surface gossans everywhere indicate the presence of the ore beneath, and that the ore itself occurs in lenticular masses, entirely separated from one another, whose longer axes correspond with the strike of the enclosing rock. This gossan has resulted, as is usual, from the formation of peroxide and hydrated peroxide of iron, due to the decomposition of the pyrrhotite and chalcopyrite which gives a prevailing red or reddish brown color to the upper portion of the deposit. This covering of iron oxide is sometimes as much as six feet in depth, although usually it is only two or three feet, gradually merging itself into the unaltered ore beneath. During the last few years prospectors have not been idle, and at the present time about twenty very promising deposits of these ores have been "located" and "taken up." The McAllister Mine, now called the Lady Macdonald Mine, was the first property on which any work was done in the summer of 1885, although later in the fall the Evans Mine was opened up and some preliminary tests made. On January 6th, 1886, the Canadian Copper Company was formed with a subscribed and paid up capital of $2,000,000, which was afterward increased to $2,500,000, to operate the Copper Cliff, Stobie and Evans Mines.

On May 1st, 1886, work was started in earnest at the Copper Cliff mine, and later on in the same year both the Stobie and Evans mines were opened up, and with the exception of a few months last summer, when, on account of some difference with the Canadian Pacific Railway, the Stobie was shut down, these three mines have been in active operation ever since. The chief business of the Canadian Copper Company is done at Copper Cliff, for here they have prepared a well equipped roast yard, two smelting furnaces, laboratory and offices, and other things requisite for carrying on this mining on an extensive scale. The Stobie and Evans mines are provided with excellent rock houses, but all their ore is brought by branch railways to Copper Cliff to be roasted and smelted. In 1889 the Dominion Mineral Company was formed to operate the Blezard mine, and later on they purchased the Worthington mine from the original owners. During the past summer this company have had their smelter in operation, and both their mines are being energetically developed. During the summer of 1889 the Murray mine was prospected under bond by Messrs. Henry H. Vivian & Co., Swansea, England, and in October of the same year they purchased it. About the end of last September, everything being ready, the smelter "was blown in" and set to work on some ore which had been previously roasted. All three companies are now prosecuting the work vigorously, and the output of these mines has already reached very large proportions. The whole district has been prospected, and I think that a very conservative estimate would now place the number of promising deposits at twenty.

The Huronian system in which these ore deposits occur may be regarded as the oldest series of sedimentary strata of which we have at present any certain knowledge. Amongst the more important of these rocks may be mentioned quartzites, greywackés, conglomerates, slates, evenly laminated gneisses, felsites, hydromica, chloritic, epidotic, hornblendic and micaceous schists and narrow bands of cherty limestone. Most of these clastic rocks have been derived from the waste of older felspathic material, and hitherto it has been most generally supposed and stated that the Laurentian gneiss was the source from which the sediments had been derived. The Huronian conglomerates, however, had no pebbles that are undeniably referable to the Laurentian, and the origin of the syenitic, quartzose and jaspery pebbles is still a matter of doubt. The microscope can throw no certain light on the original character of some of these rocks, for very often metamorphism and recrystallization has gone on to such an extent that the former structure has been either partially or completely obliterated. A close study of these uncertain rocks in the field, aided by the use of the microscope in the laboratory, will eventually enable us to assign them their proper place. We have thus numerous sedimentary rocks showing the various stages of this metamorphism, from the typical sandstone or greywacké, composed of the well rounded grains of quartz and felspar, to the compact felsite, which contains no trace of its original clastic structure. Associated with these sedimeneary strata are certain undoubted eruptive and irruptive rocks, among which may be mentioned many varieties of diabase, diorite and gabbro. Besides these igneous rocks, there are some granites and gneisses concerning whose origin many are in doubt. After a close and careful study of these rocks, which have usually been classified as Laurentian, and their relation with the true Huronian stratified deposits, I have been fully convinced of their irruptive nature. These granites and gneisses probably represent the original crust of the earth which has undergone refusion, and was in a molten or plastic condition at a period subsequent to the hardening of the Huronian sediments. The earth gradually cooling from a state of original incandescence, had reached that stage in the process when it admitted of being surrounded by an ocean nearly, if not quite, universal. Then began that tearing down and building up which has since gone on in forming the sediments which subsequently hardened into rocks. The first formed crust was necessarily thin and weak, and it is therefore not surprising that there were frequent irruptions, accompanied by the fusion of the lower portion at least of the first formed deposits.

It is unnecessary here to go into all the facts of the case, as my views have already been stated at some length in a paper read before this club on February 27th of last year. Suffice it to say that the fuller examinations of last summer have served to further strengthen these views. Both clastic and irruptive rocks have been subjected to intense pressure, as evidenced by the extensive cataclastic structure which has been developed in both series of rocks. Frequently the rocks show a pyroclastic origin, and volcanic tuffs and breccias are very commonly met with. The relations of the diabase or basic irruptive rocks with the surrounding sedimentary strata as closely examined in a large number of instances, and revealed the fact that the diabase is apparently of later age, as it breaks through and alters the bedded Huronian. The occurrence of these masses of diabase with a surrounding breccia or agglomerate in many cases would seem to point to the fact that they are the bases of Huronian volcanoes, which continued in action after the latest sediments had been deposited. Some of these diabasic masses send out dykes which ramify through and alter the surrounding strata, these dykes frequently containing fragments of highly metamorphosed Huronian quartzite. These irruptive masses are usually lenticular, although occasionally rudely circular or oval in outline, and their longer axes correspond in general with the strike of the enclosing rock. They vary in breadth from a few chains to half a mile, or even more, and frequently extend for miles in length. The origin of the nickel and copper is closely connected with this diabase or gabbro, and the formation of the fissures containing these ores was no doubt due to the disruptive forces of the intrusion, and the contraction caused by the subsequent cooling of the igneous rock matter. These fissures were necessarily most frequently formed along the line of contact with the cooler sedimentary strata although in certain cases they were formed in the midst of the igneous mass itself. In nearly every case, therefore, the deposits of nickel and copper occur close to the contact of the diabase with the stratified rocks, although in a few cases they are found in the diabase near its junction with granite or micropegmatite. Another proof of the common genesis of these ores and the enclosing diabase is that the diabase itself commonly contains these sulphides disseminated through its mass, these impregnations occasionally forming such considerable and rich deposits as to be workable.

All geologists who have examined these deposits agree that they are not true fissure veins, and although at times a certain sloping surface is obtained which seems to have a uniform inclination, yet it seems certain that there are no regular walls in the miner's sense of the term, and at both sides of the deposits the enclosing rock is impregnated more or less with the pyritous matter. Though mining is thus rendered somewhat difficult and uncertain on account of the absence of the walls and irregularity in the distribution of the ore, so that there is no means of knowing in what direction to drive the levels, this uncertainty is more than compensated by the extent and massiveness of the deposit when found. The ore bodies like the masses of diabase with which they are so intimately associated are lens or pod-shaped and "pinch out" in both directions. This structure is also characteristic of their downward extension, and the deposits have been very truly likened to a string of sausages, so that when one lenticular body of ore gives out another commences close at hand, which in its turn gives place to another, and though at the Copper Cliff they are down about 600 feet on a slope of 45°, the quantity and quality of the ore shows no diminution. I have occasionally found true veins of quartz holding this pyrrhotite, but such evidences of secondary action are extremely rare and proves nothing in regard to the origin of the more massive deposits. The ores and the associated diabase were therefore in all probability simultaneously introduced in a molten condition, the particles of pyritous matter aggregating themselves together in obedience to the law of mutual attraction. The ore bodies were, therefore, not contemporaneous with the stratified Huronian, although there is nothing to prove that they do not belong to the close of the Huronian period. Mr. Ferrier of the Geological Survey has noticed the occurrence of this nickeliferous pyrrhotite in a specimen of chloritic schist and gneissic granite, which had been taken to show the contact between the two rocks. The pyrrhotite is disseminated through both rocks, and its occurrence here in the Township of Dill at the junction of what has been called Laurentian would seem to be another proof of the irruptive origin of this gneiss.

The ore itself is a mixture of pyrrhotite, a monosulphide of iron ($Fe_7 S_8$) and chalcopyrite, a sulphide of copper and iron ($Cu\ Fe\ S_2$). The two minerals are not so intimately commingled as to form a perfect homogeneous mass, but one may be described as occurring in pockets, spots, bunches or threads in the other. The chalcopyrite is not so closely intermixed with the pyrrhotite, but isolates itself rather in spots and patches enclosed by massive pyrrhotite, so that it is not hard to separate considerable masses of chalcopyrite that will assay over 30 per cent. of copper, or pyrrhotite that will only show traces of that metal. In practice, however, careful examination and trial have proved that the two minerals are too intimately associated to make sorting by hand at all practicable, and the pyrrhotite is very often so feebly magnetic as to preclude the possibility of separation by magnetism. Although the chalcopyrite seldom occurs free from the pyrrhotite, large and massive deposits of the latter occur comparatively free from copper. In this connection Dr. Peters mentions a slope which, having furnished about 2,000 tons of pyrrhotite, gave place, just before the end boundaries were reached, to a deposit which afforded nearly 20 tons of almost pure chalcopyrite. In some instances these ore bodies show a brecciated character, large angular or partially rounded boulders or "horses" of almost barren rock being mingled with the ore, which seem to evidence the disruptive force of the intrusive mass, while in others, as at the Worthington mine, the diabase in which the ore occurs has developed a concretionary structure while cooling, and large irregularly rounded concretions, which on weathering, peel off in concentric layers, are cemented together, so to speak, by a very pure chalcopyrite and highly nickeliferous pyrrhotite. The concretions themselves usually contain more or less pyritous matter disseminated through them, but are usually cast aside as too barren for the roast heap. The pyrrhotite varies in color from steel-grey to bronze yellow, and the chalcopyrite is the usual brass or deep yellow color. Both tarnish readily, and very beautiful iridescent specimens can be easily obtained from the ore heap or scattered around the works. These sulphides, therefore, may be said to occur in three distinct ways—

1st. As contact deposits of pyrrhotite and chalcopyrite situated between the clastic rocks, such as felsites, quartzites, etc., and irruptive diabase or gabbro, or between these latter and granite or micropegmatite. Good examples of the former are furnished by the Evans, Stobie and Copper Cliff, while the Murray mine may be cited as illustrating the latter.

2nd. As impregnations of these minerals through the diabase or gabbro, which are sometimes so rich and considerable as to form workable deposits. These sulphides are in no case present as disseminations through the clastic rocks very distant from the diabase or gabbro, which seems clear evidence that they have been brought up by the latter.

3rd. As segregated veins which may have been filled subsequently to the irruption which brought up the more massive deposits. These veins are not very common, although certain portions of the more massive deposits may have been dissolved out and re-deposited along certain faults and fissures.

The composition of the ore varies according to the preponderance of either the pyrrhotite or chalcopyrite in the specimen examined. The pyrrhotite may be said roughly to be composed of 40% sulphur and 60% iron, with a varying proportion of the iron replaced by nickel, while the chalcopyrite contains 35% sulphur, 35% copper and 30% iron. The mines of the Canadian Copper Co'y, as the name of the company indicates, were first opened for their copper contents, and it was not until considerable work had been done that nickel was discovered to be present in the ore. A large shipment of ore had been made to New York, and a chemist there who was making a volumetric determination of the copper contents by the Potassium Cyanide process, was struck by the great variation in his results, which led him to make a more minute examination of the ore, when he found that nickel was present. The ore has now become of more value on account of its nickel than its copper contents, and Dr. Peters himself greatly doubted if the mines would pay to work for copper alone. The percentage of nickel and copper varies greatly, as might be expected, but assays of nine samples from the different mines of the Canadian Copper Co'y, made in November, 1888, will show the usual percentage of these metals. These assays were made by Mr. Francis L. Sperry, and show a range in the percentage of nickel from 1.12% to 4.21%, with an average of 2.38%, while the copper varied from 4.03% to 9.98%, with an average of 6.44%. A minute proportion of cobalt also occurs in the pyrrhotite, usually about $\frac{1}{20}$th as much as the nickel present. Mr. G. C. Hoffman assayed four samples from this district which I collected last summer, and these showed the nickel contents to vary from 1.95% to 3.10%, with an average of 2.25%. Three of these samples contained traces of cobalt, which are included in the above percentage of nickel. The nickel is usually spoken of as replacing an equal quantity of iron in the pyrrhotite, but the discovery of undoubted crystals of millerite or sulphide of nickel 150 feet below the surface at Copper Cliff Mine, as well as the more recent recognition of polydymite, a ferriferous sulphide of nickel, at the Vermilion Mine, in the Township of Denison, seems to justify the assumption that in the more highly nickeliferous deposits of the region at least, the nickel is also present as a sulphide, disseminated through the ore mass like the iron and copper.

This view is also borne out by Dr. Hunt's analysis of the ore of the old Wallace mine which seems precisely analogous to some of the richer deposits nearer the Canadian Pacific Railway. Traces of gold and silver, as also platinum are also usually found in these ores, and in this connection it was thought advisable to call your attention to the detection of what Messrs. Clarke & Catlett call a "platiniferous nickel ore from Canada." They say (see article xxxix, page 372, *American Journal of Science*, 1889): "During the autumn of 1888 we received, through two different channels samples of nickel ores taken from the mines of the Canadian Copper Company at Sudbury, Ont. From one source we obtained two masses of sulphides to be examined for nickel and copper, from the other came similar sulphides together with a series of soil and gravel-like material (gossan), 7 samples in all. In the latter case an examination for platinum was requested, and in 5 of the samples above mentioned it was found the gravel yielded 74.85 ozs. of metals of the platinum group to the ton of 2,000 lbs. The sulphide ores submitted to us from Sudbury were all

of a similar character. They consisted of mixed masses in which a grey readily tarnishing substance was predominant with some chalcopyrite, possibly some pyrite and a very little quartz. Two samples were examined in mass: one gave 31.41% nickel with a little copper, and the other gave 35.39% nickel and 5.2% copper. The nickel mineral itself proved to be a sulphide of nickel and iron, and as ores of that composition are not common, it was thought advisable to examine the substance further. It is steel-grey, massive and exceedingly alterable in the air with a Sp. Gr. of 4.5. An analysis of carefully selected material gave:—

Nickel	41.96
Iron	15.57
Silica	1.02
Copper	.62
Sulphur	40.80

These figures give approximately the formula $Ni_3 Fe S_3$. Neither cobalt nor arsenic could be detected. If we deduct silica together with the copper reckoned as admixed chalcopyrite and re-calculate the remainder of the analysis to 100%, we get the following figures:—

Nickel	43.18
Iron	15.47
Sulphur	41 35

In short the mineral has the composition of $Ni_4 S_3$ with about ¼th of the nickel replaced by iron, which seems to agree with Laspeyres polydymite of which it is doubtless a ferriferous variety. Probably in most cases the nickeliferous constituent of pyrrhotite is millerite, but other sulphides like polydymite may occur too. The polydymite which was selected for the above analysis came from the mass in which the average of 35.39% nickel and 5.20% copper had previously been found.

The mass weighed several kilograms and was remarkably free from quartz. The same mass, with two smaller pieces resembling it, were also examined for platinum. The results were as follows, "A" representing the large mass in which the polydymite was determined:—

A...	2.55 oz.	platinum per ton, or	.0087%
B...	1.8 oz.	" "	.0060%
C...	7 oz.	" "	.024%

Probably the platinum exists in the ore as sperrylite, although this point was not proved. The amount of platinum in the mass most thoroughly examined would require to form sperrylite only about .007% of arsenic, which is too small a quantity for detection by ordinary analysis. That platinum should exist in appreciable quantities in an ore of such a character is something quite extraordinary, but whether it could be profitably extracted is an open question. Sperrylite was first found at the Vermilion mine in the gossan or loose material, and was named after Mr. Francis L. Sperry of the C. C. C. by Messrs. Horace L. Wells and S. L. Penfield, of the Sheffield Scientific School, who examined and described this new species. It is isometric; simple cubes are common, octahedrons are exceptional, while the majority of the crystals are combinations of the cube and octahedron. II.—Between six and seven, as it scratches felspar but not quartz. The crystals have no distinct cleavage, but are very brittle and break with an irregular, probably conchoidal fracture. The chemical composition, according to the mean of two analysis was as follows:—

Arsenic	40.98
Antimony	.50
Platinum	52.57
Rhodium	.72
Palladium	trace.
Cassiterite or oxide of tin	4.62

The composition is therefore represented by the formula $Pt. As_2$, a small portion of the platinum being replaced respectively by rhodium and antimony. The color of the mineral was nearly tin white or about the same as metallic platinum. The fine powder is black. Nearly all the grains showed extremely brilliant crystal faces, though most of the crystals were fragmentary in size they were usually $\frac{1}{25}$—$\frac{1}{125}$th of an inch in diameter. Sp. Gr. 10.602.

ROASTING.

The metallurgical treatment of this ore commences at the roast yard whither it is conveyed, and, being piled in convenient heaps on previously laid cordwood, is exposed at high temperatures without fusion, or, at most, incipient fusion, to the action of a current of air. The objects of this roasting are, 1st, an oxidation of the iron, and, incidentally, of the sulphur, as complete as is posssible without involving an undue loss of copper in the slags of the following smelting, and 2nd, the expulsion of arsenic if there is any present. If the oxidation be very imperfect the resulting matte will contain so much iron that its bringing forward will be unduly costly, while, if the oxidation be too thorough, an undue loss of metal will occur on smelting the roasted ore. At Copper Cliff the Canadian Copper Company have spared neither trouble nor expense in the construction and equipment of their roast yard. The natural rough and uneven surface has been cleared and levelled, and the whole given a gentle slope, which, with carefully made drains, serve to remove at once any rain or surface. These precautions have to be taken to prevent loss of copper as soluble sulphate of copper, which is liable to be washed out by the rain.

At the Murray mine a large shed has been erected to roast ore during the winter months, with openings in the roof to allow of the escape of sulphurous fumes, but during last summer they had no regular roast yard, and the few heaps burnt could only be placed where the surface of the ground would permit. This was also the case at the Blezard and Worthington mines, and the mechanical loss alone from this carelessness must have been of considerable moment. The shaft of the Copper Cliff mine, on an incline of 45°, has reached already a depth of nearly 600 feet. It is provided with a double skip road, the skips' dumping automatically at the mouth of the breaker in the top of the rock house. Here the ore is sledged to a proper size for the 15 x 9 in. Blake crusher set to about 1¾ inches, which has a capacity of nearly 20 tons an hour. It is then passed through a revolving screen where it is sized into three classes for the succeeding operation of roasting. The coarse size passes a 4-inch ring, the medium or ragging, a 1¾-inch ring, while the fines pass through one ¾ of an inch in diameter. Each of these sizes falls into a separate bin under which a car runs. Thus the ore is loaded automatically into cars holding 1½ tons, whence it is transported to the upper story of the ore shed. There it falls into a series of bins from which it is loaded by means of inclined steel shutes into the cars and taken up a rather steep grade to a high trestle which extends the whole length of the roast yard. The only wood that can be obtained is dead pine, a good deal of the surrounding district having been burnt over about 20 years ago. This can be procured very cheaply, and although it does not roast the ores as thoroughly as hard wood, it makes very fair and economical fuel, and serves on account of its short fierce heat to ignite the pile, and this once started continues burning on account of its sulphur contents. These piles are built as follows:—The place selected is first covered with about six inches of fine ore distributed as evenly as possible over the clay soil. Sticks of cordwood of nearly uniform size should be placed side by side across both sides and ends of the rectangular area. The whole interior of this can be filled in with old stumps, roots, ties or cordwood, but in such a way as to form a level and solid bed for the ore to rest on. Over all this is placed small wood and chips to fill up all interstices, care being taken to provide small canals filled with kindlings at intervals of 8 or 10 feet leading from the outer air to the chimneys along the centre of the heap. These chimneys which assist in rapidly and certainly kindling the whole heap are usually built of four sticks or old boards, so fixed together as to leave an opening and communicating below with the draught passages. Five or six of these chimneys suffice for each pile, and they should project 2 feet above the upper surface of the heap, so that no pieces of ore could fall into the flue opening. The coarsest class of ore is first thrown on, then the ragging or medium, on top of which is scattered a layer of rotten wood or chips, and lastly the whole heap is covered over with fines till it reaches a height of about 6 feet. The whole structure should then form a shapely rectangular pile with sharp corners and as steeply sloping sides as the ore will naturally lie on without rolling (about 45°). Only a portion of the fine ore is put on at first, the rest being shovelled on after the fire is fairly started. The best way to light the pile is to place a quantity of ignited cotton waste saturated with coal oil down each of the chimneys. About 12 hours after firing, the whole heap should be pouring forth dense yellow fumes of sulphurous acid. Great attention is at first paid to the pile to prevent undue local heating which frequently causes partial fusion of the ore, and this can at once be prevented by covering the place with more fines. This heap should then burn from 50 to 70 days when the outer covering of raw or partially roasted ore is removed, and the remainder of the heap conveyed a few yards in wheelbarrows to a sunken railroad which runs alongside of the roast-yard. When filled, the cars are pushed up another steep grade along a track running over the bins back of the smelter. The sloping sides and corners of a pile are frequently covered with almost raw ore, this evil being often remedied by placing ignited sticks of cordwood around the whole structure, or by building a new pile in the passageway between two others which have been almost burnt out, the latter plan adding very materially to the capacity of the roast-yard. After this operation the ore is invariably so thoroughly roasted that it is necessary to add from 10 to 15% of raw fine ore during the smelting to prevent the matte from being too rich. Each pile usually contains about 600 tons of ore, and requires 30 cords of wood to roast it. The roast yard at Copper Cliff is nearly half a mile long by 100 feet wide, while each pile occupies a space of 40 x 80 feet, room being left to get round them, and for drains. The present capacity is about 60,000 tons, which, with a little extra work, could be increased to 90,000 tons. Working full power each roast-bed can be used four times a year, counting the time in making, roasting and clearing the beds. The yearly capacity would therefore be 240,000 tons, and by increasing the space, 360,000. The unroasted ore contains from 35 to 40% sulphur, and assays of a large number of samples of the roast heaps have varied from 2½ to 8% of sulphur. One analysis taken at random which may be taken as a fair sample of all the rest, gave 5.40% copper, 2.43% nickel 7.92% sulphur and 25% iron, lime, magnesia, etc., and the residue chiefly hornblende. Up to October 1st, 1890, 56,534 tons had been taken to the roast yard.

SMELTING OF THE ORE.

There are two smelting furnaces at Copper Cliff, and the building which contains these is 65 feet long by 40 feet wide. Thirty-five feet of this length is on a level with the ground, while the rest of the floor is 8½ feet higher, and it is on this upper flat that the ore and fuel bins are situated. The daily capacity of each of these furnaces is 125 tons, although one of the furnaces has reduced 187 tons of ore in one day, and the furnace manager says that 135 tons could be reduced without much forcing. The furnace itself is a steel plate water jacket of the Herreshoff patent, made in Sherbrooke, P.Q., by the Jenckes Machine Company. It is nearly oval in form, the longer diameter at the tuyères being 6 ft. 6 in., while the shorter one is 3 ft. 3 in. There are 11 2½ in. tuyères through which the blast enters from a Baker's rotary blower under a pressure of about 9 oz. per square inch. It is 9 feet high from these tuyères to the charging door, and is an unbroken water jacket from the cast iron bottom up. It is made of rolled steel with only a 2 inch water space, and not a single brick of any description. The well is a circular, cast iron water jacketed vessel, mounted on four strong wheels for convenience of moving it when repairs are necessary, and so made that the hole in one side connects with the outlet hole of the furnace, which is also thoroughly protected by water and it is through this that the matte and slag flow out of the furnace as rapidly as formed. They thus escape the influence of the blast, and prevent what Vivian calls "the sole objection to blast furnaces" the so-called "sows" or "salamanders" as great masses of metallic iron which choke up the furnace and tie up large quantities of copper and other metals. The charging door is situated on the upper floor, as also the bins for roast ore and coke. The coke used is from Connellsville, Pa., and is brought by way of the Great Lakes and the Sault Branch of the C. P. R. The charge for the furnace consists of 1,800 or 2,000 lbs. of ore and coke mixed, one ton of coke usually sufficing for eight tons of ore. The mass as it melts gathers at the bottom of the furnace, and flows through the outlet into the well or reservoir, where the heavier and metallic portions sink to the bottom while the lighter slag remains on the surface, running in a continuous stream over the jacketed spout into pots on wheels, which are removed when filled, an empty one always being ready to take the vacant place. The matte is drawn off at intervals of 15 or 20 minutes through a separated bronze water-cooled tap-hole casting, near the bottom of the well, and which is filled as usual with a clay plug that can readily be removed with a few blows from a steel bar. The smelting of the ores is greatly facilitated by the basic character of the accompanying gangue rock, for instead of quartz and acid silicates there is chiefly hornblende and very fusible felspars. This circumstance, as well as a judicious mixture of the different qualities of ore obviates the necessity of any flux, which is a very fortunate circumstance, as limestone is somewhat distant and suitable iron ore difficult to procure. The slag buggies or pots are made as strongly and lightly as possible, are case-hardened and shaped like inverted hollow cones, and before each tap are thickly washed with clay water to prevent the matte from welding to the iron mould. This matte is sampled and weighed and allowed to cool before being dumped from the pots and the slag also is sampled and assayed once every 24 hours, so that an accurate record can be kept of the composition of both. An average of two analyses of this matte in February and March, 1889, will probably give us the usual composition: Copper, 26.91; nickel, 14.14; iron, 31.335; sulphur, 26.95; cobalt, .935. Mr. F. L. Sperry says that platinum exists in quite appreciable quantities, so that the matte contains some ounces per ton of that rare metal, while gold and silver occur in strong traces. The first blast furnace was started on the 24th December, 1888, and with slight interruptions has been running ever since. The second furnace was built in the summer of 1889, and was started on the 4th of September of the same year. On October 1st, 1890, there was about 6,500 tons of matte, and the ore on the roast beds would produce about 6,000 tons more, containing 922 and 852 tons of nickel respectively, or a total of 1,774 tons of metallic nickel, and 3,362½ tons of metallic copper.

The average daily output of matte for the month of September, 1890, was 25 tons, but the full capacity of both furnaces would be about 60 tons of matte. If the former average was kept up, the yearly production of matte would reach 9,125 tons, but if the furnaces were run at their full capacity they would average nearly 8¾ tons of nickel a day, or nearly 3,066 tons of metallic nickel and 5,913 tons of copper a year. At present the matte is piled in heaps outside of the smelters, and, when wanted to be shipped, is broken up in pieces and placed in old oil barrels, the chinks between the larger pieces being filled with smaller fragments, so that the whole is packed tolerably firm and close. It is then sent to the various refiners in Europe or the United States according to their respective bids. So far no refining works have been built at Sudbury, but the vast quantity of material to treat, the tedious and costly process for the further refining of the ore, consisting as it does of alternate roastings and smeltings, in addition to the great expense incurred at present in shipping the matte to such long distances, seem great incentives to the early erection of refining works, so that the ore could be fully treated on the spot. The proposition to build nickel-steel works was lately submitted to the Government by the Canadian Copper Company, and it is to be hoped that some satisfactory arrangement will be arrived at to give a further impetus to our present mining activity in this region.

Nickel is a comparatively new metal, for it was not recognized as an element till 1751, when Cronstedt, the Swedish mineralogist, in examining the ores of certain veins in the German copper mines made the discovery of the two new metals, nickel and cobalt, which names he retained as they were in use amongst the miners. Nickel in its pure state is silver white in color, hard, tough, fusible with difficulty, and is susceptible to magnetism, although not to the same extent as iron.

Its use in the industrial arts has rapidly increased since it has been produced in a pure state, as it formerly existed only as an impure alloy, and so could not be so suitable for the purposes for which it is now used. The demand has only grown at a moderate rate as compared with the growth and demand for other useful metals, and a decrease in price from $2.60 per pound in 1876 to the present price, which varies from 50 to 60 cents per pound, seems to have had no very important influence in increasing that demand. The supply of late years has been more than sufficient for the demand and new deposits have always been found in advance of any necessity for their product. The first chief demand for this metal was for making nickel or german silver as a substitute for the more precious metal in making spoons and forks, and other ware in general for which silver had been previously used, and its whiteness and the facility with which it received and held the silver, after the process of what is known as electro-plating was introduced caused it to be still more widely used. It is also made use of to plate iron, zinc, &c., and also in alloy with copper for the manufacture of small coins, which are used so extensively in the United States, Germany, Belgium and other countries. The proposition to use rolled nickel plate as an advance over ordinary tin plate, is one which is receiving attention at present. It has also been recommended for making nickel crucibles to replace those of silver used in chemical manipulations as they would cost less and have the great advantage of melting at a higher temperature.

Nickel plated kitchen utensils are coming into general use as in Germany, and as it is well known that acids have a more or less solvent action on nickel, an investigation was undertaken which showed that 7½ grains of nickel could be taken into the stomach and repeated for a long time without any noticeably bad effects. There is thus no ground for uneasiness in the use of such utensils, especially if the same precautions are used as in the case of copper vessels, namely, thoroughly cleaning them and avoiding the storing of food in them. The proposition to use nickel in alloy with steel to increase the strength and quality of the latter, will, if carried out, increase the consumption very materially, and all have been eager to know the result of the recent experiments undertaken at the instigation of the United States Government. A French invention has effected the means of regulating the composition of such an alloy, and subsequent experiments in Glasgow revealed the fact that this alloy could be made in any good open hearth furnace working at a fairly high temperature as well as in the crucible. In obtaining a correct idea of the value or usefulness of alloys of nickel with iron or steel it should be borne in mind that the composition is complicated by manganese, carbon, silicon, sulphur and phosphorus, whose influence must be carefully watched, requiring a long series of experiments. A comparison of steel alloyed with 4.7% nickel raised the elastic limit from 16 up to 28 tons, and the breaking strain from 30 up to 40 tons, without impairing the elongation or contraction of area to any noticeable extent. A further gradual increase of hardness was noticed until 20% is reached, when a change takes place, and successive additions of nickel tend to make the steel softer and more ductile. The alloys polish well, and the color of the steel is lightened as the proportion of nickel increases. They do not corrode as readily as other steel. The 1% nickel steel welds fairly well, but this property lessens with each addition of nickel. It can, therefore, be seen that considerable advantage may be expected from these alloys, especially where the percentage of nickel is less than five.

The consumption of nickel and nickel alloy in the United States has increased from 293,000 pounds in 1880 to 421,000 pounds in 1888, while the total consumption of the world was estimated not to exceed 700 or 800 tons of the pure metal. The chief supply at present comes from New Caledonia, a penal colony of France (long. 165 E., S. lat. 22°). M. du Peloux states that the cost of production at this place could be so reduced that the company could sell at from 37 to 46 cents per pound, and yet have a good profit. Dr. Peters, in his evidence before the Ontario Mining Commission, stated that the Canadian Copper Company could sell it from 25 to 30 cents per pound with a handsome profit. A commission appointed by the United States Government to examine the probable quantity of nickel in the Sudbury district has given a very glowing report to their government. It is highly probable, however, as can be seen from the above figures that our mines could supply the whole demand, even if the other sources of supply did not produce anything. It has been decided by the United States Government to make use of nickel steel armour plates, and already the contract has been awarded so that there is every prospect of a brilliant future for this mining industry around Sudbury. In view of our immense deposits it will be necessary to increase its consumption in every possible direction.

Iron Ore Concentration.—The Thomas ore washer is a form of trough-washer with two revolving shafts furnished with helically arranged teeth. The box is usually 25 feet long, 5 feet wide, and 2 feet deep. A rotary screen may be used at the lower end to rewash the tailings when the washer is inclined so as to run a considerable quantity of small ore through with them. The revolving shafts are preferably geared together and driven by a pinion on a countershaft which is driven by a belt from the engine. For a washer of the dimensions given above, 35 to 40 gallons of water per minute are required, and 12 to 15 horse-power. The capacity is 50 to 70 tons daily.

The Construction of Details for a Modern Lixiviation-Plant.*

By C. A. Stetefeldt, San Francisco.

(*Continued from page 134.*)

§ 5. Apparatus for raising stock-solution to the storage-tanks.

Plunger-Pumps.—Pumps of the Knowles type, as made and kept in stock by manufacturers, are not durable in contact with hypo-sulphite solutions, none of the metals or their alloys resisting its corroding action. To make such pumps durable, valves, valve-seats and plungers should be made of hard rubber or glass. It is difficult to induce manufacturers to take such orders except at extravagant prices. The same objections apply to centrifugal and rotary pumps.

Pumps of the Koerting Type.—Such pumps must be made of material not affected by the solution. Their principal objection is the dilution of the solution by condensed steam.

The Geyser Pump.—If into a pipe, open at both ends, and immersed in a well, compressed air is introduced at the lower end, the solution in the pipe rises and is discharged, together with the air, at the upper end. The invention of this pump dates back several centuries, and it has recently received from Dr. Werner Siemens the appropriate name, "Geyser Pump." In the *Engineering and Mining Journal* of December 28, 1889, I have fully described it as Pohle's Air-Lift Pump, and, on the basis of the investigations of Messrs. Behr and Browne of San Francisco, recommended its introduction in lixiviation-works. After I had made actual working-plans, however, for its introduction, some disagreeable features presented themselves, so that its application for raising stock-solution was abandoned. The objections consisted principally in the necessity of sinking a well, 30 feet deep, for the submersion-pipe, and in supporting a vertical solution-pipe 85 feet high.

The Montejus System.—A Montejus is an iron tank from which a solution is raised through a pipe by admitting steam or compressed air above the solution. (For protection of the inside, see § 13.) With steam, the tank should be in the shape of a long cylinder of relatively small diameter, standing upright, to avoid condensation as much as possible. With compressed air as motive power, the shape of the tank is not material. It is then best to place it so that the axis of the cylinder is horizontal. One of the heads of the cylinder is put on with bolts and a gasket, so that the interior can be easily coated with an asphaltic compound.

These tanks have two openings: one at the bottom, through which the tank is filled and discharged by a three-way cock, connected with the pipes leading to the solution-sump and the storage-tank; one on the top, through which air escapes while the tank is filling, and steam or compressed air is introduced to elevate the solution, which changes are also effected by a three-way cock.

For works of large capacity, two Montejus are placed side by side below the solution-sumps, so that one is filling while the other is discharged. They should hold about 200 cubic feet. Convenient dimensions are: 4 feet diameter and 16 feet length, or 4½ feet diameter and 14 feet length, with solution-pipes from 3 to 4 inches diameter.

For large works, compressed air deserves decidedly the preference. The size of air compressor, which should give about 30 pounds pressure per square inch, is the same for a geyser-pump as for a Montejus of equal capacity.

Although the effect of compressed air is better if applied to a geyser-pump than to a Montejus, the difference plays no important part in economy, while the original outlay for installation is in favor of the latter.

§ 6. Apparatus for increasing the rate of lixiviation.

Suction-Hose.—The means hitherto employed for increasing the rate of lixiviation have been to give the hose of the solution-outlet below the filter of the ore tank great length, and discharge the solution at considerable depth below the tank, taking care that the hose remains filled with solution, and creates a suction by the weight of the solution-column. This method is objectionable, not only because it is difficult to get rid of all the air below the filter, but also for the reason that the solution has to be raised again to the precipitating-tanks, unless a very steep mill-site permits their position much below the ore-tanks.

Pumps.—These are not recommended for reasons given in § 5.

Koerting Ejectors.—A Koerting ejector is effective provided it is not made of material liable to be corroded by the solution. The lead-lined ejectors, sold by A. Allen, New York, are not durable; even the platinum steam-nozzles wear out. Ejectors of porcelain, with hard rubber steam-nozzles, are manufactured by the Koerting Brothers, Hanover, Germany. The great objection to a Koerting ejector is, however, the dilution of the solution by condensed steam. The apparatus also acts intermittently, unless carefully regulated to meet the capacity of the filter.

Montejus.—The best effect is unquestionably produced by a Montejus. For this purpose the opening at the bottom is connected with a pipe through which, by a three-way cock, the solution either runs in from the hose at the bottom of the ore-tank, or is raised to the launders in communication with the precipitating-tanks. The outlet on top has a pipe with a three-way cock, through which compressed air can be introduced for raising the solution, or a suction is created by a Koerting vacuum-pump for filling the tank, or communication is shut off both from the air-compressor and vacuum-pump, provided the apparatus is idle. Only one Koerting vacuum-pump, producing a vacuum of 68 cm. quicksilver, is needed for a number of Montejus tanks, the latter being all in communication with a pipe, at the end of which the Koerting is placed.

These vacuum-pumps are best obtained from the Koerting Brothers, Hanover, Germany.

Necessarily, the operation of the apparatus is intermittent; but the discharge of the Montejus takes such a short time that this is not detrimental.

§ 7. Apparatus for circulating extra-solution.

In circulating extra-solution of standard composition, only a quantity is used sufficient to saturate the charge in the ore-tank, and this is allowed to filter repeatedly and continuously through the ore. As will readily be seen, the Montejus system cannot be used for this purpose. Here we must rely either upon a Koerting ejector, made of porcelain, or use the geyser-pump. Which of the two deserves the preference is doubtful, the geyser-pump being untried. Their respective advantages and disadvantages may be stated as follows:

With the Koerting there is risk of decomposing extra-solution with formation of sulphates and Cu_2S, the solution coming in contact with the hot steam, and of weakening the solution by dilution. The heating, however, is beneficial. Circulation is also quicker by material increase of the rate of lixiviation.

In the geyser-pump, the extra-solution comes in contact with air only whereby it may deteriorate through the conversion of the sodium hyposulphite into tetrathionate, but without affecting the cuprous hyposulphite. By this reaction, and by the evaporation of water, the extra-solution will gain in concentration. On the other hand, the solution will be reduced in temperature and circulation will be slower, because the rate of lixiviation will not be materially increased, even by taking the submersion-pipe as long as practicable. The original cost of installation, and the expense of running, would hardly enter into calculation. Only an actual comparative test can decide which apparatus is the better.

§ 8. Filter-press and press-tank.

For lixiviation-mills of various capacities I recommend Johnson's filter-press, with 24 to 30 chambers, 15 to 18 inches diameter, without distance-rings and with closed delivery. Closed delivery obviates the necessity of having a sump below the press, the solution being at once raised to the main solution-sump.

If it is desirable to free the precipitates from adhering stock-solution, for reasons given in my paper on "Refining of Sulphides," a filter-press should be used in which the cakes can be washed after the chambers have been filled.

The chambers are of cast-iron, with a coating of asphalt varnish, which should be occasionally renewed.

The proper way of charging the filter-press is by a press-tank. In Mr. Daggett's paper (*Trans.*, xvi., 438), a press-tank is illustrated and described, constructed for steam-pressure. For works of large capacity, steam should be replaced by compressed air. In the latter case the wooden diaphragm and the pipe extending to the bottom are superfluous, and the precipitates are charged through an opening in the side of the tank near its top.

The construction, as shown in the cut, is not recommended. The bottom as well as the top should be made of boiler-iron or steel-sheet, not of cast-iron. At the Marsac mill, one of these tanks exploded, by breakage of the cast-iron bottom, at a pressure of 80 pounds. For compressed air the tank should be constructed to be safe for 150 pounds pressure to the square inch.

§ 9. Drying-chamber for precipitates.

A drying-chamber for sulphides and other precipitates, is illustrated in the paper just cited, pp. 440 and 443. Its construction is contrary to all rules for a good system of drying by hot air. A chamber of this kind, in use at the Marsac mill, has a very low efficiency. Correct principles of construction are to heat the air by a coil of steam-pipes in a separate chamber attached to the dryer, to allow the heated air to enter the drying-chamber at the top, and circulate downward between the iron pans charged with precipitates, and finally to withdraw the moist air at the bottom by a Koerting steam-jet ventilator. Upon these principles all modern apparatus for desiccation is constructed.

The outlet of the steam-pipe may be either connected with a steam-trap or with the mud-drum of the boiler. The latter can only be done if the boiler is so located that its mud-drum is lower than the outlet of the coil. In this case the coil works on the gravity principle, the most economical method of utilizing the heat of the steam. The coil should be tested for leakage at a pressure of 80 pounds.

§ 10. Auxiliary machinery.

Air-Compressors.—For Montejus or geyser-pumps and for the press-tank, two separate air-compressors are needed, the one furnishing air of about 30 pounds, the other of 150 pounds pressure. The size of the compressors must be calculated to meet the demands of the capacity of the works. The Montejus air-compressor should have a capacity to raise all the stock-solution needed per day in about 8 hours, so that the plant is not

*Trans. Am. Inst. of Mining Engineers.

in operation all the time and the solution can be transferred quickly.

Sulphide-Sampler.—The breaking up of the lumps of sulphides and other precipitates, as they come from the drying-chamber, is done in an ordinary small sample-grinder, as sold by any western foundry.

Boilers.—If considerable steam is needed for heating the stock solution and wash-water prior to its precipitation by scrap-iron; also for running Koerting ejectors and vacuum-pumps, a separate boiler is desirable for the lixiviation-plant proper.

Fire-Pumps for Sluicing Tailings.—If the water in the pipe-line has not sufficient head for sluicing tailings, a fire-pump for this purpose becomes necessary. A steam pump of the Knowles type may be used with 10-inch steam and 5-inch water-cylinder, 12-inch stroke and 4-inch suction and discharge. But I would recommend a Koerting steam-jet fire-pump, which is much cheaper than a plunger-pump and not less efficient.

§ 11. PIPE-LINES.

Iron gas-pipes are used for conveying stock-solution and sodium sulphide solution.

They should be joined by flange-couplings. The size of the stock-solution-pipes above the ore-tanks depends on the capacity of the works, and the position of the storage-tanks, producing more or less head. In large works they are generally taken from 3 to 4 inches diameter.

§ 12. COCKS.

The only cocks resisting for a long time the corroding action of lixiviation-solutions are the Pratt-Cady iron-body, Bower-Barffed plugs, asbestos-packed cocks, sold by Fairbanks & Co., New York. These cocks last very well, even on the sodium-sulphide mixing-tank. They were first introduced in lixiviation-works by the writer at the Marsac Mill, Park City, Utah.

§ 13. PROTECTION OF IRON BY ASPHALTIC COVERING, AND OTHER NOTES ON CONSTRUCTION.

Castings and Pipes.—Castings and pipes exposed to hyposulphite solutions must be protected by an asphaltic covering; the pipes, of course, on the inside. Pipes conveying sodium sulphide solution do not require such covering. A pure asphalt, called "Maltha," manufactured in San Francisco, the residue from distillation of heavy California mineral oils, now shipped in considerable quantities to the eastern States, is exceedingly well adapted to this purpose. The maltha is melted in a sheet-iron trough, and the clean and dry castings or pipes are immersed in the bath. They should remain there until the iron has reached the temperature of the liquid asphalt; this insures firm adhesion of the asphaltic covering to the iron. The propeller-screws and shafts for the precipitating-tanks are covered in the same way.

Montejus tanks and the press-tanks need different treatment. Here a malthine varnish is used. To the clean and dry inside of the vessels, a coat of varnish is applied. After drying, a second coat is put on, and, as the painting progresses, cotton cloth—weight about 6 ounces per yard—is pasted on, care being taken to saturate overlapping joints with varnish. On top of the tank the cloth is drawn over the flange. The cover is treated in the same way. Finally, a third coat of varnish is put over the cotton cloth. After perfect drying, the cover is bolted on, using a soft rope saturated with varnish for a gasket.

Fastening Castings and Flanges to Tanks by Bolts.—Bore holes to fit bolts close; countersink bolt-heads into wood and cover with thick white lead. Washers behind bolt-heads are also bedded in white lead. Bolts are first covered with asphalt.

Connecting Rubber Hose with Gas-Pipe Nipples.—The following method was communicated to me by F. M. Johnson: Draw out the nipple to fit the inside of the hose closely; heat the nipple so that it will melt rubber without burning it; then press the nipple into the hose about 4 inches and immerse immediately in asphalt varnish for cooling. The hose adheres so firmly to the iron that it can only be removed by cutting.

Mineral Production of Great Britain.—The total quantity of mineral wrought in the different districts of the United Kingdom during 1890 was 194,605,887 tons, of which 181,614,288 was coal and 8,117,476 ironstone, the rest being fire-clay, oil shale, and other minerals, making a total increase of 4,972,231 tons compared with the preceding year. There was an increase of 4,697,564 tons of coal, but a decrease of 153,066 tons of ironstone. The ratios of the fatal accidents and the deaths to the number of persons employed in and about mines under the present and former Coal Mines Acts are given in averages for the periods covered by the first three Acts and in detail with averages since 1872. From these it appears that the occupation of the miner is now more than twice as safe as it was 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 528—a much more favourable ratio. From the ratios of accidents and deaths to the number of persons employed and tons of mineral wrought in each of the districts a general average is obtained of 226,023 tons of mineral for every fatal accident, and only 167,763 tons for every death, as compared with the slightly less favourable quantity of 223,624 tons per fatal accident, and the considerably more favourable quantity of 178,227 tons per death in the preceding year.

Arsenic and Sulphur as Metallurgical Agents in the Treatment of Canadian Auriferous and Argentiferous Ores.*

By R. Dewar, Toronto.

We are all too well aware of the direful results on amalgamation caused by the presence, in the ore operated on, of arsenic, and more especially sulphur, as their capacity for neutralizing the mercury and thus rendering it useless to hold the gold or silver that passes over it, is very great. These troublesome elements are got rid of at the present time by roasting, but this causes expense, and metallurgists even hint at a loss of the precious metals by this treatment. I differ with them so far as to say, that if there is any loss, which there may be, the same is so minute that practically there is none.

The chlorination process, as it is variously applied according to the different patents granted for it, has a drawback in the treatment of these ores, in its restriction to those only in which the metals are in a state of fine division, therefore in ores like some of ours, in which the metals are in larger bodies, it is rendered useless; but in any case the ores must first be roasted to get rid of the arsenic and sulphur, as they form troublesome salts with the chlorine. Now, it is quite apparent that if part of the treatment could be dispensed with, it would be the means of increasing the returns in a great many mines at present in operation. Why then could we not dispense with the chlorination, and do the work with the roasting alone? It may seem impossible at first, as the roasting is merely a preliminary to the chlorination, which is the principal. There is a law of metallurgy which has been greatly neglected, and I may say has not been paid the attention or given the research due to it. That law expressed is that when a metal is alloyed with one or more of the other metals, the resultant alloy has a lower melting point than the mean of the several melting points of the constituents taken together. Let us take an example, for instance, an alloy of 1 part lead, 1 part tin, and 2 of bismuth: the melting point of lead is 325° C, tin 227·8° C, bismuth 259° C, their sum is 811, their mean 270° C. This will melt at 100° C, which is just 170° C below the mean. Is this not sufficient proof for this law? Let us take another example, that of an alloy of lead and platinum. Platinum does not melt even in the highest temperature obtainable in a blast furnace, but only in the flame of the oxyhydrogen blowpipe, and the calorific intensity of oxygen burned in hydrogen = 3,154° C. Now, if we take for granted that the heat absorbed by the nitrogen of the air is equal to the extra heat generated by the blast caused by the forcing of the gases through the nozzle, which consequently causes a more rapid combustion, hence a higher temperature, these figures represent the blow-pipe flames' temperature, hence the melting point of platinum. Those calculations of mine are not mathematically correct to the fraction of a degree or so, but are quite accurate enough for our purpose. Now the melting point of lead added to that of platinum = 3477, therefore the mean = 1739° C. I have melted such an alloy at 1000° C, that is 739° C below the mean; is this not a magnificent example? This law is confined to no special one, but holds good for all alloys.

Why, then, if this is a general law of all alloys, is it not applicable in the case of arsenic, sulphur, silver, and gold? You will object that arsenic and sulphur are not metals proper. That is quite true of the sulphur, but not so of the arsenic; but still that would not incapacitate them to form alloys with the metals. They may either be as a salt, such as a sulphide or arsenide, or be in molecular proportion to form chemical compounds, or in excess or deficient for such, and only form mechanical mixtures, or one contained in solution in another, or in an allotropic state; but still they are alloys, and in proof of this we have only to look at shot lead, which is an alloy of arsenic and lead; copper also alloys with arsenic as a greyish brittle metal; and has not galena the resemblance and properties of an alloy?

In consideration of this I hold that arsenic, sulphur, silver and gold do alloy, and that therefore the temperature at which they melt is lowered in virtue of their being alloyed with the sulphur and arsenic.

In accordance with this, we will now consider the following data:

As—melts at 220° C. We will say that, although it oxidises at that temperature, therefore its melting point must be lower.

S—melts at 115° C.

Au—melts at 1102° C.

Their sum is 1,437, their mean, 479° C; therefore this would seem to indicate the melting point of this alloy. This corresponds to a temperature below incipient red, as it is according to Powilett 525° C, dull red being 700° C. *I do not mean to insinuate that gold alloyed with arsenic* and sulphur will be reduced to such a ridiculously low melting point, but I do mean to say that it is lowered considerably, as I have melted them at about an incipient cherry red, corresponding to a temperature of about 800° C, and perhaps a few degrees lower, so that I can vouch for it as being correct. If the melting point of silver be added, namely, 1023° C, the sum will = 2460, the mean, 615° C. I may say I have melted them at such a temperature and below it.

Many of our ores carry sufficient S and As for this law to be taken advantage of in their treatment; but before we can see in what way it would be advantageous to us, we must consider another law. That is, namely, the spheroidal form given to small portions of metals or alloys under three different modes.

*Trans. of the Canadian Institute.

This is a law which none of the works as yet published on metallurgy have mentioned, and I don't think that any of our profession have paid any attention to it, and that some are even ignorant of its existence. We shall consider the modes under which this form is given.

1st. When metals in a thin body or sheet, such as gold leaf, are exposed to certain temperatures the sheet breaks up and forms into globules. This may be proven by taking any gilded work, say for instance on wood, and placing it on the lid of a furnace or common stove. When the wood begins to char the gold will be seen to form into globules. This is caused directly by the heat.

2nd. When certain metals are alloyed with others, they cause a shrinkage concentrated to a certain spot, which acts as nucleus, around which another portion of the alloy forms a globule when cast upon a cold surface, into water, or when pressed from under or through a crust of part of the alloy solidified. This is caused, 1st, by one of the constituents cooling more quickly than the rest. 2nd, when one of the constituents has a greater shrinkage power than the other. We can again take shot lead into account. As I have said, it is an alloy of arsenic and lead. Arsenic is of nature a great shrinker or contractor, and thus it is used to give the rotund form to the lead, as it causes it to contract when it touches any solid body and form a ball. We may further prove this law by taking an alloy that is known to shrink: melt, and cast into an open mould, let the top solidify, strike it two or three gentle taps with a hammer or die, having a broad striking surface, when the metal will be seen to force its way up through the crust and form globules on the surface.

The third mode really belongs to the former two, but we will consider it as an independent one. It is the action of the atmospheric pressure in the promotion of a spherical form in molten metal, when in small quantities. It is the best known law of hydrostatics that a fluid will flow until it finds its level; but pour water on any highly heated surface, and instead of flowing until it finds its level and keeping in a body, it will break up into little globules, and either run about or stand still, until the atmosphere in its vicinity is cooled sufficiently, when it evaporates in steam.

The same may be said of the metals with a little modification; the surface will do as well if it is cold, and not so well if it is at too high a temperature, unless there be a good supply of cold air playing in on the surface, but it all depends on the melting point of the metal, and the rapidity with which it cools. On studying this, I have come to the conclusion, that the heat radiated from the metal or alloy heats the air in its vicinity; that by the law of gravitation, the heated air having expanded, and thus having a lower density than the cold air, ascends to make room for the same; that the rapidity with which it ascends *partly breaks the equilibrium of the atmospheric* pressure; that the pressure being less on the upper surface, it is inclined to rise, and thus partly kept from spreading or finding its level; that it is aided in this by a lateral pressure, if I may so express it, which is not disturbed by the ascension of the heated air. That this is true may be seen by a great many metals when cooled suddenly by artificial means, or not formed into globules until on the point of solidifying, they will be seen to have their tops (the globules) very much flattened. This shows at once that it is the exertion of the atmospheric pressure, as if they had been hot or not cooled so suddenly, their tops would not have been flattened. Why then could these laws not be applied in the metallurgical treatment of our gold and silver ores? The sulphur and arsenic would assist to lower the temperature at which they melt, by alloying with them, and any portion that did not combine with them would act as a flux. I need not extol the virtues of such a flux; it would collect any fine gold, and bring it in conjunction with more, forming a globule, while at the same time the sulphur would act as fuel and produce heat, the arsenic, according to its nature, would cause any body of metal it happened to be in to shrink, and form a globule, thus all the fine and leaf gold would be collected into bodies large enough to be easily worked, and this could be done by roasting, but not roasting as is practised at the present day, as arsenic and sulphur are considered a disadvantage, and it is to get rid of them that it is practiced. Allow me to quote a passage from Overman, the late American metallurgist, as it will show us the object of roasting as it exists. He says: "Roasting means to heat a metallic ore or matte to at least a red heat, or such a heat that the mineral does not melt, but only the volatile or combustible substances are expelled, and as much oxygen becomes combined at the same time with the ore as it possibly can absorb." But we are aware of the weak affinity of the precious metals for oxygen, they are therefore reduced direct to the metals. In accordance with this he says further on that "sulphuret *of silver is easily liberated from its sulphur and forms* metal; the same is true of gold."

Roasting was resorted to but very little in the treatment of ores of the precious metals until lately, and even where it is used the benefit that might accrue from it is lost by restraining the temperature from rising above a certain point for fear of sintering, and thus causing extra expense in the working of it.

Well, to go into detail of how I intend to roast these ores. They must either be roasted in piles or kilns. I prefer the pile as a larger portion of ore can be operated on at once and more easily manipulated than if in kilns, and there is also very little outlay in preparing the bed to receive the same; but it all depends on the metallurgist who is considering the question, as one man can see an advantage where another could not. I shall go no further into detail than to say that the pile will be merely the ordinary one, with special attention paid to its draught

canals, which shall be two feet apart. We shall commence by building up the foundation from 18 in. to two ft in height, of hardwood, the height it is to be built depending on the amount of sulphur contained in the ore; the more sulphur the less fuel, and *vice versa* for the other extreme. The top should be easily reached so that the fines that form the covering could be easily manipulated. When the pile is all ready for lighting, we shall light it at one end only, and not all round, as is usually done, as the fire will spread soon enough for our purpose. When the end is well lighted let it have the benefit of a full draught by opening four draught canals (two on each side), and clearing the fines at the top, for four feet, when the ore having this great draught will sinter; when it has pretty well sintered, turn three or four jets or streams of water on it. This will cause it to crack and crumble; then let men with long iron hooks pull the crumbling parts away, so that the water may the better get at the other parts, and keep continually clearing away, as it is possible to do so; when within one foot of that part of the pile, whose draught canals are not open, stop putting on water, open two on each side, pull fines off top as before, let sinter put on water, and pull and clear away as ready, repeating this until the pile is finished.

The ore which has been done in the meantime is carried off to the mill and fed to the stamps; there may be sluices having hardwood riffles, leading from the mill to settling tanks, or it may be stamped dry, and the work of cleansing left to the buddles, but the wet way is to be recommended, as it will save a great deal of work in the buddles; the battery may be cleaned out every hour or a less period of time, according to the amount of ore that has accumulated in it and carried to the round buddles to be selected. All the gold and silver will be left in the battery, except, perhaps, those fine shots which may be ejected by the stroke of the stamps, and which will be intercepted by the hardwood riffles; as for the tailings, they will be found to contain practically nothing.

Naturally you will have come to the conclusion that the arsenic and sulphur which were alloyed with the gold and silver, will still remain with them and be troublesome impurities which can only be got rid of by refining, thus causing a further outlay of time and capital. This will depend principally on the temperature to which the ore has been exposed. If the temperature is only risen to that point at which the gold and silver melt, they certainly will contain these elements as an alloy, but if on the other hand, they are risen to that temperature which is obtainable in any roast pile, the gold and silver will be found free of even traces of these elements. In proof of this I shall make mention of an experiment by which I demonstrated it. I took ore known to contain both arsenic and sulphur, and divided it into two portions, which we shall call A and B. I raised A in temperature until the gold was seen to form on the surface in globules, and no higher. B I raised in temperature until it sintered. I afterwards made analysis of several of the globules from each portion; in A I found both arsenic and sulphur, and in further proof of my statement that arsenic and gold alloy, I found it (the arsenic) in the metallic state. I do believe that this could not have been confirmed more conclusively than by the finding of the metallic arsenic present. In the several globules from B, I found neither arsenic nor sulphur, thus showing that the high temperature to which the ore had been exposed had oxidized them.

The oxidization is accomplished as follows: The extreme heat of the roast pile when sintering, sets the sulphur and arsenic on fire, producing arsenical and sulphur fumes; the arsenical fumes combine with the oxygen of the air, forming arsenious acid As. O_3, of the old nomenclature, or arsenious anhydride of the new, $As_2 O_3$, and with the sulphur as sulphur dioxide, or sulphurous anhydride S. O_2, and also combine together to form the sulphides, the orange realgar As. S_2, and the yellow orpiment As. S_3. I found the former predominated. Also when the water is thrown on the ore it helps greatly the oxidization of these elements, and clears away almost all traces of them.

Now allow me to draw your attention to the advantages to be derived from this process. In the first place you must all be aware that the matrix of an ore, it matters not whether it be quartz, calc-spar, or any other mineral, when heated to redness and either suddenly immersed in water, or water thrown over it, will be rendered quite brittle, and will fall to pieces with the least concussion or blow, and even with some the disintegration is so great that they will break up during their immersion, or while the water is being thrown over them.

Now, this would be a source of great and general economy. The stamping expenses would be reduced; for instead of each stamp doing one ton per diem, they would do five tons; five days' work would be done in one; consequently saving five days' tear and wear of plant, also five days' steam and fuel, besides five days' wages to the workmen and other items of which I shall make no mention, unless to say that the returns would be quicker, thus making it a point of great importance.

I am of the opinion that many men of our profession are ignorant of the cause of the loss of a portion, if not all of the gold and silver in an ore, by assay when treated by the amalgamation process, and which they call free gold, and which appears so to the eye, but in reality is covered with a thin film of sulphur, which renders it impervious to the mercury to form an amalgam. It seems strange this has never been discovered before, but my father and I have proved it to be true, and were intending to publish a paper on it, but were anticipated by Mr. Skey, analytical chemist for the New Zealand Geological Survey, who published a paper on this subject under the title of "The Absorption of Sulphur by Gold and its effects in Retarding Amalgamation." Now, this sulphur can be got rid of by roasting at the proper temperature, and as to expenditure, have I not shown the advantage in less labor and mechanical power being required in the further treatment of these ores?

Another cause of great loss is the carrying away by water of the float gold. The cause of its floating is that, although it has the highest specific gravity, or density of all the metals except platinum, iridium, and osmium, which are 21·50, 21.15, and 21.4 respectively, gold being 19·50, and thus almost twenty times heavier than water, it has such a great surface in comparison to its weight that the water resists its sinking, and also the hydrodynamical force of the water in carrying it away even was it inclined to sink, keeps it in suspension and prevents it from doing so: thus it is carried over the amalgamated riffle plates and lost. Now, had the ore containing this fine gold been treated according to the process I have described, the fine and leaf gold would have been converted into globules, and even were the globules only the size of a pin's point they are bound to sink, as their surfaces are not to be compared with their density, and the water cannot resist them: they will all either remain in the battery or on the riffles, as they are too heavy to be carried away hydrodynamically. Then there is the great loss of mercury by neutralization by the arsenic and sulphur, which I before mentioned, and also those ores the matrix of which consists of calcium carbonate, cause enormous loss of mercury, as it is absorbed by the mercury, and causes it to be spongy and light, and to be carried away by the water more easily than the fine gold itself. Now, the amalgamation process can be dispensed with in this treatment, thus avoiding the above named loss.

As regards the presence of lead or any other of the baser metals in the ore to be treated, the lead would alloy and assist to collect the gold or silver; as to zinc, antimony or others, they would be completely oxidized.

In conclusion, I would lay special stress on the point that all ores should be selected, and not as is at present done, all rushed through as they come and by the same process, but arranged systematically and treated accordingly.

A Sinking Machine and a New System of Sinking Pits.

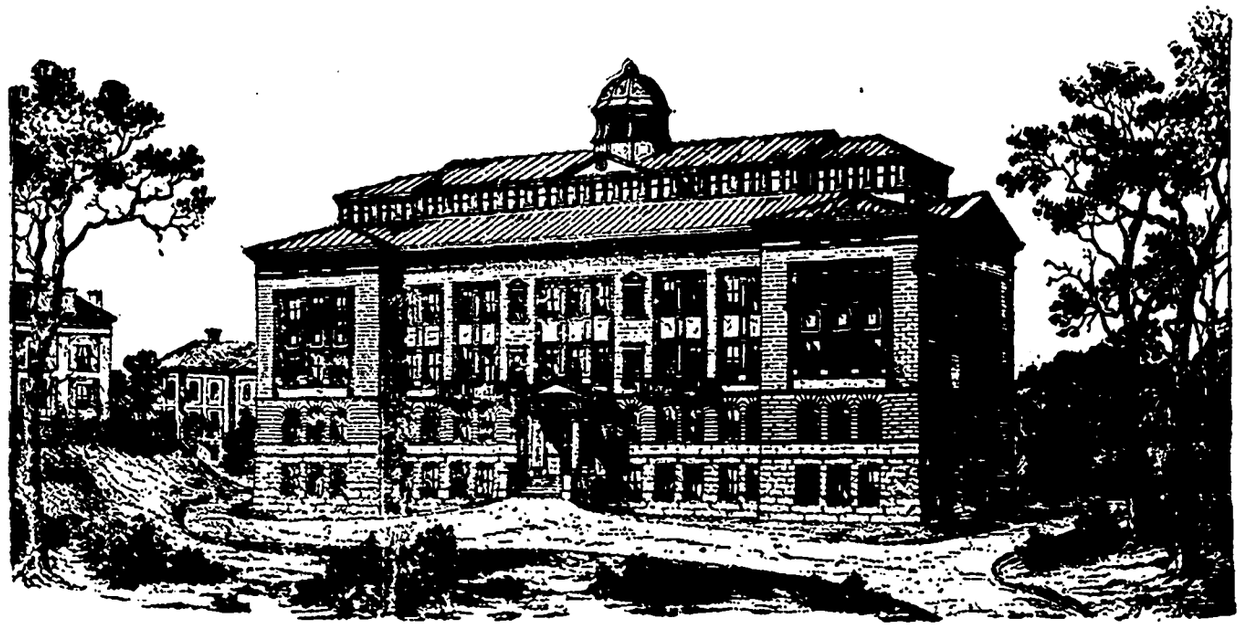
At the last meeting of the session of the Manchester Geological Society, a paper under the above title was read by Mr. Richard Sutcliffe, M.E., of Huddersfield:—

Seeing that a number of colliery owners in different parts of the country proposed sinking new pits, most of which were intended to reach a very considerable depth, and therefore must occupy a long period of time before winning the coal, he began to study and enquire to see if there was no means of improving upon the slow method of sinking as at present prevails, and he came to the conclusion that it was quite easy to devise a more speedy, safe, and cheaper system by the adoption of machinery instead of hand labour, and by replacing the present practice of sinking in the middle of the pit, by what he thought to be a more rational mode of cutting-out and setting free the layers of strata all around the pit bottom in advance of the sinking. To accomplish this he had designed and patented a machine which could be worked by means of compressed air, electricity or such other motive power as the user might decide to adopt, but he preferred the former (compressed air) on account of its cooling effects on the pit bottom, as well as its general utility in a mine. The machine consisted of a frame of steel or iron girders, firmly secured together with angle brackets at the centre, and cross girders at one end to carry bearings, which took the driving shaft. Four shoes were fitted one at each end to the girders, and allowed to slide freely on the same to the extent of 2 or 3 in., and having a flange at each side of the webs of the girders. Brackets were also secured to the sides of the girders near the ends, and these brackets contained two flanges each, between which flanges a nut was fitted, and worked by means of a ratchet, and in these flanges were suitable holes through which a screw passed, and was coupled to the shoe at each end of the girders. The air engines or their equivalents were fixed on the girders so as to gear into the cog wheel, which was keyed on the shaft, as was also the pinion, which meshed or geared into an annular rack and rotated it when the engines were set in motion. The size of the engine cylinders was about 8 in. by 12 in. An annular rack composed of four or more pieces for convenience in handling, and with which was cast a vertical flange or shroud about 2 ft. deep and 1 in. thick, to take girders and their strengthening stays. To the underside of the girders were secured four strong brackets, one at each end, fitted with journals which carried runners, upon which runners the annular rack travelled, carrying with it the whole of the under portion of the machine, a cutting barrel or cylinder composed of eight segmental steel castings, four of which were extended upwards to take slides which worked within the girders, and also the pistons of hydraulics. On the under end of the cutting barrel were cast tool boxes or sockets, to hold cutting tools, and on the internal side of the barrel were spirally-placed ribs at frequent intervals, which served to keep the annular channel clear of broken earth or *debris* by scooping out the material, and they also assisted to preserve the rotundity of the barrel by strengthening it. Also for the latter purpose an internal flange was placed at the top of these ribs, and four hydraulics for the purpose of regulating the feed and withdrawing the cutting barrel from the groove cut, or to lower the girders and their connections for a fresh cut. When the machine was being made ready for a cut, the girders were securely and firmly fixed in a horizontal position by pressing the shoes, which were packed with wood to increase friction and absorb vibration, against the sides of the pit by means of the screws and nuts, care being taken that a small space was left between the annular ring in order that the weight might be lifted off the cutting pieces before starting the machine, and when working it should be allowed to feed as it cuts. When out to their full extent the shoes should be released from the pit sides and the upper portion allowed to descend, either by means of the hydraulic or the capstan rope, on which the whole machine might hang. Small flexible tubes were conveyed from a small plunger and fixed at the engine to the hydraulics, so as to be able to work them from the engine when desirable instead of by hand. The girders in this machine were arranged to allow two sinking buckets to pass, one on each side, but where it was desirable to have only one sinking rope near the centre of the pit, the girders could be placed parallel and kept sufficiently apart. Assuming this machine to have twenty single and twenty double cutting pieces acting at the same time in the groove and making one revolution per minute in the pit bottom, it should cut at least 30 in. per hour in ordinary sinking stone, and with the stone set free all around layer after layer could be filed away without any powder. Sheet iron shields were allowed to hang from the stationary girders to protect the workmen from the rotating portion of the machine. When it was necessary to cut a walling bed, special cutters were secured to the machine, and these cutters expanded outwardly as the cutting barrel descended from the annular rack. Mr. Sutcliffe next proceeded to describe his new method of sinking. In order to expedite the raising of the sinking material he used guide ropes, and in the following manner: Suspended on four guide ropes were two parallel beams of timber tied together at each end by iron plates, in which were fixed four set screws, which pressed against the sides of the pit in order to steady the guide ropes and beams in their proper position. On these beams were secured flooring deals so as to cover the whole of the pit except the openings required for the sinking buckets, air pipes, etc., in order to facilitate working thereon and to afford additional protection to the sinkers underneath to that supplied by the special walling scaffold to be used in putting in the walling simultaneously with the sinking. For the walling or lining of the shaft he employed concrete, and to do so he placed on the flooring deals above referred to a temporary walling crib composed of iron or steel and made in four pieces or segments, which were connected together by four bolts or screws and nuts with suitable brackets as shown. The top of this temporary walling crib was placed on a level with the wall bed or annular step, and there expanded by the screws or bolts and nuts until made securely fast from pressure against the sides of the pit. When segments of wood were placed upon it in order to facilitate the closing of the next lift below to be afterwards put in underneath a course of bricks or blocks with quick-setting cement, or a low course of rich concrete was next set partly resting on the annular step cut for walling bed, and partly on the temporary walling crib. On the inner side of the wood packing was next placed a circular course of casing composed of angle iron-frames, lined with corrugated sheet iron having the undulations placed horizontally in eight segments of a height of 3 feet bolted together and having a wood packing piece in one vertical joint to facilitate the withdrawal of the same. The freshly-made concrete was poured in behind this casing, taking care that it was properly placed and packed all round by a careful hand and suitable utensils, and when filled and packed to the top another course of casing was placed on the first and filled in at the back with concrete in like manner, and so on placing course upon course and filling them with concrete at the back until the bottom of the lift of lining or walling above is reached and closed up to. When the lift of walling to be put in was a long one, the annular steps might be cut at intervals of from eight to twelve yards, so as to distribute the weight of the walling on the surrounding strata for extra security, instead of allowing it to rest entirely on the material composing the lining of the pit. It would be at once seen that a short time sufficed to allow the withdrawal of the temporary walling crib, when it could be lowered with the guide ropes and reset for another lift of walling, leaving the corrugated casings above, secured by the undulations in the lining, until required for the fresh lift, when they could be brought down and reset at the same time as sinking proceeded. In conclusion, he might say he expected and believed that six yards per day of three shifts could be sunk and lined as safely and as easily as the amount now attained in ordinary sinking.

Low Tension Shot Firing.—At a meeting of the North Staffordshire Mining Institute at Stoke-on-Trent, Mr. W. Heath presiding, Mr. T. M. Winstanley Wallis, of Derby, read a paper on "The Low Tension System of Shot Firing." He observed that the means of firing explosives used in mines were for all practical purposes limited to the time fuse and the electric fuse. There were two systems of electric shot firing, which he described, and he stated his reasons for preferring the low tension rather than the high tension system. By far the best method when an electric light or power circuit was within reach was to fire the fuses from the wires in the same way as from a battery, thus obviating the necessity of a battery or exploder.

A Canadian School of Mines—Description of the New Buildings of the Faculty of Applied Science, McGill University, Montreal.

In view of the many letters that have appeared in the press and the resolutions passed by the various societies of mining and scientific men, calling for a School of Mines, the present sketch of the new buildings devoted to this and kindred pursuits by the Faculty of Applied Science of the University of McGill at Montreal, will be of especial interest. Mining engineering and geology have for a long time been embraced in the curriculum of this Faculty, and although the facilities for instruction have been most inadequate, yet very many successful mining engineers, metallurgists and assayers have been sent out, and not only these, but men who have taken a high place in original scientific research. The number of geologists, also, whose education was obtained at McGill, is large, and among them are many prominent names. With such men as Sir William Dawson, Dr. B. J. Harrington and Mr. F. D. Adams in charge, the character of the instruction provided is assured to be of a high standard. The record of the past should be eclipsed in the future, however, for with the new buildings now almost ready for occupation, McGill is put on a par with other schools of mining and other engineering, and will doubtless attract many students who would otherwise have gone to Europe or the United States for a technical course. It is to the liberality of Mr. W. C. McDonald, of Montreal, that the University is indebted for this most useful addition. The McDonald Technical Building has been provided and in great part fitted up by him, though other gentlemen have presented the Faculty with many of the necessary machines and appliances. There are nine laboratories in the building :—



THE M'DONALD TECHNICAL BUILDING.

Nos. 1 and 2. Testing Laboratories.—These are equipped with a 100-ton Wicksteed and a 75-ton Emery machine for testing the tensile, compressive and tranverse strength of materials. For the former an addition has been especially contrived whereby the transverse strength of timbers up to 25 feet in length can be determined. The Emery machine is constructed and graduated with such accuracy as to render possible delicate experiments in elasticity. The laboratories are also provided with an autographic torsion machine, for ascertaining the torsional strength of materials, and there are besides many other appliances too numerous to mention.

No. 3. An Hydraulic Laboratory.—In this the student will study practically the flow of water through orifices of various forms and sizes, submerged openings, over weirs, through pipes, mouth pieces, etc. Suitably designed tanks are provided for the purpose, and there are also turbines, hydraulic motors, etc.

No. 4. A Cement Testing Laboratory.—This laboratory is fully equipped with the necessary apparatus for making tests of cement.

Nos. 5 and 6. Thermo-dynamic Laboratories.—An experimental steam engine of 80 h. p. has been furnished for this laboratory, and four cylinders, so connected as to allow of single, double, triple or quadruple expansion, condensing or non-condensing, etc., besides many other appliances.

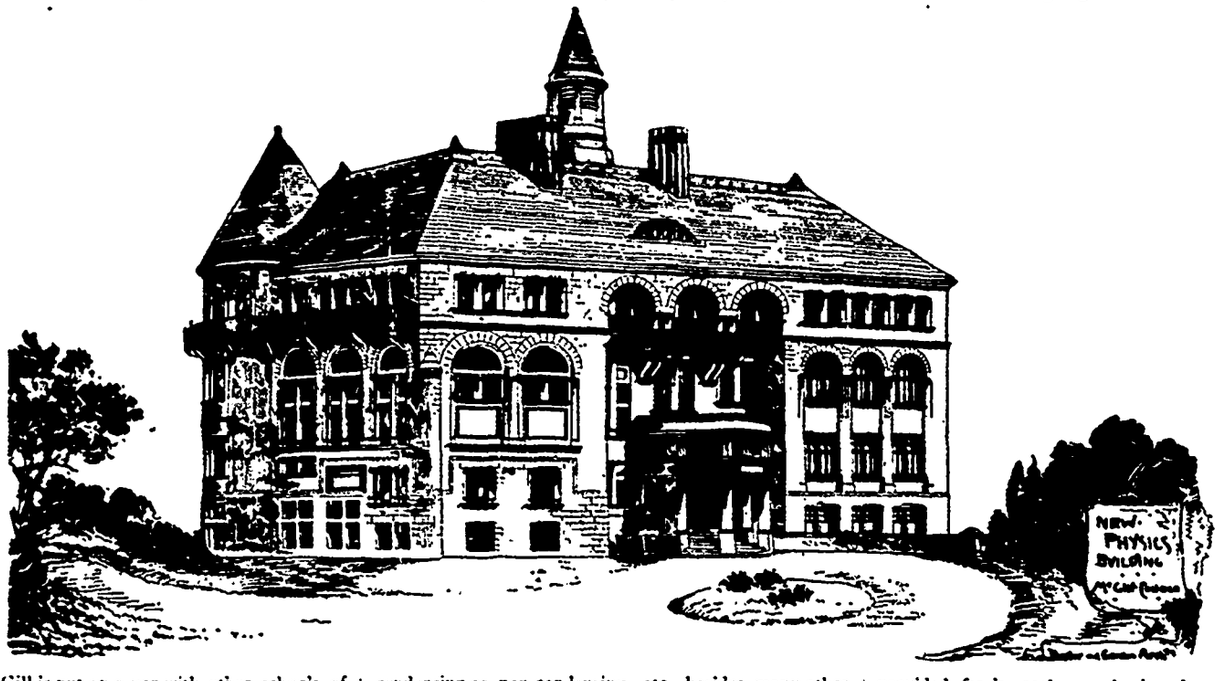
Nos. 7 and 8. Electrical Laboratories.—Are fitted up with dynamos and engines of several types, besides instruments for making electrical measurements, etc., and are in every respect complete and well equipped.

No. 9 Metrological Laboratory—This contains absolute standards of length up to 100 feet, and instruments for graduating standards of length, etc.

One large drawing-room occupies the whole of the fourth storey, covering an area of nearly 9,000 square feet, and is lighted from the roof. The course in drawing includes freehand and model drawing, descriptive geometry and topographical drawing, the preparation of the drawings of parts of machines and other structures, and finally, complete machine and structural designs.

Another fine building, the McDonald Physics Building, illustrated in this issue, is now in course of erection on the University grounds. It will be fully equipped with laboratories and apparatus for the study of experimental physics, and will be available for the use of students in the Faculty of Applied Science.

In keeping with the greater facilities thus offered, the Faculty of Applied Science has been divided into five departments, viz: civil engineering and surveying, mining engineering, mechanical engineering, electrical engineering and practical chemistry. The course in each extends over four years and is designed to afford a thorough training both of a theoretical and practical character. Full courses of lectures are given in mathematics, chemistry, mining, surveying, physics, mechanism, zoology, geology, applied mechanics, thermo-dynamics, hydraulics, geodesy, mineralogy, metallurgy, assaying, electrical engineering, and also in modern languages. In the department of mining engineering the work includes such of the civil and mechanical engineering course as is essential to the education of a mining engineer. A thorough training is provided for in geology and mineralogy, and in order to give a practical character to the work frequent geological excursions are made and numerous minerals and rocks are determined and analyzed in the laboratory. In the lectures special attention is devoted to the economic aspects of geology.



Work in the chemical laboratory is begun in the first year and continued throughout the course, mainly consisting of assaying by the dry, wet and electrolytic methods. In the third year a special course of lectures on mining is given. It is illustrated by diagrams and models, and includes the discussion of blasting, quarrying,

hydraulic mining, boring; special methods of exploitation employed in the working of metalliferous deposits and coal seams, ventilation of mines, pumping, etc. In the fourth year the lectures on metallurgy are illustrated by diagrams, models, and collections of ores and metallurgical products. An additional lecturer on mining will be appointed in time for the next session.

Students are expected to spend their summer vacations in practical mining operations or field surveys, and to present reports in the ensuing sessions.

As yet there is no special mining laboratory in which practical operations in ore-dressing, etc., might be carried on, but it is hoped that this deficiency will be supplied in the near future. Following is the curriculum of subjects taken up in each of the four years of the course:—

FIRST YEAR.	THIRD YEAR.
Arithmetic, Euclid.	Theory of Structures.
Algebra, Trigonometry	Materials.
Geometrical Conics.	Mining.
Solid Geometry.	Practical Chemistry.
Descriptive Geometry. (By permission of the Faculty)	Blowpipe Analysis.
Freehand Drawing.	Descriptive Geometry.
Chemistry.	Analytical Geometry.
Sanitation.	Calculus.
English.	Mathematical Physics.
French or German.	Experimental Physics.
	Geology and Mineralogy.
	Modern Languages.
SECOND YEAR.	FOURTH YEAR.
Practical Chemistry.	Assaying.
Mechanism.	Mathematics.
Surveying.	Metallurgy.
Descriptive Geometry.	Geology (advanced.)
Algebra.	Mineralogy (advanced.)
Analytical Geometry.	Heat and Heat-Engines.
Calculus.	Hydraulics.
Mathematical Physics.	Materials.
Experimental Physics.	Designs.
Zoology.	Estimates. Specimens.
English.	Modern Languages.
French or German.	

LEGAL.

The Emerald Phosphate Company v. The Anglo-Continental Guano Works Co.

This case was tried in the Superior Court at Aylmer before Mr. Justice Malhiot. The action was brought to restrain the plaintiff from alleged trespass on defendant's property, and a preliminary injunction was granted by the Court while the case was in progress. Judgment was rendered on June 3, in favor of the plaintiff. The following is an excerpt from its text:—

The plaintiff alleges that it is in possession of lot 19 in the 12th range of the Township of Buckingham, and that defendant is in possession of lot 18B in the same range and township; and that the possession of the two parties dates from 1874 is admitted. It is proved that E. W. Murray took possession of lot 19 in 1875. His possession was aggressive; it was made as openly as possible. He drove the agents of the Buckingham Mining Company from the lot *vi et armis*. No more public possession could be desired. After him came Mrs. Murray, Allan, Paige, The Ottawa Phosphate Mining Company, S. P. Franchot and the Emerald Phosphate Company, who according to the evidence of McIntosh, Franchot, Henwood, Stuart, and others, retained possession of lot 19 up to a line marked out by George C. Rainboth in November, 1875.

After Rainboth's survey in 1875, Murray, then owner of lot 19, considered that those who owned lot 18B were trespassing below the surface upon his lot. The Buckingham Mining Company then owned 18B. He went down into their pit accompanied by George C. Rainboth, his surveyor, who certified that those working lot 18B had already trespassed upon lot 19 to the extent of six inches. The opening through which this encroachment was made is known as the *Grant Pit*. Upon the occasion of his visit, Mr. Murray warned the foreman of the Buckingham Mining Company that he should go no further west. The foreman, Dickson, then stopped his westerly operations.

No operations seem to have been done on lot 18B from the time when Murray warned Dickson in 1875 up to 1887 when Mr. McIntyre who had bonded the property of 18B seems to have had a survey made by Edward J. Rainboth. This survey was *ex parte*. The owners of No. 19 were not called upon to take part in it. This survey was not an act of possession. From 1875 to 1890 no claim seems to have been made by defendant or its predecessors beyond the George C. Rainboth line of 1875. Mr. Isbester who purchased 18B at a sale by the sheriff of the lands of the Buckingham Mining Company says he never knew of the G. C. Rainboth line of 1875; but his foreman, Dickson, knew of it; and Mr. McIntyre, who may have walked over the lots in question during his leisure moments, does not establish any possession in favor of himself or those to whom he sold.

There was no dispute of the G. C. Rainboth line during the occupancy of Murray, Allan, Paige, The Ottawa Phosphate Mining Company, Franchot, or of the Emerald Phosphate Company until the arrival of J. Burley Smith. Mr. Smith knew the line of division was in dispute. His protest of August is, however, a retractation of his protest of June, 1890. Instead of adopting the proper proceedings to have a boundary defined, Mr. Smith seems to have been desirous of taking the law into his own hands.

When he comes into court, the pleas he fyles on behalf of his company do not correspond with his own testimony. He pleads that no phosphate was ever taken by his company from lot 19. This is an equivocation. He then pleads that no delimitation line had ever been drawn between the lots. This plea condemns defendant. Why should it despoil the land in dispute which is proved to be most valuable of all its worth without taking steps to have the line determined? The court does not wish to say anything further than that Mr. Smith's pleas and his evidence do not agree.

It is in evidence that Murray held possession of the lot 19 up to the G. C. Rainboth line, and that the owners of the same lot, under the chain of title which is admitted to be correct, have held up to the same line since 1875.

Our law of injunctions is wider than that of England. No one who has not had possession during a year of a piece of land can enter upon it without being met with a writ of injunction if the possessor chooses to use the writ.

No proof of possession during a year by defendant has been adduced. E. J. Rainboth's survey in 1887 was not followed up by possession. As surveyor, he had a right to go upon the property.

Plaintiff and defendant have both requested leave to amend their procedure. Leave is granted in each case. As to the petition for contempt against defendant, the court cannot allow it, inasmuch as Mr. Smith seems to have ignored the nature of the writ, but his company must pay costs as work was actually carried on after the writ was served.

The injunction is made permanent with costs until a proper division line is fixed either by the Court or by amicable agreement.

This report of the judgment was received from Mr. T. P. Foran, plaintiff's solicitor. Since then we have been handed another *verbatim* report by Hon. Mr. Laflamme, Q.C., who was retained by the defendants. This differs in several important points from the above, and as we confess we cannot tell which is the genuine article, we present the second one also, leaving the decision to our readers' judgment.

The Court having heard the parties by their counsel upon the merits, firstly of the defendant's petition for suspension of the injunction, secondly, upon the plea to the form, thirdly, upon the merits of the injunction, and fourthly, upon the merits of plaintiff's motion to have defendant fined for contempt of this court for disobedience to the injunction given to defendant in this case:

Having examined the proceedings and heard the evidence in open court,

Considering that it is proved that defendant continued to extract phosphate on the land in dispute after service of the writ of injunction herein issued and notwithstanding the order to the contrary in said writ, but that it appears from defendant's answer to said motion and the affidavit of William Burley Smith, defendant's manager, that the said works were not done in contempt of the order of this court, but from misunderstanding and that as soon as defendant's manager, Smith, knew the nature of the injunction the defendant immediately obeyed it,

Doth dismiss the said motion but with costs thereof against the defendant.

And adjudicating upon the plea to the form:

Considering that amongst other reasons therein mentioned the defendant alleges that plaintiff is a foreign corporation not having its principal office in the town of Buckingham, but in the State of New York, in the United States of America, and that this is proved,

Considering, however, that plaintiff has obtained permission to amend the writ and proceedings upon this point on payment of the costs of an exception to the form and that the writ and proceedings have been accordingly amended;

Considering that the other grounds of the said plea to the form are unfounded,

Doth dismiss the said plea without costs.

And adjudicating at the same time upon the plaintiff's injunction and upon defendant's petition for suspension of the injunction;

Considering that it is proved that plaintiff and defendant worked a phosphate deposit which exists upon the lot number nineteen (19), and on the south half of number eighteen (18), in the 12th Range of Buckingham, the plaintiff working on lot No. 19, and the defendant on the south half of lot No. 18, and that the plaintiff pretends that its lands extend to a boundary line drawn by George C. Rainboth, surveyor, on or about the 4th November, 1885, to divide the said lots;

Whereas defendant does not admit said line and pretends that its line extends beyond it to the west way and that it has the right to extract phosphate for a certain distance beyond the said lines;

Considering that it is admitted that plaintiff's predecessors owned and occupied lot No. 19 since the year 1874, and that defendant and its predecessors owned and possessed since the same date the south half of lot No. 18;

Considering that the said lots of lands are contiguous and that in November, 1875, Edward William Murray, then in possession as owner of the south half of lot No. 19 had a line drawn by George C. Rainboth, surveyor, to divide the said lot No. 19 from the said lot No. 18; that the said line was marked by posts on clear ground and by blazed places on trees in the bush land; that the said line was drawn in presence of the owner of the south half of lot No. 18, who at that time made no objection to the line and even assisted in drawing it;

Considering that subsequently, to wit, in the same year or the next year the said George C. Rainboth at the request of and in company with the same Edward Murray descended into the shaft on lot No. 18, known as the Grant pit, to verify if the Buckingham Mining Company, then owner of mining rights on lot No. 18, and working the said mine, was not trespassing upon the south half of lot No. 19, of which the said Edward Murray was in possession, by going beyond the said line drawn by the said George C. Rainboth in his subterrannean excavation in the Grant pit and that said George C. Rainboth after having made the necessary measurements established that the said company had gone about 6 inches across the line, and that the said Murray then stopped the employees of the said Buckingham Mining Company from working in a westerly direction; namely, in the direction of lot No. 19, and that in fact the said Buckingham Mining Company ceased working in said direction and directed its operations eastwards, and that it does not appear that the said Buckingham Mining Company have trespassed to the west of said line thereafter in mining phosphate in the Grant pit;

Considering that some time before George C. Rainboth had drawn the said line and measured the said shaft the said Buckingham Mining Company had been in possession of the said lot No. 19, and had extracted phosphate upon it and had been stopped from so doing by the said Edward William Murray;

Considering that there has been a well defined possession over to said boundary by the said Edward Murray and that this possession by the said Edward William Murray should avail his successors and assigns, and that it is proved that the Ottawa Phosphate Mining Company and afterwards Stanislaus Pascal Franchot, and afterwards the plaintiff, who succeeded one another as owners of lot No. 19, always possessed up to the line drawn by George C. Rainboth in 1875;

Considering that a year or two after the said George C. Rainboth had drawn the said line the said Buckingham Mining Company went into liquidation and ceased to exist, and that the mines on said lot No. 18 ceased to be worked until Defendant commenced to work them in March or April, 1890, and during all this time, namely during about twelve years, there does not appear to have been any effective act of possession done by the proprietor of lot No. 18, West of the said line drawn by the said George C. Rainboth;

Considering that the line drawn by Edward J. Rainboth in 1888 at the request of Alexander Fraser McIntyre, defendant's predecessor, having been drawn without the knowledge of the owners of lot No. 19, and without their participation cannot be considered an act of a nature to interrupt the possession of the plaintiff and its predecessors; that the latter continued until the institution of this proceeding in possession of lot No. 19 over to the said line drawn by the said George C. Rainboth in 1875;

Considering that on the 4th of June, 1890, the defendant, through J. B. A. Baudin, notary, notified the plaintiff that there was no boundary line between the said lots, and called upon it to appoint a surveyor to proceed with the surveyor appointed by the defendant, namely, the said Edward J. Rainboth, to draw the boundary line between the said lots of land;

That the defendant named Richard W. Farley, of Hull, its surveyor, to carry out the said *bornage*, and that the said surveyors could not agree upon the boundary to be given;

Considering that it is proved that in March last, before the issue of the injunction in this case, defendant in working its phosphate mine on the south half of lot No. 18 went about 6 feet in said Grant pit beyond the said line drawn by George C. Rainboth in 1885 towards the west and trespassed to that extent upon the land of plaintiff, being said lot No. 19, and mined and extracted phosphate therefrom;

Considering that the extent of ground in dispute between the parties in this case, and of which the plaintiff is in possession, is about in the middle of the phosphate deposit on the said lots, and that this deposit constitutes the sole value of the lots;

Considering that plaintiff is right in asking to be maintained in possession of the said lot No. 19 to the said line drawn by the said George C. Rainboth, at least until a boundary should have been established legally by the parties voluntarily or by a judgment of this court, and in demanding that defendant be enjoined to stop all the works to the West of the said line, and to stop removing phosphate from the West of the said line;

That the plaintiff's petition to this end is well founded, and that defendant's petition for suspension of injunction is unfounded;

Doth dismiss the latter petition and declare the injunction issued in this case good and valid; doth again order and enjoin the defendant to abstain from working or causing any work to be done upon said lot No. 19 as divided from said lot No. 18 by the said line drawn by the said George C. Rainboth on or about the Eighteenth of November, one thousand eight hundred and seventy-five, and refrain from taking out any phosphate of lime from the west of the said line so long as a boundary line between the said lots shall not have been determined either by the parties voluntarily or under judgment of this court or until it shall have been otherwise ordered by this court; the whole under all penalities of law;

Doth condemn the defendant to pay the costs of these

presents which are granted to T. P. Foran, Esquire, attorney for plaintiff.

Defendants have appealed from this verdict, and it was understood that the case would come before the Court of Appeals on the 23rd inst., but on further consideration they have decided to bring it before the Court of Queen's Bench, where it will be argued in September before a full bench.

Johnson's Asbestos Co. (Ltd.) v. Bell's Asbestos Co. (Ltd.)

This action has been taken in order to obtain a judicial settlement of the boundary line between the properties of these companies. The amount involved is not definitely known, as it depends upon the value and amount of the asbestos in the strip of land under dispute, but it is possible that $25,000 would not cover the value. The case is under advisement before Mr. Justice Plamondon at Arthabaskaville, P.Q. No judgment has yet been rendered. Hon. G. Irvine, Q.C., is retained by the plaintiffs, and Messrs. Camirand, Hurd & Fraser of Sherbrooke, by the defendants.

Criminal Prosecution of Wellington Strikers.

At the Assize Court at Victoria, B.C., last month, the case of Bates and the fourteen union miners' charged with conspiracy was taken up by the grand jury. Judge Drake in addressing the jury explained to them the law in the case. He said all the trouble arose from the unfortunate strike there in progress; unfortunate, because by it many men were prevented from earning their bread by the act of the miners' union. The strike was not unlawful, but if the strikers had sought to compel others to come out or cease from work, then the bounds set by law had been overstepped. The union had claimed that the right of free contract was the basis of all freedom, but yet the union had followed a course directly contrary to the principle of free contract. The tyranny of the union was of the nature that its members would be the first to resist were it directed towards themselves. The unionists did not wish any outside the union to enjoy the freedom of contract. In the case of the Wellington miners, the evidence showed that a serious breach of the peace had only been prevented by the self-control and good sense of the non-unionists. The grand jury, after considering the matter, reported that they stood eight for a true bill and seven for no bill. The court decided that this amounted to no bill, and the accused were in consequence discharged.

Phosphate Shipments.

The following are the official returns of the quantities of Canadian phosphates shipped to Europe from the port of Montreal since the opening of navigation to date:—

Date	Name of Ship.	Destination.	Shippers.	Tons.
May 9	SS. Charrington.	Bristol.	Lomer Rohr & Co.	75
9	do	do	Millar & Co.	30
16	" Pecklumben.	Hamburg.	Lomer Rohr & Co.	50
23	" Cynthiana.	Newcastle.	do	75
27	" Canopus.	Liverpool	Wilson & Green.	500
29	" Steinhoft.	Hamburg.	Lomer Rohr & Co.	280
June 3	" Lake Winnipeg.	Liverpool.	Irwin Hopper & Co.	205
3	" Ripon City.	do	Lomer Rohr & Co.	350
6	" Athens.	Hull.	do	200
8	" Toronto.	Liverpool.	do	305
9	" Elsof Inversnad	Sharpness.	do	250
11	" Gothenburg City	W. Hartlepool	do	180
11	do	do	Millar & Co.	120
11	do	Newcastle.	Lomer Rohr & Co.	180
15	" Bushmills.	London.	do	200
15	do	do	Millar & Co.	200
16	" City of Lincoln.	Liverpool.	Wilson & Green.	605
17	" Naples	W. Hartlepool	Lomer Rohr.	350
18	" Sarnia.	Liverpool.	do	100
18	Barque Jan Melchers	Bristol.	Wilson & Green.	189
23	SS. Sarnia.	Liverpool.	Lomer Rohr & Co.	100
				4544

SHIPPERS' RECAPITULATION.

	Tons.
Lomer Rohr & Co.	2695
Wilson & Green	1294
Millar & Co.	350
Irwin Hopper & Co	205
Total shipments to date.	4544

RECAPITULATION OF EXPORTS.

	Tons.
Bristol	294
Hamburg	330
Newcastle	255
Liverpool	2165
Sharpness	250
London	400
West Hartlepool	650
Hull	200
Total tons exported	4544

Copper in Coal.—The blue coloration which is evident when salt is thrown upon ignited coal is traced by Salet to the presence of traces of copper. He shows that copper is usually present in minute quantities in the ash derived from coal.

MINING NOTES.

[From Our Own Correspondents.]

Nova Scotia.

Pictou County.

Operations in the Six-foot seam at the Vale have again been greatly interrupted by water; another new pump has been put in, but even yet the operators are going to have all they can do to keep the water down.

At their East River mine the Messrs. Muir & Sons are doing better this summer than they have done since starting.

The Foord pit has been put in thorough repair with brick and stone arches. The levels running north and south have been arched with brick two feet thick packed on top with sand with steel supports for a distance of some 300 feet. This completely isolates the old workings.

The coke-ovens built here turned out 5,000 tons of coke last month. This amount will be largely increased, for the production owing to repairs and other work has been much interfered with.

The Douglas slope is now in good working order. A tunnel has been driven across the measures cutting the large pit seam, and another to the four-foot seam where eighteen inches of Cannel coal has been opened. With three good seams this mine is, therefore, most favorably situated, and will produce largely. A vein of iron-ore, reported on analysis to carry 50% of metallic iron, has recently been found in these workings.

The Macgregor pit is working along much in the usual style.

At the Drummond colliery three levels in the lower lift are now being driven; these are down 4,000 feet, and the quality of the coal is undoubtedly improving at depth. The new engines are not quite ready yet for work.

The Acadia is working away as usual, never in a rush, but always giving a good account of itself. New hoisting-engine working very satisfactorily.

Cumberland County.

The Chignecto colliery is idle.

The Springhill collieries are in full blast, yielding their usual large outputs.

The coal at the Lawson mine is improving to the dip.

Patrick & Minudie mines, idle.

Work at the Joggins continues steady. Mr. Baird has overcome many difficulties, and is making longwall working a great success, materially increasing the production at a reduction in cost, while the men are making better wages all round than formerly.

Operations at the mines of the New Glasgow Coal, Iron and Railway Co., have not been carried on so briskly as during the summer of 1890, the attention of the company being devoted to the construction of the railway, 10 miles in length, and the blast furnaces at Eureka, both of which are now under active construction. The furnace will produce 100 tons of pig iron a day. An improved pattern of coke ovens is being constructed, capable of producing the coke required at the furnaces. Mining operations have never been entirely suspended, two gangs of men having been kept on development work at Bridgeville and Black Rock, and the ore still continues to stand the test of development. An issue of 8% preference stock has been made, almost all of which is subscribed for, and is considered an excellent investment.

The Board of Examiners met in Stellarton on June 10 to adjudicate on the papers of the several candidates who had appeared before the several divisions of the Board. There were twenty one candidates in all, seven from Cumberland, six Pictou, and seven Cape Breton. Of the number two only were successful in capturing Underground Managers' certificates, viz: Frank W. Crawford and Joseph Quigley of Westville; and one an Overman's certificate, viz: A. D. Ferguson of Spring Hill. The papers were very difficult, which perhaps, accounts for so large a number having failed.

Halifax County.

The next monthly meeting of the Gold Miners' Association will be held at Waverley on Saturday, 4th prox. at 10 a.m. Teams will meet the morning trains from Halifax and Truro at Windsor Junction. Trains will also leave Dartmouth at 9 a.m. for the accommodation of members wishing to drive to Waverley. Each member may bring one guest. Lunch will be provided. From the Review's personal acquaintance with the hospitality of the good folks in this district it can safely predict a good time for all the members of the Association who can take in this meeting.

Quebec.

Eastern Townships.

The Scottish Canadian Asbestos Company have some 45 men working on their Black Lake properties, and the results so far are reported most satisfactory.

Mr. T. A. Poston, Provincial Revenue Inspector, has been through this district lately and has declared himself perfectly satisfied that the powder magazines at the various mines conform to the requirements of the law. We are curious to know if his report is meant to cover that standing menace to the safety of the community, the magazine of the Bell's Company at Thetford village?

Dr. James Reed, Reedsdale, is reported to have sold his properties in Range A, Coleraine, to a strong French syndicate represented by Mr. O. Ladureau, who is now in the district.

The recent destructive fire at Black Lake demolished the store-shed at the railway owned by the American Asbestos Company; some 150 tons of the mineral in the building at the time was considerably damaged.

Messrs. King Bros. have put in a crushing and fibreizing plant at their mines.

Advices from the Jeffrey Asbestos Mines at Richmond, under date of 22nd June, report an output during the past three days of twenty tons of excellent grade; this is all the more creditable when it is considered that the whole work has been done here with but the crudest machinery. The output of all grades for 1890 was in the neighborhood of 800 tons. Mr. Jeffrey has decided to put in two new steam hoists (Copeland & Bacon), pneumatic drills, and other suitable plant.

Lievres River.

The Anglo-Continental Guano Works Company has its new steam scow the "Squaw" in full running order. A new saw-mill is also being built on the river bank. Work at the mines goes on steadily and a fair output is maintained almost entirely from the "Ætna" which is reported to be doing very well at depth. The Appeal in the injunction suit with the Emerald will be heard in Montreal in September.

The Dominion Phosphate Company of London shut down their mine at the Rapids at the end of May. The production was not up to expectations.

The Spruce Lake Mine is being worked steadily with a force of eight men, and is turning out a fair proportion of high grade ore.

Mr. Hayes of Gatineau Point, is continuing the development of the new mining lots lately opened at Notre Dame de Salet. About 30 tons of phosphate have been hauled to the river bank.

At the North Star Mine, the Dominion Company recently overhauled their steam plant, and put it into repair. They have started up again, and Capt. Williams reports that they have come into fresh paying ground.

Mr. Reid, Superintendent at the Ross Mountain Mine, has been obliged to shut down the steam pits on top of the hill for want of water for the boilers owing to the dry season. This has been compensated for by good results on the new openings on the east or river side. Fifty-three men are steadily employed.

Work at the General Phosphate Corporation's property High Falls is chiefly confined to three steam pits on the southeast flank of the High Falls Hill. A force of 75 men is employed, and the output, although not so plentiful as could be desired, is of very high test. In consequence of the delay in the determination of the improvement of navigation in the Long Rapids, the production of this mine can only be run through these rapids at the time of high floods, and, in the present state of the river, must await the spring of '92 for shipment.

The contract work for the locks at the Little Rapids is being pushed on energetically, the masonry work being handled with skill and economy. The low water in the Lievres is again making the necessity of these locks to be fel The ascent of scows has been much hampered by the breaking down of the steam boiler of the winding winch, and the burning of the steamer "Eva" has been another source of irregularity in the river transport.

Mr. Jacob Weart, President of the Graphite Lubricating Company, Jersey City, N.J., has equipped his plumbago property in this district with a first class plant, including Krom rolls, concentrators and jigs.

Mr. Walter W. Pickford, who has been manager of the Phosphate of Lime Company's mines at High Rock, has resigned, having left for Florida during the end of last month. He has been succeeded by Mr. A. P. Twidell, who, by the way, THE REVIEW heartily congratulates on his recent marriage. At present 170 men are employed, and the production from the various pits, particularly No. 11, No. 19 and Cap Rock, is very satisfactory. About 1200 tons have been shipped since opening of navigation. A rumor is current that the General Phosphate Corporation has the purchase of these mines under consideration.

Very little work is being done on the Union property owned by the Canadian Phosph... Company; present developments are chiefly confined to the Crown Hill pits.

Superintendent Gilchrist is to be congratulated upon the very efficient and creditable plant in operation at Central Lake. 1000 tons were hauled from the mine during the winter.

Templeton District.

The Murphy property of the General Phosphate Corporation has shown a falling off in the original Bonanza pit, but new openings commenced at the north-east end of the property are turning out phosphate and promise well. Mr. Hector McRae has this year undertaken a contract to put down a number of test holes with the diamond drill, the results of which will furnish valuable information as to the future value of this property. Forty-three men are now employed.

The old Post mine in the east half of lot 9, 10th Range, is being worked by Mr. C. B. Falardeau, with a force of about 25 men. Present operations are chiefly confined to a long cutting called No. 19. It is operated by a steam plant and is now showing rich and abundant ground.

On the Jackson Rae mines on the west half of lot 9, operated by Mr. Thos. Fee, the pit at the old cobbing house has been suspended on account of water. Work is confined to the old pit in the north-west corner of the property. About 8 men are at work with a steam plant.

The Blackburn mine continues to lead in the regularity of its outputs. Mr. Lomer is confident that not less than 700 tons will be taken out this month with a force of 110 men.

Ontario.

Kingston District.

The Foxton mine is producing about 150 tons per month with a force of 30 to 40 men employed. 1,000 tons have been already shipped this year from the property.

The Kingston Mining Co.'s output averages from 100 to 150 tons. 400 tons taken out this year to date.

Capt. Boyd Smith has some 2,500 tons of phosphate ready for shipment from his Blessington mines.

Perth District.

The Anglo Canadian Phosphate Co. has resumed, and is enlarging, its operations at Otty Lake since the return of Capt. Adams from England. 30 men are now working. Several of the pits at last reports were looking very well and yielding satisfactorily.

The Bob's Lake mines, owned by this company, are being worked under contract. Latest advices report the discovery of some promising new 'shows.'

British Columbia.

Following are the foreign coal shipments of the different collieries for the month of May:—

	Tons.
New Vancouver Coal Co.....	35,452
Wellington collieries....	15,952
East Wellington collieries.....	975

The Glen Iron Mining Co. have ordered an aerial wire rope tramway for their mine at Cherry Creek. When the machinery is in position, it will take out from two to three hundred tons of ore per day, from the works to the spur of the railroad—a fall of about 400 feet.

The Building for the Whitewater Mining Company's mill has been completed and is pronounced a first-class structure of the kind. The machinery for the mill was placed on the cars at Nelson and run down to the Whitewater company's platform, opposite Ward's crossing. It will be packed thence to the mill-site by Wilson and Perdue's train. The mine is said to be looking well, and Mr. Goepel of Victoria, who is an owner in the property, says he hopes to see the Whitewater sending out gold bullion within 60 days. The company have put in a platform and chute opposite Ward's hotel and have acquired that property along with the ferry from the Wards.

Mining is being vigorously prosecuted on the Bonanza, and on Marshall & William's ledge. Hydraulic operations are progressing on the Vancouver Enterprise and the Lillooet Hydraulic, both of which are doing well.

Work has been commenced on waggon roads in both Toad Mountain and Hot Springs districts. The road in the latter district is under the superintendence of A. M. Wilson. It commences at the United mine and will run to the Number One, thence toward the Skyline. This route gives general satisfaction. In Toad Mountain District, work was resumed where it was left off last fall. Winslow Hall is superintendent, with "Bob" Yuill and "Dan" Dunn as foremen. Over sixty men are already employed, and the number will be increased from time to time. Cutting the right-of-way has reached a point about 4 miles from Nelson.

Indications seem to point to the Kootenai District as about to enter upon a new and greater era of development. The extensive prospecting now being carried on, will undoubtedly result in the discovery of deposits of ore not now known, and that there are large quantities of minerals in the Kootenai district is certain. Whether many of the leads now being worked are true fissure veins is doubtful, but that some are and others will be discovered is beyond question. It only needs one or two mines upon well defined veins of a certain thickness the mineral in which will pay a fair profit on the working cost, to start a movement which will surprise those who have no knowledge of the history of the great mining camps on this continent. It only required the Stevens and Iron mines in California gulch to start the rush to Leadville in 1878, and if current reports are true, there are some lodes already discovered in Kootenai which surpass in magnitude even that in the Robert E. Lee mine at Leadville.

The Gordon Hydraulic Mining Company, the incorporation of which is noted in our Companies column, has been organized to work some valuable placer diggings in the Leach River district. Mr. James Bennett of Port Angeles who was the chief promoter, is chairman, and Mr. J. B. Jones vice-chairman, Messrs. Garesche Green & Co., being the bankers and treasurers of the company. The company has a grant of 480 acres on the Leach River, about 35 miles from Victoria. It is all very rich placer, and shows from 10 to 20 colors to the pan, while at the bed rock the ore shows plenty of coarse heavy gold. The Beacon Bar Hill claim is included in the property. Mr. Roper, one of the directors, has been mining there since 1884, and is satisfied that the diggings are very rich, and only require capital to make them pay heavy returns. It was through his experience and judgment that the necessary capital was advanced to develop the claims.

An electric plant will, it is understood, be installed shortly in the mines of the New Vancouver Coal Co. It will be a combination electric light, power and drill generator, with a capacity for coal cutters and electric percussion drills. The Edison General Electric Co. have also contracted to put down an electric tramway plant to be operated in No. 1 mine on levels 1 and 3. It is intended to replace the mules at present in use and consists of two 30 H.P. and one 15 H.P. Electric Locomotives. These motors will obtain their power from an 80 H.P. Edison generator. When complete there will be three miles of electrically equipped track in the mine. The steam power will be supplied by a 130 H.P. Leonard Ball high pressure engine. The whole plant is to be in operation within seventy days from the signing of the contract, and will cost about $25,000. This will be the first electrical tramway in the Province.

The Union Colliery Company of Comox have equipped their mines with a complete electric mining plant, purchased from the Jeffrey Manufacturing Co. of Columbus, O., consisting of one automatic engine, one dynamo with electrical instruments, copper wire, and four electric coal-mining machines. The plant has been installed and is now in operation, and is reported as working very well.

Steel Supports in Mines.—Mr. H. W. Hughes, in the *Journal of the British Society of Mining Students*, gives his experience with the use of steel supports in mines. For bars up to 7 feet in length a section measuring 5 by 4 by ½ inches, weighing 66 lbs. per yard is used. They cost 9s. 3¼d. each, and replaced oak bars measuring 6½ inches quarter girth and costing 2s. 8d. Before dennite results were obtained, the mine fired. After a lapse of nine months the mine was reopened, and it was found that the steel bars had scarcely suffered, while the timbers were much broken. Twelve foot bars weighing 78 lbs. per yard, and costing £1 0s. 11½d. each, are also used to replace timber 9 inches quarter girth and costing 9s. In many cases the steel bars outlasted three to four sets of timber. In one place these bars lasted thirteen weeks, whilst oak bars never lasted more than a fortnight. Where there is a heavy weight, or in return air-ways, steel bars have great advantages. They should be set carefully with an equal level bearing on both props and roof. When they take a permanent set, they should be turned over or straightened. With these precautions the author has not had a breakage.

CANADIAN COMPANIES.

The Alberta and British Columbia Exploration Company (Ltd.)—This company has been incorporated under the British Columbia Act (Registration of foreign companies) to develop the resources of any lands by planting, clearing or mining, to subscribe out of the funds of the company towards any purpose likely to improve or benefit such properties, together with other powers for attaining similar purposes, such as the procuring of foreign capital to develop mines, &c. Head office, 21 Bastion street, Victoria. Capital stock £20,000, in 200 shares of £100 each.

The Sudbury Nickel Company (Ltd.)—This company has been incorporated under Ontario laws to carry on the business of exploring for, mining, refining, and selling nickel, lead, silver, gold, copper, and other ores and metals; and with other powers. Head office, Toronto. Capital stock, $50,000 in 1,000 shares of $50. Those incorporated are J. Wright, G. S. Crawford, W. M. Richards, A. B. Cameron, W. L. McK. Lindsey, all of Toronto.

The Nickel-Steel Company of Ontario.—This company is applying for incorporation under Ontario laws for the purpose of exploring for, mining, treating smelting, amalgamating and manufacturing copper, gold, iron, nickel, lead, silver and other ores, minerals, &c.; to acquire, construct and operate crushing mills, blast furnaces, amalgamating and reduction works and other plant; to sink artesian wells, and produce petroleum, salt and natural gas; to deal in lumber, develop electric or other power, and to carry on a general forwarding business. Operations to be carried on in the Districts of Algoma and Manitoulin and elsewhere in Ontario. Head office, Toronto. Capital stock $1,000,000 in 2,000 shares of $500 each. Applicants, R. L. Gibson, W. J. Fenton, A. Baillie, S. M. Flynn, M. G. Cameron, F. A. Fenton, Toronto, and Jacob Reese, Philadelphia, all of whom are to be the first directors. Solicitors, Ross, Cameron and McAndrew.

New Vancouver Coal Mining and Land Company (Ltd.)—At the general meeting of the New Vancouver Coal Mining and Land Company (Limited) held on Tuesday, May 26, at the Company's offices, 12, Old Jewry Chambers, E.C., the report and accounts for the year ended 31st December, 1890, were approved and adopted, and a dividend at the rate of 6 per cent. per annum was declared, payable 10th June.

The Gordon Hydraulic Mining Company.—This company has been organized under the British Columbia Act to work certain placer diggings in the Leach River district. The capital stock of the company is $50,000, divided into 50,000 shares of the value of $1 each. The directors for the first year are James Bennett, of Port Angeles, president, and Fred. S. Roper, John Boyd Jones, William Gordon Stevenson and John R. Stewart, of Victoria.

The Stadacona Silver-Copper Mining Company (Ltd.)—Application for incorporation under British Columbia laws, will be made by the above company, to take over an agreement made between the applicants and certain other parties for the purchase of the "Grizzly Bear Mining Claim," on Toad Mountain, Kootenai Division; also to carry on the business of smelters, refiners, founders, assayers, etc., to carry on the business of miners, and mine and work ores and minerals, etc., and crush, wash smelt and amalgamate their own or other ores; to do a general commercial business except banking and insurance, together with all other powers. Head office, Victoria, B.C. Capital stock, $100,000 in 100,000 shares of $1 each. Applicants, J. E. Ross, Spokane, Wash., P. C. Dunlevy, T. F. Sinclair, W. H. Ellis, T. S. Milligan, C. T. Dupont, J. Grant, J. Irving and S. O'Brien, all of Victoria. The first trustees are, P. C. Dunlevy, C. T. Dupont, J. Grant, J. Irving and C. D. Rand.

Intercolonial Coal Mining Company.—At a meeting of the Board of the Intercolonial Coal Mining Company, held on the 24th inst., Mr. J. P. Cleghorn was elected president and Mr. R. B. Angus a director of the company.

Toronto Mining Association (Ltd.)—This association, the incorporation of which we noticed some time ago, has been organized for the purpose of establishing in Toronto a centre of information on all matters pertaining to mining, from prospecting onwards, and a place where specimens may be received and examined, and such work done in connection therewith as may be required by prospectors. It is intended to collect in the rooms of the Association specimens of all merchantable Canadian minerals, with full particulars as to the place of deposit and as full additional information from a mercantile as well as a scientific point of view as can be had. The Association will also act as an agent in bringing forward schemes requiring capital, after necessary investigation by mining engineers and analysts. The capital is $3,000, in 300 shares of $10 each, and the membership fee has been placed at $4 for shareholders and $5 for non-shareholders. The secretary of the association is Mr. J. S. Lockie, 50 Yonge street, Toronto.

General Phosphate Corporation (Ltd.)—Subscription lists were opened in London on Tuesday, 9th June, for an issue of £100,000 in six per cent. debentures of £100 each, to be paid off at par on 1st June, 1896. It will be remembered that this Corporation was Registered just a year ago with the object of acquiring and developing phosphate lands in Canada and elsewhere. Of the authorised capital of one million pounds sterling some 16,598 shares or £195,980 sterling were allotted, but it appears that but a small portion only, £39,196 or £2 per share has been called up to date. The High Falls and Ross Mountain properties, situated on the Lievres River, in the County of Ottawa, Province of Quebec, were acquired at a cost of £95,000, and a contract entered into with one of the vendors, Mr. George Stewart, of Ottawa, by which he guaranteed an output of 10,000 tons of high grade mineral (*i.e.* from 70 to 80%) before 1st May, 1892, the cost of mining and transport to wharf in Montreal being limited to $9.00 per ton. At the hour of going to press we have not learned whether the debentures have been taken up by the public.

Eastern Development Company (Ltd).—At a meeting of the Privy Council on May 8 last, the privilege of crossing the Cape Breton Railway was conceded to this company, to enable them to carry the ores from the Coxheath copper mines to tidewater on the north-east arm of Sydney Harbour; the manner of crossing to be left with the Chief Engineer of Railways, Mr. Schreiber. Last week General Manager Gragg, with counsel, had a hearing before the Chief Engineer. The Government had an underneath crossing plan prepared, and the company one of a grade crossing, and after some discussion the latter was adopted, thus saving the company some $10,000. The Company's plan for extensive smelting works on Sydney Harbor adjacent to the abundant supply of coal there, is regarded as of importance to that section of the country, and is likely to receive governmental aid in some form or another.

The New Glasgow Iron, Coal and Railway Co. (Ltd.)—An issue of 5,000 8 per cent. preference shares of this company, cumulative after July 1, 1892, is now being offered to the public. The capital thus raised is to be devoted to the completion of a blast furnace and of a railway 12½ miles long to connect the iron and lime deposits of the East River with the Intercolonial Railway at the furnace site. The blast furnace will, it is estimated, produce about 20,000 tons of pig iron per year, at a cost of $10 per ton, and which can be sold at $17 per ton, thus making a profit of $140,000. Besides this, there is a bounty of $2 per ton of 2,000 lbs. on pig iron, which would add over $44,000 to the profits of the company. The shares are being offered at $55, or a discount of 45 per cent. Over 4,000 have already been subscribed for and allotted. The contract for the railway has been let to Messrs. McIntosh & McGregor, two good local men, who are pushing it, and are to have it ready for the rails before December 31. The construction of the furnace is also being advanced as rapidly as possible; the plates for the shell are now on their way out from Glasgow, and the company expect to be making pig iron before March 31, 1892. The ore deposits are being further developed, and continue to give great satisfaction. Mr. H. Graham, New Glasgow, N.S., is the secretary of the company.

Latest Stock Quotations of Canadian Companies in England.

	Price.	
Excelsior Copper, Limited, £410,738 fully-paid shares of £1	—	
Nicola, Limited, £35,000 fully-paid shares of £1	—	
Shuniah Weachu, Limited, £99,888 fully-paid shares of £1	—	
Silver Wolverine, Limited, £68,465 fully-paid shares of £1	—	
Tilt Cove Copper, Limited, £160,000 fully-paid shares of £2	—	
Ditto, £80,000 5½ per cent. debentures	—	
General Mining, Limited, £219,752 fully-paid shares of £8	3¼	3¾
Low Point, Barrasois and Lingan, £509,100 fully-paid shares of £100	—	
New Vancouver Coal Mining and Land, Limited, £185,000 fully-paid shares of £1	¾	1
North-Western Coal and Navigation, Limited, £160,500 6 per cent. debenture coupons, June 30 and December 31; principal 1904	—	
Ditto, £149,500 fully-paid ordinary shares of £10	—	
Ditto, £900 fully-paid deferred shares of £100	—	
Sydney and Louisburg Coal and Railway, Limited, £50,000 cumulative 10 per cent. first preference shares of £10, £6 paid	7½	8½
Ditto, £14,560 fully-paid non-cumulative 6 per cent. second preference of £10	3	5
Ditto, £250,000 fully-paid ordinary shares of £10	¼	¾
Anglo-Canadian Asbestos, Limited, £11,500 fully-paid shares of £1	—	
Anglo-Canadian Phosphate, Limited, £46,510 fully-paid preference shares of £10	—	
Ditto, £25,000 fully-paid deferred shares of £10	—	
White's Asbestos, Limited, £20,000 fully-paid shares of £1	—	
Ditto, £15,000 shares of £1, with 15s. paid	—	
Bell's Asbestos, Limited. £140,000 fully-paid shares of £5	9½	9¾
Ditto, £68,400 debentures, 5 per cent.; interest January 1 and July 1	—	
Canadian Phosphate, Limited, £100,000 fully-paid shares of £1	¼	½
General Phosphate, Limited, 5 per cent. ordinary shares of £10, £2 paid	—	
Ditto, £5,000 fully-paid founders' shares of £10	—	
Western of Canada Oil, Limited, £200,000 fully-paid shares of £100	—	
Ditto, £99,850 fully-paid shares of £50	—	
Western of Canada Oil, Limited, £199,700 12 per cent. debentures of £100	—	

Excelsior Copper.—Registered September 26, 1888. Accounts to December 31 submitted in April. No dividend yet. Liquidation and reconstruction have been decided upon.

Nicola.—Accounts to December 30 submitted in November. No dividend yet.

Shuniah Weachu.—Accounts to November 20 submitted in February. No dividend yet. Shares for £12,870 held by the Company.

Silver Wolverine.—Registered October 19, 1888. No report of meeting received yet.

Tilt Cove.—In March, 1890, the properties were leased for 99 years to the Cape Copper Company, Limited, at a rent of £4,400. The Cape Copper Company advance £15,000 at 5 per cent. interest, and when this is repaid out of profits; surplus profits are to be divided equally between the Cape Copper Company and the Tilt Cove Company. The lease may be determined by the Cape Copper Company at any time on twelve months' notice. Accounts annually to March 31 submitted in November.

General Mining.—Accounts to December 31 submitted in April, but an interim meeting is held in November. Dividend for 1884, 5 per cent.; for 1885 and 1886, 3⅛ each year; for 1887, £4 13s. 9d. per cent., and for 1888 and 1889, 3¾. Reserve fund, £29,850.

Low Point.—Accounts to December 31. For 1887, 1888, and 1889, 5 per cent was paid each year on the ordinary shares publicly held; for 1888 the ordinary shares issued to the vendors got 3½ per cent., and for 1889, 2½.

New Vancouver Coal.—Reconstructed in 1889. Accounts to June 30 and December 31 submitted in November and May. For the two half-years to June, 1889, 5 per cent. per annum was paid, and for the two half-years to June, 1890, 4. Debentures, £60,000.

North-Western Coal.—The deferred shares receive no dividend until 15 per cent. per annum (cumulative) has been paid on the ordinary. Accounts to June 30. Dividend for 1887-8 and 1888-9, 5 per cent. per annum.

Sydney and Louisburg Coal.—Accounts to December 31 submitted about May. In respect of 1889 15 per cent. was paid on the first preference, leaving arrears of 50 per cent.

Anglo-Canadian Asbestos.—Reconstructed in 1889. At general meeting held on 16th April, a dividend at the rate of 20% per annum was declared.

Anglo-Canadian Phosphate.—The preference shares rank first for 7 per cent., and after a like rate has been paid on the deferred shares, both classes rank equally. Accounts to November 30, submitted in May. No dividend yet on either class. Debit to profit and loss on November 30, 1889, £4,784. One of the mines has recently been sold and another leased.

Bell's Asbestos.—Accounts to December 31 submitted in January. Dividends for 1888 and 1889, 22½ per cent. each year. Reserve, £5,000. The debentures are redeemable by 1913, by annual drawings at 115 from a sinking fund, which the directors may increase.

Canadian Phosphate.—Accounts to November 30 submitted in February. Eleven months to November 30, 1888, resulted in a profit of £2,576. which was carried forward. A dividend of 6d. per share is to be paid November 1, 1891.

White's Asbestos.—Registered April 9, 1889. Accounts submitted on December 31. Liquidation has been decided on.

An Assay Furnace.*

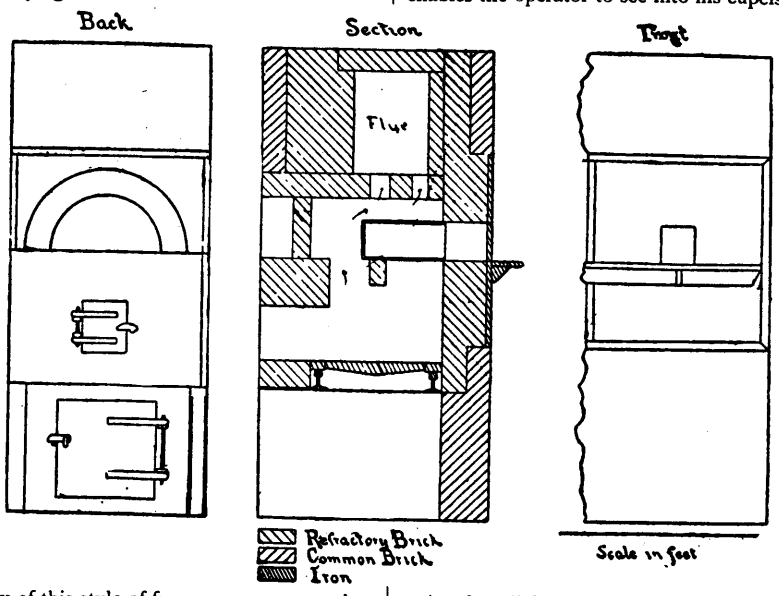
By Herbert Wood, M.A., Fellow Toronto University.

The accompanying diagram represents a muffle furnace as used in the Pueblo Smelting and Refining Company, Colorado. This furnace is one of a group of three which stand side by side, and the flue here given is the one used by the three furnaces. A flue measuring 6 inches by 8 inches is, however, quite large enough for one furnace. The approximate cost of such a furnace is about $100:

400 fire-brick	$20
400 red brick	5
200 lbs. fire-clay	8
Mason, five days, $5 per day	25
Castings	20
Extras, mortar and carpenter	10
	$88

For transportation, etc., will require about $10.

Such a furnace is hardly suitable for a mine unless it is well equipped in its various departments, and has a large amount of fire assaying to do.



The superiority of this style of furnace over every other consists in:—

Its economy of fuel (I have made cupellations on 16 lbs. of soft coal); its cleanliness, being far less filthy than the Kerl furnace, which is fed in front.

Its rapid heating and excellent draughts.

Its large muffles.

I have worked with the Kerl furnace, the double muffle and the Battersea and I consider this the best.

A furnace which is fed behind is always to be preferred to one fed in front, since the heat and dust of the latter is not recompensed by any gain in time—if indeed there be any gain in time. If the grate be properly cleaned or barred out with a long iron bar, and sufficient coal put in, the quantity being easily determined by practice, it need not be touched again during the assay. The increase of temperature required at the end of an assay for brightening a bead, removing the last traces of lead, or perfect liquidation in scorification, can be got by stirring the coal a little and closing the furnace door. The draught is excellent, and the position of the flues, as will be seen, causes the flame to circulate entirely around the muffle. There is one disadvantage, and that is the danger in feeding of breaking the cross-bar, *i.e.*, the supporting fire-brick under the muffle; this may be remedied, however, by constructing knees or projections from the wall which serve as a rest. With care a muffle in constant use should last a month, and then a new bottom may be inserted from an old muffle. When the muffle finally becomes unfit for use the bricks in the arch are carefully shoved in without damaging them, so that they may be used again, and the new muffle thrust into position. The arch is again walled up with fire-brick and fire-clay mortar. A little fire-clay mortar at the front where the muffle touches the door, is often necessary. The furnace should now be allowed to stand a short time till the mortar is nearly dry. The muffle should be placed with a slight slope from the back to the door. This admits of a free circulation of air, and enables the operator to see into his cupels.

Another slight objection which I found in working with this furnace was the distance of the muffle door from the floor. It will be seen by the diagram that it is four feet. For my own use and for others of medium height, six inches less would make it more convenient.

The size of the muffles used is:—

Small size, 9 inches by 15 inches.
Large size, 13 inches by 15 inches.

I have made thirty cupellations at once in the large size and got crystals on all. Twenty crucible assays may be made without difficulty at one time.

The most refractory ores may be made easily by crucible process. About thirty to forty minutes is required for a crucible assay in this furnace. I worked some eight months with this furnace and met with no such satisfaction in any other that I ever used.

* School of Mines Quarterly.

SUPPLEMENT

TO THE

CANADIAN MINING AND MECHANICAL REVIEW

JUNE 1891.

HON. GEO. IRVINE, Q C., Quebec, President.
Johnson's Asbestos Co.

B. T. A. BELL, Ottawa, Secretary.
Editor Canadian Mining and Mechanical Review.

A. W. STEVENSON, C.A., Montreal, Treasurer.

ROBT. N. HALL, Q.C., Sherbrooke, Vice-President.

CAPT. ROBERT C. ADAMS, Montreal, Vice-President.
Anglo-Canadian Phosphate Co.

(The portraits of Hon. G. A. Drummond and R. Profontaine, Q.C., M.P , Vice-Presidents, have been unavoidably omitted.)

OFFICERS OF THE GENERAL MINING ASSOCIATION OF THE PROVINCE OF QUEBEC.

SUPPLEMENT

TO THE

CANADIAN MINING AND MECHANICAL REVIEW

JUNE 1891.

F. J. FALDING, M.E., Sherbrooke
Moulton Hill and Howard Copper Mines.

L. A. KLEIN, Black Lake,
American Asbestos Co.

A. LOMER, Montreal.
McLaurin Phosphate, and other Syndicates.

S. P. FRANCHOT, Buckingham,
Emerald Mining Co.

O. M. HARRIS, Montreal,
Canadian Phosphate Co.

W. H. IRWIN, Montreal.
Anglo-Canadian Asbestos Co.

LT.-COL. LUCKE, Sherbrooke,
Beaver Asbestos Co.

(The portraits of Mr. James King, Quebec and Mr. J. B Smith, Glenalmond, are unavoidably omitted.)

COUNCIL OF THE GENERAL MINING ASSOCIATION OF THE PROVINCE OF QUEBEC.

MACHINERY MECHANICS & INVENTIONS

Electric Power Transmissions in Mining Operation

(Continued from page 105.)

THE ELECTRIC MAGNETIC RECIPROCATING ENGINE.

By CHARLES J. VA DEPOELE.

One of the recent developments in the electric line is the perfection of a new electric-magnetic reciprocating engine.

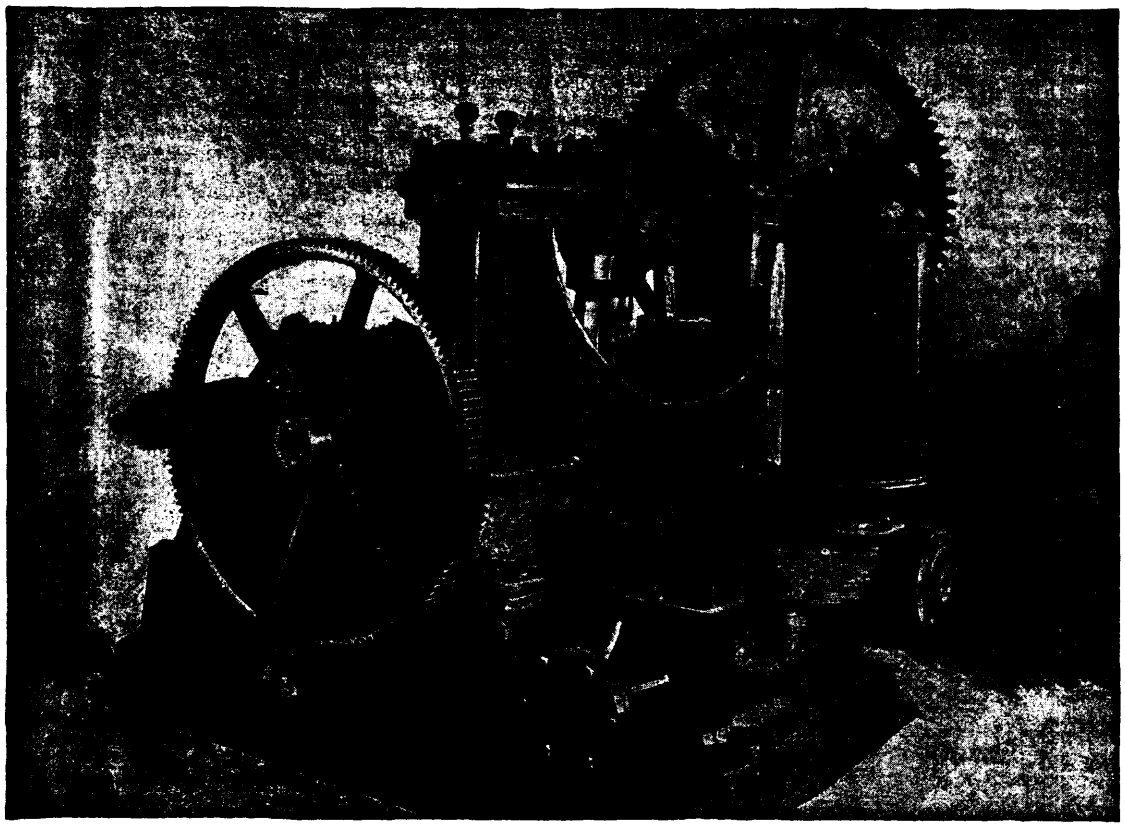


FIG. 12.—GOULD ELECTRIC PUMP.

For years past, and, indeed, ever since electricity was first used to magnetize an iron bar by means of a coil of wire, the idea of producing a reciprocating motion by the electric current has been entertained, and many unsuccessful attempts have been made to construct and operate such machines.

It is a well-known fact that when a current is made to flow through a coil of copper wire, or what may be termed a solenoid, a bar of iron placed near the ends of such a coil will be sucked into the solenoid, and the moment the current is broken the plunger or iron bar will be dropped by its own weight, or may be expelled by means of springs if the machine is in any other position than vertical. This principle, however beautiful, could never be successfully applied in the construction of heavy machinery on account of the make and break of the circuit, which has to take place in order to produce the pulsations of the current which causes the pulling and letting go of the plunger.

Not until the invention and construction by the writer of an electric generator which would give currents rising and falling at a definite speed, could the current be sent to the coils of a reciprocating engine, there alternately attracting and repelling its plunger. In this apparatus, however, as will be seen later on, the rising and falling of the current is produced in such a way that it is absolutely certain that no spark is produced either in the machine or in the generator producing the current. The current is caused to rise and fall in closed circuits, and actuates the plunger of the reciprocating-engine with a speed corresponding absolutely to the speed of the defined rise and fall of currents produced by the generator. Thus, the generator can be caused to produce, say 400 pulsations of current a minute, or it can be made to produce either a higher or lower number than this, so that the engine's speed can be regulated according to the size of its piston and the work it has to do.

The engine itself is a simple piece of machinery, consisting of two or more coils of copper wire, or solenoids, incased in an iron envelope protecting them from outside injury. Within these coils is placed a brass tube, and within this an iron plunger, capable of moving to and fro under the action of the currents in the coils. To the end of this iron plunger is attached a piston-rod, similar to that of an ordinary engine, and to this is attached the hammer, drill or whatever tool is to be operated by the engine.

A very simple means of connecting the reciprocating-engine to the current, is applied to the machine, so that it can be stopped and started instantly. The cables leading from the generating-station to where the current is to be used, are perfectly insulated in the usual manner, and switch-boxes are disposed along the main cables. From these, flexible cables are led to the reciprocating-machine, so that it can be moved, if necessary, from one place to another, without any trouble whatever. The cable is incased in a rubber tube to protect it from injury and to prevent loss of current by contact with the ground.

It will readily be seen that one of the first applications of these machines will be to rock-drills, such as are now in use in nearly all mining and rock-work, for quarrying, prospecting, etc. The simplicity of the machine lends itself most readily to this application, as it will be seen that there are no movable parts on the whole machine, except the plunger and piston-rod carrying the tool. There are no valves, as in steam-engines, no switches, no make and break of the circuit, and no exposed current-carrying parts, so that the whole can be handled with safety and without any skill above that of common laborers. By turning on the switch the machine is started; by turning off the current, it is stopped. There is absolutely nothing to be done to the machine, except occasionally to pour in a few drops of oil, to lubricate the piston and its rod.

For ordinary mining-work the drill is mounted on a tripod similar to that now in use with the steam and air-drills which are well known to-day, or it can be attached to horizontal bars or to vertical columns; in in fact, it lends itself to absolutely the same work as has been done heretofore by the air and steam drills. It will work in any position, from horizontal to vertical. The weight of these drills will be approximately the same as that of the steam or air drills of the same capacity, and everything is so arranged that the men accustomed to work the latter machines will find no difficulty in operating the new electric drills.

The apparatus for generating currents to operate these drills or electro-magnetic engines, can be placed at any distance from where the drills are at work, and any number of drills can be worked from the same source, each drill working independently of the other, and whether one or more are in operation, the generator will regulate and furnish a current exactly proportional to the demand.

Where a long distance exists between the generator and the place where the current is to be distributed, a system of conversion is used; that is, the current is changed from a high to a low potential, so that the primary current, transmitting the power from the prime motor, can be of a high tension. Since this current could be guarded against possible contact, there would be no danger in using high voltage. At the point of application, the high potential is converted to a low potential of such pressure only as may be found desirable and practicable. Where the distance is, say, only 1 or 2 miles, it will not be neces-

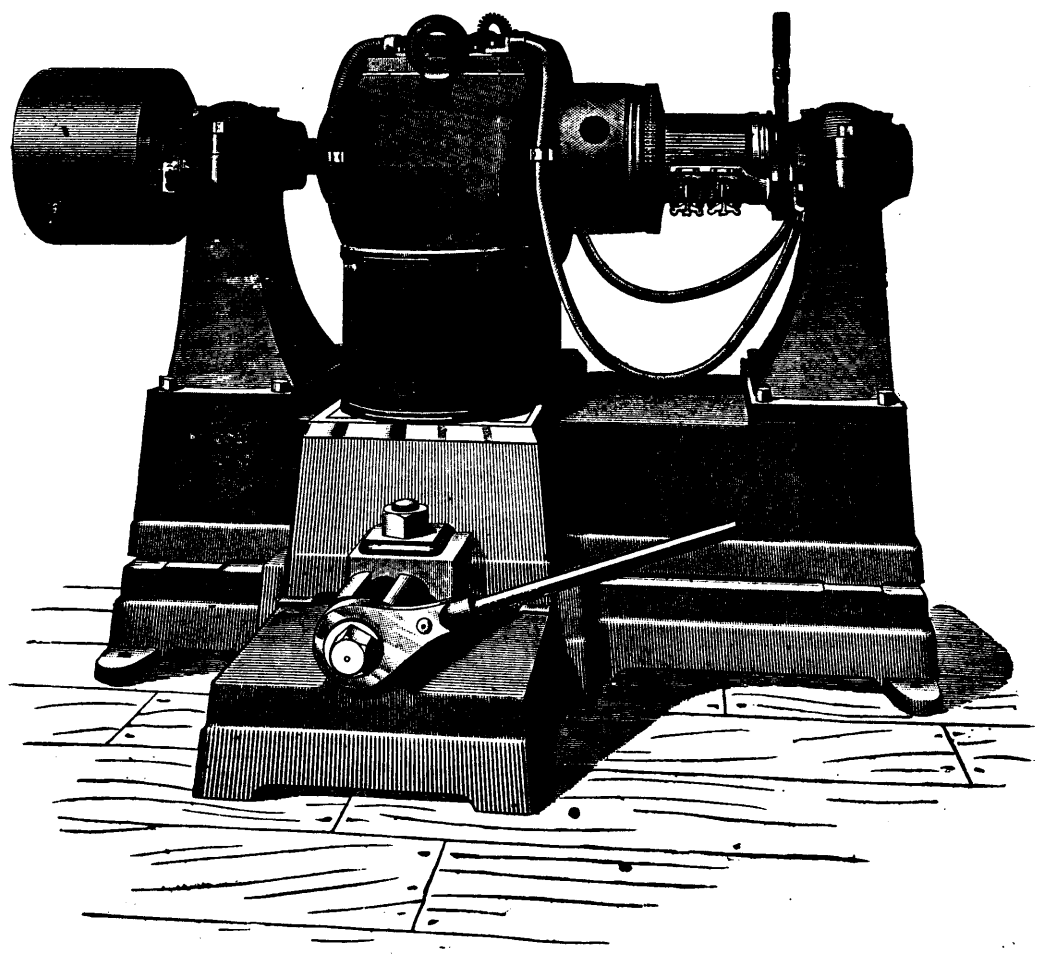


FIG. 13.—GENERATOR.

sary to use any system of conversion whatever, as a current of suitable potential can be run directly from the generator to the mines.

The main advantage, however, is the superior economy over the motors now in use where steam or air is to be conveyed to a distance of only a few hundred feet. There is an enormous loss in this transmission, and methods of steam or air-transmissions are certainly very limited in scope. There is, also, the trouble of leakage, making a system of piping much more costly in maintenance; but this is done away with when electricity is employed. All parts are so simple, that they will require little or no repair for very long terms; and such repairs as will have to be made, will always be much less expensive than in the case of steam or air-driven machines.

Plate II.

THE PRACTICAL APPLICATION OF ELECTRICITY TO COAL MINES.

By J. S. Doe.

It is now only about fourteen months since the Jeffrey electrical coal-mining machine made the first really practical test of electricity in the mining of coal on record in this country. This was carried out in April, 1889, in the mines of the Shawnee and Iron Point Coal and Iron Company, at Shawnee, Perry County, Ohio, in what is known as the Big Vein coal field of Hocking Valley. This company had previously been experimenting upon electrical haulage, and, to this end, had put in a power-plant consisting of a 40 horse-power generator, built by Foree Bain, of Chicago, Ill., with an exciter, both being belted direct to a Beck high-speed engine of 60 horse-power. The terminal potential of the generator is 260 volts, and that required by the mining machine motors is 220 volts; therefore, there is a loss of 40 volts in the line. In the course of the experiments at the Shawnee mines, the Jeffrey Manufacturing Company, which had been manufacturing for the past ten years a coal-mining machine run by compressed air, was called upon to assist the coal company in the installation of its plant, and, in connection with that work, made and put in for trial the first electrical mining-machine. The same machine, with only a few minor changes, has been in practical daily operation in the mines ever since; and during the same period the Jeffrey Manufacturing Company has installed or contracted for 23 electrical mining-machines, as follows:

The Thurmond Coal Company, Thurmond, W. Va., four machines, with two 80 horse-power generators, and two 85 horse-power high-speed engines.

The Sterling Mining Company, Cannelton, Pa., two machines, with one 80 horse-power generator, and one 85 horse-power engine.

The Monongah Coal and Coke Company, Camdenburg, W. Va., five machines with three generators and three engines. This company will add more machines as fast as territory is opened to permit their use.

The Consumers' Coal Mining Company, Spilman, W. Va., two machines, one 60 horse-power generator, and one engine.

The Ellsworth and Morris Coal Company, Jobs, Ohio, four machines, with two generators, and one 150 horse-power engine. This company has also given an order for another plant of four machines.

The Upson Coal Company, Shawnee, Ohio, is now putting in a plant to consist of two or more machines.

All the foregoing plants have sufficient additional power to run from one to four more machines when required. A number of other orders, calling for many machines, are under negotiation at this time, and several of the above companies have contracted for additional machines, after a practical trial of their first ones, thereby testifying to their satisfaction with the use of electricity in coal-mining. The distance from the power-house to the working places in the mines, varies in the above instances from 1,000 to upwards of 5,000 feet.

As already observed, the motors on the mining machines are wound for 220 volts, with a capacity of 15 horse power. This voltage has been found to be perfectly safe, there being no danger from any accidental contact with the wire. The amount of work done by each machine averages from 600 to 900 square feet of surface under-cut in 10 hours. It requires two men to handle the machine. The machines cut into the coal or fire-clay bottom, as may be desired, at the rate of about 1 to 1½ feet per minute; the standard machine under-cutting 5 or 6 feet deep, 39 or 42 inches wide and 4 inches high. After the cut is made, the cutter-bar is withdrawn by throwing a lever; the machine is then moved over the length of the cutter bar for another cut, and proceeds as before. Upon completion of the room, the machine is loaded upon a truck provided for the purpose, and moved into another room for more cutting; the first room being then drilled and the coal shot down for loading.

The same power, electricity, has been applied to the running of electric drills, manufactured by the Jeffrey Company. These drills penetrate the coal at the rate of two or more feet per minute. The mines are also, in some instances, lighted by incandescent electric lamps. Electricity is also applied to the running of pumps and fans in some of the above named coal mines, with perfectly satisfactory results. There can be no doubt that electricity in coal mines has become a permanent, practical success. We are, however, only in the infancy of its uses. There will be many and valuable improvements made as time progresses; but, with the light we have, it is evident that considerable advantages will accrue to those who first put in electrical coal-mining machinery.

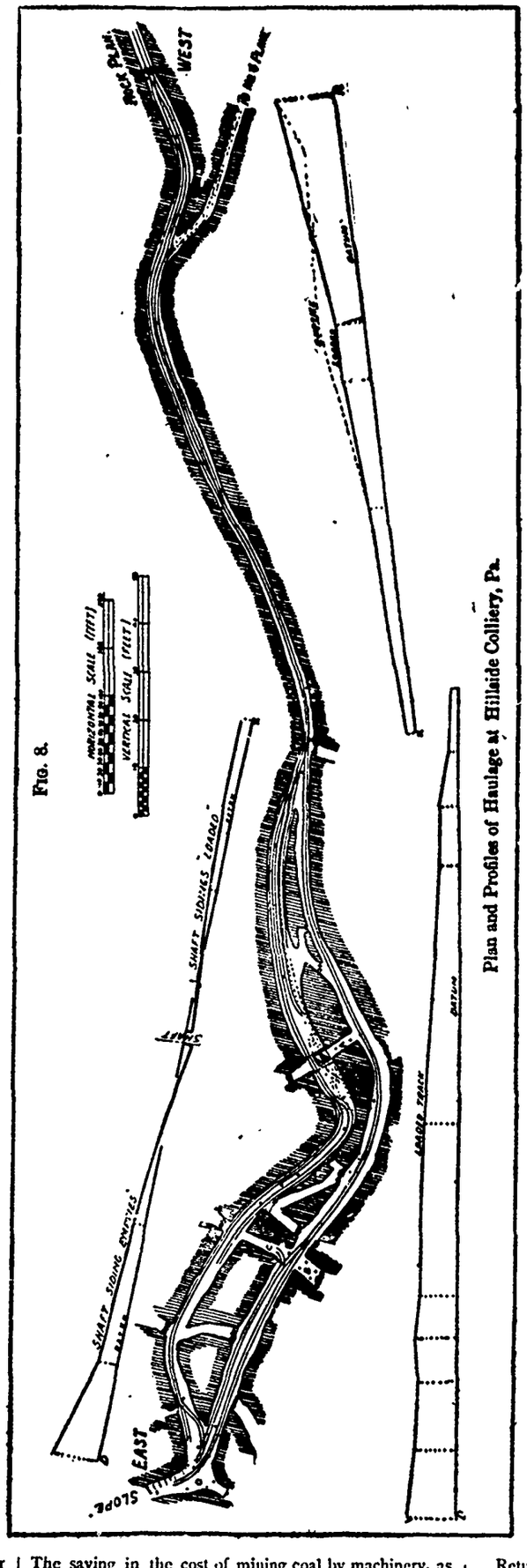


FIG. 8. Plan and Profiles of Haulage at Hillside Colliery, Pa.

The saving in the cost of mining coal by machinery, as compared with hand work, varies considerably in different localities and in different sized veins; but it may be roughly estimated to average about 20 to 25 per cent., with an additional saving of merchantable product, since machine-mined averages coarser than hand-mined coal.

A few words may be added on the use of electricity in the hauling of coal. It is unnecessary, at this late day, to call attention to electricity as a motive power in the transportation of heavy and quick-moving loads. Our many street railway lines give us daily an hourly demonstration of that. The Jeffrey Manufacturing Company is building and has in practical operation electric mine motor cars of 20 horse power capacity, each weighing 5 tons; the same type of motor, with the same voltage, being used as on the mining machines. The frame of the motor car is made of cast iron, with heavy cast iron draw bars, and pilots to clear the track of any obstruction, such as coal, etc. The wheels, 20 inches in diameter have steel tires with steel axles, power being transmitted from the motor to the axles through straight pinions and gears. The speed of the motor car is 8 miles per hour. The electrical power is transmitted to the motor by means of a 4-wheeled trolley running on a double all-metal line, placed along the side of the entry, there being no rail or ground return. Sand boxes and electric head lights are placed upon the motor. The "motorneer" sits at one end, and handles and guides his iron horse, fed from nature's storehouse, with far more comfort and ease than can be had with the stubborn mule.

The Jeffrey motor car has hardly as yet demonstrated its maximum power. We cannot say how much coal it would haul on a level. It has hauled as high as 50 tons in one train, up and over a 4½ per cent. grade. The Shawnee and Iron Point Coal and Iron Company have one of these cars, and the Thurmond Coal Company another, while the Upson Coal Company is putting in the plant for one.

ACCUMULATORS AND MINING.

By Francis A. Pocock.

At the Washington meeting in February, 1880, Mr. Pedro G. Salom read a paper on "Electrical Accumulators, or Storage Batteries."

In the following paper, it will be my object to investigate the question, as far as possible, from a purely mining point of view. That the use of accumulators in mines is not far off, is almost certain; and it will be of interest to many of the members to see how far this reservoir of power will bear filling and drawing upon at the present time, and what the relative cost of the two electrical systems may be expected to be, not so much in first outlay as in the running expenses of the plant.

The first thing to be decided is the weight of these accumulators, and the easiest way to define this, is the weight per horse power. Mr. Salom says, it takes 25 pounds of battery to give 1 horse power hour, and that to give 100 horse power hours, or 10 horse power for 10 hours, requires 5,500 pounds of battery or 220 elements; but 25 pounds is the net weight and 32 pounds the real total upon which we must base our calculations, so that we have a total of 7,040 pounds as the weight of this battery. The next question is, how much room will this take upon a mine locomotive? A mine locomotive of 10 horse power should not be more than 9 feet long, and 2 feet of this will be taken up by the bumpers, leaving 7 feet in length for the battery. Then for a 3 foot track it should not be more than 5 feet wide. Allowing 1 inch all around a cell, it will be possible to set ninety-six of these on the floor-space of the locomotive; but we must have fourteen more than this, which will make the width 68 inches. The height of this cell is 8 inches; and, allowing 2 inches space above it, and 1½ inches of plank, the top of the second tier will be 19½ inches high above the floor.

If the motor is to be placed below this floor (and there is no other place for it), then the bottom of the floor will be 2 6 inches from the track; and, allowing the floor to be 3 inches thick, to stand the weight, the top of this car will be 4 feet 4½ inches above the track. Remembering that the height of the 40 horse power motor at Lykens Valley is only 4 feet high, and the one at Erie Colliery, also 40 horse power, is 4 feet 4 inches high, and that they are both narrower and of the same length as the proposed storage motor, and of four times the power, there is certainly one point established against the present use of accumulators.

Table of Weight, etc., of Electric Mine-Locomotives.

Location.	Horse-power of Motor.	Weight of Locomotive. Pounds.	Largest Load. Tons.	Speed. Miles Per Hr.
Zankerode	4.5	3000	13½	6
Paulus.....	5 to 6	4200		6
Lykens.....	40	12,000	165	6.8
"	40	12,000	150	6.8
Shawnee....		4500	21	5
Buckingham.		7000	60	8
"		4000	30	8
Bear Run...	60	18,000	150	6
Erie.....	40	13,500	107	6

Returning to the subject of weight, we calculate that, to that of the accumulators, 7040 pounds, must be added that of the motor, say 1300 pounds, the wheels and axles, say 1100 pounds, and the frame of the machine, say, for strength alone, 1400 pounds, giving the total weight of motor, etc., as 10,840 pounds.

From the above, it appears that the small German motors weigh about 700 pounds per horse power, and that the large American motors only weigh 300 pounds

per horse power, whereas the accumulator motor would weigh at least 1000 pounds per horse power. It is true that weight is necessary to traction, but it it also true that unnecessary weight will entail loss of power, and from the very limited information at hand it appears that 700 pounds per horse power is found to work satisfactorily with small motors, and that the weight per horse power decreases as the horse-power increases. Consequently, for a 10 horse power motor, 1000 pounds per horse power appears to be too high. There will be a waste of power in moving this weight and, if we wished to operate a 40 horse power locomotive with batteries, the number of cells would be 880, and their weight 28,160 pounds. They might be divided into two batteries and towed in a tender, but even then each would weigh 14,080 pounds and this would absorb at least 500 pounds of the total pull of the motor, when running on the level, and considerably more where grades are to be overcome.

Dr. Lewis Bell has pointed out that, whereas a good roadbed is necessary for electrical traction by overhead wire, it is even more imperatively so when storage batteries are used. We have found in practice that a 25 pound per yard steel rail is too light for a locomotive of 13,000 pounds weight to be run upon; therefore, there is no saving to be looked for in this direction by the use of accumulators. On the contrary, when we begin to put in a roadbed heavy enough to stand the weight of a locomotive weighing, say, 23,000 pounds, there are many disadvantages that the colliery manager will be the first to see. Besides the first cost of the track, the keeping of this weight of track in good repair, in a mine where the floor is forever moving (as it is in many of our mines), would be a work of no slight expense in itself. It appears, therefore, that not much is to be expected from accumulators as a means of haulage.

However, this is one side of the question only. There is another side which should be considered, and that is the use of the accumulator motor in collecting the cars to a point where the heavy haulage motor can reach them. The prospect, as viewed from this point, is more encouraging. From what I have seen of the work, a motor of about 5 horse-power would do the work of three or four mules, and the weight would be about 5000 pounds, as follows:—

	Pounds.
Accumulators (110 cells)	3500
Motor	600
Wheels and frame	1000
Total weight	5100

This machine could be built low, so as to take up little height. It is only possible to make this form a commercial success, in my opinion, when the gangways are low and the roof would have to be cut to gain height enough for mules to work. Then, the cost of the cutting saved by the use of the motor would counterbalance the repairs on the battery and the extra care and expense in laying and keeping the track in order. The cost of the system may be estimated as follows:—Assuming the first cost of the locomotive complete to be $2300, and allowing that the mine can afford to charge these cells for $40 per horse power per year, the generator and engine being already installed and doing work during the day time, and this sum representing fuel and interest on machinery. The attendance should not be more than $300 per year, as the pump man and night engineer can do the work:—

Estimate of Expense of 5 Horse Power Accumulator Motor.

Interest at 6 per cent. on $2300	$138.00
Repairs to battery	500.00
Repairs to motor, etc	150.00
Cost of power, at $40.00 per horse power	200.00
Attendance in charging at night	300.00
Engineer, at $2.00 per day, for 260 days	520.00
	$1808.00

The cost of running three mules and drivers would be about as follows:—

Interest and depreciation (26 per cent.) on $450.00	$117.00
Feed, shoeing, harness and attention, at $0.33 per day	361.00
Three drivers, for 260 days, at $2.00 per day	1560.00
Total	$2038.00
Less	1808.00
Annual saving on 3 mules	$230.00
Or, for 4 mules: total expense	$2717.00
Less	1808.00
Annual saving on 4 mules	$909.00

Or, about 44 per cent. on the investment, under the circumstances assumed.

The rail and track being an important item in the economy of this method, I think that perhaps the cheapest, and at the same time the best method would be to use from 20- to 25-pound steel rail, and, in laying the track, to place the ties first about 3 feet apart from centre to centre, and on these, and under each rail, to place a string-piece of wood 1½ by 3 inches, nailed to the ties, and spike the rails on the top, keeping the stringer-joints and the rail-joints from coinciding. The combination makes a solid track, and a very smooth-running one, and it has the advantage of not lifting easily into very uneven points; the ends of the rails do not jump as when only laid on the ties, and the track has not the swing to it which is so injurious.

The true place for accumulators at present is in lighting, and it looks as if they could be used to advantage in this connection. They are very heavy, it is true; but the lighting-arrangement for eight hours' work would not be a large or very heavy affair, and could be taken to the working place on the first car, and brought out on the last, so that it would not have to be carried by hand at all. The advantage to the operator would be material, as the men can work better in good light than in poor, and the coal would come faster and cleaner from a well lighted place. The lighting of switches, turnouts, etc., could be easily accomplished in all parts of the mine, and the jar which would be detrimental to traction would not occur in this case. The charging could be done at night, and a clear steady light delivered during the working hours.

THE USE OF ELECTRIC POWER TRANMISSION AT ASPEN, COLORADO.

By C. E. Doolittle.

At the request of Mr. Spalding, I give a brief statement in regard to the plant in use at this place by means of which water power is utilized for generating electric currents and the latter are applied to mine hoisting, etc.

This mining town had been lighted by electricity for three years, the power being obtained from several small water powers, when owing to the limited quantity of water flowing in the mountain streams of this region in winter, it became necessary either to put in a steam plant or to use water under a much greater head. It was determined to adhere to water power; and the construction of a plant to use water under a head of 900 feet, was begun eighteen months ago.

A dam was built on Hunter Creek, about three miles from town, at a point where a dam 12 feet in height creates a reservoir covering several acres of ground. It has been necessary, during a few of the coldest winter nights, to draw upon the supply of water in this reservoir, but the reservoir always refilled itself during the following day.

From the dam the water is carried some two miles in a wooden flume, buried in the ground, to the head of the pipe-line. The pipe-line is 4500 feet long, and has a fall of 876 feet, giving a pressure of 380 pounds per square inch at the water wheels. Lapwelded pipe, 14 inches in diameter and about ¼ inch in thickness, is used.

In the power-house there are eight Pelton water-wheels, each two feet in diameter, and each capable of developing 150 horse power. The water wheels run at the rate of 1100 revolutions per minute, and each wheel is belted directly to one or more dynamos.

This power has now been in use more than a year and has proved absolutely reliable. The wheels at present furnish power to operate three arc dynamos, sixty lights each; four incandescent dynamos, supplying 2500 incandescent lamps, and two 500 volt power dynamos, one requiring about 60 horse power, the other about 120 horse power under full load.

These power generators furnish current to electric motors used principally for hoisting in mine inclines. For this purpose, motors of the street car type are used, so that the speed is under control of the engineer. The motors are connected to ordinary mine-hoists by spur gearing and paper friction wheels. These electric hoists are all underground, at points where it would be both difficult and expensive to obtain power in any other way. The distance of the motors from the dynamos is, in most cases, about 2 miles. Some of the hoists have been running more than two years, and all have proved satisfactory and reliable. The expense for motor repairs has been very small. There are also motors in use for running blowers, rock-crushers, etc. The motors range in size from 3 to 75 horse power.

An electric tramway for mine use is now in process of construction. The locomotive for this purpose consists of a street car motor, mounted on a truck, with the armature shaft at right angles to the car axles. This arrangement involves the use of a set of bevel gears. There should be a special motor for this purpose, so designed that the locomotive will not be too broad to run on the 18 inch gauge tracks when the armature shaft is placed parallel to the axles, thus allowing spur-gearing to be used.

While the application of electric motors to hoisting has been a pronounced success, there are still two obstacles in the way of the general utilization of electricity for all mining purposes, viz., the lack of electric drills and electric pumps. As soon as an electric drill is produced that will do the work of an air drill, and an electric pump that will take the place of the present sinking pump, then the time for the general application of electricity for all mining purposes, to the exclusion of other power, will be at hand.

Mould's Hydraulic Coal-Getter.

For a considerable time past, Mr. E. Mould has been endeavouring to design a suitable mechanical contrivance that would take the place of explosives in dusty and fiery mines. He has produced screws and hydraulics of various forms, as well as a cylinder in the far end of the hole and water forced through a tube. But the bursting of the tubes was a nuisance. He then tried the cylinder outside, but this design was too heavy and cumbersome and others inefficient. However, he now claims to have designed an instrument of a little over 60 pounds in weight, to break loose almost any coal in the ordinary way of working.

This apparatus, which may be used as an ordinary hydraulic jack for any lifting purposes up to 10 tons, is thus described by the inventor:—There are (1) the head, (2) the cylinder, (3) the mandrel, (4) the piston-rod, the side pieces and the pump handle. The side pieces and the pump handle are the only loose parts.

The head contains the pump, and in part answers the purpose of a reservoir.

The cylinder is simply a round parallel barrel, screw-threaded at each end, and is so connected to the head at the top end and to the mandrel at the bottom end. This cylinder is covered by a shell cylinder, leaving a cavity between the two—the inner and outer cylinder. The inner cylinder is perforated on the side at the bottom end, to allow the water to pass from the under side of the piston while it is being forced into the cylinder on the top side of the piston by means of the pump, thus supplying the pump during the operation of breaking loose the material in which it has been placed. As already stated, the inner cylinder is screw-threaded at each end. Now, while it has been screwed together, the outer shell is drawn into faced joints, both top and bottom end, and is so made water-tight, and becomes a portion of the reservoir for water. Thus there is ample provision in the head, the cylinder, and the cavity. This is to avoid the necessity of constantly refilling with water, which may be more or less unclean.

The mandrel is screwed into the bottom end of the cylinder, and so becomes a permanent joint. The mandrel is also provided with recesses, constituting inclined planes. In these inclined planes are placed side pieces or wedges, thus making the mandrel cylindrical in form, and is so placed in the hole prepared for it.

In addition to the cylinder and a piston, there is a piston-rod. The rod passes from the piston in the cylinder through the mandrel, and on the bottom end there is placed a collaring, so as to enlarge the bearing, because this becomes the basis of pressure. It is very important that the machine should go to the far end of the hole, and to ensure this the drill should always be ⅛ in. larger in diameter than the machine.

Now, supposing the machine is in the hole, quite at the far end, the moment pumping is commenced, the piston-rod being against the far end of the hole cannot go forward, therefore the machine moves outward, and the frictions on the sides of the hole being greater than that of the incline planes, the said pieces become fixed, and the machine moving outward, produces lateral pressure by means of the incline planes, thus forcing asunder the material in much larger blocks than when exposed to the shattering influence of an explosive; securing better results, and at the same time avoiding all the evils contingent on the use of explosives.

The merits claimed for this machine are:—(1). Efficiency. (2). Portability, being a little over 60 lb. when charged with water; the same is used over and over again, it may be for months, so that you see the pump is intact; and this is accomplished by the simple means of a thumbscrew. When the operation is completed, by turning a thumbscrew, the water returns to the underside of the piston. (3). Economy, being less in first cost, and less liable to get out of repair, its loose parts being so few in number—viz.: side pieces and pump handle. (4). Simplicity—place the side pieces in the recesses of the mandrel, force it to the far end of the hole; if the coals are to be lifted up or forced down the side pieces must be top and bottom. But if the coal is to be forced sideways the side pieces must be right and left. Then commence pumping, and in about five minutes the coals will be down or on the sprags ready for dropping as required.—*Colliery Guardian.*

Electrical Transmission of Power for Mining Work.—An electric plant is now being installed at the Loganlea collieries, near West Calder, Scotland. A new engine house has been erected with an engine of nearly 100 h.p. The dynamo used will develop 60 h.p. at a pressure of 200 volts. At the bottom of the mine a large road—to be used in working the main seams—is being driven through the solid stone. A motor of 30 horse power will do the bulk of the hauling here. The water met with in the construction of the road will be pumped to the surface by means of another motor of 15 horse power. When the installation is complete it is estimated that it will develop about 150 horse-power, capable of being applied not only to the purposes mentioned, but to rock drilling, coal drilling and coal cutting. It will also serve to light up the whole of the extensive works. The installation at Loganlea, it is believed is the first of its kind in Scotland.

A New Granulating Mill.—The American Ore Machinery Company have just completed a new mill for producing a granulated product, from the size of a wheat-berry down to a twenty-mesh screen. This mill is called the Narod Granulator. It is of the same size and type, and about the same weight as the Narod pulverizer, and requires the same horse power, namely, 15 to 20. It differs only from the Narod pulverizer in having a screen in the base instead of around the mill, and in the absence of the six spiral fans by means of which attrition is engendered on the pulverizer. The demand for the granulator promises to exceed that of the pulverizer, hence there will be a very wide and profitable field for this new mill.

Coal Cutting By Machinery.

The principal inducement to operators to use coal cutting machinery in preference to mining by hand labor is naturally due to a reduction in the cost of getting out the coal to be gained by the former method. With it it is possible to effect a larger saving of coal than is possible by hand labor, due to the small height of the undercut; also the number of men which have to be employed can be materially reduced. To get out the same amount of coal it is not necessary to keep as many working places open, in mines using machinery, as it would be when employing hand labor, thus making it possible to have the working places more concentrated, and thereby to save a large amount of expense in the form of dead work, such as keeping open gangways. To give an approximate idea of the cost of mining with machinery, as compared with hand labor, it can be stated that a coal cutter in the Hocking Valley is capable of giving an output of eighty to eighty-five tons a day. The price paid for cutting coal by machines in rooms is 8 cents per ton; the price paid for loading coal after the cutting is 35 cents per ton. A miner can mine and load on a average 3 tons per day, being paid 70 cents per ton. This shows a cost of 43 cents per ton of coal mined by machines against 70 cents mined by hand. To the former will have to be added wages for one engineer, fuel, interest and depreciation, and wear and tear of the plant. By working the machines day and night, however, these last items can be reduced to a minimum. This policy is being followed in most mines using machinery, as it enables a comparatively small machine plant to give a large daily output. For example, should an output of eight hundred tons per day be required, and the machines be worked during the day only, ten coal cutters (with the necessary engines), etc., would be required. By working day and night five coal cutters would be sufficient, as well as engines, generators or compressors, and ducts of half the size. The work of loading and hauling would be done during the day only.

There are at present two general styles of coal cutters in use; those using rotary cutters and those using reciprocating cutters, both of which have special features, which make it advisable to use one or the other, according to the nature of the coal. It has even been found good policy in some mines to use both styles of coal cutters, preference being generally given to the rotary, using the reciprocating machine wherever the former cannot be used, or where, as in driving gangways, it is advisable to shear the coal (loosen it at the sides), in addition to undercutting.

ROTARY COAL CUTTERS.

Of the two styles, the rotary is the more rapid machine, and is used wherever possible on that account. The general features of this machine are as follows: the undercut is made by means of revolving tools, the axis around which they revolve being either a horizontal line parallel with the coal (cutter bar), a horizontal line at right angles with the coal (augers), or a vertical line (chain-machine). The machines in general consist of a stationery bed upon which slides a movable frame bearing the cutting devices. The latter is gradually fed into the coal as the knives or tools cut the coal away in front of it. The motor (either compressed air or electricity) is attached to the movable frame or to the stationery bed, suitable gearing transmitting the power to the cutting devices. The feed is automatic, and consists either of a screw and nut, or rack and pinion. The best speed for feeding seems to be from one-ninth to one-tenth of an inch per revolution of the cutting devices; although for some coal this speed might be increased with advantage. An important feature of this style of coal cutters is a proper device for withdrawing the coal dirt or slack from the cut to prevent the knives from becoming clogged.

In the Room and Pillar Work in use in America, the coal is generally undercut the entire width of the room to a depth equal to the height of the vein. It takes about nine or ten cuts to accomplish this in a room 30 feet wide. After the undercut is made from three to four holes are drilled in the coal, about two-thirds of the height from the floor, but varying with the condition of the vein. These holes are filled with powder, and the coal shot down. After having been blasted down, the coal is loaded into the mine cars by a set of miners, and the room is cleaned up for another set of cuts. While the process of drilling, blasting and loading is going on, the coal cutter is taken into another room prepared for it, and there again undercuts the coal the entire length of the room.

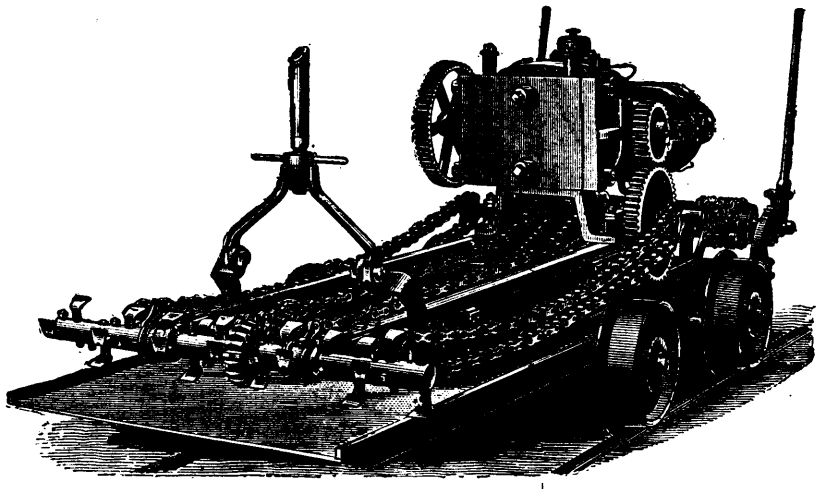
The best part of the coal is generally at the bottom of the vein, and it is therefore desirable to save as much as possible. For this reason the "bearing in," or cut, is often made in the fireclay underlying the coal, if this is not too gritty, or in a slate parting in the coal. If the latter is high up in the vein, the machines can be worked from the bench. In other words if the coal underlying the parting is allowed to remain down for a sufficient distance from the face of the room to allow the machines to rest on it while making the new cut. When undercutting in fireclay, care is generally taken to cut partially in the coal, as the white clay adhering to the latter would decrease its value in the market. Wherever neither a suitable parting in the coal nor a fireclay bottom exists, and it is desirable to get out the largest amount of lump coal possible (especially in some of the small veins), the height of the cut has to be made as small as possible; it is, however, not advisable to reduce it below three inches and a half, as otherwise it may not allow the coal to tumble over properly when shot down.

CAPACITY.

The amount of work a machine is capable of performing in a given time can be expressed in tons only when the thickness of the vein and the amount of impurities in the shape of partings, bony coal or slate, etc., are known. A better method of designating the amount of work the coal cutter is capable of performing in one day is by giving the number of cuts it can make, or the number of square feet it can undercut. This daily work, of course, varies somewhat with the nature of the coal, whether the latter is hard or soft, or contains sulphur or bastard, the width of the workings, and the territory to be covered by one machine. The largest record so far made with rotary coal cutters is said to have been 52 cuts in 10 hours, or 950 square feet undercut. The average work in the same mine in wide workings is 35 cuts, or 645 square feet, for narrow and wide workings 30 cuts, or 555 square feet.

When handled by expert men and with not too hard coal, machines can make about thirty to thirty-five cuts a day in from nine to ten hours, making it necessary to prepare at least four rooms for each to work in.

With the exception of one type, all the rotary coal cutters used in America are fastened down in proper position at the face of the coal to be undercut. They then make a cut in the coal to a certain depth and of a width depending on that of the cutting device. The latter is then withdrawn, and the whole machine moved sideways and placed in position to make another cut adjoining the former. The time consumed in shifting the machines averages about 1½ minutes. To reduce this lost time as much as possible, it is advisable to undercut as many square feet as possible with one setting of the machine. There is, however, no advantage in making the cut deeper than the vein is high, that is, in a 5-foot vein, the cut would be 5 feet deep, as otherwise the coal would not "shoot" down properly and tumble over. If the coal simply settles down in its former place, it is in a worse condition for mining than if it had not been undercut. Neither is it advisable to make the machines longer than required for the six foot cut, as they would become too unwieldy. It is necessary to make the cut as wide as possible, so as to reduce the number of times the machine has to be shifted to cut the coal in a room of a certain width. The machines used by the Edison General



Electric Company are capable of making a cut 3 feet 6 inches wide; machines manufactured by other companies make cuts varying in width from 3 feet to 3 feet 3 inches.

HANDLING MACHINES.

These coal cutters are generally handled by two men only, and for this reason it is necessary to reduce the weight of the machines as much as possible. It must also be borne in mind that they are not only handled very roughly, but have to do very hard work, being at times forced through coal containing small streaks of sulphur, or other impurities, harder by far than the coal itself. Should these foreign substances occur very frequently in the "bearing in seam," that is, in that part of the coal in which the undercut is to be made, the reciprocating coal cutters, of course, would be the proper machines to use. If, however, only small streaks of sulphur occur, the rotary coal cutters are generally forced through them.

The main feature of a successful coal cutter is great strength. To show that this is of far greater importance than lightness, the record is given of the time required to shift a three thousand pound machine, 36 seconds being the average time in six tests to shift the machine from one position to another. This, of course, is exceptionally quick, and it is not to be expected that men would be able to keep it up all day. This machine is probably the heaviest on the market, the motor alone on it weighing about 1,700 pounds. It is hardly reasonable to expect that the machine can be shifted in less than one minute and a half as average for a day, no matter how light it is made, and this is being easily accomplished by expert men with machines having the abnormal weights given above.

To convey the machines from room to room they are mounted on small trucks and hauled by mules or horses from one place to the other. These trucks are generally provided with a suitable winch and chain, by means of which the machines can be readily loaded. The average time to this is about 2 minutes 45 seconds; the average time to unload the coal cutter is 2 minutes 35 seconds, and to get the machine ready for the cut will take 3 minutes. A quick record for this work is one minute 45 seconds to load, 1 minute 30 seconds to unload, 1 minute 26 seconds to set and get ready for the cut. The time required to move the machine may be estimated as from 40 to 50 seconds for each room between the one cut and the one to be cut, although it may take all the way from 10 minutes to an hour before a mule can be secured for this work. A truck so constructed that it can be operated by electricity in mines using the latter for power purposes is therefore very desirable.

RECIPROCATING COAL CUTTERS.

The second style of machine used in America is the reciprocating coal cutter. As before stated, this machine is not capable of quite as rapid work as the rotary cutter. It has, however, some features which make it well adapted to certain kinds of coal and certain conditions. It has already been said that when the quantity of sulphur or similar substances is not too great in the bearing in seam of the coal, the rotary cutter can be used.

Should sulphur occur in large quantities and in the shape of what is called "sulphur balls," or "nigger heads," it will be necessary to use reciprocating cutters. Another reason for using the latter machine in preference to the former in small veins can be found in the following: In certain districts, the miners are paid for the amount of lump coal mined. The small sizes of coal which pass through the screens, having bars from one and one-eighth to one and one-quarter inches apart, namely, nut, pea coal and slack, are clear profit to the operator. In these districts the royalties on the coal are also paid by the amount of lump coal mined. Whenever the small grades of coal, therefore, have a good market, it may be to the advantage of the operator to get out as much of these sizes as possible; and this can be done by means of the punching or reciprocating cutter. All the coal coming out of the cut made by the rotary machine is in the form of fine slack, and is not marketable; that coming out of the cut made by the punching machine is generally in the shape of nut or pea coal. It is also necessary to make the height of the cut with the latter machines higher than that made by the rotary machine to enable the tool to enter it and to undercut the coal to the proper depth.

TRANSMITTING POWER.

As the work in the mine progresses, the distances at which the coal cutters have to work from the power station will increase, and therefore, quite an extensive part of the mine has to be equipped to allow coal cutters to be kept at work continuously, making it very important that the devices used for transmitting power to the machines should be small, flexible and efficient. A general comparison between the agents adapted to this purpose—electricity and compressed air—need hardly be given at this day, as the advantages of electricity for power purposes over compressed air and other agents are now too well known. Nearly all mine owners who have heretofore used compressed air plants are seriously contemplating the advisability of changing their system, having reached the limit to which their compressed air plant can be used, and recognizing the fact that the amount of pipe already laid in the mine represents a cost nearly sufficient to cover the cost of an entire electric plant, not including the steam engine and boilers.

SUPERIORITY OF ELECTRICITY.

Outside of its well-known advantages for ordinary power transmission, the electric system offers some special features that make it well adapted for use for coal cutting. It has already been remarked that to avoid letting the machines stand idle a large territory in the mine has to be equipped for them, and this necessitates a number of bends and branches in the ducts, which with a compressed air plant, results in loss of efficiency. This has no effect on an electric system. It is also a very easy matter to lay the wires for the latter in such a manner that they are at all times easy to inspect and repair if interferred with accidentally.

But the main advantages are to be found in the machines themselves. The electric motor naturally has a rotary motion, and this removes from the machine, as experience has proven, the violent vibration met with in the use of the necessarily high speed reciprocating air engines. The life of the coal cutter is, therefore, considerably increased, and annoying delays caused by breakdowns, and the frequently necessity of giving the machine a thorough repair are reduced to a minimum. The work of the machine men is also greatly reduced, as it is evident that with a machine subject to violent vibrations it is difficult to keep firm the braces which hold the machine in place. The shunt wound electric motor retains a speed practically constant under the greatest variations in the load, and more especially has not the tendency to race which an air engine has when its load is suddenly removed.

In the case of the electric motor, it is very much easier to reverse the coal cutter without stopping the motor in

order to withdraw the cutting device after the cut is made, and also to save the machine or bits from breaking if they suddenly encounter a substance too hard for them to penetrate.

THE EDISON GENERAL ELECTRIC CO.'S COAL CUTTER.

Of the many different coal cutters in use at present, those that have so far met with best success are undoubtedly those using the cutter bar, that is a shaft revolving parallel with the coal in a horizontal plane, and having knives distributed all around the surface, so as to cut a groove in the coal the entire length of the bar. The type of coal cutter adopted by the Edison General Elecric Company has been in use for years, and has been thoroughly tested. This machine has the advantage of great strength, and excels other machines of the same class as regards the design and the distribution of the material to give the necessary strength and rigidity. A special feature of this machine is that the cutter bar revolves in such a direction that the coal is cut in an upward direction. This method greatly assists the weight of the machine in holding it down to the ground, and to a great extent avoids the necessity of carefully fastening it by means of braces or jacks. It is evident that if these have to be applied tightly, the machine is in great danger of being warped out of shape, unless the floor upon which it rests is very even. This trouble is often encountered with other machines, and consequently it has become customary in using them to level the coal cutter carefully by means of wedges, before applying the jacks. Such wedges are not required for the machine used by the Edison Company.

With machines using the cutter bar, the bearings holding this bar have necessarily to be very short, for otherwise the ridge of coal left standing in front of them, which cannot be reached by the cutters, would be too wide and strong to be readily broken away by the wedge-shaped front of the bearing.

It has been customary to make these bearings 1¼ inches wide, and to transmit the power to the cutter bar direct by means of a chain. In this manner the cutter bar has not only to withstand the strain due to the resistance of the coal being cut, but also that of the chain itself, which, when 15 horse-power are transmitted to the cutter bar, amounts to 3,600 pounds.

The Edison Company has adopted a countershaft behind the cutter bar, to which the power is transmitted direct from the motor by means of four chains. This countershaft has bearings 6 inches long, and strong enough to withstand any strain the chains may exert on them. To transmit the power from the countershaft to the cutter bar, gears are used with peculiarly shaped teeth, which prevent the coal dust from settling between them. The only strain on the cutter bar of the Edison Company's machine is due to the resistance of the coal. The superiority of this construction to that used by the other machines is evident, when it is considered that the bar is very much weakened by the number of holes drilled into it to receive the cutting tools and the set screws required to hold them. The cutter bar is already about as strong as it can well be made. Any increase in diameter would also increase the height of the cut, which already is 4½ to 5 inches high.

There are other advantages in the design of the machine used by the Edison Company which make it adapted to withstand the rough usage to which it is subjected in mines, better than any other machine using a cutter bar. Among them can be named, simplicity in design of the feeding devices, and the use of rollers for the sliding frame, which reduce to a minimum the friction between it and the stationary bed, and decreases the danger of binding between the two.

POWER REQUIRED.

To determine the amount of power required for coal cutters, a number of tests were recently made with machines at work in coal of varying degrees of hardness. These tests have shown that a 15 horse power motor is sufficient for the purpose. In some places the power required exceeded this amount, but as the machines only ran off and on, having their full head on for about four minutes at a time, a motor having the above-named capacity was found to be sufficient; and a careful examination of the condition of the armature and magnet of the machine showed them to be perfectly cool.

The motor used for the Edison General Electric Co.'s coal cutter is capable of giving 15 horse-power when doing steady work. When running off and on only, as would be the case when used with coal cutters, it is capable of giving by far larger power. This motor is especially well adapted to the work it has performed; it runs entirely without sparking and has all its vital parts well protected. The insulation of the machine has been given especial attention, and in this respect the Edison Company has been greatly aided by its experience with the large number of its motors now running in mines and upon street cars.

The Edison Company builds coal cutters capable of making a cut 4 feet, 5 feet and 6 feet deep, by 3½ feet wide.

All coal cutters are provided with a suitable truck, by means of which they can readily be moved from place to place. The devices on the truck to load and unload the machines are very simple and efficient, and each machine is supplied with a cable 150 feet in length, and provided with suitable devices to enable it to be readily attached to the main wires and detached from them.

COST OF EQUIPMENT.

The average cost of equipping a mine with the electric plant necessary for mining 400 tons per day in a 5-foot vein of bit coal (the plant being operated 20 hours per day) would be about $9,500. This does not include steam engine, boilers and building.

Modern Explosives: Their Inflammation and Comparative Power.

Lieutenant Willoughby Walke has communicated to the *Journal of the American Chemical Society* an important paper on the comparative power of the modern explosives most generally in use. The points of inflammation of these had already been determined by the experiments of Mr. C. E. Munroe, who for that purpose had used a thin copper cartridge placed in a thin bath or paraffin infusion. The initial temperature was taken, the bath was afterwards rapidly heated till the explosive caught fire, and then the temperature was noted again by a thermometer. These figures were as follows:—

Nature of explosives.	Points of inflammation. Degrees.
Compressed guncotton	186—201
Guncotton dried in the air (results of several trials)	137—189
Pyroxyle dried in the air (results of several trials)	186—199
Hydro-nitro-cellulose	201—213
Nitro-glycerine	203—205
Kieselguhr dynamite, No. 1	197—200
Explosive gelatine	203—209
Camphorated explosive gelatine	174—182
Fulminate of mercury	175—181
Gunpowder	278—287
Hill picrate powder	273—290
Forcite, No. 1	184—200
Emmensite, No. 1	167—184
" No. 2	165—177
" No. 3	205—217

In order to determine the comparative power of these explosives, Lieutenant Walke used a Quinan apparatus which is on the principle of compression of small leaden cylinders subjected to the direct action of the explosive. The results obtained permit of the various explosives being classified in the following order, in representing by 100 the power of nitro-glycerine:—

Nature of explosive.	Compression of cylinder in inches.	Relative power.
Explosive gelatine (Vouge process)	0·585	106·17
Hellhoffite	0·585	106·17
Nitro-glycerine (old)	0·551	100·00
Smokeless powder (Nobel)	0·509	92·38
Nitro-glycerine (fresh)	0·509	92·38
Explosive glycerine	0·490	86·93
Guncotton, 1889	0·458	83·12
Guncotton, 1895	0·458	83·12
French nitro-glycerine	0·451	81·85
Laboratory guncotton	0·448	81·31
No. 1 dynamite	0·448	81·31
Trauzl dynamite	0·437	79·31
Emmensite	0·429	77·86
Oxonite	0·383	69·51
Tonite	0·376	68·24
Bellite	0·362	65·70
Atlas powder	0·333	60·43
Ammoniac dynamite	0·332	60·25
Volney powder, No. 1	0·332	60·25
" " No. 2	0·294	53·18
Melinite	0·280	50·82
Fulminate of silver	0·277	50·27
" mercury	0·275	49·41

From this table it will be seen that nitro-glycerine explosives are the most powerful yet manufactured. What is rather astonishing is the low position of melinite, which was long regarded as one of the most powerful explosives, possessing nearly the qualities of nitro-glycerine without its inconveniences.

The Establishment of the Manufacture of Iron and Steel in Australia.—For some time past attention has been directed towards the establishment of the manufacture of iron and steel in Australia. This has been specially noticeable in New South Wales, which is the only Australian colony that contains, so far as is at present known, materials in workable quantities for iron and steel working, and there they are undeveloped. We learn that a syndicate is now being privately formed in England with a view of thoroughly investigating and proving the deposits of minerals in New South Wales, which have already to some extent been examined and very favorably reported upon, and if it is found that the quantity and quality are satisfactory then a definite company, with limited liability, will be formed for the purpose of opening out the mines and erecting furnaces and mills on the most modern and improved type for the manufacture of steel and iron for the supply of the colonies of Australasia and other available markets, including China, Japan, Straits Settlements, &c. From what is already known as to the extent and quality of the deposits of iron ore, coal, &c., it is calculated that hematite pig iron, suitable for conversion into steel, can be made at 40s. per ton, and the cost of making steel rails is estimated at 90s. per ton, whereas the average cost of imported steel rails delivered at Sydney over the past twelve years has been £6 9s. 4d. per ton, or nearly £2 per ton more. If iron and steel works are established in New South Wales the railway commissioners have agreed to charge special terms for the carriage of raw materials to, and manufactured goods from, the works, very considerably under those now paid by the public, and the authorities are promising every facility for the establishment of works in the colony.

Patent Magnetic Separator.—Christy and Carter's Magnetic Separator is a useful machine designed for the separation of pieces of iron, such as nuts, bolts, horse shoes, &c., from bones or other non-magnetic substances which have to be ground. It is well known that iron, if allowed to pass through the disintegrator or other grinding machine, is very destructive to the machine and detrimental to some materials ground. The magnetic method employed for separating the iron from the substance for grinding is as follows:—The substance is, by means of a shaking hopper, made to pass in a continuous stream over a cylindrical barrel studded with a number of powerful electro-magnets set radially on a central core or yoke of cast iron, the outer ends being alternately north and south poles. The magnets are wound with insulated copper wires, through which the electric current passes—this current being controlled by means of the commutator at the end of the barrel in such a manner that all magnets on the descending half are active, while the ascending ones are passive. As the material is shaken down the inclined hopper, the iron, being heavier, gravitates to the under side of the bones, and, therefore, falls directly on to the magnets and clings to them, the bones or other material falling off at the side, while the iron is carried round and deposited in a receptacle underneath the machine. Several modified designs are made to suit various purposes. The small amount of current required can be produced either by a small dynamo, or, if the factory is electrically lighted, the lighting current can be used.

New Engine Governor.—A new type of engine governor, the construction of which presents some features of interest, is being introduced by Messrs. Schaffer and Budenburg, of Manchester. This appliance takes the form of an automatic expansion regulator, and is of the nature of an inertia governor, being actuated from the slide valve spindle, and the driving strap being thus dispensed with. The governor valve spindle carries a rotary balance wheel or pendulum, which is connected by means of a spring with the slide valve rod. Owing to the action of the inertia of the balance wheel upon the spring, the movement of the governor equilibrium valve is increased or reduced as the speed of the engine is increased or decreased, and in consequence an earlier or a later cut-off is effected and the speed of the engine regulated. So long as the speed of the engine is sufficiently slow to enable the spring to overcome the inertia of the weight, the valve is fully opened. If the speed is very great, the balance wheel would be practically stationery, and the valve would remain closed, the spring alone being actuated by the eccentric rod. Between these extreme limits, there is a certain speed at which the valve would open to the normal extent, and this speed would depend upon the weight of the balance wheel and the strength of the spring, the governor regulating the engine to this particular speed.

An Electrical Safety Apparatus for Cages.—In a paper read before the Federated Institute of Mining Engineers, Mr. Yates said that although great advances had been made in recent years in nearly every branch of mine engineering, we were no better off to-day for a reliable safety cage than we were 20 years ago. Engineers had either been unable to devise a good safety apparatus, or they had not given that attention to the matter which it deserved. The numerous accidents which have taken place in recent years must convince the most sceptical as to the desirability of safety cages. All were well aware that many of these so-called safety cages had been brought forward from time to time, but had not found much favour in this country, although on the continent they were very generally applied. That the safety cages which have so far been put before the public have not been an unqualified success is due to the fact that they rely upon springs to set the apparatus in action, and that something more than the mere breaking of the rope is requisite to let these springs act. The fracture of the rope is not in itself sufficient to actuate the apparatus—many of them require a release of tension or compression, whilst others depend upon the cage attaining a certain velocity. Experience has shown that an apparatus which acts indirectly, through the medium of a spring or otherwise, is not to be relied upon. What is wanted is an apparatus which will require nothing more to bring it into action than the breaking of the rope, and which will be entirely independent of everything but this. For some time past he had been at work on this matter, and the result of his labour has been the invention of an apparatus which appears to promise perfect safety in case of breakage of rope. The rope was. to all intents and purposes, the ordinary hauling rope, except that it had two insulated copper wires in the hemp core. It differed from the ordinary winding rope in no other respect, and thus so far as winding was concerned, it was practically the ordinary rope. That such a rope could be made, and would transmit a current of electricity in a satisfactory manner, was beyond doubt, for a similar rope was now in use with Armstrong's Electrical Signalling Apparatus—an apparatus for signalling between the engine house and the cage whilst in motion. The cost of applying and maintaining such an apparatus would be trifling, and he must call their attention to the fact that the apparatus combines in itself all the qualities that a safety cage should possess, and it would therefore appear that the miners had at last within their reach a perfectly reliable safety apparatus, which would make those terrible accidents caused by the breakage of ropes a thing of the past.

The Chairman said as this was the first time this apparatus had been brought before the public they were not in a position to judge of its merits until an active trial had taken place.

IRON STEEL AND HEAVY METALS.

Iron and Steel.

Montreal, June 24th, 1891.—The speculation which disturbed the course of the British iron market during the month of May has now subsided, and prices have reached a more normal point. The last quotation from Glasgow for Scotch Warrants was 47/8, but this is still an extremely high figure in view of the present condition of the market. Private advices from Glasgow state that the London syndicate have still the bulk of Scotch Warrants under their control, and little or nothing is being done by outsiders in point of speculation. Sooner or later this syndicate will have to unload on the market and unless something happens in the meantime, it is expected that lower figures will prevail. Makers' prices for shipping brands are almost identical with those current a year ago, but they are still too high to compete successfully with American iron in Western Canadian markets. The reason of the present high prices is to be found in the price of fuel which in Scotland is altogether too high. It is doubtful whether those iron masters who are also coal masters and own the collieries which supply their furnaces, would not be better off if they were to close down their furnaces and sell the coal alone. This would certainly be a short-sighted policy, but it would be more profitable for them in the meantime. If the Scotch makers wish to retain their hold on the Canadian market it must be at prices from 5/- to 10/- lower than they are at present, and it is to be hoped that they will see it to their interest to to meet American competition.

A considerable quantity, however, of Scotch iron, especially of the lower grades, has been placed for summer delivery at prices ranging from $21 to $22 for No. 1 irons down to $19 or $20 for the lower grades. The quantity arriving is not very large, as business this season is much smaller than during the past two or three years.

On the American side we learn that business is very good, but prices are extremely closely cut, and many of the large furnaces have enormous stocks on hand. It is doubtful if pig iron was ever made at lower prices than it now costs to make it in the United States. It is even lower than the Scotch iron can be produced at, and it is a question whether this wonderful development of the iron trade in the United States could ever have been brought about had it not been fostered for many years by a protective policy, until it was in a position to hold its own against outside competition as it is at present. The same argument must certainly apply to Canada, especially to that branch of it concerned with manufacture of charcoal pig iron. This is a business peculiarly Canadian, owing to the plentiful supply of fuel in close proximity to the iron deposits, and both at a very short distance from the chief centres of consumption. The present ventures in the direction of the manufacture of charcoal iron are being carefully watched, and we do not doubt that before very long they will be able to hold their own against American brands. A little time, however, must be allowed for the growth of this industry, and in the meantime it is due to those who have ventured their capital that the present protective policy should be sustained for some time to come.

Very little new can be said in reference to the finished iron trade. Bars, sheets, hoops and other classes of manufactured iron continue unchanged and business is fairly good.

Ingot copper is now much firmer than it has been for a little time past, and the lowest figure of to-day is 14 cents against 13½ cts. a few weeks ago.

Tin plates continue fairly firm in view of the shutting down of so many of the works in South Wales. The attempt to force the manufacturers to keep these works going is not likely to be successful, especially as present prices cannot be very remunerative.

London, June 16, 1891.—The general position of the market is decidedly uncertain though no material change has occurred. The "squeeze" in warrants seems about over, and values will, it is supposed, before long drop to their proper level. At present they are very irregular, and their exact position is hard to define. Very little has been done in warrants, the "bear" account having been reduced to small dimensions. There is some curiosity to observe how the "bulls" will "get out" of their warrants, and also as to whether the ascendancy of Glasgow has been really broken by late occurrences. Connal's stocks at Glasgow are increasing slowly, while shipments are small, and the importations of Cleveland pig iron into Scotland on a large scale. In some of the finished iron departments there is rather more work in hand, and the engineers are pretty well engaged, but, as a whole, the outlook is not very brilliant.

Scotch Pig Iron Warrant Market.—Following is our usual table of statistics:—

Scotland.

	1891.	1890.	1889.	1888.	1887.
Price of Scotch warrants, June 9	48/6	44/7	42/7	38/1	42/-
Furnaces in blast in Scotland, June 9	66	84	82	87	78
Quantity of iron in public stores	515554	733[*]77	1027353	991676	883055
Shipments of Scotch pig iron for week ending June 6.	5295	9466	62,7	10738	6531
Do. since beginning of year	104523	202131	182640	174318	172407
Middlesbro' iron imported at Grangemouth, week ending June 6	7461	2190	3680	4026	7195
Do. since beginning of year	160165	57304	154503	153954	158967

Cleveland.

Price of Middlesbro' No. 3 warrants on June 9	39/9	41/2	37/7	31/7	34/10
Furnaces in blast in Middlesbro' district	89	103	104	94	94
Quantity of iron in public stores[*]	129586	100524	223282	291742	336804
Shipments of pig iron from Middlesbro' for week ending June 6	20775	20058	18254	22460	18884
Do. since beginning of year	368260	353897	435703	431711	350484

West Cumberland and North Lancashire.

Price of hematite M/Nos. warrants	49/9	50/7½	48/5	42/1	43/9
Furnaces in blast in W. Cumberland and N. Lancashire	41	45	56	49	54
Quantity of iron in public stores[†]	139718	302155	41573	427422	323741
Shipment of hematite iron for week ending June 6	8440	9025	5828	12327	12692
Do. since beginning of year	220240	242830	235960	203478	254816

* Connal's & N. E. Rly. Co's.
† Workington, Maryport, and Barrow.

New York, June 26th, 1891.—The number of furnaces in blast on June 1st was 258, with a weekly capacity of 146,782 tons, as compared with 227 with a capacity of 115,590 tons on May 1st. The increase is due to the settlement of the coke strike and the blowing in of a number of furnaces in the Shenango and Mahoning Valleys, which had been idle since February. The iron market has been quiet, not to say dull, with hardly any change for the last two or three weeks. This state of affairs is in the ordinary course of events, however, as it is the season of suspension of operation at many of the rolling mills. It is the general opinion that business will continue dull at all events until August, and no material improvement is likely to happen before September, when, if the crops fulfill their present promise, a season of activity may be looked for. There has been no change to speak of in prices, but the opinion seems to prevail, in some quarters at least, that values will decline somewhat before a more active period of trade. The general disposition on the part of buyers to hold off corroborates this. At all events there is no expectation of a rise in prices in the next two months. In the local iron market although no great activity was looked for with the termination of the strike of the foundrymen, yet a little stronger demand was anticipated than has as yet materialized. Dealers agree that business is practically as quiet as it was last week, and the general impression is that no change will occur before August. The small number of orders that are being placed are strictly of hand-to-mouth character, buyers filling immediate wants only. They think apparently that there will be no difficulty in securing iron when they need it, and at the present moment it does not seem that they are far from right. Prices are firm at Northern No. 1 X, $17 @ $18; No. 2 X, $16 @ $17; Southern, No. 1 X, $17 @ $18; No. 2 X, $16 @ $17. In spiegeleisen and ferro-manganese the market is decidedly flat. There seems to be no demand for these materials, and we hear of no transactions outside of job lots. Very little ferro-manganese is being imported at present, and the market is evidently in for the general midsummer dullness. Quotations are, nominally, spiegeleisen, 20%, $27.50 @ $28.50; ferro-manganese, 80%, $64.50 @ $65.50.

Cleveland, O., June 25, 1891.—The situation of affairs at present is such that although there are signs of an impending change, no one seems able to decide whether it will be for the better or worse. Perhaps the majority take the former view, although not a few hold to the opinion that the look out is but a dark one. Some ore men are making large sacrifice sales in order to keep their trade, whilst others are holding off for the better prices they anticipate before very long. The pig iron market, although void of improvement in the way of better quotations, is quite firm, and the quantity of iron for sale for future delivery is getting scarcer from day to day, which is a very good sign. The inquiries for iron of all makes is rather lively, and at this rate the chances are more than good for a stiffening in the price.

Copper.—The market has been decidedly firm for some time past; within the past ten days it has exhibited remarkable strength, both in Europe and the United States. The exports from the latter country have been very heavy, to fill the large demand, especially for lower grades. Hardly any casting copper is now being offered in the American market, what little there is bringing 12 cts. @ 12⅜ cts. Arizona copper is not obtainable at all as better prices are to be had in Europe, and the whole output for some months ahead is contracted for. Lake copper is still procurable in ingots ex-store New York, at 13 cts., but first hands are firm and ask 13½ cts. for future delivery, though no contracts have yet been made on this basis. The Anaconda mine is still shut down and this is now telling heavily on the supplies. Manufacturers are well stocked with orders, but the demand for electrical purposes is not as great as it might be.

English statistics in spite of the heavy receipts show a decrease of 400 tons for the first half of June. The demand both in England and on the continent has been very heavy, both for electrical and general purposes and has steadily reduced stocks, while at the same time prices have risen, G. M. B. copper being more than £4 higher than our quotations last month, being now worth about £56 2s. 6d. @ £56 5s. for spot and £56 12s. 6d. @ $56 15s. for three months. We quote English tough, £58@£58 10s.; best selected, £59@£59 10s.; strong sheets, £66@£67; Indian sheets, £62@£63; yellow metal sheets, 5¾d.@6d.

Lead.—The higher prices that have obtained in the American market had the effect of bringing out more sellers and checking buying to some extent. Consequently of late there has been very little doing, prices being steadily maintained at about 4.40 cts.@4.45cts. with some shading of these prices in some instances to effect sales. St. Louis and Chicago both report a very moderate amount of business at nominally unchanged values, but sellers are having some difficulty in maintaining them. In London Spanish lead is quoted at £12 15s. and English at £13.

Nickel.—There has been an active demand for nickel of late, but hardly any spot is to be had. The imports from Europe into the United States have been very light and the prices are firm and rather higher, 70cts.@75cts. according to quality and brand.

Speculation in Iron Warrants and its Influence on Legitimate Trade.

(Colliery Guardian).

The promoters of the Pig Iron Warrants Bill could not have or desire more conclusive testimony to the value of and necessity for their measure than the state of the warrant market during the last two months. It has been the sport incontrovertibly of gamblers, pure and simple, who have not a fraction of real interest in the trade itself, and legitimate business has practically been suspended, for it could not be expected that regular buyers would operate when such a wild, uncertain condition of affairs prevailed. In the face of this it is difficult to believe that there should be any opposition to a genuine attempt to restrict or regulate what, it must be conceded, is an unmitigated evil, and has worked incalculable injury to the industry at large. The true interests of the trade would be infinitely better promoted if, by legislation or any other means, such organisations as the London and Glasgow iron "rings" were abolished, for it is nothing short of a grave scandal that the regulation of prices should be taken altogether out of the hands of the producer and consumer, who have a vital interest in them, and given to people who have nothing at all to do with the production, distribution, or consumption of the iron. The ordinary supply of and demand for iron have little to do with the determination of the value of pig iron when the gambling fraternity step in. The speculation has undoubtedly intensified the depression which was in progress when it set in so fiercely, and the legitimate traders who have reaped any good out of the business of the last two months have been few indeed. The paralysis of legitimate trade has told very keenly upon many branches of the iron and steel industries besides the pig iron department, and we hear of works being closed in many parts of the country through lack of orders.

Any improvement in the iron trade must naturally begin with the finished departments, and extend to the pig iron branch; it is out of the question that it should commence with the raw material. But the artificiality of the course of the market during the last two months will be recognised when we state that pig iron warrant prices have gone up 20 per cent. or more, when the legitimate demand for and consumption of pig iron were actually declining, and when business in the finished iron and steel trades was falling off. The present situation has been brought about in this wise. When the Scotch blast-furnacemen's strike, which lasted from October to March, was ended by the men abandoning their claim for extra

pay for Sunday work and accepting 20 per cent. reduction of wages, the Scotch pig iron makers began to blow in their furnaces. Naturally the Glasgow "bears" inferred that an increased production of pig iron coming with a decreased consumption of it would lead to lower prices, and they commenced to sell very heavily, at the current rates, warrants which they had not got, and which they put off buying while they forced prices down. They made a determined onslaught upon these, and without doubt depressed the quotations for warrants much more than the actual state of the trade really justified. They neglected buying to cover their sales until there appeared no chance of running down the value of warrants and further. But here they were finely caught, for when the time came for them to deliver the iron they had sold, and when it was absolutely necessary that they should buy without more delay, they found they could not get the iron they needed. When they were recklessly selling, the London "bulls," who are reputed to be very wealthy individuals, bought up large quantities of Scotch warrants, and when the Scotch "bears" were compelled to buy they had to pay pretty nearly whatever price the London operators chose to ask, for these latter were undoubtedly the masters of the situation. They have made the "bears" smart more severely than they have for years past. Very heavy losses among them have been the consequence; in fact, it is contended that by the late deals the Glasgow people have dropped over a quarter of a million sterling, and some failures among the speculators have followed, with others in prospect. The establishment of the London iron market has thus proved more detrimental to the operations of the Glasgow "bears" than the latter ever expected it would; it has prevented them having it all their own way in the matter of regulating prices, as they had been accustomed to have. These London operators appear to have got the measure of the Scotch "bears," and know just how much they can be "squeezed;" they therefore do not force up prices as high as they might, because, if they did, the "bulls" might themselves be losers, for while they might get the heavy differences out of a few of the sounder "bears," they would drive the weaker fraternity into the bankruptcy courts, and secure nothing from them, for debts of this kind are not recoverable at law. The "bears" had their innings till the first week in April, the 6th being the day of the minimum prices, when Scotch pig iron warrants were down at 42s. 2½d., hæmatite at 46s. 7d., and Middlesbrough at 37s. 7½d. Then it was that the "bulls" found that their opportunity had come, and since that day they have sold Scotch warrants at 54s. 3d. cash, hæmatite at 53s. 9d. and Middlesbrough at 42s. 9d.—advances of 12s. 0½d., 7s. 2d. and 5s. 1½d. respectively.

NORTH-WEST MOUNTED POLICE

RECRUITS.

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

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

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

The term of engagement is five years.

The rates of pay are as follows:—

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

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

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

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

Applicants may be engaged at the Immigration office, Winnipeg, Manitoba; or at the Headquarters of the Force Regina N. W. T.

The Position of Copper.

The statistical position of copper appears to be so strong—on paper at all events—that the rise in values is not at all surprising. Were we positive that the published statistics include all the copper on hand the position would be clearer and might be stronger. As a matter of fact it is not shown in a definite form that the remnants of the stock of the late French syndicate and its allies are included, consequently the market is being influenced in an upward direction, while the very important question of the syndicate stock is either overlooked or left out of account as being of no moment. Taking the figures as they stand, however, it is undeniable that they make what the Americans term "a good showing" for higher prices. Deliveries seem to be in excess of the current supplies, and stocks (always presuming that these *do* include the French ring's remnants) are lower than for some years past. The following figures, taken from Merton & Co.'s returns, establish these points conclusively:—

—	Supplies.	Deliveries.	Stocks.	Price of G. M. B.		
1891—	Tons.	Tons.	Tons.	£	s.	d.
May..	9,672	11,180	57,808	55	5	0
April.....	12,227	11,264	59,316	51	12	6
March.....	9,284	9,962	58,353	53	2	6
February....	7,105	8,670	59,031	52	15	0
January	7,494	12,264	60,596	52	12	6
1890—						
December ..	11,807	11,881	65,366	52	10	0
November ...	8,445	11,230	65,440	55	7	6
October.....	8,525	10,206	68,225	58	7	6
September ..	10,187	10,240	69,906	59	10	0
August	9,393	11,967	69,959	60	5	0
July.....	11,470	11,430	72,533	57	0	0
June.... ...	9,233	18,781	72,498	58	10	0
Totals	114,842	139,075	....	.....		
1889—						
May 31.....	....	....	117,420	41	0	0
1888—						
June 30.....	...	....	72,243	70	0	0

It should be noted that the Chili charters for the month of May are estimated at 800 tons. This may or may not be near the truth—probably it is a close approximation to the actual facts—but it must not be overlooked that the charters from Chili average over 2,000 tons monthly, and

in April reached as high as 3,650 tons. The shortage in May, therefore, may be expected to be made up in June or July, despite the disturbance of the Chilian mining industries caused by the civil war in that country. But the leading reliance of those who look for a further rise in prices is upon the cessation of production at the Anaconda mine in the United States. Probably they will be somewhat less sanguine of the future if it proves to be true that the Anaconda may start up again this month or in July, so soon as its new electrolytic plant is in working order. The restarting of that great mine would necessarily add to the available supplies. Meantime it is noticeable that exports of copper from the United States have been exceedingly heavy since the beginning of 1891. In the first four months of the year they amounted to 19,871 tons of fine copper (about half in ingot, bar, &c., and the other half in matte) or equal to about 80 per cent. of the total exports of 1890. This would seem to show that the prices lately prevalent suit the American producers, hence it is only fair to infer that the higher prices will stimulate the output even more than heretofore. That effect will follow, indeed, all over the world, and in due course will be likely to defeat the objects of those who are said to have once more taken in hand "copper for a raise." No definite information on this point is available, but it is alleged that the new movement is being promoted from Paris, and that it has for its main object the pushing up of Rio Tinto shares. It is even stated that M. Secrétan is one of the leaders of the movement. On the other hand, it is asserted that the copper "bulls" are located in London, and are identical with those who have effected the upward move in Scotch pig iron warrants. From a legitimate trade standpoint it is not very material who the speculators may be. If they attempt to go too fast or too far they will inevitably bring about their own destruction. They may succeed in manipulating values for a time, but if they push prices beyond, say 60/. a ton, they will at one and the same time diminish consumption and promote production all over the world.—*Ironmonger.*

Sand-Moulding Machine.—An illustration is given in *Industries* of a sand-moulding machine. The pattern is formed or fitted on the upper and lower side of a plate which swings and slides on one of the pillars. The mould is formed in sand contained in two flasks, one above, the other below the pattern plate. The base of the machine carries two hydraulic rams, one inside the other. The plate on the outer ram head serves to lift the boxes and to compress the sand, while the inner ram ejects the mould from the flask. In operation the pattern plate is swung clear, the lower box is filled and the plate is swung back. The upper box is then lowered on to it and filled with sand. The boxes and plate are then lifted up to the top of the machine, where the sand is compressed against the top plate. The boxes are then dropped and separated, the pattern is swung out, and the boxes are again brought together, so that the inner ram may expel the mould.

Hauling Machinery in Cumberland.—Mr. C. M. Percy has just completed a very full inspection of the underground hauling appliances at the extensive collieries of the Whitehaven Colliery Company in Cumberland, the principal proprietor of which is Sir James Bain, M.P. The coal is all under the sea. The present workings are three miles out, and the firm have powers to work the coal to a considerably greater distance. The gradient is all against the load, and under such circumstances the underground conveyance is an all-important matter. The system at all the collieries is endless rope, with steam engines stationed on the surface. The coal being worked is of high quality and of substantial thickness, and constitutes the chief industry in Whitehaven.

TENDERS FOR COAL.

SEALED TENDERS addressed to the undersigned, and endorsed "Tender for Coal," will be received at this office until Tuesday, the 14th day of July next, for the supply and delivery at Sorel, Quebec, of 3,400 gross tons (2,240 lbs.) of best steam coal, freshly mined and well screened before loading, as the "run of the mine" will not under any circumstances be accepted.

Tenders to state the name of the mines and quality of coal offered, and the price per ton delivered on the wharf at Sorel.

Each tender must be accompanied by an accepted bank cheque for the sum of $550, not limited as to time of payment, made payable to the order of the Honourable the Minister of Public Works, which will be forfeited if the party decline to enter into a contract when called on to do so, or if he fails to deliver the quantity contracted for. If the tender be not accepted the cheque will be returned.

By order,
E. F. E. ROY,
Secretary.

Department of Public Works,
Ottawa, June 24th, 1891.

SEALED TENDERS addressed to the undersigned, and endorsed "Tender for Coal, Public Buildings," will be received until Thursday, 23rd July next, for all or any of the Dominion Public Buildings.

Specification, form of tender, and all necessary information can be obtained at this Department on and after Monday, 29th June.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures.

Each tender must be accompanied by an accepted bank cheque made payable to the order of the Honorable the Minister of Public Works, *equal to five per cent.* of the amount of the tender, which will be forfeited if the party decline to enter into a contract when called upon to do so, or if he fail to supply the coal contracted for. If the tender be not accepted the cheque will be returned.

The Department will not be bound to accept the lowest or any tender.

By order,
E. F. E. ROY,
Secretary.

Department of Public Works,
Ottawa, June 24th, 1891.

A New Specimen.—A distinguished professor was lecturing one day on mineralogy. He had before him a number of specimens of various sorts to illustrate the subject; but a roguish student for sport slyly slipped a piece of brick among the stones. The professor was taking these up one after another and naming them. "This," he said "is a piece of granite. This is a piece of felspar," &c. Presently he came to the brickbat. Without betraying any surprise or even changing the tone of his voice, he said, "This, gentleman, is a piece of impudence."

The Purification of Blast Furnace Gas.—The "Cyclone" dust-collector has been in use in Germany for some time past. The gas from which the dust is to be deposited is subjected in this machine to a rapid centrifugal motion. The effect of this is to throw the dust against the casing of the machine, whence it falls through a hole in the inverted conical base, the gas passing out at the top. The machine gives good results, is simple in construction, and needs no watching.

No. 3 blast furnace of the Phœnix Works at Berge-Borbeck has recently been blown-out after what is claimed to be the longest blast on record on one lining. It was blown-in on March 31, 1873, and was in blast until July 15, 1890. During this period of over seventeen years it made 355,236 tons of pig iron. The dimensions are: Height, 49 feet and 5 inches; diameter at the boshes, 16 feet. Until within a year of the termination of the blast iron-pipe stoves were used; since then two Cowper stoves have been erected, and the furnace has made 80 tons of pig iron a day.

PROVINCE OF NEW BRUNSWICK.

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

—LEASES FOR MINES OF—

GOLD, SILVER, COAL, IRON, COPPER, LEAD, TIN and PRECIOUS STONES.

GOLD AND SILVER.

PROSPECTING LICENSES up to 100 areas, (each 150 feet by 250 feet), issued at 50 cts. an area up to 10 areas, and 25 cts. afterwards per area, good for one year. These Licenses can be renewed for second year, by payment of one half above amount.

LEASES for 20 years to work and mine, on payment of $2 an area of 150 feet by 250 feet. Renewable annually at 50 cts. an area in advance.

Royalty on Gold and Silver, 2½ per cent.

MINES, OTHER THAN GOLD AND SILVER.

LICENSES TO SEARCH, good for one year, $20 for 5 square miles. Lands applied for must not be more than 2½ miles long, and the tract so selected may be surveyed on the Surveyor General's order at expense of Licensee, if exact bounds cannot be established on maps in Crown Land Office. Renewals for second year may be made by consent of Surveyor General, on payment of $20.

Second Rights to Search can be given over same ground, subject to party holding first Rights, on payment of $20.

LEASES.—On payment of $50 for one square mile, good for two years, and extended to three years by further payment of $25. The lands selected must be surveyed and returned to Crown Land Office. Leases are given for 20 years, and renewable to 80 years. The Surveyor General, if special circumstances warrant, may grant a Lease larger than one square mile, but not larger than two square miles.

ROYALTIES.

Coal, 10 cts. per ton of 2,240 lbs.
Copper, 4 cts. on every 1 per cent. in a ton of 2,352 lbs.
Lead, 2 cts. on every 1 per cent. in a ton of 2,240 lbs.
Iron, 5 cts. per ton of 2,240 lbs.
Tin and Precious Stones, 5 per cent. of value.

APPLICATIONS can be fyled at the Crown Land Office each day from 9.30 a.m. to 4.30 p.m., except Saturday, when Office closes at 1 p.m.

L. J. TWEEDIE,
Surveyor General.

MINING REGULATIONS
TO GOVERN THE DISPOSAL OF
DOMINION LANDS CONTAINING MINERALS, OTHER THAN COAL, 1890.

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

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

QUARTZ MINING.

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

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

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

At any time before the expiration of FIVE years from the date of his obtaining the agent's receipt it shall be open to the claimant to purchase the location on filing with the local agent proof that he has expended not less than FIVE HUNDRED DOLLARS in actual mining operations on the same; but the claimant is required, before the expiration of each of the five years, to prove that he has performed not less than ONE HUNDRED DOLLARS' worth of labour during the year in the actual development of his claim, and at the same time obtain a renewal of his location receipt, for which he is required to pay a fee of FIVE DOLLARS.

The price to be paid for a mining location shall be at the rate of FIVE DOLLARS PER ACRE, cash, the sum of FIFTY DOLLARS extra for the survey of the same.

No more than one mining location shall be granted to any individual claimant upon the same lode or vein.

IRON AND PETROLEUM.

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

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

PLACER MINING.

The Regulations laid down in respect to quartz mining shall be applicable to placer mining as far as they relate to entries, entry fees, assignments, marking of localities, agents' receipts, and generally where they can be applied.

The nature and size of placer mining claims are provided for in the Regulations, including bar, dry, bench, creek or hill diggings, and the RIGHTS AND DUTIES OF MINERS are fully set forth.

The Regulations apply also to

BED-ROCK FLUMES, DRAINAGE OF MINES AND DITCHES.

The GENERAL PROVISIONS of the Regulations include the interpretation of expressions used therein; how disputes shall be heard and adjudicated upon; under what circumstances miners shall be entitled to absent themselves from their locations or diggings, etc., etc.

THE SCHEDULE OF MINING REGULATIONS

Contains the *forms* to be observed in the drawing up of all documents such as:—"Application and affidavit of discoverer of quartz mine." "Receipt for fee paid by *applicant for mining location.*" "*Receipt for fee on extension of time for purchase of a* mining location." "Patent of a mining location." "Certificate of the assignment of a mining location." "Application for grant for placer mining and affidavit of applicant." "Grant for placer mining." "Certificate of the assignment of a placer mining claim." "Grant to a bed-rock flume company." "Grant for drainage." "Grant of right to divert water and construct ditches."

Since the publication, in 1884, of the Mining Regulations to govern the disposal of Dominion Mineral Lands the same have been carefully and thoroughly revised with a view to ensure ample protection to the public interests, and at the same time to encourage the prospector and miner in order that the mineral resources may be made valuable by development.

COPIES OF THE REGULATIONS MAY BE OBTAINED UPON APPLICATION TO THE DEPARTMENT OF THE INTERIOR.

A. M. BURGESS,
Deputy Minister of the Interior.